T.C.
PAMUKKALE ÜNİVERSİTESİ
SAĞLIK BİLİMLERİ ENSTİTÜSÜ

FİZİK TEDAVİ VE REHABİLİTASYON ANABİLİM DALI
DOKTORA TEZİ

FİBROMİYALJİ'Lİ BİREYLERDE TERAPATİK NÖROBİLİM EĞİTİMİNİN ETKİNLİĞİNİN İNCELENMESİ:RANDOMİZE KONTROLLÜ ÇALIŞMA

Elif GÜR KABUL

HAZİRAN 2021
DENİZLİ

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Tez Danışmanı: Doç. Dr. Bilge BAŞAKCI ÇALIK

Denizli, 2021

YAYIN BEYAN SAYFASI

Pamukkale Üniversitesi Lisansüstü Eğitim ve Öğretim Yönetmeliği Uygulama Esasları Yönergesi Madde 24-(2) “Sağlık Bilimleri Enstitüsü Doktora öğrencileri için: Doktora tez savunma sınavından önce, doktora bilim alanında kendisinin yazar olduğu uluslararası atıf indeksleri kapsamında yer alan bir dergide basılmış ya da basılmak üzere kesin kabulü yapılmış en az bir makalesi olan öğrenciler tez savunma sınavına alınır. Yüksek lisans tezinin yayın haline getirilmiş olması bu kapsamda değerlendirilmez. Bu ek koşulu yerine getirmeyen öğrenciler, tez savunma sınavına alınmazlar” gereğince yapılan yayın/yayınların listesi aşağıdadır (Tam metinleri ekte sunulmuştur):

Ek-1. **Kabul EG,** Aslan UB, Calık BB, Taşçı M, Çobankara V. Exploring the relation between impairment rating by DAS-28 and body function, activity participation, and environmental factors based on ICF hand core set in the patient with rheumatoid arthritis. ***Rheumatol Int*** 2018; 38 (7): 1267-1275.

Ek-2. Calik BB, **Kabul EG,** Taskın H, Atalay OT, Aslan UB, Tascı M, Bıcakcı F, Yıldız AI. The efficiency of inspiratory muscle training in patients with ankylosing spondylitis. ***Rheumatol Int*** 2018; 38 (9): 1713-1720.

Ek-3. Calık BB, **Kabul EG**, Taşçı M, Erel S, Şimşek IE, Demir P, Çobankara V. Reliability And Validity Of The Turkish Version Of The Abılhand Questionnaire İn Rheumatoid Arthritis Individuals, Based On Rasch Analysis. ***Arch Rheumatol*** 2019; 34 (4): 395-405.

Ek-4. Cetin SY, Calik BB, Ayan A, **Kabul EG**. The effectiveness of 10-Tai Chi movements in patients with ankylosing spondylitis receiving anti-tumor necrosis factor α therapy: A randomized controlled trial. ***European Journal of Integrative Medicine*** 2020; 39: 101208.

Ek-5. Calık BB, **Kabul EG,** Buke M, Unver F, Altuğ F. A comparison of Different Quadriceps Femoris Isometric Strengthening Methods in Healthy Young Women. ***Turk J Physiother Rehabil*** 2020; 31 (1): 21-28.

Ek-6. Cağlayan BC, Keskin A, **Kabul EG**, Calık BB, Aslan UB, Karasu U. Effects of clinical Pilates exercises in individuals with fibromyalgia: A randomized controlled trial. ***Eur J Rheumatol*** 2020. doi: 10.5152/eurjrheum.2020.20037.

Ek-7. **Kabul EG,** Calık BB, Korkmaz C, Aslan UB, Tascı M, Cobankara V. The Relationship Between Disease Activity, Demographic and Characteristic Features in Individuals with Rheumatoid Arthritis. ***J Rheum Dis Treat*** 2020: 6 (1); 079.

Ek-8. Calık BB, **Kabul EG,** Korkmaz C, Tekin ZE, Yener GO, Yuksel S. The efficacy of clinical Pilates exercises in children and adolescents with juvenile idiopathic arthritis: A pilot study. ***Rev Columb Reumatol*** 2020; 27 (4): 269–277.

Ek-9. Telci EA, Aslan UB, Yagci N, Cavlak U, **Kabul EG**, Kara G, Kose T, Yarar F, Karahan S, Atalay OT. The Turkish version of the Neck Bournemouth Questionnaire in patients with chronic neck pain: a cultural adaptation, reliability, and validity study. ***Arch Med Sci*** 2021; 17 (3): 708–713.

Ek-10. Calik BB, Kurtca MP, **Kabul EG,** Atalay OT, Taskin H, Yigit M, Tasci M, Cobankara V. Investigation of the effectiveness of aerobic exercise training in individuals with ankylosing spondylitis: Randomized controlled study. ***Mod Rheumatol*** 2021; 31 (2): 442-450.

Ek-11. **Kabul EG**, Calik BB, Oztop M, Cobankara V. The efficacy of manual soft-tissue mobilization in ankylosing spondylitis: A randomized controlled study. ***Int J Rheum Dis*** 2021; 24 (3): 445-455.

Ek-12. Calık BB, **Kabul EG,** Taskın F, Dınc G, Aslan UB. Investigation of the relationship between menopausal symptoms and physical activity level in the postmenopausal period of women. ***Annals of Clinical and Analytical Medicine*** 2021. doi: 10.4328/ACAM.20464.

Bu tezin tasarımı, hazırlanması, yürütülmesi, araştırılmalarının yapılması ve bulgularının analizlerinde bilimsel etiğe ve akademik kurallara özenle riayet edildiğini; bu çalışmanın doğrudan birincil ürünü olmayan bulguların, verilerin ve materyallerin bilimsel etiğe uygun olarak kaynak gösterildiğini ve alıntı yapılan çalışmalara atfedildiğini beyan ederim.

Öğrenci Adı Soyadı : Elif GÜR KABUL

İmza :

ÖZET

FİBROMİYALJİ'Lİ BİREYLERDE TERAPATİK NÖROBİLİM EĞİTİMİNİN ETKİNLİĞİNİN İNCELENMESİ: RANDOMİZE KONTROLLÜ ÇALIŞMA

Elif GÜR KABUL
Doktora Tezi, Fizik Tedavi ve Rehabilitasyon AD
Tez Yöneticisi: Doç. Dr. Bilge BAŞAKCI ÇALIK
Haziran 2021, 120 Sayfa

Bu çalışmanın amacı, Klinik Pilates Egzersizleri ve Terapatik Nörobilim Eğitiminin Fibromiyalji'li bireylerdeki etkilerini araştırmaktı. 25 Fibromiyalji'li kadın çalışmaya dahil edildi. Katılımcılar randomize olarak müdahale grubu (Klinik Piltes Egzersizleri+Terapatik Nörobilim Eğitimi, n=11, yaş ort=46,81±10,55 yıl) ve kontrol grubu (Klinik Pilates Egzersizleri, n=14, yaş ort=51,57±9,51 yıl) olmak üzere 2 gruba ayrıldı. Fonksiyonel durum Fibromiyalji Etki Anketi (FEA) ile, ağrı Vizüel Analog Skalası (VAS), Yaygın Ağrı İndeksi (YAİ) Ve Semptom Şiddeti Ölçeği (SŞÖ), Kısa Ağrı Envanteri (KAE), Ağrıyı Felaketleştirme Ölçeği (AFÖ) ile, korku kaçınma inanışı Tampa Kinezyofobi Ölçeği (TKÖ) ile, biyopsikososyal durum Bilişsel Egzersiz Terapi Yaklaşımı Ölçeği (BETY-BÖ) ile, kognitif fonksiyonlar Dinamik Loewenstein Mesleki Terapi Kognitif Değerlendirme (DLMTKD) testi ile ve basınç ağrı eşik ölçümleri basınç algometresi ile değerlendirildi. Tüm değerlendirmeler tedavi öncesi ve tedavi sonrasında yapıldı. Klinik Pilates Egzersizleri her iki gruba da, haftada 3 kez 6 hafta uygulandı. Terapatik Nörobilim Eğitimi sadece müdahale grubuna haftada bir defa 6 hafta yapıldı. Grupların kendi içinde tedavi öncesi ve tedavi sonrası verileri analiz edildiğinde; müdahale grubunda FEA, VAS, YAİ, SŞÖ, KAE-Ağrı Şiddet Skoru, KAE-Ağrının Oluşturduğu Engeller Skoru, TKÖ, BETY-BÖ, DLMTKD'nın "Düşünme" kognitif alanında ve toplam puanında, Sol Trapezius Maksimum ve Ortalama dışında tüm basınç ağrı eşik ölçümlerinde anlamlı fark elde edildi ($p<0,05$). Kontrol grubunda ise FEA, VAS, SŞÖ, KAE-Ağrı Şiddet Skoru, AFÖ-Ağrıyı Büyütme, DLMTKD'nın "Görsel Motor Organizasyon" ile "Düşünme" kognitif alanlarında ve toplam puanında, basınç ağrı eşik ölçümlerinde sadece Sol Medial Diz Ortalama skorunda anlamlı bir fark belirlendi ($p<0,05$). Delta verileri karşılaştırıldığında; FEA, YAİ, basınç ağrı eşik ölçümlerinden Sağ Trapezius Ortalama, Sol Trapezius, Sağ Quadriceps Femoris, Sağ Medial Diz ve Sol Medial Diz Maksimum ve Ortalama skorlarında müdahale grubu lehine anlamlı fark olduğu görüldü ($p<0,05$). Fibromiyalji'de Terapatik Nörobilim Eğitimi, Klinik Pilates Egzersizlerinin etkinliğini arttırmıştır.

Anahtar Kelimeler: Fibromiyalji, egzersiz, ağrı, kognisyon.

Bu çalışma, PAÜ Bilimsel Araştırma Projeleri Koordinasyon Birimi tarafından desteklenmiştir (Proje No: 2019SABE010).

ABSTRACT

INVESTIGATION OF THE EFFECTIVENESS OF THERAPEUTIC NEUROSCIENCE EDUCATION IN INDIVIDUALS WITH FIBROMYALGIA: RANDOMIZED CONTROLLED TRIAL

GUR KABUL, Elif
PhD Thesis in Physical Therapy and Rehabilitation
Supervisor: Assoc. Prof. Bilge BASAKCI CALIK (PT, PhD)
June 2021, 120 Pages

The aim of this study was to investigate the effects of Clinical Pilates Exercises (CPE) and Therapeutic Neuroscience Education (TNE) in individuals with Fibromyalgia. 25 women with FM were included in the study. Participants were randomly divided into two groups as the intervention group (CPE+TNE, n=11, mean age =46.81±10.55 years) and the control group (CPE, n=14, mean age=51.57±9.51 years). Functional status were evaluated with the Fibromyalgia Impact Questionnare (FIQ), pain with Visual Analogue Scale (VAS), Widespread Pain Index (WPI), Symptom Severity Scale (SSS), Brief Pain Inventory (BPI), Pain Catastrophizing Scale (PCS); fear-avoidance beliefs with Tampa Scale for Kinesiophobia (TSK); biopsychosocial status with Biopsychosocial Questionnaire (BETY-BQ); cognitive functions with Dynamic Loewenstein Occupational Therapy Cognitive Assesment (DLOTCA) and pressure pain thresholds with a pressure algometer. All evaluations were done pre and post-treatment. CPE were applied to both groups 3 times a week for 6 weeks. TNE was given to only the intervention group once a week for 6 weeks. When the pre-treatment and post-treatment data of the groups were analyzed; significant difference was in FIQ, VAS, WPI, SSS, BPI-Pain Severity Score, BPI-Pain Interference Score, TSK, BETY-BQ, the "Thinking operations" cognitive area and total score of DLOTCA, all pressure pain thresholds except Left Trapezius Maximum and Mean scores in intervention group ($p<0.05$). In control group, a significant difference was found in FIQ, VAS, SSS, BPI-Pain Severity Score, PCS-Magnification, the ”Visuomotor construction” and "Thinking operations" cognitive areas and total score of DLOTCA, only Left Medial Knee Mean score from pressure pain thresholds ($p<0.05$). Comparing delta data; there was a significant difference in favor of intervention group in terms of FIQ, WPI, Right Trapezius Mean, Left Trapezius, Right Quadriceps Femoris, Right Medial Knee and Left Medial Knee Maximum and Mean scores from pressure pain thresholds ($p<0.05$). TNE in Fibromyalgia has increased the effectiveness of CPE.

Keywords: Fibromyalgia, exercise, pain, cognition.

This study was supported by Pamukkale University Scientific Research Projects Coordination Unit through Project numbers 2019SABE010.

TEŞEKKÜR

Akademik kariyerime başladığım ilk günden beri bana hep ışık tutan, sahip olduğu değerli bilgilerini aktarmada her zaman çok cömert davranan, akademik açıdan bildiğim her şeyi bana öğreten, her konuda yardımcı hep destekleyici olan, birlikte çalışmaktan büyük zevk ve şevk duyduğum, beni hep bir adım öteye götüren, hem akademik hem de kişisel gelişimim açısından hergün kendisinden yeni şeyler öğrendiğim, hep örnek aldığım ve birlikte çalışma fırsatı bulduğum için kendimi çok şanslı hissetiğim, hem naif, hem adaletli, hem donanımlı, bir o kadar da alçakgönüllü olan çok değerli ve kıymetli hocam, danışmanın Sayın Doç. Dr. Bilge BAŞAKCI ÇALIK'a tüm emekleri ve bana kattıkları için,

Yüksek lisansa başladığım zamandan itibaren her konuda desteğini esirgemeyen, çok değerli bilgi ve tecrübelerini aktarmada hep cömert davranan, en meşgul olduğu zamanlarda bile değerli vaktinden bana mutlaka yer ayıran, her zaman çalışmalarım sırasında bana titizlikle yardım etmiş ve kılavuzluk yapmış olan, hastalandığımda çorba getirecek kadar manevi desteğini de hep hissetmiş olduğum çok değerli ve kıymetli hocam Sayın Prof. Dr. Ummuhan BAŞ ASLAN'a tüm emekleri ve bana kattıkları için,

Klinik açıdan hiçbir zaman bizden desteğini esirgemeyen, Romatolojik Fizik Tedavi ve Rehabilitasyon ünitesinin gelişimine çok büyük katkıları olan, birlikte çalışmaktan çok mutlu olduğumuz ve kendimizi şanslı hissettiğimiz, uzun yıllar birlikte çalışmayı umut ettiğimiz çok değerli ve kıymetli hocam Sayın Dr. Öğr. Üyesi Uğur KARASU'ya tüm desteği ve katkıları için,

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Her an her konuda sabır ve sevgiyle hem destek olan hem de yardımlarını esirgemeyen hayattaki en büyük şansım biricik eşime,

Herşeylerim biricik kızım ve oğluma,

sonsuz şükran, minnet ve teşekkürlerimi sunarım.

İÇİNDEKİLER DİZİNİ

Sayfa

randomized controlled trial. ***Eur J Rheumatol*** 2020. doi: 10.5152/eurjrheum.2020.20037.

Ek-7. **Kabul EG,** Calık BB, Korkmaz C, Aslan UB, Tascı M, Cobankara V. The Relationship Between Disease Activity, Demographic and Characteristic Features in Individuals with Rheumatoid Arthritis. ***J Rheum Dis Treat*** 2020: 6 (1); 079.

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Ek-13. Etik Kurul Kararı

Ek-14. Kayıt ve Değerlendirme Formu

Ek-15. Fibromiyalji Etki Anketi

Ek-16. Vizüel Analog Skalası

Ek-17. Yaygın Ağrı İndeksi ve Semptom Şiddet Ölçeği

Ek-18. Kısa Ağrı Envanteri

Ek-19. Ağrıyı Felaketleştirme Ölçeği

Ek-20. Tampa Kinezyofobi Ölçeği

Ek-21. Bilişsel Egzersiz Terapi Yaklaşımı Ölçeği

Ek-22. Basınç ağrı eşiği ölçümleri

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Sayfa

SİMGE VE KISALTMALAR DİZİNİ

AFÖ…….Ağrıyı Felaketleştirme Ölçeği
ARD…….Amerika Romatoloji Derneği
BETY-BÖ……Bilişsel Egzersiz Terapi Yaklaşımı Ölçeği
DLMTKD…….Dinamik Loewenstein mesleki terapi kognitif değerlendirme
EEG…….Elektroensefalografik
EULAR……...Avrupa Romatizmal Hastalıklar ile Savaş Derneği
FEA……..Fibromiyalji Etki Anketi
FM……...Fibromiyalji
HPA……..Hipotalamik-Hipofiz-Adrenal
KAE……..Kısa Ağrı Envanteri
Non-REM…….Non-Rapid Eye Movement-Hızlı Olmayan Göz Hareketi
OMERACT…..Outcome Measures in Rheumatology-Romatoloji'de Sonuç Ölçütleri
SŞÖ……..Semptom Şiddeti Ölçeği
TKÖ……..Tampa Kinezyofobi Ölçeği
TNE……..Terapatik Nörobilim Eğitimi
VAS……..Vizüel Analog Skalası
YAİ……...Yaygın Ağrı İndeksi

1. GİRİŞ

Fibromiyalji (FM); yaygın ağrı ve yorgunluk, uyku, kognitif fonksiyon ve konsantrasyon problemleri ile duygu durum (sıklıkla depresyon) bozukluğu gibi birçok semptomun bir arada görüldüğü kronik bir hastalıktır (Bennet vd 2007). Son yıllarda özellikle gelişmiş ülkelerde FM iş gücü ve yaşam kalitesini azaltarak ciddi bir sosyal problem olarak karşımıza çıkmaktadır. Kognitif problemler, FM hastalarının çoğunda görülmektedir. FM'li hastaların en az %76'sı konsantrasyon güçlüğü, unutkanlık, zihinsel karışıklık veya bu şikayetlerin bir kombinasyonunu bildirmektedir (Leavitt vd 2002, Zachrisson vd 2002, Katz vd 2004, Schaefer vd 2011) ve FM hastalarının neredeyse yarısı, bu semptomların şiddetini skorlaması 0 ila 10 arasında değişen bir ölçekte ≥6 olarak derecelendirmektedir (Rutledge vd 2009). Özellikle klinisyenler, FM'da görülen kognitif disfonksiyonu artık ayrı bir klinik durum olarak ele almaya başlamışlardır (Koca 2015). FM hastaları, kognitif performanslarını sadece sağlıklı kontrollere kıyasla değil, aynı zamanda diğer romatizmal hastalıkları veya kronik ağrı problemleri bulunan kişilere kıyasla önemli ölçüde daha kötü olarak değerlendirmektedirler (Grace vd 1999, Suhr 2003, Katz vd 2004, Glass vd 2005, Landrø vd 2013, Tesio vd 2015).

FM'in popülasyonun %1,3-4,8'ini etkilediği tahmin edilmektedir, bunun %80'i kadındır (Wolfe vd 1995). FM'nin ülkemizde sıklığını araştıran tek çalışmada, 20-64 yaş aralığındaki FM prevalansı %3,6 olarak bulmuştur (Topbas vd 2005). Patogenez hala büyük ölçüde bilinmemektedir, ancak hem periferik hem de merkezi patofizyolojiye dair kanıtlar vardır (Clauw 2014). FM'deki pek çok semptom birbiri ile karşılıklı etkileşim içindedir. Tıbbi olarak tam aydınlatılmamış bu hastalık klinisyenler için halen tartışma konusudur (Stahl 2009, Sarzi-Puttini vd 2012).

Ağrı hastaların en sık yakınmasıdır. Ağrı duyarlılığında genel bir artış olduğunu gösteren FM'li hastalarda merkezi ağrı işleminin değiştiği gösterilmiştir. Bu çalışmalarda, FM hastaları sürekli olarak daha düşük ağrı eşikleri göstermiş ve birincil ve ikincil somatosensoriyel korteks, insula ve ön cingulate korteks gibi alanlarda ağrılı uyaranlara daha yüksek ve daha yaygın beyin aktivasyonu sergilemiştir (Wolfe vd 1990, Diers vd 2008).

Geçtiğimiz son 10 yılda ağrının başlangıcı, gelişimi ve süregeliminde korkunun rolü giderek artan düzeyde ilgi görmüştür. Ağrı ile ilişkili korku sırasında oluşan bilişsel değişiklik, tehdit algısına neden olmakta; böylece ileride katastrofik (abartılı, normal olmayan) yapıların gelişimini güçlendirmektedir (Edwards vd 2006, 2011). Ağrı deneyimine abartılı olumsuz uyum sağlama olarak tanımlanan ağrı katastrofisi, ağrı deneyimindeki en önemli psikolojik elementtir. Abartılı olumsuz inanışları olan bireylerde ağrı şiddeti, emosyonel stres ve ağrı ile ilişkili korku düzeyinin yüksek olduğu bildirilmiştir (Sullivan vd 2001). Korku kaçınma ise uzun süreli ağrı deneyimi sonucu korkuya bağlı hareket ve aktiviteden kaçınma şeklinde görülen bir davranışsal değişimdir (Van Tulder vd 2000). FM'li bireylerde katastrofik düşünceler, artmış ağrı şiddeti ile ilişkilendirilmiştir (Edwards vd 2011).

Son yıllarda FM'de hangi kognitif disfonksiyonun olduğu ilgi çeken araştırma konularındandır. FM hastalarındaki kognitif disfonksiyonun araştırıldığı çalışmalarda; temel hafızada, konsantrasyonda, karar almada güçlük çekme ve dikkat gerektiren fonksiyonlarda yetersizlikler ve dikkat dağınıklığı saptanan en önemli bulgular arasındadır. Ağrı derecesinin kognitif disfonksiyon düzeyi ile direk ilişkili olduğu ortak görüştür (Schaefer vd 2011, Gelonch vd 2013). Hastaların diğer yaygın yakınmaları ise dikkat uzamının bozulması, kısa süreli belleğin zayıflaması, sözel akıcılığın ve kelime haznesinin bozulması ve zihinsel uyanıklığın zayıflamasıdır (Park vd 2001, Miró vd 2011). Leavitt vd (2002)'nin yaptığı çalışmada; FM hastalarının %95'inde kognitif disfonksiyon rapor edilmiştir. FM hastalarının hafif kognitif disfonksiyon bulunan grupla karşılaştırılıdığı bir çalışmada; nöropsikolojik değerlendirme sonucu kadınların %90,5'inde hafıza kaybı olduğu görülmüştür (Periot-Nierga vd 2009). Kognitif disfonksiyon için henüz standardize testler ve tedavi yöntemleri geliştirilmemiştir. Dikkat ve konsantrasyon problemlerinin iyileştirilmesi için yeterli test yapılmamaktadır ve hastalar tedavisiz kalmaktadırlar (Dick vd 2008, Schmidt-Wilcke vd 2010).

Organik bozukluklarla karşılaştırıldığında FM gibi kronik işlev bozukluğu hastalıklarının etiyolojisinde, birçok farklı ve belirleyici faktör bulunduğu görülmektedir. Bu nedenle, her ne kadar etiyolojisi gizemini korusada, FM biyolojik, psikolojik ve sosyoçevresel etmenlerin etkileşimine bakılarak anlaşılabileceği belirtilmiştir (Masi vd 2002).

FM hastalarına uygulanacak en iyi tedavi yöntemine karar vermek, klinik araştırmalarda her zaman önemli bir konu haline gelmiştir. FM için önerilen tedaviler arasında; fizyoterapi, farmakolojik tedavi ve bilişsel davranışçı terapi dahil olmak üzere multimodal bir yaklaşım vardır (Carville vd 2008, Bernardy vd 2010). FM semptomlarının tedavisi için çeşitli fiziksel egzersiz biçimleri önerilmektedir ve egzersizin FM'li hastalarda ağrı ve hassasiyet azalmasının yanı sıra fonksiyonelliği ve

iyilik halini de arttırdığı gösterilmiştir (Mannerkorpi 2005, Larsson vd 2015). Daha önceki çalışmalarda FM'li hastalarda Klinik Pilates Egzersizlerinin semptomlar üzerine olumlu etkileri gösterilmiştir (Altan vd 2009, Ekici vd 2017). Özellikle ağrının psikososyal yönüne yoğunlaşan, hastanın ağrısı ile ilgili tutum ve bilgilerini değiştirmeyi hedefleyen nöroplastik hasta eğitimleri uygulanan vakalarda umut vadeden sonuçlar bildirilmiştir. Van Oosterwijck vd (2013)'nin FM'li hastalarda 2 yüz yüze ağrı fizyolojisi eğitimi seansı uyguladıkları çalışmalarında, bu eğitimin FM hastalarının tedavisinde uzun vadede sağlık durumunu ve endojen ağrı inhibisyonunu iyileştirdiği için yararlı bir bileşen olabileceği belirtilmiştir.

1.1. Amaç

Bu çalışmada, 6 haftalık Klinik Pilates Egzersizi ve Terapatik Nörobilim Eğitiminin FM'de ağrı, korku kaçınma inanışları, biyopsikososyal ve kognisyon açısından değişiklik oluşturup olmadığını araştırmayı amaçladık.

2. KURAMSAL BİLGİLER VE LİTERATÜR TARAMASI

2.1. Fibromiyalji

2.1.1. Tanım ve semptomlar

Bugün FM olarak adlandırdığımız hastalık, on dokuzuncu yüzyılda tanımlanmıştır. Geçen yüzyılın yetmiş ve seksenli yıllarına kadar kullanılan “fibrozit” terimi, ilk olarak Gowers (1904) tarafından ortaya konulmuştur. Bu terim, patogenezde periferik inflamasyonun önemli rolü olduğunu vurgulamak amacıyla kullanılmıştır (Inanici ve Yunus 2004). Belirli bir organa ait tutulum olmadığından Graham (1953) tarafından FM’nin modern kavramı “ağrı sendromu” olarak değiştirilmiştir. Daha sonra Smythe ve Moldofsky (1977), yeni bir terim olarak “fibromiyalji” terimini kullanmış ve “hassas noktalar” olarak adlandırılan aşırı hassasiyet bölgelerini tanımlamıştır.

FM, aslında çok odaklı ağrı ile karakterize bir hastalıktır, ancak hastalık tanımı, son yirmi yılda ağrı dışında diğer semptomları da kapsayacak şekilde genişletilmiştir (Smith vd 2011). Yaygın kronik kas iskelet ağrısı, yorgunluk, uyku problemleri, baş ağrıları ve altında herhangi bir tıbbi ve nörolojik problem tanımlanmayan kognitif ve duygu durum bozuklukları ağrı dışında hastalık tanımına dahil edilen diğer semptomlardır. FM’de ağrı hissinde bozukluk olduğu kabul edilmektedir (Sirianni vd 2015). Ağrı değişkendir, yeri ve yoğunluğu hastalığın seyrine ve zamana göre değişmektedir (Smith vd 2011). Hayatı tehdit edici, deforme edici veya ilerleyici değildir. Genellikle anksiyete ve depresyon birlikte görülmektedir (Arnold vd 2006).

FM zor bir hastalıktır; bu nedenle değerlendirmesi ve tanı konulması konusunda klinikte çeşitli zorluklarla karşılaşılmaktadır.

2.1.2. Epidemiyoloji

FM'nin genel popülasyon içindeki prevalansı %1,3-8 arasında değişmektedir (Smith vd 2011, Diaz-Piedra vd 2015, Theoharides vd 2015). Osteoartrit'ten sonra en yaygın ikinci romatolojik hastalıktır. FM, tipik olarak 30 ila 60 yaş aralığında görülmektedir (Arnold 2011). Orta yaş kadınlarda daha yaygındır ve 20-55 yaş arası kadınlarda kas-iskelet sistemi ağrısının en yaygın nedenidir (Blanco vd 2010). Adölesanlar veya küçük çocuklar da tanı kriterlerini karşılayabilmektedir ve semptomlar devamlılık gösterebilmektedir ya da daha yaşlı erişkinlerde de tanı konulabilmektedir. Daha önceden kadın/erkek cinsiyet dağılım oranı 10/1 olarak düşünülse de; artık erkeklerdeki FM tanısının konulma oranı giderek artmaktadır ve kadın/erkek cinsiyet dağılımının 3/1 oranına yakın olduğu düşünülmektedir (Arnold 2011).

Türkiye'deki FM prevalansının araştırıldığı çalışmalar, çoğunlukla bölgesel olarak yapıldığından dolayı Türkiye'deki genel FM prevalansı ile ilgili literatür bilgisi bulunmamaktadır. Yapılan araştırmalar sonucunda; Trabzon'daki prevalans %3,6 olarak rapor edilirken, bu prevalansın en fazla 50-59 (%10,1) yaş aralığında olduğu bildirilmiştir (Topbas vd 2005). Diyarbakır'da ise FM prevalansı %8,8 olarak gösterilirken, kadınlardaki oran % 12,5 ve erkeklerdeki oran %5,1 olarak belirlenmiştir (Turhanoglu vd 2008).

2.1.3. Patofizyoloji

FM'nin etiyolojisi hala bilinmemektedir, ancak günümüzdeki son gelişmeler ile FM'nin patofizyolojisi, on yıl öncesine göre daha iyi anlaşılmıştır ve keşifler, bu hastalığın gizemlerinin bir kısmının çözülmesine yardımcı olmuştur (Jahan vd 2012). Günümüzde önceki teorilerin ötesine geçilmiştir ve FM'nin esas nedeninin, ağrının anormal olarak işlenmesine yol açan santral sensitizasyon olduğuna inanılmaktadır. Fonksiyonel görüntüleme çalışmaları (örn., fMRI) ve biyokimyasal çalışmalar sonucunda elde edilen veriler doğrultusunda; patogenezde merkezi, periferik ve otonom sinir sistemlerinin bazı bileşenlerinin rol oynadığı belirlenmiştir (Theoharides vd 2015). Eğer sentral sensitizasyon FM ile ilgili ana mekanizma olarak kabul edilirse, genetik, immünolojik ve hormonal diğer birçok faktör önemli hale gelmektedir.

2.1.3.1. Merkezi sinir sistemi

Günümüzde FM'nin, mekanizmasının tam olarak bilinmediği artmış ağrı ve duyu aktivasyonu sonucunda oluştuğu ve görüntüleme çalışmalarından ve diğer araştırmalardan elde edilen bilgilere göre, FM'de, merkezi sinir sisteminde birkaç nörolojik mekanizmanın etkileşimi sonucunda ağrılı uyaranların işlenmesinde anormallikler meydana geldiği bilinmektedir (Nijs vd 2014).

FM'li hastalar santral sensitizasyon ile tutarlı birçok özellik sergilerler. Fakat bu hastalardaki yaygın ağrı ve hipersensitivite, spesifik bir spinal mekanizmaya atıfta bulunan santral sensitizasyon kavramının çok daha ötesindedir ve birçok santral nörofizyolojik işlemler FM'deki ağrı algısının gelişmesine katkıda bulunmaktadır (Clauw vd 2011).

Sağlıklı kişilerde, çok önemli inen inhibitör ağrı yolakları bulunmaktadır. Bu inen inhibitör ağrı yolakları, yüksek beyin merkezlerinden çıkıp dorsal boynuzdaki çıkan ikinci derece nöronlarla sinaps yaparlar ve çıkan yolaklardaki bu ikinci derece nöronlar boyunca ağrı iletiminin ilerlemesini engellerler. Bu sayede, yoğun ve ağrılı bir uyaran için vücut tarafından kısmi bir analjezik etki oluşturulmuş olur (Nijs vd 2014).

Santral sensitizasyon; merkezi sinir sistemi sinyallerinin amplifikasyonuna yol açan ve mekanik stimulasyon yanıtının artmasına neden olan tüm inen ve çıkan nöron yolaklarının bulunduğu merkezi sinir sistemindeki çeşitli disfonksiyonları tanımlamada kullanılan genel bir terimdir. Bu tanımla birlikte; bir dereceye kadar olan santral sensitizasyonun normal olarak kabul edildiği notunun da belirtilmesi gerekir. Çünkü bu bir dereceye kadar olan santral sensitizasyon; yaralı dokuyu daha fazla yaralanmaktan korumak ve iyileşmeyi en üst düzeye çıkarmak için koruyucu davranışı geliştirmektedir (Nijs vd 2014).

Yapılan beyin omurilik sıvısı analizleri sonucunda, FM hastalarında sürekli olarak serotonin ve norepinefrin düzeylerinde azalma olduğunu bulmuştur. Ayrıca fonksiyonel MRG çalışmaları da ağrı hassasiyetine karşı rostral ön singulat korteksin aktivitesinin azaldığını rapor etmiştir. Rostral ön singulat korteksin, yüksek seviyelerde μ-opioid reseptörleri içerir, ancak FM hastalarında bu reseptörler opioidlere karşı düşük bağlanma potansiyeli gösterir. Bu bulgular, opioidlere karşı duyarlılığın azaldığını düşündürmektedir (Harris vd 2007).

Serotonin, norepinefrin düzeylerindeki azalma ve opioidlere karşı duyarlılığın azalması; FM'li bireylerde inhibitör kontrollerin bir parçası olan inen inhibitör ağrı yolaklarının zayıflamasına ya da hiç işlev görememesine neden olur. Ağrı algısı inhibe edilemez. Bu durum FM'li bireylerde ağrı-basınç eşiğinin azalmasına işaret eder. Nosiseptif reseptörler tarafından algılanan ağrının eşik düzeyindeki azalma ile birlikte

sıcak, soğuk, elektriksel ve işitsel uyaranların da eşik düzeyi azalmaktadır (Smith vd 2011). Deney hayvanlarında ve insanlarda yapılan çalışmalar, yoğun veya uzun süreli nosiseptif girdinin, santral sensitizasyon olarak adlandırılan, dorsal boynuz nöronlarının uyarılabilirliğinde uzun süreli bir artışa neden olabileceğini göstermiştir (Latremoliere ve Woolf 2009).

Böylece periferal uyaranlarin merkezi amplifikasyonu görülür. Merkezi sinir sistemindeki duyusal uyarıların anormal şekilde nörokimyasal olarak işlenme süreci başlar. Bu durum, ağrısız ve ağrılı uyarana artmış cevap ile FM'de ağrı sisteminin anormal aktivasyonu gösteren ve FM'de karakteristik olan allodini ve hiperaljeziye yol açar (Lorenz vd 1996, Yunus 2007, Staud 2010) ve ağrının işlenmesindeki bu anormallikler, kronik ağrıya neden olmaktadır.

Santral sensitizasyonun tipik özellikleri; özellikle dinamik mekanik uyaranlara karşı allodini (normalde zararsız olan bir uyaranın ağrıya neden olması), noktasal veya basınç uyaranlarına karşı hiperaljezi (ağrıya karşı artan hassasiyet), artan duyular ve temporal sumasyondur (tekrarlayan tehlikeli uyarana yanıtta aşamalı artış). Amerikan Romatoloji Derneği (ARD) 1990 kriterlerine göre, FM'nin tanımlayıcı bir özelliği, hassas noktalardaki azalmış basınç ağrı eşiğidir, yani allodinidir (Desmeules vd 2003, Banic vd 2004). FM'li hastaların hipersensitivitesi; basınç uyaranlarıyla sınırlı değildir; iğne batması, sıcak ve soğuğa karşı da hassasiyetleri artmıştır (Blumenstiel vd 2011). Ayrıca, elektrik stimülasyonu ve işitsel uyaranlar için de düşük eşik ve düşük tolerans gösterirler (Lautenbacher ve Rollman 1997, Geisser vd 2008).

Ayrıca FM'de zayıflamış olan anormal inen inhibitör yolaklar gibi, ağrıyı arttıran çıkan yolakların da aktivitesi anormal düzeydedir. Beyin omurilik sıvısı ve ikinci derece nöronlarda uyarıcı amino asitler, glutamat, madde P ve sinir büyüme faktörünün seviyelerinin iki ila üç kat arttığı bir "wind up" mekanizması vardır (Vaerøy vd 1988, Xu vd 1992, Smith vd 2011).

Anormal merkezi duyusal işleme, FM'nin tipik ve diğer sistemik semptomlarındaki artışın açıklandığı en güncel kavramdır.

2.1.3.2. Uyku problemleri

FM'li hastalar sıklıkla uyku bozukluklarından şikayet ederler ve bu problemler patogenezde rol oynamaktadır (Roizenblatt vd 2001, Bigatti vd 2008). Yapılan birçok çalışmada FM'deki uyku problemlerinin prevalansının %90'ı aştığı bildirilmiştir (Choy 2015). Örnekleminin 600 FM hastasından ve %95'inin kadınlardan oluştuğu bir çalışmada, uyku problemlerinin hastalığın başlangıcında %96 ve 1. yılda %94,7

oranında görüldüğü bildirilmiştir (Bigatti vd 2008). Günümüzde ağrı ve uyku problemlerinin bir kısır döngü oluşturduğu ve birinin diğerine neden olabileceği kabul edilmektedir. Uyku problemlerinin düzeyi, ağrının şiddeti ile ilişkilidir ve bunun tersi de geçerlidir. Uyku yoksunluğu, ağrıya olan duyarlılığı arttırmaktadır (Diaz-Piedra vd 2015). Düşük uyku kalitesi, ağrı ve yorgunluk arasında kümülatif bir etki vardır. Yaygın şikayetler arasında; gece huzursuzluğu, istemsiz bacak hareketleri, sık uyanmalar, dinlendirmeyen uyku ve gündüz uyku hali bulunmaktadır (Choy 2015).

Non-REM (Non-Rapid Eye Movement-Hızlı Olmayan Göz Hareketi) uykusunun 3. ve 4. aşamalarını temsil eden yavaş dalga uykusu, normalde toplam uyku süresinin yaklaşık %20'sini oluşturmaktadır. Bu aşama, onarıcı uykunun önemli bir kısmını temsil etmektedir. Son çalışmalar, sağlıklı kontrollere kıyasla FM hastalarında yavaş dalga uyku miktarının azaldığını göstermiştir. Normal koşullar altında, uzun süre uyanık kalındıktan sonra vücut homeostazı sağlayabilmek için yavaş dalga uyku miktarını arttırır. Fakat, FM hastalarında bir önceki gece kalitesiz bir uyku deneyimlemelerine rağmen, yavaş dalga uyku miktarında azalma görülmektedir. Bu da homeostazın bozulduğu anlamına gelmektedir (Scheuler vd 1983, Choy 2015).

Çok sayıda çalışma, FM hastalarının elektroensefalografik (EEG) incelemelerinde yavaş dalga uykusu sırasında α dalgalarının intrüzyonunu ve bu α dalgalarının δ dalgaları ile örtüşerek anormal uyarılmaya neden olduğunu bildirmiştir (Diaz-Piedra vd 2015). Ayrıca, EEG incelemelerinde, uykunun dördüncü evresinin en fazla problemin görüldüğü evre olduğu ve bunun nedeninin, büyüme hormonu ve insülin benzeri büyüme faktörü 1'in eksikliğinden kaynaklandığı düşünülmektedir (Prinz vd 1995, Van Cauter vd 1998). Bu hormonların kas mikrotravması onarımında rol alması nedeniyle, dokunun iyileşme sürecinin uyku problemlerini etkileyebileceği de tahmin edilmektedir (Bennett vd 1992).

Böylece, uyku problemlemlerinin ağrının artmasına neden olduğu gösterilmiştir. Moldofsky ve Scarisbrick (1976) yapılan çalışma; uyku problemlerinin yorgunluk, miyalji, artan hassasiyet ve azalmış ağrı-basınç eşiği dahil olmak üzere FM semptomlarına neden olduğunu gösteren ilk çalışmadır.

2.1.3.3. Genetik yatkınlık

FM gelişiminde, kalıtsal ve ailesel bileşenin çok önemli düzeyde etkisinin olduğu kabul edilmektedir. Birinci dereceden kan bağı bulunan bir bireyin, genel popülasyona kıyasla FM'ye maruz kalma riskinin sekiz kat daha fazla olduğu gösterilmiştir. Arnold ve arkadaşlarının yaptığı bir araştırmaya göre, kardeşinde FM bulunan bir bireyde, FM

gelişimi için risk oranı 13,6'dır (Arnold vd 2013). Genel olarak, aile üyelerinin birinde santral sensitizasyonun varlığı, diğer aile üyelerinde de bu sensitizasyonun gelişme riskinde artışa neden olur (Arnold vd 2004). Kato vd (2006) tarafından ikiz kardeşler üzerinde yapılan çalışmada, riskin yarısının genetik faktörlerden diğer yarısının ise çevresel faktörlerden kaynaklandığı bildirilmiştir.

Genetik varyantlar ve ağrı yanıtı arasındaki korelasyonu inceleyen çalışmalarda, ağrı ile ilişkili genlerdeki genetik varyantların ve kalıtım mekanizmalarının, kronik ağrının gelişimine %50 katkıda bulunduğu gösterilmiştir (Mogil 2012). Günümüzde, ağrı hassasiyeti veya analjezi ile potansiyel olarak ilişkili olan yüzlerce ağrıyı düzenleyen gen tespit edilmiştir. Voltaj geçişli sodyum kanalları, GTP siklohidrolaz 1, mu-opioid reseptörleri, katekol-O-metiltransferaz ve GABAerjik yol proteinlerini kodlayan genler bunlar arasındadır (Oertel ve Lotsch 2008). Çok sayıda tek nükleotid polimorfizminin, özellikle FM hassasiyeti ile ilişkili olduğuna dair çalışmalar bulunsa bile (Tablo 2.1), bu sonuçlar yapılan meta analizler tarafından doğrulanmamıştır (Gursoy vd 2001, Vargas-Alarcon vd 2009, Ferna´ndez-de-Las-Penas vd 2012, Smith vd 2012, Lee vd 2012, Arnold vd 2013, Docampo vd 2014).

Tablo 2. 1 Fibromiyalji'nin patogenezinde potansiyel olarak yer alan genlerle ilgili tek nükleotid polimorfizm'ler (Gursoy vd 2001, Vargas-Alarcon vd 2009, Ferna´ndez-de-Las-Penas vd 2012, Smith vd 2012, Lee vd 2012, Arnold vd 2013, Docampo vd 2014)

Tek Nükleotid Polimorfizm	Gen	Klinik Anlamı
5-HTTLPR	SLC6A4	Temporomandibular eklem bozukluğu
		Depresyon
		Psikolojik bozukluklar
rs4680	COMT	Depresyon
		Anksiyete
		Disabilite
rs1048101	HTR2A	FIQ Disabilite
rs6313	HTR2A	Fibromiyalji başlangıcı
rs11127292	MYT1L	Kognitif disabilite
Intronic CNV	NRXN3	Otizm
rs8192619, rs4129256	TAAR1	Dopamin varlığındaki bozukluk
		Artmış ağrı hassasiyeti
rs10799897, rs2842003, rs2805050	RGS4	Ağrı algısının azalan inhibisyonunda değişiklik
rs6454674, rs1078602, rs10485171	CNR1	Migren
		İrritabl barsak sendromu
		Travma sonrası stres bozukluğu
rs642544, rs17104711, rs2510177, rs10895837	GRIA4	Sentral sensitizasyon

Yapılan çalışmalar evrensel olarak onaylanmış tek nükleotid polimorfizmi henüz belirleyemese bile, FM ile ilgili bilgileri genişletmiştir ve patogenezin altında yatan genetik hipotezi desteklemektedir, FM'deki hassasiyete neden olabilecek genetik markerlar hakkında bilgi sunmaktadır. Genetik varyantlardaki bu farklılıkların, popülasyonlardaki özgüllükten kaynaklandığı düşünülmektedir. Ayrıca FM çok faktörlü bir hastalık olduğundan dolayı, tek bir varyanttan ziyade haplotipler ve farklı varyantların kombinasyonlarının FM geliştirme riskini etkileyebilmektedir (Vargas-Alarcon vd 2007, Vargas-Alarcon vd 2009).

2.1.3.4. Çevresel faktörler

Genetik yatkınlığın yanısıra FM'nin ortaya çıkmasında kişinin bulunduğu çevrede etkili olabilmektedir. Özellikle yaşamın erken döneminde hem fiziksel travmaya hem de psikososyal strese maruz kalındığında, gen ekspresyonlarının etkilendiği ve bu durumun FM oluşumuna katkı sağladığı belirlenmiştir (Al-Allaf vd 2002, Gur vd 2002).

Erken ve çocukluk dönemindeki kötü muamelede, nosiseptif devrede uzun süreli değişikliklerle ilişkilendirilmiştir, yetişkinlikte eşik ağrısının değişmesine neden olduğu ve yaşlı organizmada ağrı duyarlılığını arttırdığı rapor edilmiştir (H€auser vd 2011, Low ve Schweinhardt 2012).

Yetişkinlikte, özellikle ağır kaldırma, tekrarlayan hareketler veya uzun süre çömelme gibi aktiviteler nedeniyle de tekrarlanan fiziksel stresörlerin, kronik yaygın ağrının gelişimine katıldığı gösterilmiştir (Harkness vd 2004).

Stres deneyimi ve FM'nin gelişimi arasındaki bağlantıya aracılık eden fizyolojik süreçler hala bilinmemektedir (Becker ve Schweinhardt 2012).

Önceki çalışmalar, erken yaşam deneyiminin ve çevresel faktörlerin, genel olarak DNA dizisini değiştirmeden epigenetik mekanizmalar yoluyla genom fonksiyonunu ve fenotipi modüle edebileceğini göstermiştir (Szyf ve Bick 2013). Bu epigenetik mekanizmaların kronik ağrıda merkezi ve periferik sinir sistemlerinde uzun süreli değişikliklere neden olan önemli bir faktör olduğu gözlemlenmiştir (Denk ve McMahon 2012). Bu durumun gelişmesinde gen-çevre etkileşiminin olası rolü, FM patogenezindeki çevresel komponenti açıklığa kavuşturmaktadır. Özellikle, ağrı ile ilişkili bölgelerdeki metilasyon, histon modifikasyonları ve miRNA ekspresyonundaki değişiklikler, periferik inflamasyon ve sinir hasarı varlığında ortaya çıkmaktadır. Ağrı ile ilişkili genler ile çevrenin nasıl bir etkileşim içinde olduğuna dair edinilen bilgi, FM'nin ana semptomlarından biri olan kronik ağrının oluşması sırasında altta yatan etyolojik mekanizmanın daha iyi anlaşılması hususuna yardımcı olmaktadır (Rahn vd 2013, Seo vd 2013, Wang vd 2014).

Stres olaylarının bir sonucu olarak HPA (hipotalamik-hipofiz-adrenal) ekseninde bir bozulma görüldüğü ve buna bağlı olarak strese karşı yetersiz cevap oluşturulduğu ve ağrı ve yorgunluğa olan hassasiyetin arttığı bildirilmiştir (Tikkanen vd 2010). HPA ekseninindeki bu bozulmanın; stres deneyimi ve FM'nin gelişimi arasındaki ilişkiden sorumlu bir potansiyel olduğu ileri sürülmüştür (McCain ve Tilbe 1989, Crofford vd 1994). FM hastalarının artan ağrı seviyelerinin; hipotalamik kortikotropin salgılatıcı hormon seviyelerinin azalması ve beyin omurilik sıvısında artmış P maddesi ve glutamat seviyeleri ile ilişkili olduğu bulunmuştur (Crofford vd 1994, Becker ve Schweinhardt 2012,). Ayrıca, dopaminerjik, opioiderjik ve serotoninerjik sistemlerin

hipoaktivitesi FM'li hastalarda kanıtlanmıştır ve bu da psikobiyolojik paternlerin karmaşık bir düzensizliğini göstermektedir (Bleakman vd 2006).

Tüm bu kanıtlara dayanarak, çevresel faktörlerin, özellikle kronik stres ve travmatik deneyimlerin, gen ekspresyonu değişikliği yoluyla periferal ve merkezi ağrı algısında farklılık oluşturarak, nörofizyolojik cevapları etkilemesi gerektiği varsayılmaktadır (D'Agnelli vd 2019).

2.1.3.5. Beslenme faktörleri

Çeşitli vitamin eksiklikleri, yaygın veya kronik ağrının varlığıyla ilişkilendirilmektedir. Fakat, multivitamin takviyesi almanın, ağrı üzerinde olumlu etki oluşturduğuna dair kesin sonuçlar bulunmamaktadır. D vitaminin; kemik, sinir dokusu ve kas büyümesi üzerinde önemli etkilere sahip olduğu bilindiğinden dolayı, en son literatürde araştırılan konular arasında yer almaktadır. Ancak, kandaki D vitamini düzeyleri ile semptom şiddeti arasındaki ilişkiyi inceleyen çok sayıda prospektif ve kesitsel çalışmalardan elde edilen klinik veriler; tartışmalıdır ve herhangi net bir sonuç vermemektedir. FM hastalarında D vitaminin aktivasyonunu düzenleyen paratiroid hormonun salınımındaki disfonksiyonlar nedeniyle, progesteron aktivitesinin etkilendiği ve bu sonucun kadınların neden FM'ye daha yatkın olduğunun açıklanmasına yardımcı olabileceği rapor edilmiştir (Jesus vd 2013).

Tiamin (B1 vitamini) eksikliği de, kronik yaygın ağrı ve FM ile ilişkilendirilmektedir. Costantini ve ark. üç kadın FM hastasını, yüksek doz oral tiamin (600-1800 mg / gün) ile tedavi ettiklerini ve 20 günlük tedaviden sonra anlamlı düzeyde semptomatik iyileşmeler elde ettiklerini bildirmişlerdir. Hastaların kandaki tiamin seviyelerinin başlangıçta normal sınırlar içerisindeyken, tedavi sonrasında normal seviyenin üstüne çıktığını rapor etmişlerdir. Bu çalışmadaki araştırmacılar, normal tiamin seviyelerine rağmen FM hastalarının tiaminin hücre içi taşınmasındaki işlev bozukluğu nedeniyle semptomlar gösterebilecekleri, ancak etki mekanizması hakkında tahminde bulunamadıklarını belirtmişlerdir (Costantini vd 2013).

FM ve B12 vitamini ile folat eksikliği arasındaki ilişki de araştırılmıştır. Önceki araştırmalar, Kronik Yorgunluk Sendrom'lu ve FM'li hastalarda, hipo-metilasyonun, bağışıklık hücrelerinde ve DNA kodlayan bağışıklık hücrelerinde mevcut olduğunu göstermiştir. B12 vitamini ve folat, metil grupları elde etmeden sorumlu enzimler için temel hücre içi ko-faktörlerdir. Kronik Yorgunluk Sendromu ve/veya FM'si bulunan 38 hastanın B12 enjeksiyonları ve oral folat takviyeleri ile tedavi edildiği kesitsel bir

çalışmada; daha yüksek dozlarda oral folat kullananların daha iyi semptomatik iyileşme gösterdikleri sonucu elde edilmiştir (Regland vd 2015).

Diğer vitaminler ve mineraller de antioksidan özellikleri açısından incelenmiştir. Önemli seviyelerde reaktif oksijen türlerinin, FM gibi romatolojik hastalıklarda görülen lokal doku iltihabını tetikleyen oksidatif strese neden olduğu gösterilmiştir. Spesifik olarak, A, C, E vitaminleri ve magnezyum incelenmiştir; ancak çalışmalar az ve sonuçlar tartışmalıdır (Sakarya vd 2011).

2.1.4. Semptomlar

FM'nin temel klinik belirtileri ağrı, yorgunluk, uyku problemleri ve hassasiyet olarak Smythe ve Moldofsky (1977) tarafından tanımlanmış ve 1981'de Yunus vd (1981) tarafından detaylandırılmıştır. 1990 yılında ARD FM hastaları tarafından ortak olarak bildirilen birçok semptomu daha FM sınıflandırma listesine eklemiştir. Bu semptomlar; parestezi, anksiyete, baş ağrısı, irritabl bağırsak, idrar aciliyeti, sikka semptomları, gürültü ve soğuğa karşı intolerans, dismenore, depresyon, bel ağrısı, boyun ağrısı, Raynaud fenomeni ve havadaki değişiklikliğe karşı hassasiyettir (Wolfe vd 1990). Ulusal Fibromiyalji Derneği (National Fibromyalgia Association) tarafından FM tanısı konan 2569 kişi üzerinde yapılan bir internet araştırması sonucunda, semptomların şu şekilde sıralanmıştır: sabah tutukluğu, yorgunluk, uyku problemleri, ağrı, unutkanlık, zayıf konsantrasyon, uykuya dalmada zorluk, kas spazmları, anksiyete ve depresyon (Bennett vd 2007). Alman Fibromiyalji Derneği (German Fibromyalgia Association) tarafından benzer bir anket, 3996 hastaya postalamış ve 699 hasta tarafından doldurulmuştur; en sık görülen semptomların sıralaması şu şekildedir: kas ağrısı, sabah tutukluğu, uyku problemleri, zayıf konsantrasyon, enerji eksikliği, düşük verimlilik ve unutkanlık (Hauser vd 2008).

2.1.4.1. Yaygın kas iskelet ağrısı

FM'nin en temel tutulumu; çok bölgeli ağrı olarak da adlandırılan kronik yaygın ağrıdır. Hastalar tüm vücut bölgelerinden ziyade, çok sayıda lokalize bölgede ağrı yaşadıklarını rapor etmişlerdir (Staud vd 2006, Ge vd 2011). Tipik olarak FM'li bireylerde en az altı bölgede (baş, kollardan biri, göğüs, bacaklardan biri, üst sırt ve torakal vertebralar, alt sırt ve lumbal vertebralar (glutealleri de içeren)) etkilenim

görülmektedir. El ve ayaklardaki ağrı bulgusu da nadir değildir (Reilly ve Littlejohn 1992). Ağrı, başlangıçta genellikle boyun ve omuzlar ile lokalizedir (Arnold vd 2019).

FM'li hastalar ağrılarını tanımlarken McGill Ağrı Anketi'den en sık zonklayıcı, hassas, yorucu, halsiz bırakıcı kelimelerini seçmişlerdir (Leavitt vd 1986, Lautenbacher vd 1994, Hughes 2006). Çoğu hasta, periyodik alevlenmelerle birlikte değişken yoğunlukta olmasına rağmen ağrıyı, sürekli olarak tanımlamaktadır (Hughes 2006, Affaitati vd 2011). Özellikle basınç ağrısına karşı daha belirgin hipersensitivitesi olan hastalarda; ağrı, sertlik ve yorgunluğun sabahları en yüksek şiddette; öğleden sonraları ise en hafif olduğu bildirilmiştir (Bellamy vd 2004). FM'li bireylerin hissettikleri ağrının günlük bir varyasyona sahip olduğu ve en az ağrı hissedilen zaman diliminin yaklaşık olarak 11:00 ile 15:00 saatleri arasına denk geldiği literatürde bulunan bilgiler arasındadır (Moldofsky 1994).

FM ağrısı tipik olarak bazı zaman dilimlerinde şiddetlenir ve daha sonra azalır. Bu alevlenmelerin; alışılmadık efor, uzun süreli hareketsizlik, yumuşak doku yaralanmaları, cerrahi operasyon, kalitesiz uyku, soğuğa maruz kalma, uzun araba yolculukları, duygusal olarak üzüntü oluşturan durumlar ve psikolojik stres faktörleri ile ilişkili olduğu rapor edilmiştir. Birçok FM hastası; soğuk ve nemli havada ve basıncın düşük olduğu bölgelerde ağrılarının arttığını tarif etmektedirler (Bennett vd 2007). Dinlenme, rahatlama ve sıcaklık ise hastaların çoğunluğu tarafından yararlı olarak kabul edilmektedir (Okifuji ve Turk 2002, Bennett vd 2007).

FM'nin ağrı ve diğer semptomları görünmezdir ve hastaların çoğunda her zaman mevcut olsalar da oldukça değişkendirler, yani yoğunlukları günden güne ve gün içinde değişmektedir (Zautra vd 2007, Okifuji vd 2011, Bossema vd 2013, Toussaint vd 2014,). Bu semptomların öngörülemezlikleri ile birlikte ailelerin, arkadaşların ve hekimlerin bu semptomların gerçekliğini kabul etmedeki güçlükleri, FM hastalarının kendi içlerindeki başka stres ve sıkıntı kaynaklarıdır. Ağrıyı ve diğer semptomları olumsuz yönde etkileyen ve kontrol eden bir dış faktörün varlığı; kişinin ağrı algısını azaltır ve bu da özyeterliliğin azalmasına neden olur. Birçok faktör özellikle de katastrofi ağrı algısını güçlü bir şekilde etkilemektedir ve hastanın ağrı ile başa çıkma stratejilerini yönlendirmektedir (Burckhardt vd 1997, Hassett vd 2000, Sánchez vd 2011, Van Liew vd 2013).

Hastaların büyük çoğunluğu tipik olarak tüm kaslarında ağrı tanımlarlar ve yumuşak dokularında bir şişlik hissi tarif ederler. Bu his, genellikle eklem bölgesinde lokalizedir. Genellikle eklemlerini incinmiş gibi hissettiklerini belirtirler (Reilly ve Littlejohn 1992, Clauw 2014, Arnold vd 2019). Genellikle hasta tanımlamaları şu şekildedir: "Her yerimi incitmiş gibi hissediyorum" veya "Her zaman grip olmuş gibi hissediyorum".

2.1.4.2. Yorgunluk

FM hastalarının en az %75'i yorgunluk bildirmiştir (Wolfe vd 1990, Nakamura vd 2014). FM'li hastalar, sadece sağlıklı kontrollere kıyasla değil, aynı zamanda diğer romatizmal hastalıkları bulunan kişilere kıyaslada, önemli ölçüde daha yüksek yorgunluk seviyelerinden muzdariptirler (Zautra vd 2007, Roehrs vd 2013). Ancak FM hastalarının yorgunluk düzeyi önemli ölçüde günler arasında değişkenlik göstermektedir (Zautra vd 2007). Yorgunluklarını ağrılarından daha şiddetli olarak değerlendirmektedirler (Bennett vd 2007, Malin ve Littlejohn 2012).

Orta ve yüksek şiddette, geçmeyen yorgunluk, FM'nin temel özelliklerindendir. Uzun süreli inaktivite, yorgunluğu kötüleştirebilmektedir. Hastalar 8 ile 10 saat arasında uyumalarına rağmen dinlenememiş olmaktan yakınırlar. FM hastaları karakteristik olarak sıklıkla sabahları erken saatlerde uyanıp, uyumakta zorluk çekerler ve derin uykuya dalamazlar. Yorgunluk, devamlı fiziksel ve emosyonel tükenmişlik hissi şeklinde olabilmektedir (Arnold vd 2019).

Bu semptomun çok açık şekildeki önemine rağmen, FM hastalarının çoğunlukla bunaltıcı olan yorgunlukları hakkında ne demek istedikleri tam olarak anlaşılamamaktadır. FM'deki sonuç ölçütlerini belirlemeye yönelik büyük girişimler bile (Outcome Measures in Rheumatology/ Romatoloji'de Sonuç Ölçütleri=OMERACT, or the Patient-Reported Outcomes Measurement Information System/Hastanın Raporladığı Sonuç Ölçütleri Bilgi Sistemi=PROMIS gibi), yorgunluğu önemli bir alan olarak tanımlamalarına rağmen, tarifinin yapılmasında başarısız kalmaktadırlar (Cella vd 2007, Mease vd 2008, 2011). Bununla birlikte, OMERACT'ın, bazı detaylı hasta görüşmeleri gerçekleştirerek FM'de kavramsal bir yorgunluk modeli geliştirme girişimi olmuştur (Humphrey vd 2010). Hastaların kullandığı tanımlayıcılar, FM'deki yorgunluğun fiziksel, duygusal ve zihinsel/bilişsel boyutları olan karmaşık bir çoklu sistem kavramı olduğunu göstermektedir (Vincent vd 2013).

Yorgunluk ile ilişkili çok çeşitli faktörler bulunmuştur (Vincent vd 2013). Hem kesitsel hem de longitudinal çalışmalarda; ağrı, sertlik, uyku problemleri, anksiyete ve depresyon yorgunluk ile pozitif ilişki gösterirken, olumlu duygu durumu negatif yönde ilişki göstermiştir. Ayrıca, yapılan longitudinal çalışmalarda yorgunluk ile uyku kalitesi ve uyku süresi arasında negatif korelasyon; yorgunluk ile duygusal stres, olumsuz olaylar ve olumsuz duygular arasında ise pozitif bir ilişki olduğu rapor edilmiştir. Şaşırtıcı şekilde, olumlu olaylar aynı gün yorgunluğun azalması, ancak ertesi gün artan yorgunluk ile ilişkilendirilmiştir (Parrish vd 2008). Bu durum, pozitif olaylardan kaynaklanan ek enerji artışının FM hastaları için ne kadar maliyetli olabileceğinin altını çizmektedir. Kesitsel çalışmalarda artan yorgunlukla ilişkili olduğu bulunan diğer

faktörler arasında; FM'nin şiddeti, hassasiyet, disabilite, bilişsel şikayetler ve iç ve dış kontrol odakları bulunmaktadır (Vincent vd 2013). FM'de yorgunluğun değerlendirilmesi konusunda fikir birliğine varılmış bir tanım veya standart olmadığı göz önüne alındığında, bu ilişkilerin anlamının büyük bir dikkatle yorumlanması gerektiği bildirilmektedir (Borchers ve Gershwin 2015).

2.1.4.3. Uyku problemleri

FM'li hastaların çoğu (birçok çalışmada %>90 ile 70 arasındadır), düşük uyku kalitesi bildirmiştir (Bennett vd 2007, Bigatti vd 2008, Neumann vd 2008, Cobankara vd 2011, Miró vd 2011). Uyku kalitesi anketlerine göre, sadece sağlıklı kontrollere kıyasla değil, aynı zamanda diğer romatizmal hastalıkları veya diğer ağrı problemleri bulunan hastalara kıyasla FM'li hastaların uykuya dalması daha uzun sürüyor, gece daha sık uyanıyorlar, uyudukları saat sayıları daha az ve anlamlı düzeyde dinlenmeden uyanıyorlar (Cöster vd 2008, Diaz-Piedra vd 2015). Polisomnografi sonuçları, FM'li hastalar tarafından bildirilen düşük uyku kalitesini kısmen doğrulamaktadır. En tutarlı bulgular; uyku verimliliğinin azaldığı (toplam uyku süresi / yatakta geçen süre), toplam uyku süresine oranla hafif uykuda daha fazla süre geçirildiği ve uykunun başlangıcından itibaren daha fazla uyanıklık süresinin bulunduğu yönündedir (Rizzi vd 2004, Diaz-Piedra vd 2015).

Moldofsky vd (1975) kontrol grubuna kıyasla FM'li hastalarda Non-REM uykusu sırasında α-ritim sıklığının arttığını gözlemlemiştir. α EEG frekansları genellikle uyanıklıkla ilişkili olduğundan, Moldofsky vd (1975) Non-REM uykusu sırasında bu artmış α aktivitesinin FM hastalarında nonrestoratif uyku düzeninden sorumlu olduğunu bildirmişlerdir. Derin NREM uykusu sırasında α EEG frekanslarının artmış oluşumu, birçok çalışmada sağlıklı kontrollere kıyasla FM'li hastalarda tanımlanmıştır (Mahowald ve Mahowald 2000, Roizenblatt vd 2001, Rizzi vd 2004, Olsen vd 2013). α-dalgası, aslında uyku kalitesinin göstergeleri arasındadır. Ancak, Non-REM uykusu sırasındaki α-dalgasının FM'ye özgü olmadığı, ancak çeşitli ağrı sendromları olan hastalarda, hatta sağlıklı kontrollerde de görülebildiği unutulmamalıdır. α EEG aktivitesinin ölçülmesi zordur; bu nedenle çalışmalardaki FM'li hastaların oranları değişkenlik gösterebilmektedir. Son zamanlarda yapılan birkaç çalışmada, FM'li hastalar ve sağlıklı kontroller arasında α-δ uykusunda önemli farklılıklar olmadığı da rapor edilen sonuçlar arasındadır. Bu durum kısmen, FM'li hastalarda çok daha yüksek oranda görülen bireyler arasındaki değişkenliğe bağlanmıştır (Chervin vd 2009, Besteiro González vd 2011). Siklik Alternan Patterni, FM'de uyku kalitesinin belirlemesinde çok daha iyi bir

gösterge olarak kabul edilebilmektedir. Siklik Alternan Pattern oranı uyku verimliliği ile negatif, hassas noktalar ile pozitif korelasyon göstermektedir. Sağlıklı kontrollere göre FM'li hastalarda sıklığının arttığı tespit edilmiştir (Rizzi vd 2004).

Obstrüktif uyku apnesi ve huzursuz bacak sendromu gibi uyku bozuklukları, FM'li hastalarda, özellikle erkek hastalarda, genel popülasyona göre daha yaygın görünmektedir. Bu tür uyku bozukluklarının varlığı yalnızca uyku kalitesinin daha kötü algılanması ile değil, aynı zamanda ağrı, yorgunluk semptomların şiddetinin daha fazla hissedilmesi ile de ilişkilidir (Roizenblatt vd 2011, Civelek vd 2014). FM'li hastaların bildirdiği uyku kalitesi ile ilişkili diğer faktörler; depresyon, anksiyete, algılanan disabilite ve stres düzeyi, uyku ile ilgili olumsuz inanışlar, fiziksel aktivite ve öz-yeterliliktir (Theadom ve Cropley 2008, Miró vd 2011, Munguia-Izquierdo ve Legaz-Arrese 2012, Diaz-Piedra vd 2014).

Longitudinal çalışmaların sonuçları, FM'li hastalarda ağrı ve uyku problemleri arasındaki ilişkinin çift yönlü olduğunu vurgulamaktadır. Yeterince uyku ile geçirilemeyen bir gecenin ertesi gününde, ağrı yoğunluğu daha fazla hissedilmekte ve daha fazla ağrı daha kötü uykuya neden olmaktadır, her iki durumda da ağrıya olan dikkat artmaktadır (Affleck vd 1996). Uyku problemleri, artan ağrı veya diğer stresli olaylarla başa çıkma yeteneği üzerinde de olumsuz etkilere neden olabilmektedir (Hamilton vd 2007). Ayrıca, uykunun kalitesinden ziyade, uyku ile geçirilen sürenin uzunluğunun; stresle başa çıkma yeteneği üzerinde çok daha etkin olduğu ve birkaç gecenin yeterli sürede uyku ile geçirilmemesinin etkilerinin kümülatif olduğu bildirilmiştir (Hamilton vd 2008). Hem uyku problemlerinin hem de ağrının, depresyon ve anksiyete semptomları ve fonksiyonel limitasyonlarla da ilişkili olduğu rapor edilmiştir (Miró vd 2011, Hamilton vd 2012, Diaz-Piedra vd 2014), ancak hangi faktörün hangisine sebep olduğu konusunda bazı anlaşmazlıklar bulunmaktadır. Bir modelde, uyku problemleri ağrıya neden olmakta ve kişinin stres ve fonksiyonel limitasyonla başa çıkma becerilerini olumsuz yönde etkilemektedir (Hamilton vd 2012). Bir diğerinde ise ağrı uyku problemlerine neden olmakta, böylece stres ve günlük fonksiyonellikte öz yeterliliğin azalması ile süreç devam etmektedir (Miró vd 2011, Diaz-Piedra vd 2014).

2.1.4.4. Kognitif problemler

Kognitif problemler, FM hastalarının çoğunda görülmektedir. FM'li hastaların en az %76'sı konsantrasyon güçlüğü, unutkanlık, zihinsel karışıklık veya bu şikayetlerin bir kombinasyonunu bildirmektedir (Leavitt vd 2002, Zachrisson vd 2002, Katz vd 2004, Schaefer vd 2011) ve FM hastalarının neredeyse yarısı, bu semptomların şiddetini

skorlaması 0 ila 10 arasında değişen bir ölçekte ≥6 olarak derecelendirmektedir (Rutledge vd 2009). FM hastaları, kognitif performanslarını sadece sağlıklı kontrollere kıyasla değil, aynı zamanda diğer romatizmal hastalıkları veya kronik ağrı problemleri bulunan kişilere kıyasla önemli ölçüde daha kötü olarak değerlendirmektedirler (Grace vd 1999, Suhr 2003, Katz vd 2004, Glass vd 2005, Landrø vd 2013, Tesio vd 2015). Bu öznel şikayetlerin gerçekten bozulmuş işlevi mi yoksa hasta tarafında önyargılı algıyı mı yansıttığı konusunda bir miktar belirsizlik bulunmaktadır. Hastaların konsantrasyon ve hafıza problemlerini fazlasıyla abarttıklarını gösteren veriler de mevcuttur (Grace vd 1999, Suhr 2003).

FM hastalarında kognitif disfonksiyonun en sık tanımlanan yönlerinden biri, dikkattir (Dick vd 2002, Glass 2009). Dikkat; uyarma, yönlendirme ve yürütme işlevleri olmak üzere 3 kısımda incelendiğinde; FM hastalarında uyarma ve zamansal yönlendirmede eksiklikler görülürken, görsel yönlendirme ve yürütmenin kontrolününde herhangi bir problem saptanmamıştır (Glass 2009, Correa vd 2011, Glass vd 2011, Miró vd 2011, Reyes Del Paso vd 2012, Martinsen vd 2014, Tesio vd 2015). Kognitif inhibisyon, dikkati dağıtacak bir faktör varlığında odaklanmayı sürdürme yeteneğidir ve yürütme işlevinin bir bileşeni olarak kavramsallaştırılabilmektedir. Birçok çalışmanın sonuçlarındaki tutarlılığa göre, FM hastalarında kognitif inhibisyonun bozulduğu belirlenmiştir. FM hastalarındaki kognitif defisitler, sadece dikkat testlerinde değil aynı zamanda çalışan bellek testlerinde de, dikkati dağıtan bir uyaranın varlığında en belirgin hale geldiğine dair göstergeler bulunmaktadır (Leavitt ve Katz 2006, Dick vd 2008). Çalışan bellek, FM hastalarının sağlıklı kontrollere kıyasla daha kötü performans gösterdikleri başka bir bilişsel alandır (Glass 2009, Ambrose vd 2012, Reyes Del Paso vd 2012, Seo vd 2012, Tesio vd 2015). Daha az sayıda çalışmada ele alınsa da, FM'de anlamsal belleğin bazı ölçümlerinde de etkilenim olduğu gösterilmiştir; bunlar sözel akıcılık, adlandırma hızı ve kelime bilgisindeki azalma gibi problemlerdir (Glass 2009, Ambrose vd 2012, de Melo ve Da-Silva 2012). Ayrıca, son veriler, sözel belleğe göre görsel-uzaysal etkilenimin daha belirgin olabileceğini öne sürmektedir (Cánovas vd 2009, Kim vd 2012).

Tüm kognitif fonksiyonlarda, işlem hızı önemlidir. FM hastalarında çeşitli testler kullanılarak yapılan değerlendirmeler sonucunda bazı görevlerde normal sonuçlar elde edilmesine rağmen (Park vd 2001, Walitt vd 2008); işlem hızında önemli düşüş olduğu rapor edilmiştir (Leavitt ve Katz 2008, Reyes Del Paso vd 2012, Montoro vd 2014, Tesio vd 2015).

Mini-Mental Durum Testi'nin kullanıldığı bir çalışmada FM'li hastaların %58'inin kognitif defisit sergilediği bildirilirken (Can vd 2012), bir diğer çalışmada ise bu oran yalnızca %15 olarak belirtilmiştir (Rodriguez-Andreu vd 2009). Daha spesifik

nöropsikolojik değerlendirmelerde, çeşitli hafıza testlerinden en az birindeki defisit sıklığı %23 (Grace vd 1999), günlük dikkat testinde %60 (Dick vd 2002), işlem hızında %49 (Leavitt ve Katz 2008), yürütücü işlevin çeşitli yönlerini değerlendiren testlerde %40 olarak gösterilmiştir (Tesio vd 2015).

FM'deki kognitif disfonksiyonların depresyon veya depresif belirtiler ile ilişkisini inceleyen çalışmalardan, yalnızca birkaçı bu ilişkiyi tam olarak açıklarken; bazılarında bu ilişkiye kısmen açıklık getirilmiş, bazılarında ise herhangi bir ilişki olmadığı gösterilmiştir (Glass 2009, Glass vd 2011, Kim vd 2012, Reyes Del Paso vd 2012, Veldhuijzen vd 2012, Duschek vd 2013). Bu tutarsızlıkların, çalışmalarda depresif belirtileri değerlendirmek için farklı araçların kullanılmasından ve depresif belirtilerin etkilerinin, alana ya da göreve özgü olarak ortaya çıkmasından kaynaklanabileceği düşünülmektedir (Suhr 2003, Walteros vd 2011, Kim vd 2012). Ayrıca, diğer metodolojik farklılıklar ve hasta heterojenliğinin de gözlemlenen tutarsızlıklara katkıda bulunabileceği belirtilmektedir. Dorsolateral prefrontal korteks, depresyondan korunmada güçlü bir şekilde rol oynamaktadır (Koenigs ve Grafman 2009) ve sağlıklı kişilerde ve FM'li hastalarda çalışan belleğin performansı sırasında dorsolateral prefrontal korteksin aktifliği genel olarak bilinen bir bulgudur (Luerding vd 2008, Seo vd 2012). Bu bilgiler ışığında, depresyon ve hafıza işlevi arasında herhangi bir ilişkinin olmadığı düşünülmemektedir. Ancak dorsolateral prefrontal korteksin aktiflik derecesi sağlıklı kontrollere göre FM hastalarında daha düşük bulunmuştur ve bu farkın büyük ölçüde depresif belirtilerden kaynaklandığı belirtilmektedir (Seo vd 2012). Anksiyete belirtileri ise, hatırlamadaki gecikme, hafıza ve işlem hızı dahil olmak üzere çeşitli kognitif değişkenlerle ilişkilendirilmiştir (Grace vd 1999, Montoro vd 2014).

FM'li hastalar, yorgunluğun kognitif fonksiyonlar üzerinde büyük bir etkisi olduğunu düşünmektedirler (Oncu vd 2013). Hastalar tarafından bildirilen yorgunluk ile algılanan kognitif bozukluk ilişkili bulunurken (Katz vd 2004, Humphrey vd 2010, Williams vd 2011); kognitif fonksiyonun objektif olarak değerlendirildiği araştırmaların büyük bir çoğunluğu, yorgunluğun kognitif performans üzerinde önemli bir etkisinin olduğunu ortaya koymamaktadır (Glass 2009, Glass vd 2011, Kim vd 2012, Reyes Del Paso vd 2012, Veldhuijzen vd 2012). Hasta grubunda zihinsel aritmetik bir görev sırasında yorgunluk, daha düşük doğru yanıt oranı ile ilişkilendirilirken (Montoro vd 2014), yap/yapma görevindeki performansla önemli ölçüde ilişkilendirilmemiştir (Glass vd 2011).

Aynı zamanda uyku kalitesinin de kognisyonu etkilemesi beklenmektedir ve algılanan hafıza problemleri ile de ilişkili bulunmuştur (Williams vd 2011). Uyku kalitesinin, objektif olarak değerlendirilen uyanıklığın, tek anlamlı ön belirleyicisi olduğu

belirlenmiştir (Miró vd 2011), ancak hastaların bildirdiği uyku süresi ve kalitesi düzeltikdikten sonra dikkat ve hafıza problemleri devam etmiştir (Dick vd 2008).

Ağrı yoğunluğu, FM'de diskognisyonu objektif olarak değerlendiren önemli bir belirleyici olarak tanımlanmıştır **(**Glass 2009, Duschek vd 2013, Montoro vd 2014) ve hatta FM'li hastalarda gözlemlenen işlem hızı ve dikkat eksikliklerini neredeyse tamamını açıklamakta kullanılmaktadır (Dick vd 2008, Reyes Del Paso vd 2012). Kognitif fonksiyonların gerçekleştirildiği birçok beyin bölgesi ile ağrının algılanması ve kontrol edilmesinde önemli rol oynayan beyin alanları kısmen örtüşmektedirler (Cook vd 2004, Luerding vd 2008). Hem ağrı ile ilgili işlemleri gerçekleştiren hem de kognitif fonksiyonlarda görev alan bu beyin bölgelerinin, ağrı ile olan meşguliyetleri nedeniyle kognitif görevlerini yerine getiremediklerinden dolayı FM'de kognitif disfonksiyonun oluştuğu hipotezi öne sürülmektedir (Glass vd 2011). Bu durumun, özellikle FM'li hastalarda olduğu gibi ağrı yoğunluğunun yüksek olduğu ya da ağrıya bağlı olarak oluşmuş anksiyete ve katastrofi düzeyi yüksek olan kişilerde görülebileceği belirtilmektedir (Geisser vd 2003, Crombez vd 2004). Bununla birlikte, katastrofinin ağrılı uyaranlara karşı verilen nöral cevabı arttırıp arttırmadığı konusunda tartışmalar devam etmektedir (Gracely vd 2004, Jensen vd 2010). Hem ağrının işlenmesinde hem de kognitif görevlerde rol alan beyin bölgelerinin hangi görevi gerçekleştirmede daha baskın olacakları konusundaki mevcut veriler doğrultusunda, otomatik işlemlerde herhangi bir etkilenim olmazken, öncelikle kontrollü işlemlerde etkilenim olduğu düşünülmektedir (Grisart vd 2002, Reyes Del Paso vd 2012).

FM hastalarının kognitif fonksiyonlarındaki problemlerin, gri cevher morfolojisindeki değişikliklerden de kaynaklanabileceği belirtilmektedir (Ceko vd 2012). FM hastalarında böyle bir ilişkinin varlığından bahsetmek için en önemli kanıtlar; sözel çalışan bellek performansı ile bilateral medial frontal korteksteki gri madde değerleri arasındaki anlamlı pozitif korelasyonunun ve sözel olmayan çalışan bellek ile sol orta frontal girustaki gri madde değerleri arasındaki ilişkinin keşfedilmesi sonucunda elde edilmiştir (Luerding vd 2008). Ayrıca, sağlıklı kişilerle karşılaştırıldığında FM'li hastaların anterior singulat korteks, prefrontal korteks ve insular korteksinde içinde bulunduğu yüksek düzeyde kognitif işlemlerin yapıldığı beyin alanlarında; gri madde yoğunluğunun önemli ölçüde azaldığını gösteren çalışmalar da bulunmaktadır (Kuchinad vd 2007, Burgmer vd 2009, Wood vd 2009, Robinson vd 2011, Ceko vd 2012, 2013).

FM hastalarının önemli bir kısmının nöropsikolojik değerlendirmeler için standartlaştırılmış testlerdeki başarısı, yetersiz seviyede kalmıştır (Gervais vd 2001, Suhr 2003). Bazı nörogörüntüleme çalışmalarının sonuçları, FM hastalarının sağlıklı kontrollerle aynı seviyede fonksiyonellik elde edebilmek için, daha fazla beyin bölgesini

kullandıklarını ortaya koymaktadır (Bangert vd 2003**,** Glass vd 2011). Bu durum, FM hastalarının daha büyük çaba gösterdiklerinin bir yansıması olarak yorumlanmıştır (Ambrose vd 2012). FM'li hastalar her zaman sağlıklı kontrollere göre daha fazla beyin aktivitesi göstermezler. Bu hastaların sağlıklı kontrollere göre daha kötü performans gösterdiği görevler sırasında yapılan fMRI sonuçlarına göre, FM hastalarının sağlıklı kontrollere kıyasla herhangi bir beyin bölgesinde artan aktivasyon görülmemiştir (Seo vd 2012, Martinsen vd 2014). Bununla birlikte, olması gerekenden daha fazla beyin bölgesinin kullanılması, her zaman sonucu olumlu etkilememektedir. Orta ve ön serebral arterlerdeki kan akışını değerlendirmek için uygulanan fonksiyonel transkraniyal Doppler sonografinin kullanıldığı bir çalışmanın sonuçlarına göre, ek olarak aktif hale getirilen beyin alanların aslında görevle ilgisiz olan alanlardan anormal bir şekilde tahsis edildiğini göstermektedir ve bu tür görevle ilgisiz alanların aktivasyonu, FM hastalarının çeşitli kognitif fonksiyonlarda daha kötü performans göstermelerinin nedenlerini açıklamada kullanılan hipotezlerden birini oluşturmaktadır (Montoro vd 2014).

FM tedavisinde rutin olarak kullanılan ilaçlardan bazılarının da kognisyonu etkilemesi olasılıklar dahilinde bulunmaktadır, fakat ilaçların kesilmesi de kafa karıştırıcı unsurlara neden olabilmektedir. FM hastalarının nöropsikolojik değerlendirmelerinin çoğu, farklı ilaçlar alan az sayıda denek üzerinde yapılmıştır. Buda, herhangi bir ilaç sınıfının önemli bir etkisini tespit etmeyi zorlaştırmaktadır (Dick vd 2002, Sephton vd 2003, Dick vd 2008, Miró vd 2011, Reyes Del Paso vd 2012, Duschek vd 2013, Landrø vd 2013, Montoro vd 2014).

2.1.4.5. Psikiyatrik semptomlar

Psikiyatrik problemlerin FM gelişimine önemli katkı sağladığı görülmektedir. FM'den etkilenen hastalar arasında psikiyatrik problemlerin prevalansı, diğer romatizmal hastalığı olanlara göre daha yüksektir (Giesecke vd 2003).

En sık görülen bozukluklar anksiyete, somatizasyon, distimi, panik bozuklukları, travma sonrası stres ve genel depresyondur (McBeth vd 2001, Clauw ve Crofford 2003, Carta vd 2018, Galvez-Sánchez vd 2018). Depresyon ve/veya anksiyete, tanı anında hastaların yüzde 30 ila 50'sinde görülmektedir (Ghiggia vd 2017, Løge-Hagen vd 2019). Depresyon, diğer kas-iskelet sistemi hastalıkları ile karşılaştırıldığında FM'de daha sık görülmektedir (Epstein vd 1999). Kanada'da yapılan bir çalışmada, çalışmaya dahil edilen 127.000 kişiden, 1635'inin FM olduğu ve FM olmayan kişilerle karşılaştırıldığında FM'li kişilerde depresyonun 3 kat daha fazla görüldüğü rapor

edilmiştir (Fuller-Thomson vd 2012). Ayrıca, FM grubunun yüzde yirmi ikisinde eşzamanlı olarak majör depresyon bulunduğu bildirilmiştir. Bu FM grubundaki depresyon ile genç yaş, kadın cinsiyet, bekar medeni durum, kronik koşullar ve aktivitelerdeki kısıtlamalar arasında ilişki olduğu belirtilmiştir. Depresyon FM semptomlarını ya da FM semptomları depresyonu kötüleştirebilir (Arnold vd 2000).

FM'de depresyon prevalansı ile ilgili 11 çalışmanın meta-analizi sonucunda, FM hastalarının dörtte birinin mevcut majör depresyona sahip olduğu ve yarısında yaşam boyu majör depresyon öyküsü bulunduğu gösterilmiştir (Løge-Hagen vd 2019). Anksiyete bozuklukları, bipolar bozukluk, travma sonrası stres bozukluğu, katastrofi ve aleksitimi gibi problemler FM'li hastalarda genel popülasyona göre daha yaygındır (Ghiggia vd 2017, Carta vd 2018, Galvez-Sánchez vd 2018).

2.1.4.6. Baş ağrısı

Baş ağrısı FM'li hastaların yüzde 50'den fazlasında bulunur ve migren ve gerilim tip baş ağrısı şeklindedir. FM komorbiditesi; baş ağrısı sıklığı, anksiyete, perikraniyal hassasiyet, uyku problemleri (az uyuma) ve fiziksel disabilite ile ilişkilidir. FM özellikle epizodik migren hastalarında yaygındır (de Tommaso vd 2011, Küçükşen vd 2013).

2.1.4.7. Parestezi

Martinez-Lavin vd (2003), birçok FM hastasının, nöropatik ağrı sendromlu hastaların deneyimlediklerine benzer şekilde; esas olarak cilt hissindeki değişiklikleri ifade eden nöropatik semptomlar gösterdiklerini bildirmiştir. FM'li hastalar, özellikle hem kollarda hem de bacaklarda uyuşma, karıncalanma, yanma veya keçelenme gibi duyuları içeren parestezideniden şikayet ederler (Watson vd 2009, Caro vd 2018, Lodahl vd 2018).

2.1.4.8. Periferik dokular

Cilt, kaslar ve mikrodamarlar gibi periferik dokular daha yakından araştırılmaktadır. Kaslarda vasküler disregülasyon, oksidatif stres cevabındaki yetersizlik, saturasyonun gece düşerek kötüleşmesi, kutanöz dokularda artan interlökin-1, kas dokularında artmış P maddesi ve kas liflerindeki DNA

parçalanmalarının; FM'de muhtemel rol oynayabileceği düşünülmektedir (Lario vd 1996, Ozgocmen vd 2006, Staud 2006, Katz vd 2007).

2.1.4.9. Diğer semptomlar ve bozukluklar

FM'li hastalar ayrıca karın ve göğüs duvarı ağrısı, irritabl bağırsak sendromunu düşündüren semptomlar ve interstisyel sistit / ağrılı mesane sendromunu (kadın üretral sendromu) düşündüren pelvik ağrı ve mesane semptomları dahil olmak üzere tam olarak anlaşılamamış çeşitli ağrı semptomlarına da sahip olabilmektedirler (Arnold vd 2019). İrritabl bağırsak sendromu FM ile ilişkili en yaygın gastrointestinal sendromdur. Gastroözofageal reflü hastalığı da, genel popülasyona göre FM'de daha yaygındır (Wang vd 2017). Otonom sinir sistemi disfonksiyonu, göz kuruluğu ve Raynaud fenomeni belirtileri de FM'de sık görülmektedir. Ortostatik hipotansiyon ve kalp hızı değişkenliği, FM'de otonom sinir sistemi disfonksiyonunun ortak belirtilerindendir (Kang vd 2016). Göz kuruluğu sendromu, genel popülasyona kıyasla FM'de 1.4 kat daha fazla görülmektedir (Chen vd 2016). Raynaud fenomeni, FM'de sık görülmesine rağmen, Primer Raynaud fenomeni'de görülen termografik ve mikrovasküler anormallikler FM hastaları tarafından belirtilen Raynaud fenomeni'de bulunmamaktadır (Scolnik vd 2016). İşitme kaybının, FM'li hastalarda genel popülasyona göre dört ila beş kat daha sık görüldüğü bildirilmiştir (Stranden vd 2016).

Bazı bireyler, belirli hava koşullarının veya havadaki değişikliklerin, semptomlarını kötüleştirdiğini ifade etmesine rağmen, yapılan birçok çalışmada, bu gibi durumların günlük ağrı veya yorgunluk üzerindeki etkileri tutarlı bulunmamıştır. Örnek olarak, FM'li 403 kadını içeren havanın ağrı ve yorgunluk semptomları üzerindeki etkisine ilişkin ayrıntılı olarak yapılan bir çalışmada, havanın ağrı veya yorgunluk üzerine istatistiksel olarak anlamlı fakat küçük bir etkisinin olduğu bildirilmiştir (Bossema vd 2013). Bu semptomların, sesler ve ışıklar dahil, çevresel aşırı duyarlılığın bir parçası olabileceği ifade edilmiştir (Arnold vd 2019).

2.1.5. Tanı

En az 3 aydır sürekli ağrısı bulunun bir birey, Yaygın Ağrı İndeksi ve Semptom Şiddet Ölçeği'nın kriterlerini karşılıyorsa, başka herhangi bir şeye gereksinim duyulmadan FM tanısı konur (Tablo 2.2).

Tanı kliniktir, hastalığa özel laboratuar veya görüntüleme bulguları ve altın bir standartı yoktur ve büyük ölçüde hastanın kendi kendine bildirdiği bir dizi kritere dayanmaktadır (Jay ve Barkin 2015).

Tablo 2. 2 Amerikan Romatoloji Derneği Fibromiyalji tanı kriterleri (Wolfe vd 1990, Wolfe vd 2010, Bennett vd 2014, Wolfe vd 2016)

1990	2010	2013	2016
1) Palpasyonla 18 hassas noktadan 11'inde ağrının hissedilmesi	1) Yaygın Ağrı İndeksi'nden 7 ve üstü ve Semptom Şiddet Ölçeği'nden 5 ve üstü ya da Yaygın Ağrı İndeksi'nden 3 ile 6 arasında ve Semptom Şiddet Ölçeği'nden 9 ve üstü puan almak	1) Ağrı Yerleşim Skoru'ndan 17 ve üzeri puan almak ve Semptom Etkilenme Skorlaması'ndan 21 ve üzeri puan almak	1) Yaygın Ağrı İndeksi'nden 7 ve üstü ve Semptom Şiddet Ölçeği'nden 5 ve üstü ya da Yaygın Ağrı İndeksi'nden 4 ile 6 arasında ve Semptom Şiddet Ölçeği'nden 9 ve üstü puan alıyorsa,
2) En az 3 aydır devam eden yaygın ağrı öyküsü	2) En az 3 aydır devam eden semptomlar	2) En az 3 aydır devam eden semptomlar	2) Semptomlar 3 ay ya da daha uzun süredir aynı seviyede devam ediyorsa 3) 5 bölgenin en az 4'ünde genel ağrı varlığı (Çene, göğüs ve karın ağrısı genel ağrı tanımına dahil değildir)
Hassas Noktalar	Yaygın Ağrı İndeksi (0-19 arası puan)	Ağrı Yerleşim Skoru (0-28 arası puan)	Yaygın Ağrı İndeksi (0-19 arası puan)
-Suboksipital kas sonlanmaları	Sağ-sol omuz kuşağı	Boyun	Sol üst bölge (1.bölge)
-C6 vertebranın anteriordaki iz düşümü	Sağ-sol üst kol	Sağ-sol çene,	sol çene
-Trapezius kasının üst sınırının orta noktası	Sağ-sol ön kol	Sağ-sol sırt	sol omuz
-Spina skapulanın medial sınırına yakın supraspinatus kasının orjini	Sağ-sol kalça(trokanter)	Sağ-sol bel,	sol kol
-İkinci kostanın kostakondral birleşim yeri	Sağ-sol üst bacak	Orta sırt-orta bel	Sol önkol
-Lateral epikondiller	Sağ-sol alt bacak	Göğüs-ön,	Sağ üst bölge (2.bölge)
-Gluteal kasların dörtte birlik üst dış kısmı	Sağ-sol çene	Sağ-sol omuz	Sağ çene
-Büyük trokanterin posterior çıkıntısı	Göğüs, karın, boyun, sırt, bel	Sağ-sol kol,	Sağ omuz
-Dizin eklem hattına yakın medial yağ yastığında		Sağ-sol el bileği	Sağ kol
		Sağ-sol el,	Sağ önkol
		Sağ-sol kalça	Sol alt bölge (3. bölge)
		Sağ-sol uyluk,	Sol kalça
		Sağ-sol diz	Sol uyluk
		Sağ-sol ayak bileği,	Sol bacak
		Sağ-sol ayak	Sağ alt bölge (4. bölge)
			Sağ kalça
			Sağ uykluk
			Sağ bacak
			Aksiyal bölge (5. bölge)
			Boyun
			Üst sırt
			Alt sırt
			Göğüs
			Karın

Devamı arkada

Tablo 2.2 Amerikan Romatoloji Derneği Fibromiyalji tanı kriterleri

	Semptom Şiddet Ölçeği (0-12 arası puan)	**Semptom Şiddet Ölçeği (0-100 arası puan)**	**Semptom Şiddet Ölçeği (0-12 arası puan)**
	a. Halsizlik b. Yorgun uyanma c. Bilişsel semptomlar d. Somatik semptomlar a, b ve c için: (0=normal, 1=hafif, 2=orta ve 3=şiddetli) kaydedilir. klinisyen değerlendirmesi (41 somatik semptom için): 0=semptom yok, 1=az sayıda semptom, 2=orta düzeyde semptom, 3=çok sayıda semptom var Not: 2011 modifiye kriterlerinde 41 semptom, 6 semptom olarak değiştirildi.	Ağrı (0-10) Enerji (0-10) Tutukluk (0-10) Uyku (0-10) Depresyon (0-10) Hafıza problemleri (0-10) Anksiyete (endişe) (0-10) Dokunmaya duyarlılık (0-10) Denge problemleri (0-10). Yüksek ses, parlak ışık, koku ve soğuğa duyarlılık (0-10)	a. Halsizlik b. Yorgun uyanma c. Bilişsel semptomlar a, b ve c için: (0=normal, 1=hafif, 2=orta ve 3=şiddetli) kaydedilir. Geçen altı ay boyunca hastada görülen aşağıdaki semptomların sayısı 1=Baş ağrısı (0-1) 2=Alt karında ağrı ve kramplar (0-1) 3=Depresyon (0-1)

2.1.6. Klinik değerlendirme

FM, yaygın kas iskelet ağrısı ile karakterize, kognitif ve psikiyatrik problemlere ek olarak özellikle yorgunluk ve uyku problemleri gibi diğer somatik semptomların eşlik ettiği bir hastalıktır. Fiziksel değerlendirmede, belirli anatomik bölgelerdeki yumuşak dokuda hassasiyet gözlenebilir. Laboratuar testleri diğer hastalıkların yokluğunda normaldir (Clauw 2014, Arnold vd 2019, Walitt vd 2015).

2.1.6.1. Hasta hikayesi (Anamnez)

FM semptom ve bulgularına, anksiyete ve depresyon komorbiditeleri de eklenebilir. Bu durum, fiziksel ve bilişsel bulguların bir hastalığa özel olarak güvenli bir şekilde atfedilmesini zorlaştırmaktadır.

- Hastaların genellikle çeşitli bölgelerinde (örneğin boyun, bel, omuz, kalça, ekstremiteler) uzun süreli kas-iskelet sistemi ağrı sendromu hikayesi vardır ve sonucunda yaygın ağrı gelişir (Clauw 2015).

- Birçok hasta, semptomlardan ve değişen ağrı hissinin neden olduğu düşünülen diğer sendromlardan yakınır (Clauw 2015).
  -Gerilim baş ağrıları
  -Temporomandibular eklem ağrısı
  -Vulvodini
  -İrritabl barsak sendromu (örneğin, kabızlık, ishal, şişkinlik, açıklanamayan karın ağrısı)
  -Ağrılı mesane sendromu (örn., Kronik pelvik ağrı, enfeksiyon yokluğunda dizüri)
  -Huzursuz bacak sendromu (örn. Parestezi, bacakları hareket ettirmek için açıklanamayan dürtü)
- Dinlenmenin sağlanamadığı uyku ve yorgunluk yaygındır (Clauw 2015).
- Bilişsel zorluklar, anksiyete ve depresyon sık görülür (Clauw 2015).
- Tıbbi hikaye, olayı tetikleyici bir potansiyel olarak tanımlanabilir (örn. Travmatik yaralanma, enfeksiyon, enflamatuar durum) (Clauw 2015).
- Aile öyküsü, kronik ağrıya neden olabilir (Clauw 2015).

2.1.6.2. Fiziksel bulgular

Fiziksel değerlendirme, objektiflik açısından genellikle dikkate değer değildir. FM hastalarında genellikle fizik muayene ile elde edilebilecek bulgu, 1990 ARD sınıflama kriterlerinde tanımlanmış olan ve özellikle hassas nokta bölgelerindeki yumuşak dokular üzerinde uygulanan palpasyonla belirlenen; hassasiyettir. Bu hassas noktalar;

-Suboksipital kas sonlanmaları
-C6 vertebranın anteriordaki iz düşümü
-Trapezius kasının üst sınırının orta noktası
-Spina skapulanın medial sınırına yakın supraspinatus kasının orjini
-İkinci kostanın kostakondral birleşim yeri
-Lateral epikondiller
-Gluteal kasların dörtte birlik üst dış kısmı
-Büyük trokanterin posterior çıkıntısı
-Dizin eklem hattına yakın medial yağ yastığı

FM tanısı koymak için hassas noktalardaki hassasiyete gerek yoktur. Hastalar dokunmaya genel bir hassasiyet gösterebilir (Jay ve Barkin 2015).

Bu hastaların eklemleri hassas değildir. FM, yumuşak doku ve eklemlerde eritem ve şişliğe neden olmaz.

Nörolojik değerlendirme ile bazen, başka bir hastalığın olmadığı durumlarda, küçük duyusal ve motor anormallikler ortaya konabilmektedir (Watson vd 2009). FM hastalarında nadiren, küçük bir lif nöropatisi ile karşılaşılabilmektedir ve bu hastaların bir kısmı, periferik nöropatiyi düşündüren bazı bulgulara sahip olabilmektedir; ancak bu bulguların anlamı belirsizidir (Caro vd 2018, Lodahl vd 2018).

2.1.6.3. Laboratuvar testleri

FM, rutin klinik laboratuvar testlerinde (örneğin, tam kan sayımlarında, akut faz reaktanlarında ve kandaki kimyasallarda) veya görüntülemede herhangi bir anormallik oluşturmamaktadır.

2.1.6.4. Hastalığa özgü değerlendirme ölçekleri

Tedavi için objektif olarak ölçülebilir hedefler koymak, FM semptomlarını izlemeye ve tedavinin etkinliğini değerlendirmeye yardımcı olabilir. Tedaviye başlamadan veya tedavi yöntemini değiştirmeden önce, ulaşılması amaçlanan her hedef veya semptom için temel ölçümleri değerlendirmek önemlidir. Böylece hastalığın seyri veya semptom iyileşmesi için objektif bir değerlendirme yapılabilir. FM'li bireylerin değerlendirilmesinde pek çok ölçek kullanılmaktadır. FM'ye özel olarak sağlık durumu ve yaşam kalitesi değerlendirmesinde 'Fibromyalgia Impact Questionnaire' (Fibromiyalji Etki Anketi) ve 'Short Form-36' (Kısa Form-36) kullanılmaktadır. Fonksiyonelliği değerlendirmede genellikle Health Assessment Questionnaire (Sağlık Değerlendirme Anketi), ağrı ve yorgunluğu değerlendirmede Vizüel Analog Skalası, anksiyete ve depresyon seviyelerini bir arada belirlemek için Hospital Anxiety and Depression Scale (Hastane Anksiyete ve Depresyon Skalası), uyku kalitesi değerlendirmesinde Pittsburgh Sleep Quality Index (Pittsburgh Uyku Kalitesi Ölçeği) kullanılmaktadır (Soran vd 2008, Sívas vd 2009, Vallejo vd 2012, Wu vd 2017). Bireylerin biyopsikososyal durumlarını değerlendirmek için Bilişsel Egzersiz Terapi Yaklaşımı eğitimine uzun zamandır devam eden romatizmal hastalıklara sahip bireylerin, gelişim özelliklerinin toplanmasıyla oluşturulan Bilişsel Egzersiz Terapi Yaklaşımı Ölçeği bu alana özgün bir katkı sunmaktadır (Zahid 2018).

2.1.7. Fibromiyalji'de tedavi yaklaşımları

Mevcut kanıtlar küçük dozlarda trisiklik antidepresanlar, kardiyovasküler egzersiz, bilişsel davranışçı terapi ve hasta eğitiminin FM'de etkili olduğunu göstermektedir. Bununla birlikte, etkinlikleri genellikle tatmin edici değildir ve yeni klinik müdahalelere ihtiyaç vardır. FM tedavisi; fiziksel, farmakolojik ve bilişsel unsurları içeren çok boyutlu bir yaklaşım gerektirmektedir. Fakat, FM hastalarını klinik olarak doğru karakterize etmek zor olduğundan ve klinik olarak elde edilen gelişme yetersiz olduğundan, hastalar tarafından tedaviye gösterilen uyumsuzluk önemli bir sorundur (Talotta vd 2017).

Avrupa Romatizmal Hastalıklar ile Savaş Derneği (European League Against Rheumatism=EULAR)'ın en son rehberine göre, FM tanısı doğrulandıktan sonra birinci basamaktaki çok yönlü tedavi; bilgilendirme, eğitim ve egzersizden oluşmalıdır. Ancak hastanın ağrısı, bilişsel semptomları veya uyku bozuklukları çok şiddetli ise farmakolojik veya psikolojik bir yaklaşım tercih edilmelidir (MacFarlane vd 2017). Diğer uluslararası rehberler ise aerobik egzersiz, bilişsel-davranışçı terapi ve amitriptilin kullanımını içeren çok bileşenli bir tedavinin kullanılmasını tavsiye etmektedir (Thıeme vd 2017).

Çalışmaların metodolojik heterojenliği ve FM hastalarının geniş semptomatik spektrumu nedeniyle, uluslararası kılavuzlar arasında hala bir fikir birliği yoktur (Talotta vd 2017).

2.1.7.1. Farmakolojik tedavi

FM için Amerikan Ağrı Derneği (American Pain Society) ve EULAR tarafından yayınlanan çok sayıda kanıta dayalı tedavi kılavuzu ve ayrıca Kanada, İspanya ve Almanya tarafından da belirlenen ulusal kılavuzlar bulunmaktadır. Hepsi tedavide ortak farmakolojik yaklaşımlar önermektedir. Bunlar dört geniş ilaç sınıfını içermektedir=anti-epileptik ilaçlar, trisiklik anti-depresanlar, seçici serotonin geri alım inhibitörleri ve serotonin-norepinefrin geri alım inhibitörleri (Halpern vd 2015). Diğer ilaçlar arasında kas gevşeticiler, 5-HT3 reseptör antagonistleri, dopaminerjik agonistler, antioksidanlar ve araştırma ilaçları bulunmaktadır (Calandre vd 2015). Bununla birlikte, Amerika'da FM tedavisi için Amerikan Gıda ve İlaç Dairesi tarafından yalnızca pregabalin, duloksetin ve milnasipran onaylanmaktadır. Diğer tüm ilaçların kullanımı endikasyon dışı olarak kabul edilmektedir. Health Canada yalnızca pregabalin ve duloksetini

onaylarken, Avrupa İlaç Ajansı bu hastalık için hiçbir ilacı onaylamamaktadır (mavi Chinn vd 2016).

2.1.7.2. Nonfarmakolojik tedavi

Hastalarda çeşitli bütünleştirici müdahaleler ile davranış ve düşünce değişiklikleri yaratarak nöroplastisiteleri yeniden organize edebilecekleri fikrini geliştirmek, bireyin kendi kendine yeterliliğini teşvik ederek, ilaç dışı tedavilerin ilaçlara kıyasla daha iyi etkinlik gösterebileceği bildirilmiştir (Perrot ve Russell 2014). Hastayı aktif olarak dinleyerek, empati göstererek ve bireyin bakış açılarını ortaya koyarak, stres yanıtının fizyolojisi olumlu yöne değiştirilebilinir ve böylece otonomik disfonksiyon, ağrı duyarlılığı ve diğer semptomların azaltılmasına yardımcı olunabilir (Brosschot vd 2005).

Nonfarmakolojik tedaviler arasında en fazla araştırma yapılan 3 yöntem; eğitim, egzersiz ve bilişsel davranışçı terapidir. Hepsi de FM'de etkinlik konusunda güçlü (seviye 1A kanıtı) kanıtlara sahiptir. Bu tedavi yöntemlerinin iyileşme yönünde oluşturduğu cevabın büyüklüğü, genellikle farmakolojik tedavilerden daha fazladır. En büyük fayda; kronik ağrıda tedavinin ana hedefi olan fonksiyonun geliştirilmesinde görülmektedir (Williams vd 2002, Goldenberg vd 2004). Bu tedavilerden elde edilen iyileşmeler kalıcı olabilmektedir (örneğin 1 yıldan daha uzun süreli). Bu tedavilerin klinik pratikte uygulanması sırasında karşılaşılan en sık problemler, tedaviye ulaşma, devamlılık ve uyumdur (Clauw 2014).

Bazı kanıtlar, bu tedavilerin hastalara hastalıkları üzerinde daha büyük bir kontrol hissi verdiğini göstermektedir. Hastalara tedavi seçenekleri sunmanın, vücudun internal analjezik mekanizmalarını harekete geçirebileceği ve vücutta plasebo yanıtının oluşma olasılığını artırabileceği bildirilmiştir (Mist vd 2013).

Ağrı ve olumsuz duygu durumu kısır bir döngü yaratarak kişide aktiviteden kaçınmaya yol açabilmekte ve bu durum da ağrı ve fonksiyonda daha fazla kötüleşmeye neden olabilmektedir. Bu nedenle pasif fizyoterapi yaklaşımları yerine hasta ve egzersiz eğitimi ön planda olmalıdır (Unal vd Dizmek 2014).

2.1.7.2.1. Hasta eğitimi

FM'li bireylerin tedavisinde eğitim önemli bir bileşendir. FM teşhisi alan bir bireye semptomları için kesin açıklama yapılmadığı zaman internet, medya ve diğer

kaynaklardan yanlış bilgi arayışına giren hastaların aldıkları farklı ya da yetersiz bilgiler, hastanın çeşitli şekillerde korku üretmesine neden olmaktadır. Korkunun ortaya çıkmasında; birey semptomlarının giderek kötüleşeceği, yardım edilebilecek bir durumu olmadığı ve sorunlarının hepsinin psikolojik (hayali) kaynaklı olduğunu düşüncesi etkili olmaktadır (Turk ve Adams 2016). Bir çalışmada, sosyal destek ile birlikte eğitim alan FM hastalarının, sadece sosyal destek alan gruba göre daha az çaresizlik yaşadıkları bildirilmiştir (Oliver vd 2001). Bir diğer çalışmada, aerobik egzersiz eğitimine ilave olarak hasta eğitimi alan FM'li bireylerin almayanlara göre başa çıkma ve öz yeterlilik konusunda daha başarılı oldukları görülmüştür. Son zamanlarda yapılan bir çalışmada ise egzersiz eğitimlerinin grup temelli hasta eğitimi ile desteklenmesinin önemi vurgulanmıştır (King vd 2002).

2.1.7.2.2. Egzersiz

Egzersiz eğitimi, FM'li bireyler için en güçlü kanıt düzeyine sahip olması nedeniyle tedavi ve yönetim stratejilerinin temel taşı olarak kabul edilmektedir (Fitzcharles vd 2013, MacFarlane vd 2017). FM'li bireylerin ağrı ve semptomlarının şiddeti nedeniyle daha az fiziksel aktivite yaptıkları ve buna bağlı olarak fiziksel uygunluk düzeylerinin daha düşük olduğu bilinmektedir (Musumeci 2015, Segura-Jimenez vd 2015, 2016). FM hastalarında fiziksel uygunluğun azalması, semptom şiddetinin artışı ile ilişkilidir. (Estevez-Lopez vd 2015). 2014 yılındaki bir sistematik derleme, farklı egzersiz yöntemlerinin fiziksel fonksiyonlar üzerinde yararlı bir etkiye sahip olduğu ve FM'nin bazı semptomlarının azalmasına yardımcı olduğu sonucuna varılmıştır (Bidonde vd 2014). Düzenli egzersiz ile FM'li bireylerde, ağrı, hassas nokta sayısı ve depresyon azaltılabilmekte; kas gücü, uyku kalitesi, fonksiyonel kapasite ve yaşam kalitesi arttırılarak fiziksel ve psikolojik semptomlar üzerinde olumlu etkiler oluşturulabilmektedir (Hakkinen vd 2001, Valkeinen vd 2004, Bircan vd 2008, Kingsley vd 2010, Gavi vd 2014, Larsson vd 2015, Ericsson vd 2016, Martinsen vd 2018).

FM'li hastalarda egzersiz sonrası gelişen ağrı, yorgunluk ve hassasiyet egzersize uyumda sorun oluşturabilmektedir (Busch vd 2008, Bidonde vd 2014). Bu nedenle, egzersiz programları hastanın şikayetlerini arttırmayacak şekilde, bireyin fiziksel yeteneklerine uygun ve istekleri göz önünde bulundurularak belirlenmelidir (Jones ve Clark 2002, Fitzcharles vd 2013, Nijs vd 2013, Bidonde vd 2014a). Hastanın egzersiz yoluyla aktivitesinde artış elde edebilmek, en çok istenen tedavi hedefi olmasına rağmen, birçok hasta bu duruma direnç gösterebilmektedir. Bu nedenle, hastaların hem egzersiz rutinini başlatmasına hem de devam ettirmesine yardımcı

olmaya yönelik çaba sarfedilmelidir. Motivasyonel görüşme teknikleri, dirençli hastaları düzenli bir egzersiz alışkanlığı kazandırmada etkili olabilmektedir. Hastaya egzersize başlama ve devam ettirme konusunda ki problemleri sorulmalı ve şiddetli egzersiz sonrası ağrı oluşabileceği belirtilmelidir. Hastanın, değişimin sürekliliği sırasındaki mevcut pozisyonunun belirlenmesi sonrasında (ön hazırlık, inanma, hazırlık, eylem ve bakım), bir üst aşamaya geçmesi hedeflenmelidir. Mevcut verilere göre, hastaların düzenli olarak zevk alabileceği ve isteyerek yaptığı her türlü egzersiz yöntemi, sezgisel olarak başarının anahtarıdır. Bireyin kendisinin belirlediği ve yaşam tarzı haline getirdiği 30 dakikalık fiziksel bir aktivitenin bile, FM semptomlarında iyileşme sağlayabildiği bildirilmiştir (Fontaine vd 2010).

FM'li bireylerde aerobik egzersizin etkinliğine yönelik yapılan çalışmalarda; yaşam kalitesinin geliştirilebildiği (Sanudo vd 2010, Kayo vd 2011), ağrının (Sencan vd 2004, Sanudo vd 2010) ve yorgunluğun (Kayo vd 2011) azaltılarak, fiziksel fonksiyonların (Sanudo vd 2010, Kayo vd 2011) arttırılabildiği gösterilmiştir. Aerobik egzersiz ile endorfin salınımındaki artış; ağrı hissinin azalmasına, duygu durumunun ve uyku kalitesinin iyileşmesine olanak sağlamaktadır (Scheef vd 2012, Yang vd 2012). Ayrıca, aerobik egzersiz ile oksidatif stres ve inflamasyon azaltılarak, anksiyete ve stres cevaplarında azalma elde edilebilmektedir (Moylan vd 2013, Klaperski vd 2014). Hastaların fiziksel uygunluğunun genellikle yetersiz olması nedeniyle, FM'li bireylere uygulanan aerobik egzersiz protokolünün hafiften başlatılarak şiddetliye doğru ilerlemesi gerektiği, ortalama 35 dk'lık, haftada üç gün ve 15 hafta boyunca devam eden müdahalelerin daha uygun olabileceği rapor edilmiştir (Bidonde vd 2017). Bununla birlikte, yüksek şiddetli aerobik egzersizin FM'li bireylerin şikayetlerini artırabileceği de vurgulanmıştır (Van Santen vd 2002).

Kuvvetlendirme egzersizleri, günlük yaşam aktivitelerinin uzun süre yorulmadan daha iyi bir şekilde yapılmasına olanak sağlamaktadır. Kuvvetlendirme egzersizleri ile kasta oluşan mikro travma, tamir ve adaptasyon toleransı artırılarak, ağrıya olan cevap azaltılabilmektedir (Busch vd 2013). FM'li bireyler için kuvvetlendirme programlarının, düşük yoğunlukta (1 max tekrarın %40'ı) başlaması ve yoğunluğun aşamalı olarak arttırılması önerilmektedir (Ericsson vd 2016).

FM'li bireylerde, esneklik egzersizleri ile ağrı, (Valencia vd 2009), tutukluk (Chen vd 2011), yorgunluk ve psikolojik semptomlar (depresyon, anksiyete) azaltılabilmektedir. Egzersizlerinden hemen sonra esneklikte geçici olarak bir artış elde edilebilmektedir, fakat uzun süreli bir kazanımın sağlanabilmesi için 10-30 sn süreyle yapılan statik germelerin, haftada en az iki ya da üç defa, yaklaşık üç ya da dört haftalık düzenli bir program ile uygulanması gerekmektedir (de Weijer vd 2003, Reid ve McNair 2004, Decoster vd 2005, Guissard ve Duchateau 2006, Radford vd 2006,

Kokkonen vd 2007). FM'li bireylerde, esneklik egzersizlerinin tek başına yeterli olmadığı, aerobik ve kuvvetlendirme egzersizlerinin başlangıç ve/veya sonlarında 5-10 dk'lık periyotlarda uygulanması gerektiği ya da ağrı üzerinde olumlu bir etkisi olan gevşeme programlarının bir parçası olarak kullanılması gerektiği bildirilmektedir (Theadom vd 2015, Kim vd 2019).

Su içi egzersizler, ısıtılmış bir havuzda fizyoterapist gözetiminde yapılmaktadır. Fiziksel uygunluğu düşük FM'li bireyleri, egzersize başlatmada kullanılan yöntemlerden biridir. Ilık suda yapılan egzersizler, sedanter FM'li bireylerde, egzersiz ile oluşan ağrıda rahatlama sağladığı için tercih edilebilmektedir (Bidonde vd 2014a). FM'li bireylerin uzun süreli aerobik egzersize toleransları olmadığı için, germe, mobilite ve kuvvetlendirme gibi egzersizlerin 32°C'nin üzerinde yapılması tavsiye edilmektedir (Garber vd 2011). Haftada 3 veya daha fazla, en az 20 dk'lık su içi aerobik egzersiz programının en az 20 hafta süre ile uygulanması tavsiye edilmektedir (Lima vd 2013).

Tai Chi, solunum kontrolü, yavaş hareketler, zihinsel rahatlama ve meditasyonu içermektedir. Son zamanlarda yapılan araştırma çalışmalarında, Tai Chi'nin FM ile ilgili sendromları hafifletme konusunda güvenli bir egzersiz olduğu belirtilmektedir. FM'li bireylerde Tai Chi'nin etkinliğinin görülebilmesi için dozaj, frekans ve toplam uygulama süresi ile ilgili net bir fikir birliği olmasada; haftada 1-3 defa, 1 saat süren Tai Chi uygulamasının 12 hafta süresince yapılması önerilmektedir (Cheng vd 2019).

Yoga'da solunuma odaklanmak emosyonel açıdan iyileşmeye (Arch ve Craske 2006, Brown ve Gerbarg 2009), meditasyon ise FM ile ilişkili semptomların azaltılmasına yardımcı olmaktadır (Kozasa vd 2012). Yogada yer alan nefes pratiklerinin (Örn. pranayama), kognisyon ve anksiyeteyi iyileştirerek, parasempatik aktivasyonu arttırdığı bildirilmektedir (Chandla vd 2013) Yoga gibi davranışsal müdahaleler, FM'li bireyleri yaşam tarzlarındaki alışkanlıkları değiştirme hususunda aktif bir rol üstlenmeye zorlayabilmektedir ve genel olarak daha büyük bir öz güven duygusu uyandırabilmektedir (Woodyard 2011, Anderzén-Carlsson vd 2014, Golec ve Valier 2018).

2.1.7.2.3. Klinik pilates

Pilates egzersizleri, 1920'lerde Joseph Pilates tarafından oluşturulmuştur (Latey 2001, Friedman ve Eisen 2005). Orijinal adı "Kontroloji"dir. Vücut pozisyonu ve hareketinin kontrolüne vurgu yapılmaktadır (Anderson ve Spector 2000). 1980'lerin sonlarından bu yana, giderek daha popüler bir egzersiz yöntemi haline gelmiştir. 21. yüzyılda insan vücudunun ve nasıl çalıştığının daha iyi anlaşılmasıyla birlikte, Pilates

yönteminin amacı daha iyi keşfedilmiştir. Günümüzde Pilates, tüm varlığı, bedeni ve zihni güvenli bir şekilde bağlamanın ve bütünleştirmenin bir yolu olarak görülmektedir (Latey 2001b).

Pilates, ilk olarak özellikle jimnastikçiler, boksörler, dansçılar ve fit görünmek isteyen kişiler tarafından kullanılmakta iken, geçtiğimiz on yılda rehabilitasyon ve egzersiz alanında popüler hale gelmiştir (Latey 2001, Bryan ve Hawson 2003). Pilates egzersizleri, farklı durumlarda kullanılmanın artması ile çeşitlenmiştir. Geleneksel egzersiz teknikleri, kanıta dayalı prensiplerle uyumlu olacak şekilde güncellenmiştir ve kişilerin farklı beceri ve ihtiyaçlarına göre modifiye edilebilmektedir (Anderson ve Spector 2000, Latey 2002, Owsley 2005). Çeşitli Pilates'e başlangıç egzersizlerinin dahil edilmesi ile artık genel popülasyonun tümüne uygulanabilmektedir (Latey 2002). "Pilates" teriminin kullanımına ilişkin ticari marka kısıtlamalarının kaldırılması da, yaygın bir varyasyona yol açmıştır (Brown 2002).

Egzersizler; mat üzerinde veya ayarlanabilir yay direnci bulunan özel ekipmanların kullanımı ile yapılabilmektedir (Anderson ve Spector 2000, Latey 2001). Joseph Pilates, zihin ve vücudun dengelenerek nasıl daha iyi yaşanabileceği konusundaki felsefesiyle birlikte Birinci Dünya Savaşı boyunca edindiği deneyimler ışığında, egzersizlerin yapılabileceği çeşitli ekipmanlar geliştirmiştir. Savaş yaralılarının rehabilite edilmesine yardımcı olmak için yaylı yatakları denemeye başlamış ve bilgilerini bu alanda uygulamaya çalışmıştır. Hastaların yatağa bağlıyken dirençe karşı egzersiz yapabilmelerine olanak sağlamak için, yayları yatakların ucuna bağlamıştır. Dirençli egzersizlerin direnç olmadan yapılan egzersizlere göre, hastaların kas tonusunu daha hızlı iyileştirdiğini fark etmiştir. Bu deneyimler, Joseph Pilates'in kişinin üzerine oturabildiği, yaslanabildiği veya ayakta durabilidiği, yaylara sahip, kayan bir platform olan Universal reformer'ı ve dört tarafında yayları bulunan bir yatak olan '' Cadillac'ı geliştirmesine olanak sağlamıştır (Friedman ve Eisen 1980). Bu çalışmalar, diğer birçok aparatı içerecek şekilde genişlemiştir ve bu yeni aparatlar, mat egzersizlerindeki çeşitliliğin artmasına ilham kaynağı olmuştur (Latey 2002).

Pilates'te, birçok hareket yöntemi Pilates'in kendi özel egzersiz tarzına entegre edilmiştir (Wide 1906, Latey 2001a,b). Dansçılar tarafından büyük bir istekle benimsenmesinin nedenlerinden biri, dansa olan benzerliğidir. Kararlılık ve kontrol bir dansçının her zaman başarmaya çalıştığı bir şeydir. Pilates yaralı bir dansçının yaralı olan vücut kısmının iyileşmesine izin verirken; vücudunun geri kalanını güçlü ve esnek tutamasına olanak sağlamaktadır. Böylece, dansçı yarası iyileşir iyileşmez neredeyse tam anlamıyla eski performansına geri dönebilmektedir. Geleneksel Pilates egzersizleri, çoğunlukla sagital düzlemdeki hareketlere (anterior ve/veya posterior yöndeki hareketler) izin vermektedir. Modern Pilates'e göre çok az diagonal ve spiral

hareket bulunmaktadır. Modern Pilates'te özellikle Pilates'e başlangıç ve orta seviye egzersizlerinde, diagonal ve spiral hareketler arttırılmıştır. Bu hareketler, oblik abdominal kasların devreye sokulması için ve iliak kristalar ile kostaların koordinasyonu için çok önemlidir. Pilates, kişilerin vücutlarına hem sözel hem fiziksel olarak rehberlik etmektedir. Kişinin hareketi doğru olarak gerçekleştirmesine yardımcı olmak için elle dokunarak yapılan müdahaleler işin çok önemli bir parçasını oluşturmaktadır. Dokunma ile kasın devreye sokulması, farkındalığı ve gevşemesi daha kolay sağlanabilmektedir (Latey 2002).

Pilates, vücudun daha fazla çalışmaya ihtiyaç duyduğu bölgelere odaklanılması için egzersizlerin gün boyunca tekrarlanması gerektiğini belirtmiştir (Pilates ve Miller 1945). Ayrıca, kişilerin ihtiyacına özel egzersizler geliştirmiş ya da egzersizleri modifiye etmiştir. Günlük hayata geri dönüşte, özellikle zorlu bir egzersiz olan "The Hundred''ın daima yapılması gerektiğini tavsiye etmiştir. Bununla birlikte, bu egzersizin Pilates'e yeni başlayan biri için son derece tehlikeli olduğu ve gözetim altında bile ciddi yaralanmalara neden olabileceği vurgulanmalıdır. Pilates, niceliğe değil niteliğe vurgu yapmıştır. 1980'lerde egzersizlerdeki en önemli faktörün, 20 veya daha fazla tekrara ulaşmak olduğu fikri genel olarak kabul görse de; Pilates egzersizde en etkili unsurun birkaç iyi yapılmış hareket olduğunu düşünmekteydi (Latey 2002).

Joseph Pilates'in "Kontroloji ile Hayata Dönüş" adlı kitabında ana hatlarını çizdiği prensipler bugün hala geçerlidir (Pilates ve Miller 1998). Joseph Pilates tarafından geliştirilen ekipmanların kullanımı ile dizilimin daha düzgün hale getirilmesi, kuvvetin arttırılması, esnekliğin arttırılması ve zindeliğin sürdürülmesi için, Pilates egzersizleri günümüzde bu mevcut prensipler doğrultusunda uygulanmaktadır (Latey 2002). Pilates egzersizlerinin 8 prensibi bulunmaktadır: konsantrasyon, kontrol, merkezleme, akıcılık, kararlılık, solunum, gevşeme ve dayanıklılıktır (Latey 2002).

Konsantrasyon=Bedenin "bilinçli" kontrolünün ilk prensibi, düşünmeyi ve odaklanılmış dikkati gerektirmektedir. Pilates, yanlış yapmamak için her egzersiz yapıldığında hareketin doğruluğuna konsantre olunulması gerektiğini belirtmiştir (Pilates ve Miller 1945). Ne yapacağınıza odaklanmanız ve zihin ve bedeninizi bütünleştirmeniz; vücudunuzdaki duyu sistemlerinize uyum sağladığınız anlamına gelmektedir. Dikkatimizi kendimize yönlendirmemiz için düşüncelerimize odaklanır ve konsantre oluruz (Latey 2002). Konsantrasyon, dikkatin çalışan vücut segmentine çekilmesi sonucunda, hareketlerin kalitesinde artış elde edilmesine olanak sağlayan nöromüsküler bağlantıların gelişimine katkıda bulunmaktadır (Winsor 1999). Kişi sadece hareketleri yapmak yerine; hareket sırasında zihnini de aktif hale getirir ve bir sonraki adımı gözünde canlandırır (Gallagher ve Kryzanowska 1999). Kişi hareketi yaparken ne kadar çok dikkatini toplarsa, hareketin kalitesi o kadar çok artar.

Klinisyenlerin kişilere görsel ve dokunsal müdahalelerde bulunması konsantrasyonun kolaylaştırılmasında büyük katkı sağlamaktadır.

Kontrol= Pilates egzersizleri, bir kişiye vücudunu kontrol etmeyi öğretmektedir. Pilates egzersizleri doğru şekilde yapıldığında, yaralanmaya neden olan kuvvetler azalmakta ve zihin-beden bağlantısı artmaktadır. Bunun için vücudun mutlak kontrolü gereklidir. Pilates egzersizlerinin doğru şekilde yapılması için, birçok faktörün aynı anda gerçekleştirilmesi gereklidir. Bu faktörlere örnek olarak; solunum, konsantrasyon ve germe verilebilir (Winsor 1999). Egzersizlere yeni başlayanlar, bu faktörleri aynı anda gerçekleştirmek konusunda genellikle çok zorlanmaktadırlar. Fakat, vücut farklı yönlerde hareket etmeyi öğrendikçe, bu zorluk hissi azalmaktadır. Egzersizler bilinçli ve bilinçaltı düzeyde tam olarak öğrenildikten sonra, hareketler akıcı ve zarif hale gelmektedir (Pilates ve Miller 1998).

*Merkezleme***=** Joseph Pilates “core” bölgesini güç merkezi olarak tanımlamıştır ve “core”un kontrolünün tüm insan hareketleri için esas unsur olduğunu kabul etmiştir (Pilates ve Miller 1998). Güç merkezini doğru kullanmayı öğrenmenin; kişinin postürünün düzgünlüğünü, omurgasının stabilizasyonunu ve hareketlerinin kalitesini artıracağını düşünmektedir (Winsor 1999). “Core”, lumbopelvik kalça kompleksinden oluşmaktadır. “Core” bölgesi ile ilgili kaslar; m. transversus abdominis, m. obliquus internus ve externus abdominis, m. multifidus, m. quadratus lumborum, m. iliopsoas, m. erector spinae (derin), diaphragm ve pelvik taban kaslarıdır (Hodges ve Richardson 1996, Porterfield ve DeRosa 1998, Feaver 2000, Aokoski vd 2001, Trentman 2003). Bu kaslar, gövdenin fasyal sistemleri (torakolomber ve abdominal fasya) ile birlikte frontal, horizontal ve sagital düzlemlerde spinal stabilite sağlamaktadırlar (Porterfield ve DeRosa 1998). “Abdominal-hollowing” manevrasının, derin karın kaslarını (m. transversus abdominis ve m. obliquus internus abdominis) aktif hale getirmenin en iyi yolu olduğu düşünülmektedir (Beith vd 2001). Bu manevranın gerçekleştirilmesinde kişiler zorlanabilmektedir. Bu nedenle, uygulayıcıların sözel ve dokunsal müdahaleler ile geribildirimde bulunmaları gerektiği vurgulanmaktadır (Porterfield ve DeRosa 1998).

*Akıcılık***=** Pilates egzersizlerinde, bir egzersizden diğerine geçerken dansa benzeyen akıcılık bulunmaktadır. Egzersizler, herhangi bir süreksizlik olmadan yumuşak geçişlerle gerçekleştirilmektedir (Clark ve Romani-Ruby 2004).

*Kararlılık***=** Pilates egzersizi, nicelik değil nitelikliği esas almaktadır. Belirli sayıda tekrara ulaşmak yerine, egzersizlerin doğru yapılabildiği tekrar sayısında yapılması gerekmektedir. Örneğin, bir kişi dört tekrardan sonra hareketin düzgünlüğünü bozmaya başlıyorsa, dörtte durmalıdır. Hatta kişinin kas gücünü arttırana kadar egzersizin modifiye edilmiş bir versiyonunu yapması gerekebilmektedir. Pilates'in kararlılık prensibi için, vücudun mutlak kontrolü gerekliliktir (Winsor 1999).

*Solunum***=** Egzersiz sırasında doğru nefes almak çok önemlidir. Solunumun, core stabilitesi için bir katalizör olduğu düşünülmektedir (Anderson 2001). Pilates'in solunum yaklaşımı uygulayıcılar arasında farklılık gösterse de, çoğu diyafram solunumunu kullanmaktadır. Çoğu insan, göğüs solunumu yapmaktadır (havayı göğüslerinin üst kısmına doldurmaktadırlar). Birinin nasıl nefes aldığını kontrol etmenin en iyi yolu, kişiyi supin pozisyonda yatırmak ve bir eli sternuma diğerini diyaframın üzerine koymaktır. Kişiye doğru solunumu nasıl yapması gerektiği öğretilirken; ellerini alt göğüs kafesinin her iki yanına yerleştirmesi istenir. Göğüsünün üst kısmını olabildiğince hareket ettirmeden, nefesini ellerinin bulunduğu kısımdaki kaburgalara doğru alması ve bu bölgeyi genişletmesi söylenir. Akciğerlerin alt loblarının doldurulduğunun hayal edilmesi gerekmektedir (Winsor 1999).

*Gevşeme***=** Pilates egzersizleri, vücudun bir bölgesi aktifleştirilirken diğer bölgesinin gevşetilmesini ile gerçekleştirilmektedir. Bu durum, gereksiz gerginliği azaltmaya yardımcı olmaktadır. Örneğin, bir kişi omuzlardaki gerginliği azaltıp gevşemeye çalışırken, güç merkezini aktifleştirmektedir (Owsley 2005).

*Dayanıklılık***=** Pilates egzersizleri, core ve diğer küçük stabilizatör kaslarda endurans sağlamaktadır. Kassal endurans, core eğitiminde kas kuvvetinden daha önemlidir. Çünkü, omurgadaki derin stabilizatörler sürekli olarak çalışmaktadır. Tüm egzersizler boyunca bu kasları sürekli olarak zorlayarak, kişiler endurans eğitimi alırlar (Owsley 2005).

Klinik pilates egzersizleri boyunca sürdürülmesi gereken 5 anahtar element (Oksuz 2017)**:**

1) Solunum: Egzersizler sırasında yardımcı solunum kaslarının aktivasyonundan kaçınılır. Hastalara bibazal solunum öğretilir.

2) Odaklanma: M. transversus abdominis, m. multifidus, diyafragma ve pelvik taban kaslarının ko-aktivasyonu ile lumbal omurganın nötral pozisyonu öğretilir.

3) Göğüs Kafesi Yerleşimi: Göğüs kafesi hareketler sırasında rahat ve gevşek bir şekilde pozisyonlanır. Pelvisle olan uyumun korunması öğretilir.

4) Omuz Yerleşimi: Skapulanın retraksiyon ve depresyon pozisyonu öğretilir.

5) Baş ve Boyun Yerleşimi: Derin boyun fleksörlerinin uygun pozisyona yerleştirilmesi ve sürdürülmesi öğretilir.

Pilates, gövde ve alt sırtta stabilizasyondan sorumlu kasların aktifleştirilmesine odaklanmaktadır. Alt sırt ağrısı bulunan kişilerin, bu kaslarındaki inhibisyonun günlük hayattaki fonksiyonelliklerini engellediği gösterilmiştir ve bu nedenle Pilates bu hastaların tedavisinde sıklıkla kullanılmaktadır (Hides vd 1994, Hodges ve Richardson 1996, O'Sullivan vd 1997, Anderson ve Spector 2000, La Touche vd 2008, Wallwork vd 2009, Ferreira vd 2010). Pilates egzersizleri, inhibe olmuş bu kasların yeniden aktive

edilmesine yardımcı olmaktadır; böylece bel desteğini arttırmakta, disabilite ve ağrıyı azaltmaktadır (La Touche vd 2008).

2.1.7.2.4. Bilişsel davranışçı terapi

Biyopsikososyal bakış açısını benimseyen Bilişsel Davranışçı Terapi hastaların düşünce tarzlarını geliştirerek, FM ile başa çıkmalarına yardımcı olabilmektedir.

Biyopsikososyal bakış açısı, ağrının varlığına neden olan faktörleri göz önüne alarak, tedavide ağrının yokluğunu değil, etkin ağrı yönetimini hedef almaktadır. Bireylerin ağrıları ile nasıl başa çıkacaklarını öğretmeye odaklanarak, bireylerin ağrı deneyimleri ve hastalığı ile başa çıkmada kendi kendisini geliştirmesine olanak sağlamaktadır. Bu gelişim sayesinde bireyin ruh halinde iyileşme, fiziksel aktivitesinde artış, düşünce değişikliği ve kişilerarası ilişkiler geliştirilebilmektedir. Kronik ağrıda biyopsikososyal yaklaşım, bireyin ağrısını kabullenerek kendi kendine ağrı ile mücadelede bir plan oluşturması gerektiğini vurgulamaktadır. Bu yaklaşım ile, tedavide birey, ağrıyı kontrol edebileceğine olan inancını arttırmaktadır ve olumsuz davranışlarını azaltmaktadır. Böylece, fizyolojik aktivitede değişiklikler elde edilerek, ağrı şiddetinde ve fonksiyonel yetersizlikte azalma gerçekleşmektedir (Jensen ve Turk 2014). FM hastalarında görülen ağrı, yorgunluk, uyku problemleri, anksiyete, depresyon gibi şikayetlerin; günlük hayatı olumsuz yönde etkileyerek yaşam kalitesini azalttığı, sosyal hayatta aile ve çevre ile ilişkilerde problemlere neden olduğu ve kaygı düzeyinde artışa sebebiyet verdiği bilinmektedir (Madenci vd 2006, Van Koulil vd 2007). Tüm bu kompleks bulguların, sadece ilaç tedavileri ile iyileşmelerinin mümkün olmadığı; hastayı tedaviye daha istekli kılmak için, FM hastalarında biyopsikososyal modelin uygulanması gerektiği bildirilmektedir (Madenci vd 2006).

Bilişsel Davranışçı Terapi, ağrının biyolojik, psikolojik ve sosyal özelliklere sahip olduğunu kabul eder ve kişinin ağrı deneyiminde bu faktörlerin etkileşim içinde olduğuna inanarak bireye yaklaşmaktadır (Jensen ve Turk 2014). Bilişsel Davranışçı Terapi, FM'li kişilerin rahatsızlıkları ile başa çıkma yeteneklerini, yaşamlarında sosyal desteklerin varlığını ve değerini inceleyerek bu parametreleri geliştirmeye yardımcı olmaktadır. Bu gelişim, bireye sorumluluklarını kabullenmesi, semptomlara uyumu, engellilik algısı, tedavi yöntemlerine uyumu ve aile, arkadaş, ve sağlık uzmanları da dahil olmak üzere insanlarla olan etkileşimleri açısından olumlu bir yön vermektedir (Turk ve Adams 2016). Bilişsel Davranışçı Terapi'nin hedefi fonksiyonu geliştirmektir; bu nedenle de FM'li hastalarda etkili olabilmektedir. Fiziksel fonksiyonlarını geliştirmeyi amaçlayan Bilişsel Davranışçı Terapi grup seanslarına (4 haftada 6 seans) katılan FM'li

bireylerin, standart tıbbi bakım alan kontrol grubuna göre fiziksel fonksiyon açısından klinik iyileşmelerinin sürekli ve anlamlı olduğu belirtilmiştir. Çalışmalarda Bilişsel Davranışçı Terapi'nin FM'li hastalarda ağrı şiddeti, ağrıyı kontrol edebilme yetisi, emosyonel stres ve fonksiyonel kapasite açısından olumlu yönde etki gösterdiği saptanmıştır (Williams vd 2002).

2.1.7.2.5. Terapatik nörobilim eğitimi

Terapatik Nörobilim Eğitimi (TNE), fizyoterapistler tarafından kullanılan bir müdahaledir (Louw vd 2011). Bir bilişsel davranışçı terapi yöntemi olarak tanımlanabilmektedir (Moseley 2003b). Hastaların ağrı durumlarının temelini oluşturan biyolojik süreci daha iyi anlamalarına yardımcı olarak; ağrıyı ve kas iskelet yaralanmalarıyla ilişkili korkuyu azaltmak ve hareket ve fonksiyonelliği arttırmak gibi terapötik etkiler elde etmeyi amaçlamaktadır (Ryan vd 2010).

Ağrısı bulunan kişilerin ağrıları ile ilgili daha fazla bilgi edinme arzusunda oldukları bildirilmiştir (McDonald vd 2001, Bender vd 2008, Louw vd 2009,). Bununla beraber, hastaların ağrının nörofizyolojisini anlama yeteneğine sahip olduğu gösterilmişken, profesyonellerin hastaların ağrılarıyla ilgili "karmaşık" sorunları anlama yeteneklerini hafife aldıkları gösterilmiştir (Moseley 2003b).

Kronik kas iskelet sistemleri ile ilgili problemler hakkında çalışma yapan güncel bir sistematik derlemede, ağrının nörofizyolojisi ve nörobiyolojisini ele alan bir eğitim stratejisinin ağrı, disabilite, katastrofi ve fiziksel performans üzerinde olumlu bir etkiye sahip olabileceğine dair ikna edici kanıtlar olduğu bildirilmektedir (Louw vd 2011). TNE'nin etkinliğinin araştırıldığı randomize kontrollü çalışmalarda; korkuyu azalttığı ve kişinin ağrısına ilişkin algısının değiştiği, hastaların ağrıya ilişkin tutumları üzerinde hemen olumlu bir etki gösterdiği (Moseley 2003c), ağrı, kognisyon ve fiziksel performansta gelişmeler sağladığı (Moseley 2004), fiziksel performanlar sırasında ağrı eşiğini arttırdığı (Moseley vd 2004b), terapatik egzersizlerin sonuçlarını iyileştirdiği (Moseley 2002) ve ağrı deneyiminin yaygın beyin aktivitesinde önemli azalma (Moseley 2005) sağladığı rapor edilmiştir. Bu elde edilen olumlu sonuçların çoğunun uzun süreli olduğu ve bazı araştırmalarda yapılan bir yıllık takip süresi sonunda değişikliklerin kalıcı hale geldiği gösterilmiştir (Moseley 2002, Moseley 2003c, Oliveira vd 2006).

Cerrahlar ve fizyoterapistler, hastalarına ağrıyı açıklamak için genellikle anatomi ve patoanatomi tabanlı modeller kullanmaktadırlar (Houben vd 2005, Henrotin vd 2006, Spoto ve Collins 2008, Weiner 2008). Bu modeller, sadece ağrıyı ve disabiliteyi azaltmada sınırlı etkinlik göstermemiş, aynı zamanda hastalarda korku duygusunda

artışa ve bu da ağrılarının daha şiddetli olmasına yol açmıştır (Greene vd 2005, Morr vd 2010). TNE'nin yaklaşımı, dokulara ve doku hasarına odaklanan bu biyomedikal modellerin tam tersidir (Houben vd 2005, Henrotin vd 2006, Weiner 2008). TNE, ağrının nörobiyolojisini ve nörofizyolojisini ve sinir sisteminin ağrıyı nasıl işlediğini eğitim seansı/seanları ile en iyi açıklayan eğitim olarak kabul edilmektedir. Doku hasarı ya da nosisepsiyon ile ağrıyı açıklamaya çalışan geleneksel model yerine; TNE'de, sinir sistemi, periferal sinir sensitizasyonu, sentral sensitizasyon, sinaptik aktiviteler ve beynin işlemesinin nasıl olduğu bir bütün olarak açıklanmaktır (Louw vd 2011). Hastaya vermeye çalışılan temel mesaj, "nosisepsiyon" ve "ağrı" arasındaki açık farktır. Hastalara, sinir sisteminin, kalıcı ağrıyla baş edebilmesi için sensitivitesini (nöroplastisite) artırma veya azaltma yeteneğine sahip olduğu öğretilir (Moseley vd 2004b, Van Oosterwijck vd 2011). Normal hareket ve aktivitenin kazandırılması, ağrının ve fonksiyonel disabilitenin azaltılması için maladaptif ağrı kognisyonu, hastalık ile ilgili algılar ve/veya başa çıkma stratejileri değiştirilmeye çalışılmaktadır (Nijs vd 2011). Aslında, TNE tipik olarak stres yönetimi, kademeli aktivite ve egzersiz terapisi gibi biyopsikososyal odaklı bir rehabilitasyon programının çeşitli bileşenlerini izlemektedir (Nijs vd 2011). Eğitim seanslarında bu tedavi bileşenlerinin santral sinir sisteminin aşırı duyarlılığını azaltmaya neden ve nasıl katkıda bulunabileceğine dair yapılan açıklamalar, hastanın hastalık algısının değişmesi hususunda oldukça önemlidir. Değişen hastalık algıları, hastaların rehabilitasyon programına uyumunu ve motivasyonunu olumlu yönde değiştirmektedir. Sık görülen yan etkiler ve semptomlardaki dalgalanmalar, santral sensitizasyon modeli kullanılarak açıklanabilmektedir (Nijs vd 2011).

Hastalar ağrıyı doku sağlığının bir göstergesi olarak gördüğünden ve aktivitenin dokularına daha fazla zarar verebileceğini düşündüklerinden dolayı, azalan fiziksel hareketler mantıksal bir koruyucu mekanizma olarak görülebilir (Moseley vd 2004a). Mekanik olmayan birçok faktör ağrının şiddetinin artmasına neden olabilmektedir, bunlara örnek olarak; iyileşme sürecinde uygulanan başarısız tedaviler, geleceğe dair korkular ve farklı sağlık uzmanları tarafından yapılan farklı açıklamalar ya da internetten edinilen farklı bilgiler verilebilir. Bu çalışmaların sonuçları, ağrı algısının değişmesi ve mekanik olmayan faktörlerin daha iyi anlaşılması ile hastaların kendilerini aktivitelerini artırmaya daha yatkın olarak görmeye meyilli olabileceğini göstermektedir (Thomas ve France 2007, Cleland vd 2008b, Smeets 2009a,b).

TNE; kişilere yaralanmaların sinir sistemi tarafından işlenmesi sırasında çeşitli psikososyal faktörlerle de bağlantı kurarak bu görevini yerine getirdiğini ve ağrı deneyimlerini hem yaralanma hem de psikososyal faktörlerle birleştirerek kodladığını anlatmaktadır. Ağrının her zaman dokuların durumunun gerçek bir temsili olmadığı

konusunda eğitim verilir (Doku yaralanması ve ağrı iki ayrı konudur. Doku yaralanman olduğunda ağrı hissetmeye bilirsin; ağrın olduğunda da doku yaralanman olmayabilir. Bir dokudaki sorun, ağrıya neden olmak için yeterli olmayabilir. Ağrı, beynimizin verdiği bir karar sonucunda ortaya çıkmaktadır). Ağrısını, dokularındaki yaralanmanın derecesinin doğru bir ölçüsü olarak değil, sinir sisteminin (beynimizin) yaralanma tehdidinin bir yorumu olduğu konusunda açıklamalarda bulunarak kişinin ağrısını yeniden kavramsallaştırmasına olanak tanınır. Hastalar; hareket etme, egzersiz yapma ve hissettikleri huzursuzlukları uzaklaştırma konusunda cesaretlendirilmektedirler. Hastanın dikkati, somatik işaretlerden adaptif başa çıkma stratejilerine ve yeniden güven duygusunun oluşması yönünde kaydırılmaktadır. Bu eğitimde hastanın tedaviye güveninin, kronik ağrısı olanlarda sürekli bir tedavi hedefi olması gerektiği savunulmaktadır (Nijs vd 2011).

TNE, kişinin kendine olan güveninde ve aktivite düzeyinde artış sağlamaktadır. Manuel terapi veya egzersiz gibi fizyoterapi müdahaleleri olmadığında bile, değişen ağrı inançlarının doğrudan değişen hareket performansı ile ilişkili olduğu gösterilmiştir (Moseley 2004). Bu durum, ağrı inançlarındaki olumsuz tutumlar ile motor performansın limitlenebileceği anlamına gelmektedir ve motor performanstaki bu limitasyon klinik olarak da doğrudan gözlemlenebilmektedir (Moseley 2005).

TNE; uygulamanın zamanlamasına bağlı olarak akut ağrı durumlarında koruyucu bir yöntem olarak ve kronik ağrı durumlarında bir tedavi / rehabilitasyon müdahalesi olarak görülebilir (Louw vd 2011).

TNE seansları sırasında ele alınan konular şunları içermektedir: ağrının nörofizyolojisi, nosisepsiyon ve nosiseptif yollar, nöronlar, sinapslar, aksiyon potansiyeli, spinal inhibisyon ve fasilitasyon, periferal sensitizasyon, santral sensitizasyon, sinir sisteminin plastisitesi. Anatomik ve patoanatomik modellere hiç değinilmemektedir ve ağrının duygusal veya davranışsal yönleri hakkında hiç tartışılmamaktadır.

Literatürde TNE'nin etkinliğinin araştırıldığı çalışmalarda, seansların süresi ve sıklığı oldukça farklıdır. Eğitim seanslarının süresi, dört saatten (Moseley 2003c) 30 dakikalık sürelere kadar çeşitlilik göstermektedir. Daha yeni çalışmalarda genellikle 30 dakikalık seansların yapıldığı rapor edilmiştir (Meeus vd 2010, Van Oosterwijck vd 2011). Ayrıca eğitim seansları, bir (Moseley 2003b, 2003c, Moseley vd 2004b, Brox vd 2008, Meeus vd 2010, Ryan vd 2010) ya da daha fazla sayıda (Moseley 2002, 2003c, Van Oosterwijck vd 2011) yapılmaktadır. Birden fazla eğitim seansı yapılan çalışmalarda, seanslar arasındaki en yaygın sıklık 1 hafta arayla olmuştur (Moseley 2002, 2003c, Van Oosterwijck vd 2011).

Eğitim seansları genellikle birebir sözlü iletişim yöntemi kullanılarak yapılırken (Moseley 2002, 2003c, 2004, Moseley vd 2004b, Meeus vd 2010, Van Oosterwijck vd 2011), grup yönteminin de kullanıldığı çalışmalar bulunmaktadır (Moseley 2003b, 2003c). Fakat, birebir eğitim seanslarının sonuçlarının grup seanslarının sonuçlarından daha iyi olması sebebiyle, birebir eğitim seanslarının uygulanması tavsiye edilmektedir.

TNE seansları sırasında belirli eğitim araçları kullanılmıştır. Literatürde TNE seanslarına özetle şu eğitim araçları eşlik etmiştir:

- Hazırlanan resimler (Moseley 2004, Moseley vd 2004b, Meeus vd 2010, Ryan vd 2010, Van Oosterwijck vd 2011)
- Örnekler (Moseley vd 2004b, Meeus vd 2010, Van Oosterwijck vd 2011)
- Metaforlar (Van Oosterwijck vd 2011)
- El çizimleri (Moseley 2003b, 2004, Ryan vd 2010)
- Okuma / soru-cevap şeklindeki çalışma kitabları (Moseley 2002, Moseley vd 2004b)
- Nörofizyoloji Ağrı Anketi (Van Oosterwijck vd 2011)

2.2. Hipotezler

H_1:FM'li bireylerde Klinik Pilates Egzersizi ile birlikte uygulanan Terapatik Nörobilim Eğitimi sadece Klinik Pilates Egzersizi uygulanan gruba göre ağrı açısından daha üstündür.

H_2:FM'li bireylerde Klinik Pilates Egzersizi ile birlikte uygulanan Terapatik Nörobilim Eğitimi sadece Klinik Pilates Egzersizi uygulanan gruba göre korku kaçınma inanışları açısından daha üstündür.

H_3:FM'li bireylerde Klinik Pilates Egzersizi ile birlikte uygulanan Terapatik Nörobilim Eğitimi sadece Klinik Pilates Egzersizi uygulanan gruba göre biyopsikososyal fonksiyonlar açısından daha üstündür.

H_4:FM'li bireylerde Klinik Pilates Egzersizi ile birlikte uygulanan Terapatik Nörobilim Eğitimi sadece Klinik Pilates Egzersizi uygulanan gruba göre kognitif fonksiyonlar açısından daha üstündür.

3. GEREÇ VE YÖNTEMLER

3.1. Çalışmanın Yapıldığı Yer

Bu çalışma Pamukkale Üniversitesi Romatoloji Bilim Dalı ile Pamukkale Üniversitesi Fizik Tedavi ve Rehabilitasyon Yüksek Okulu'nun Romatolojik Fizyoterapi ve Rehabilitasyon Ünitesi'nin ortak çalışması olarak yüksekokulda yer alan egzersiz ve ünite salonlarında yapıldı.

3.2. Çalışmanın Dizaynı

Bu çalışma, paralel grupların randomize kontrollü bir çalışması olarak planlandı.

3.3. Örneklemin Oluşturulması

Çalışmanın örneklemi oluşturulurken katılımcıların belirlenmesi aşamasında, seçimin dahil edilme ve hariç tutulma kriterlerine uygun olarak yürütülmesi hususunda, romatolog ve fizyoterapistler birlikte sürece dahil oldu. Dahil edilme ve hariç tutulma kriterlerine uygun olan tüm katılımcı olabilecek adaylara, yüz yüze yapılan bir görüşme ile çalışma hakkında sözel olarak bilgi verildi ve çalışmanın detaylarının bulunduğu yazılı bir doküman temin edildi. Eğer kişi çalışmaya katılmayı gönüllü olarak kabul ettiyse, gönüllü onam formu imzalatıldı ve değerlendirmeleri yapılmak üzere ikinci bir yüz yüze görüşme için randevu verildi. Katılımcılara ayrıca herhangi bir yükümlülük altına girmeden istedikleri herhangi bir zamanda çalışmadan ayrılabilecekleri bilgisi de verildi. Çalışma, Helsinki Bildirgesi'ndeki etik pransiplere uygun olarak yapıldı ve etik onay, Pamukkale Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu Komisyonu'ndan 05.03.2019 tarihli ve 05 sayılı toplantıda alındı. Daha sonra çalışmadaki değişiklikler ile ilgili öneri verildi ve en son güncel karar 27.10.2020 tarihli ve 20 sayılı toplantıda alındı (Ek-13).

3.4. Katılımcılar

Pamukkale Üniversitesi Romatoloji Kliniği tarafından takip edilen ve 2016 ARD'nin FM sınıflama kriterlerine göre romatolog hekim tarafından FM tanısı konmuş 18-65 yaş aralığında, dahil etme kriterlerine uygun 25 kadın çalışmaya dahil edildi.

IBM SPSS Statistics 22 paket programında katılımcıların randomizasyonu yapıldı ve katılımcılar müdahale grubu ve kontrol grubu olmak üzere 2 gruba ayrıldı. Müdahale grubu (Klinik Piltes Egzersizleri+Terapatik Nörobilim Eğitimi) 11 kişi ve kontrol grubu (Klinik Pilates Egzersizleri) 14 kişi olacak şekilde çalışma tamamlandı.

3.5. Gönüllüler İçin Araştırmaya Dahil Edilme Kriterleri

- 18-65 yaş aralığında olmak
- Kadın cinsiyete sahip olmak
- 'ağrı yok' 've' 'mümkün olan en kötü ağrı' ile 0-100 arasında puanlanan VAS'dan haftalık ağrı şiddeti açısından en az 40 mm bildirmek (Jensen vd 2012).
- Yaygın ağrının yanı sıra bir dizi somatik ve bilişsel belirtinin ortaya çıkması için en az 1 yıl süreyle FM teşhisi almış olmak (Wolfe 2010).
- Geçen en az 6 ay boyunca sabit dozda ilaç kullanıyor olmak (serotonin noradrenalin geri alım inhibitörleri [Ör,duloksetin,milnasipran]; alfa 2-delta reseptör ligandı [Ör,pregabalin]; gabapentinoidler).

3.6. Gönüllüler İçin Hariç Tutulma Kriterleri

- Fiziksel durumunu etkileyecek düzeyde başka hastalığın olması
- Kooperasyon kuramayacak düzeyde kognitif yetersizliği olmak
- Hamile olmak
- Türkçe anlama veya konuşma yetersizliği
- Eşzamanlı otoimmün veya enflamatuar hastalık,
- Santral sinir sistemini etkileyen hastalıklar (örneğin multipl skleroz, parkinson hastalığı),
- Katılımı önleyen ciddi psikiyatrik durumlar (örneğin, psikotik bozukluklar).
- Geçtiğimiz yıl içerisinde bir rehabilitasyon programına katılım,
- 6 aydır düzenli egzersiz yapmak
- Tedavilerin en %75’ine katılımın olmaması

3.7. Değerlendirmeler

Tüm katılımcılar için değerlendirmeler; yüz yüze görüşme yöntemi ile tedavi öncesi ve tedavi sonrasında, aynı koşulların sağlandığı bir ortamda, standart test protokollerine göre aynı araştırmacı tarafından yapıldı. Her bir değerlendirme yaklaşık olarak 90 dakika sürdü. Katılımcıların demografik bilgileri kaydedildikten sonra, fonksiyonel durumları Fibromiyalji Etki Anketi ile, ağrıları Vizüel Analog Skalası, Yaygın Ağrı İndeksi, Semptom Şiddeti Ölçeği, Kısa Ağrı Envanteri, Ağrıyı Felaketleştirme Ölçeği ile, korku kaçınma inanışları Tampa Kinezyofobi Ölçeği ile, biyopsikososyal durumları Bilişsel Egzersiz Terapi Yaklaşımı Ölçeği ile, kognitif fonksiyonları Dinamik Loewenstein Mesleki Terapi Kognitif Değerlendirme testi ile ve basınç ağrı eşik ölçümleri basınç algometresi ile değerlendirildi.

3.7.1. Kayıt ve değerlendirme formu

Katılımcıların yaş, cinsiyet, boy, kilo, dominant taraf, Vücut Kitle İndeksi, meslek, medeni durum, eğitim yılı, kullandığı ilaçlar gibi bilgiler hazırlanan forma kaydedildi (Ek-14).

3.7.2. Fibromiyalji etki anketi

Burckhardt vd (1991) FM hastalarında fonksiyonel durumu ölçmek amacıyla geliştirilmiştir. Türkçe geçerlik güvenirlilik uyarlaması Sarmer vd (2000) tarafından yapılmıştır. Bu anket temel olarak; fiziksel fonksiyon, kendini iyi hissetme hali, işe gidememe, işte zorlanma, ağrı, yorgunluk, sabah yorgunluğu, tutukluk, anksiyete ve depresyon olmak üzere 10 ayrı özelliği ölçmektedir ve 10 sorudan oluşmaktadır. Her alt başlığın maksimum olabilecek puanı 10'dur. Böylece toplam maksimum puan 100'dür. Yüksek puanlar, daha kötü fonksiyonel durumu göstermektedir (Ek-15).

3.7.3. Vizüel analog skalası

Ağrı gibi sayısal olarak ölçülemeyen bazı değerleri sayısal hale çevirmek için kullanılmaktadır. 10 cm lik bir çizginin iki ucuna değerlendirilecek parametrenin iki uç tanımı yazılır ve hastadan bu çizgi üzerinde kendi durumunun nereye uygun olduğunu

bir çizgi çizerek veya nokta koyarak veya işaret ederek belirtmesi istenmektedir. Çalışmamızda, kişinin değerlendirmeden önceki bir haftalık genel ağrı düzeyi Vizüel Analog Skalası kullanılarak değerlendirildi. 0='ağrı yok', 10='mümkün olan en kötü ağrı' olarak tanımlandı. Ağrının hiç olmadığı yerden hastanın işaretlediği yere kadar olan mesafenin uzunluğu, hastanın ağrı şiddeti olarak belirlendi (Wewers ve Lowe 1990) (Ek-16).

3.7.4. Yaygın ağrı indeksi ve semptom şiddeti ölçeği

Yaygın Ağrı İndeksi; hastanın son bir haftadaki ağrısının 19 bölge açısından sorgulandığı indekstir ve 0-19 arasında puanlanmaktadır. Semptom Şiddet Ölçeği; halsizlik, yorgun uyanma ve bilişsel semptomlar ile ilgili sıkıntı olmak üzere 3 sorudan oluşmaktadır. Bu 3 yakınmanın her birinin son bir haftadaki şiddeti 0: hiç sorun olmadı, 1=hafif derecede sorun, 2=orta önemli derecede sorun, 3=ciddi derecede sorun şeklinde skorlanmaktadır. Semptom Şiddet Ölçeği ayrıca, geçen altı ay boyunca baş ağrısı, alt karında ağrı ve kramplar ve depresyon varlığını, “var (1 puan)” veya “yok (0 puan)” şeklinde sorgulamaktadır. Semptom Şiddet Ölçeği, 0-12 arasında puanlanmaktadır (Wolfe vd 2010) (Ek-17).

3.7.5. Kısa ağrı envanteri

Ağrıyı değerlendirmek için kullanılabilecek kısa, uygulaması kolay bir değerlendirme yöntemidir. Ağrı şiddeti ve ağrının oluşturduğu engeller olmak üzere iki bölümden oluşmaktadır. Ağrı şiddeti ile ilgili 4 maddesi ve ağrının oluşturduğu engeller ile ilgili 7 maddesi bulunmaktadır. Her bir madde, 0’dan 10’a sayısal değerlendirme skalalarını içermektedir. Her iki bölüm içinde toplam puan; her bir maddeye verilen puanların toplanarak soru sayısına bölünmesi ile hesaplanır ve 0 ile 10 arasında değişmektedir. Yüksek puanlar, daha fazla ağrı ve ağrının daha fazla engele neden olduğu anlamına gelmektedir (Cleeland ve Ryan 1994). Türkçe geçerlik ve güvenilirlik çalışması yapılmıştır (Dicle vd 2009) (Ek-18).

3.7.6. Ağrıyı felaketleştirme ölçeği

Sullivan vd (1995) tarafından hastaların deneyimledikleri ağrıya ilişkin katastrofik düşünce ya da duygularını ve etkin olmayan başa çıkma stratejilerini tespit etmek amacıyla geliştirilen bu ölçek, 13 maddeden oluşan Likert tipinde bir öz-değerlendirme ölçeğidir. Her madde 0–4 puan arasında puanlanmaktadır. Toplam puan, 0 ile 52 arasında değişmektedir. Yüksek puanlar, felaketleştirme seviyesinin yüksek olduğunu göstermektedir. Ağrıyı büyütme (6,7 ve 13. maddeler), ruminasyon (8,9,10,11. maddeler) ve çaresizlik (1,2,3,4,5 ve 12. maddeler) olmak üzere 3 alt testi bulunmaktadır. Türkçe geçerlik ve güvenilirlik çalışması yapılmıştır (Ugurlu vd 2017) (Ek-19).

3.7.7. Tampa kinezyofobi ölçeği

Hareket/ tekrar yaralanma korkusunu değerlendiren 17 maddeden oluşan bir ölçektir (44). Toplam skor 17 ile 68 arasında değişmektedir. Yüksek puan kişide kinezyofobinin yüksek olduğunu göstermektedir. Türkçe geçerliliği ve güvenirliliği Yılmaz vd (2011) tarafından yapılmıştır (Ek-20).

3.7.8. Bilişsel egzersiz terapi yaklaşımı ölçeği

Bu orijinal ölçek, Unal vd (2017) tarafından romatolojik hastalığı bulunan bireylerin biyopsikososyal durumlarını değerlendirmek amacıyla geliştirilmiştir. Her soru için 5'li likert tipi skorlamanın kullanıldığı, 30 sorudan oluşmaktadır. Türkçe olarak oluşturulmuş bir ölçektir. Yüksek skor, kötü biyopsikososyal durumu göstermektedir (Ek-21).

3.7.9. Dinamik Loewenstein mesleki terapi kognitif değerlendirme

Dinamik Loewenstein mesleki terapi kognitif değerlendirme (DLMTKD) test bataryası, Loewenstein Occupational Therapy Cognitive Assesment bataryasının yeni bir versiyonudur (Itzkovich vd 2000). 18-69 yaş aralığındaki yetişkin kişilerin temel kognitif becerilerini değerlerlendirmek için dizayn edilmiştir. Bu bataryanın; 7 kognitif alan için oluşturulan 28 alt testi bulunmaktadır. Bu 7 kognitif alan; oryantasyon,

farkındalık, görsel algılama, uzaysal algılama, praksis, görsel motor organizasyon ve düşünme yeteneğidir. Bu batarya ile dinamik bir değerlendirme yapılmaktadır: İlk olarak 7 kognitif alan için oluşturulmuş 28 alt testin her biri için; değerlendirilen kişiden istenen şeyin açıkça belirtildiği standardize edilmiş cümleler değerlendirmeci tarafından ifade edilmektedir. Eğer değerlendirilen kişi istenilen şeyi tam olarak gerçekleştirmişse, en yüksek puan işaretlenerek bir sonraki alt teste geçilmektedir. Eğer değerlendirilen kişi istenilen şeyi tam olarak gerçekleştirememişse, duruma uygun olan skor işaretlenmektedir ve birinci adımdan başlanarak kademe kademe mediasyon skorlarında ilerlenilmektedir ve değerlendirilen kişinin durumuna göre işaretleme yapılmaktadır. Bu mediasyon bölümü; oryantasyon ve farkındalık hariç diğer 5 kognitif alan için geçerlidir. Her bir alt teste özel olarak, dört ya da beş adımdan oluşmaktadır. Değerlendirilen kişiyi doğru sonuca yönlendirecek şekilde değerlendirmecinin söylemesinin istendiği bir takım standardize edilmiş cümlelerdir. Tüm bataryanın uygulanma süresi, alt testlerde mediasyon bölümüne ne kadar ihtiyaç duyulduğuna bağlı olarak 1 saat ile 2 saat arasında değişmektedir. Eğer değerlendirilen kişi, değerlendirmeyi tek bir oturumda tamamlayamazsa, testi makul bir süre içinde birden fazla oturumda da tamamlamak mümkündür. Puanlama, her bir alt test için üç bileşenden oluşmaktadır: 1.Mediasyon bölümünden önceki temel puan (5 puan en iyi performansı göstermektedir). 2.Mediasyon puanı (yüksek puan (4 ya da 5) kötü performansı göstermektedir). 3. Mediasyon bölümünden sonraki puan (5 puan en iyi performansı göstermektedir) (Katz vd 2011).

Resim 3.1 DLMTKD materyali

3.7.10. Basınç ağrı eşik ölçümleri

Basınç ağrı eşiği ölçümü; vücuda karşı 90 açıyla tutularak hastanın ağrı eşiğine ulaşana kadar sabit bir oranda artan basınç ile baskı uygulanan sert kauçuk problu bir aparatı olan basınç algometresi (Commander Echo) kullanılarak değerlendirildi.

Değerlendirmeler, bilateral olarak 4 farklı bölgede yapıldı: Bu 4 bölge; m. trapezius, dirsekler (lateral epikondil), m. quadriceps femoris ve dizlerden (eklem hattına yakın medial yağ yastığında) oluşmakta idi ve Okifuji vd (1997) kılavuzuna göre belirlenen hassas noktalar ile aynı idi. Önceki çalışmalar, basınç ağrı eşik ölçümlerinin sınırlı sayıda bölgede değerlendirilmesinin, genel duyarlılığın iyi bir tahminini verdiğini göstermiştir (Petzke vd 2001).

Bilateral olarak her bir bölge için toplam 8 hassas noktaya 3'er ölçüm yapıldı. Bu 3 ölçüme dayanarak 8 hassas noktaya ait; maksimum basınç ağrı eşiği ve ortalama basınç ağrı eşiği olmak üzere 2 sonuç elde edildi ve kaydedildi (Jensen vd 2012) (Ek-22).

Resim 3.2 Basınç algometresi

3.8. Müdahaleler

3.8.1. Klinik pilates egzersizi

Klinik Pilates egzersizleri, aynı uzman fizyoterapist tarafından gözetim altında grup tedavisi şeklinde yapıldı. Egzersizler her iki gruba da, haftada 3 kez 6 hafta boyunca toplam 18 seans uygulandı. Bir seans; 5 dakika ısınma, 45 dakika Klinik Pilates egzersizleri ve 10 dakika soğuma periyotlarından oluşmakta idi (toplam 60 dakika). Uygulanan egzersizler detaylı olarak Tablo 3.1'de gösterildi. Egzersizlere 6-8 tekrar ile başlandı. Egzersizlerin zorluk derecesi 2 hafta aralıklarla (yani 2. ve 4. haftanın sonunda) katılımcıların tolere edebilmesine göre; tekrar sayılarının arttırılması, bir üst seviyedeki egzersize geçilmesi ya da egzersizlerin uygulanması sırasında theraband kullanımının eklenmesi ile arttırıldı.

Her iki gruptaki katılımcılara ilk değerlendirmeden sonra, Klinik Pilates egzersizlerinin 5 anahtar elementi olan; solunum, odaklanma, göğüs kafesi yerleşimi, omuz yerleşimi, baş ve boyun yerleşimi öğretildi. Egzersizleri ilk olarak fizyoterapist

kendi üzerinde gösterdi ve egzersizler sırasında dikkat etmeleri gereken noktaları belirtti. Daha sonra katılımcılardan yapmaları istendi. Egzersizler sırasında hareketlerin doğru yapılabilmesi için imgelemelerden ve sözlü uyarılardan yararlanıldı. Solunum kontrolünün önemi belirtildi ve her egzersiz öncesi hareketin zorlu kısmında nefes vermenin gerekliliği anlatıldı. Egzersizler sırasında hata yapıldıysa egzersiz yarıda kesilmedi, katılımcıya nasıl doğru yapılacağı anlatılarak egzersizi tekrarlaması istendi. Bu şekilde katılımcının vücut farkındalığının arttırılması amaçlandı.

Tablo 3. 1 Klinik pilates egzersizleri

Isınma Periyodu	**Soğuma Periyodu**
Toy soldier	Spine stretch
Upper back warm up	The saw
Dumb waiter	Mermaid
Cleopatra	Upper body rolls
Chest stretch	Side plie with stretch
Low er body series: walking	
Klinik Pilates Egzersizleri (0-2 hafta)	
Hundreds	Swimming
One leg stretch	Roll up
Double leg stretch	Clam
Scissors	Hip twist
Shoulder bridge	Side kick
Swan dive	One leg circle
One leg kick	Arm openings
Klinik Pilates Egzersizleri (2-4 hafta)	
Abdominal preparation	Hudreds in supine crook lying
Scapula isolations	Heels together-toes apart
The plough	Single leg heel
Biceps curl	Hundreds in side lying
Roll up	Side kick in lying
Diamond press	One leg stretch
External rotation	One leg kick
Short spine prep	Swimming
Side kick press	Hundreds in sitting
Swimming in kneeling	Scissors
One leg stretch	Leg push
Point and flex	Leg push with stretch
Spine twist	Shell
Klinik Pilates Egzersizleri (4-6 hafta)	
Swan dive	Heels apart external rotation
The slice	One leg stretch
Open book	Shoulder brigde 1-2
Triceps pull	Side kick in kneeling
Roll up with obliques	Side kick in lying-advanced
Triangles	Swimming
Diamond press with arm openings	Double leg stretch
Heels together toes apart	Spine twist
Side circles	Walking
Swimming in kneeling	Scissors
External rotation	Shell
Side bend	Psoas stretch

3.8.2. Terapatik nörobilim eğitimi

TNE eğitimi sadece müdahale grubundaki tüm katılımcılara, International Spine and Pain Institute tarafından online olarak verilen TNE eğitimi almış aynı fizyoterapist tarafından uygulandı. Seanslar, eğitim için özel olarak ayrılmış bir odada, sadece bir katılımcı ve fizyoterapistin bulunduğu birebir yüz yüze görüşme yöntemi ile sözel olarak gerçekleştirildi. Öğretilmek istenilen bilgileri her katılımcının özel yaşam durumlarına adapte edebilmesi için seanslar bireyselleştirilmiş interaktif tartışma (sorular ve cevaplar) ortamı oluşturularak yapıldı. Müdahale grubundaki her bir katılımcı haftada bir defa olacak şekilde 6 hafta boyunca toplam 6 seans TNE eğitimini tamamladı. Her bir seans yaklaşık olarak 45-60 dakika sürdü.

TNE eğitimi kapsamında ele alınan konular şunları içermekte idi: ağrının nörofizyolojisi, nosisepsiyon ve nosiseptif yollar, nöronlar, sinapslar, aksiyon potansiyeli, spinal inhibisyon ve fasilitasyon, periferal sensitizasyon, santral sensitizasyon, sinir sisteminin plastisitesi. Anatomik ve patoanatomik modellere hiç değinilmedi, ağrının duygusal veya davranışsal yönleri hakkında hiç tartışılmadı (Louw vd 2011).

Eğitim bilgileri sözlü (terapist tarafından açıklama) ve görsel olarak (“Why You Hurt” Louw, International Spine and Pain Institute, USA) sunuldu. Önceki çalışmalarda da önerildiği gibi hastanın anlamasını kolaylaştırmak için geliştirilen çeşitli örnekler, metaforlar ve resimli kartlar bu çalışmada da kullanıldı. (Louw vd 2011, 2013, Nijs vd 2011).

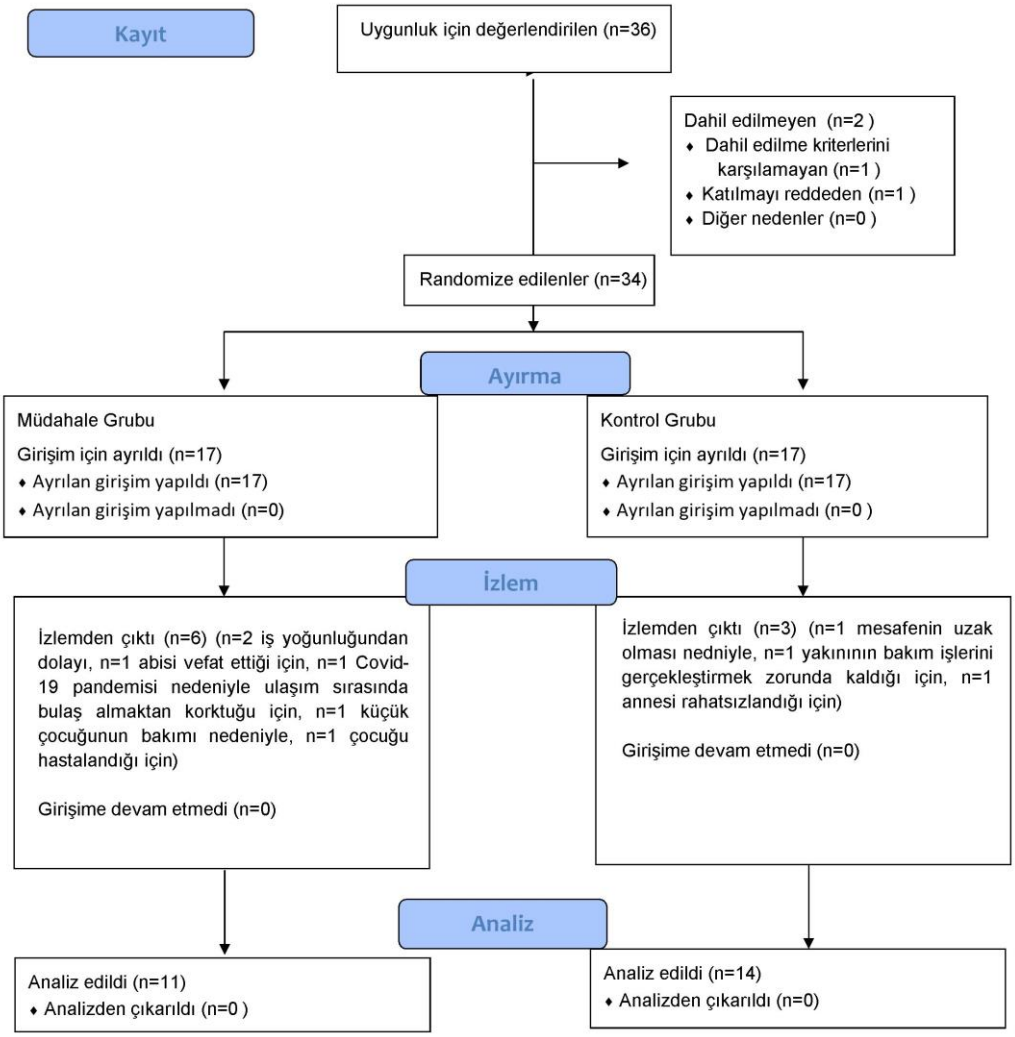
Eğitimin amacı katılımcılara ağrının sadece doku yaralanmasından ziyade çok faktörlü bir deneyim olduğunu öğretmekti. Her katılımcı için her seansın sonunda “Ağrıları ile ilgili daha fazla bilgi sahibi olan ve ağrı mekanizmasının nasıl çalıştığını bilen kişiler, daha az ağrı hissederler. Bu bilgiler, beynin çeşitli ağrı kesici maddeler üretmesine olanak sağlayarak daha iyi hissetmenize yardımcı olur. Ne kadar çok bilirseniz, o kadar iyi olacaksınız. Bugün ağrı hakkında öğrendiğiniz herşeyi düşünün. Aşağıya herhangi bir sorunuz varsa yazın, böylece bir sonraki görüşmemizde onu tartışabiliriz. Bu öğrenme süreciniz, iyileşmenizin anahtarıdır.” ifadelerinde bulunuldu ve onlardan o gün anlatılanları aile üyelerinden birine ya da bir arkadaşlarına anlatmaları ya da bir kağıta yazmaları ve öğrendiklerini günlük hayatlarına nasıl adapte edebileceklerini düşünmeleri istendi. Her bir katılımcı için her seansta, bir önceki seansta öğrenilen bilgiler ile ilgili soruların varlığı durumunda 10 dakikaya kadar ekstra süre tanındı.

3.9. İstatistiksel Analiz

Referans olarak incelenen çalışmada elde edilen etki büyüklüğünün orta düzeyde olduğu (d=3,49) görüldü. Referans çalışmadaki Tampa Kinezyofobi Ölçeği ile ilgili sonuçlardan yola çıkarak, daha düşük düzeyde bir etki büyüklüğü de elde edebileceğimizi (d=1,1) varsayarak yaptığımız güç analizi sonucunda, çalışmaya en az 22 kişi (her grup için en az 11 kişi) alındığında %95 güven düzeyinde %80 güç elde edilebileceği hesaplandı (Téllez-García vd 2015). Veriler IBM SPSS Statistics 22 paket programıyla analiz edildi. Sürekli değişkenler median (minimum/maksimum) ve kategorik değişkenler sayı ve yüzde olarak verildi. Bağımsız grup farklılıkların karşılaştırılmasında Mann Whitney U testi; bağımlı grup karşılaştırmalarında, Wilcoxon eşleştirilmiş iki örnek testi kullanıldı. İstatistiksel anlamlılık değeri, $p<0,05$ olarak kabul edildi.

4. BULGULAR

Çalışmaya ilk olarak 36 FM'li kadın ile başlandı. 1 kişi doğuştan bilateral pes ekinovarus deformitesi ve buna bağlı olarak alt ekstremitede çeşitli kontraktür ve dizilim bozuklukları olduğu ve kişinin fonksiyonelliği etkilendiği için çalışmaya dahil edilmedi. 1 kişi çalışmaya katılmak istemedi. Böylece dahil edilme kriterlerini karşılayan ve çalışmaya katılmayı kabul eden 34 FM'li birey, IBM SPSS Statistics 22 paket programında randomize edilerek 2 gruba ayrıldı (müdahale grubu (Klinik Piltes Egzersiz+TNE, n=17) ve kontrol grubu (Klinik Pilates Egzersiz, n=17). Müdahale grubundan; iki kişi (biri hemşire, biri fırıncı) iş yoğunluğundan dolayı, bir kişi abisi vefat ettiği için, bir kişi Covid-19 pandemisi nedeniyle ulaşım sırasında bulaş almaktan korktuğu için, bir kişi küçük çocuğunun bakımı nedeniyle ve bir kişi de çocuğu hastalandığı için tedaviye devam etmedi. Kontrol grubundan ise; bir kişi mesafenin uzak olması nedeniyle, bir kişi yakınının bakım işlerini gerçekleştirmek zorunda kaldığı için ve bir kişi de annesi rahatsızlandığı için tedaviye katılımını sonlandırdı. Bu durumda bu çalışma müdahale grubunda 11 kişi (yaş ortalaması=46,81±10,55 yıl) ve kontrol grubunda 14 kişi (yaş ortalaması=51,57±9,51 yıl) olmak üzere toplam 25 katılımcı ile tamamlandı. Şekil 4.1, çalışmanın akış şemasını göstermektedir. Tedaviler sırasında herhangi bir yaralanma rapor edilmemiştir. Tedavi seanslarına katılım oranı müdahale grubunda % 92,92 iken, kontrol grubunda % 82,96 idi.



Şekil 4.1 Çalışmanın akış şeması

4.1. Tanımlayıcı Bulgular

4.1.1. Katılımcıların demografik verileri

Katılımcıların demografik verileri Tablo 4.1'de gösterildi. Demografik veriler açısından tedavi öncesinde gruplar arasında fark yoktu (p>0,05).

Tablo 4. 1 Katılımcıların demografik verileri

Değişkenler	Müdahale Grubu (n=11)		Kontrol Grubu (n=14)		p*
	Median(Min/Maks)	Ort±Ss	Median(Min/Maks)	Ort±Ss	
Yaş (yıl)	48 (27/63)	46,81±10,55	52,50 (30/65)	51,57±9,51	0,228
Boy (m)	1,64 (1,51/1,70)	1,61±0,06	1,58 (1,52/1,68)	1,59±0,04	0,297
Kilo (kg)	69 (50/97)	70,18±11,65	74,50 (53/103)	75,00±13,78	0,261
VKİ (kg/m^2)	25,39 (19,53/38,86)	27,11±5,27	29,04 (22,06/42,87)	29,66±5,76	0,189
Hastalık Süresi (yıl)	3 (1/10)	5,13±3,80	3,50 (1/22)	5,85±6,74	0,719

Min=Minimum, Maks=Maksimum, Ort=Ortalama, Ss=Standart Sapma,VKİ=Vücut Kitle İndeksi, *Mann Whitney U testi

4.1.2. Sonuç ölçütlerinin tedavi öncesi ve tedavi sonrasına ait tanımlayıcı verileri

Katılımcıların fonksiyonel durumları Fibromiyalji Etki Anketi ile, ağrıları Vizüel Analog Skalası, Yaygın Ağrı İndeksi, Semptom Şiddeti Ölçeği, Kısa Ağrı Envanteri, Ağrıyı Felaketleştirme Ölçeği ile, korku kaçınma inanışları Tampa Kinezyofobi Ölçeği ile, biyopsikososyal durumları Bilişsel Egzersiz Terapi Yaklaşımı Ölçeği ile ve kognitif fonksiyonları DLMTKD testi ile değerlendirildi. Tedavi öncesi ve tedavi sonrasındaki sonuç ölçüt değerlendirmelerinden müdahale grubunun aldığı puanların tanımlayıcı bilgileri Tablo 4.2 ve kontrol grubunun aldığı puanların tanımlayıcı bilgileri Tablo 4.3'te gösterildi.

Tablo 4.2 Müdahale grubunun tedavi öncesi ve tedavi sonrasına ait sonuç ölçüt puanlarının tanımlayıcı verileri

Değişkenler	**Müdahale Grubu (n=11)**					
	n	**Tedavi Öncesi**		**n**	**Tedavi Sonrası**	
		Median(Min/Maks)	**Ort±Ss**		**Median(Min/Maks)**	**Ort±Ss**
Fibromiyalji Etki Anketi	11	53,98 (24,66/74,86)	52,07±16,29	11	31,95 (5,72/44,71)	**25,60±14,86**
Vizüel Analog Skalası	11	7 (5/8)	6,68±1,23	11	4 (1/7)	**3,90±1,81**
Yaygın Ağrı İndeksi	11	13 (4/18)	11,81±4,44	11	5 (2/12)	**5,72±3,28**
Semptom Şiddeti Ölçeği	11	8 (4/11)	7,54±2,20	11	5 (0/9)	**4,36±2,83**
Kısa Ağrı Envanteri- Ağrı Şiddet Skoru	11	5,75 (2,25/6,87)	5,32±1,44	11	2,75 (0,50/7,25)	**3,27±2,26**
Kısa Ağrı Envanteri- Ağrının Oluşturduğu Engeller Skoru	11	3,71 (0/5,71)	3,38±1,88	11	1,14 (0/4,85)	**1,71±1,72**
Ağrıyı Felaketleştirme Ölçeği- Toplam	11	10 (0/48)	15,81±15,53	11	6 (0/36)	**11,00±11,29**
-Ağrıyı Büyütme	11	3 (0/8)	3,00±3,06	11	2 (0/9)	**2,90±3,33**
-Ruminasyon	11	3 (0/16)	5,27±5,56	11	3 (0/13)	**3,72±4,33**
-Çaresizlik	11	5 (0/24)	7,54±7,76	11	4 (0/15)	**4,36±4,43**
Tampa Kinezyofobi Ölçeği	11	33 (25/50)	35,63±9,75	11	31 (24/46)	**32,63±7,96**
Bilişsel Egzersiz Terapi Yaklaşımı Ölçeği	11	44 (1/71)	40,27±20,99	11	27 (8/74)	**27,90±19,48**
DLMTKD- Oryantasyon (0-2)	11	2 (1,87/2,00)	1,98±0,03	11	2 (2/2)	**2,00±0,00**
- Görsel Algılama (Önce) (1-4)	11	3,66 (3,66/4,00)	3,78±0,17	11	3,66 (3,33/4,00)	**3,75±0,21**
- Görsel Algılama (Sonra) (1-4)	7	4 (3/4)	3,85±0,37	7	4 (3/4)	**3,71±0,48**
- Görsel Algılama (Mediasyon) (1-4)	7	4 (2/4)	3,28±0,95	7	4 (1/4)	**3,42±1,13**
-Uzaysal Algılama (Önce) (0-1)	11	0,91 (0,83/1,00)	0,92±0,06	11	1 (0,83/1,00)	**0,97±0,05**

Tablo 4.2 Müdahale grubunun tedavi öncesi ve tedavi sonrasına ait sonuç ölçüt puanlarının tanımlayıcı verileri (Devamı)

Değişkenler	**Müdahale Grubu (n=11)**					
	n	**Tedavi Öncesi**		**n**	**Tedavi Sonrası**	
		Median(Min/Maks)	**Ort±Ss**		**Median(Min/Maks)**	**Ort±Ss**
-Uzaysal Algılama (Sonra) (0-1)	7	1 (0/1)	0,85±0,37	2	1 (1/1)	**1,00±0,00**
-Uzaysal Algılama (Mediasyon) (1-4)	7	1 (1/4)	2,07±1,42	2	1 (1/1)	**1,00±0,00**
-Praksis (Önce) (0-2)	11	1,83 (1,16/1,91)	1,66±0,23	11	1,66 (1,25/2,00)	**1,64±0,24**
-Praksis (Sonra) (0-2)	11	2 (2/2)	2,00±0,00	10	2 (2/2)	**2,00±0,00**
-Praksis (Mediasyon) (1-4)	11	2 (1/3.37)	1,89±0,74	10	1,75 (1/3)	**1,65±0,66**
-Görsel Motor Organizasyon (Önce) (1-5)	11	4,28 (1,42/5,00)	4,10±1,01	11	4,42 (2,14/5,00)	**4,82±0,77**
-Görsel Motor Organizasyon (Sonra) (1-5)	9	5 (3,57/5)	4,82±0,47	10	5 (3,71/5)	**4,87±0,40**
-Görsel Motor Organizasyon (Mediasyon) (1-5)	9	3 (1/4)	2,56±1,16	10	1,33 (1/4,28)	**1,71±1,08**
-Düşünme (Önce) (1-5)	11	3,28 (1,28/4,33)	3,05±0,95	11	4 (1,71/4,83)	**3,74±0,88**
-Düşünme (Sonra) (1-5)	11	4,25 (2,57/5)	4,02±0,77	10	4,41 (3/5)	**4,22±0,75**
-Düşünme (Mediasyon) (1-5)	11	3,33 (2,50/5)	3,55±0,79	10	3,33 (1/5)	**3,21±1,24**
-Düşünme Sözel Matematik Soruları (Önce) (0-1)	11	0,75 (0/1)	0,61±0,34	11	0,75 (0/1)	**0,63±0,37**
-Düşünme Sözel Matematik Soruları (Sonra) (0-1)	9	1 (0,25/1)	0,86±0,28	7	1 (0,75/1)	**0,96±0,09**
-Düşünme Sözel Matematik Soruları (Mediasyon) (1-5)	9	2 (1/5)	2,52±1,64	7	3,66 (2/4,75)	**3,48±0,89**
DLMTKD-Toplam (3-20)	11	16,24 (10,43/18,76)	16,13±2,35	11	17,32 (11,76/19,66)	**17,03±2,13**

Tablo 4.3 Kontrol grubunun tedavi öncesi ve tedavi sonrasına ait sonuç ölçüt puanlarının tanımlayıcı verileri

Değişkenler	**Kontrol Grubu (n=14)**					
	n	**Tedavi Öncesi**		**n**	**Tedavi Sonrası**	
		Median(Min/Maks)	**Ort±Ss**		**Median(Min/Maks)**	**Ort±Ss**
Fibromiyalji Etki Anketi	14	53,00 (18,66/78,77)	53,33±16,12	14	41,12 (21,33/86,24)	**44,61±18,72**
Vizüel Analog Skalası	14	6,75 (5,00/10,00)	7,00±1,93	14	6,00 (2,00/10,00)	**6,03±2,11**
Yaygın Ağrı İndeksi	14	12 (5/19)	12,35±4,14	14	10,50 (2/19)	**10,71±5,62**
Semptom Şiddeti Ölçeği	14	7,50 (4/12)	7,78±2,66	14	6 (1/10)	**5,92±2,46**
Kısa Ağrı Envanteri- Ağrı Şiddet Skoru	14	5,25 (2,50/8,25)	5,21±1,60	14	4,25 (1,50/7,50)	**4,09±1,89**
Kısa Ağrı Envanteri- Ağrının Oluşturduğu Engeller Skoru	14	3,28 (0,57/8,57)	3,71±2,44	14	2,13 (0,28/10,00)	**2,96±2,92**
Ağrıyı Felaketleştirme Ölçeği- Toplam	14	27 (3/51)	25,28±14,90	14	13 (4/51)	**21,71±16,11**
-Ağrıyı Büyütme	14	6,50 (3/12)	6,92±3,24	14	4 (1/12)	**5,35±3,71**
-Ruminasyon	14	6 (0/16)	7,21±6,17	14	3 (0/16)	**6,07±6,37**
-Çaresizlik	14	12,50 (0/22)	11,28±6,62	14	8 (2/23)	**10,14±6,51**
Tampa Kinezyofobi Ölçeği	14	40 (28/52)	39,50±6,33	14	41 (29/53)	**40,57±6,73**
Bilişsel Egzersiz Terapi Yaklaşımı Ölçeği	14	52,50 (21/98)	57,57±26,08	14	54 (9/116)	**50,64±28,40**
DLMTKD- Oryantasyon (0-2)	14	2 (1,87/2)	1,99±0,03	14	2 (2/2)	**2,00±0,00**
- Görsel Algılama (Önce) (1-4)	14	3,66 (3,33/4)	3,71±0,25	14	3,83 (3,33/4)	**3,78±0,25**
- Görsel Algılama (Sonra) (1-4)	12	3 (3/4)	3,38±0,48	7	4 (3/4)	**3,71±0,48**
- Görsel Algılama (Mediasyon) (1-4)	12	4 (2/4)	3,44±0,72	7	3 (1/4)	**2,71±1,11**
-Uzaysal Algılama (Önce) (0-1)	14	0,95 (0,75/1)	0,92±0,09	14	1 (0,91/1)	**0,97±0,04**

Tablo 4.3 Kontrol grubunun tedavi öncesi ve tedavi sonrasına ait sonuç ölçüt puanlarının tanımlayıcı verileri (Devamı)

Değişkenler	**Kontrol Grubu (n=14)**				
	Tedavi Öncesi		**Tedavi Sonrası**		
	n	**Median(Min/Maks)**	**Ort±Ss**	**n**	**Median(Min/Maks)**	**Ort±Ss**
-Uzaysal Algılama (Sonra) (0-1)	7	1 (0,5/1)	0,85±0,24	4	1 (1/1)	**1,00±0,00**
-Uzaysal Algılama (Mediasyon) (1-4)	7	2 (1/3,25)	2,03±0,91	4	1,50 (1/3)	**1,75±0,95**
-Praksis (Önce) (0-2)	14	1,66 (1,33/1,83)	1,67±0,13	14	1,75 (1,41/1,91)	**1,72±0,14**
-Praksis (Sonra) (0-2)	14	2 (1,50/2)	1,92±0,18	13	2 (0/5)	**1,80±0,55**
-Praksis (Mediasyon) (1-4)	14	2,50 (1,25/3,50)	2,42±0,59	13	1,75 (1/4)	**1,96±1,00**
-Görsel Motor Organizasyon (Önce) (1-5)	14	3,99 (3,14/5)	4,00±0,53	14	4,49 (3,57/5)	**4,44±0,42**
-Görsel Motor Organizasyon (Sonra) (1-5)	13	5 (4,60/5)	4,86±0,16	12	5 (4,60/5)	**4,94±0,13**
-Görsel Motor Organizasyon (Mediasyon) (1-5)	13	3 (1,5/3,80)	2,83±0,92	12	2 (1,75/3,80)	**2,38±0,68**
-Düşünme (Önce) (1-5)	14	2,71 (1,28/4,50)	3,02±0,97	14	3,64 (2/4,66)	**3,48±0,97**
-Düşünme (Sonra) (1-5)	14	4,70 (2,71/5)	4,40±0,76	14	4,22 (3/5)	**4,25±0,72**
-Düşünme (Mediasyon) (1-5)	14	3,20 (2,33/4)	3,23±0,59	14	3 (2/4)	**2,93±0,52**
-Düşünme Sözel Matematik Soruları (Önce) (0-1)	14	0,5 (0/1)	0,57±0,33	14	0,75 (0/1)	**0,69±0,29**
-Düşünme Sözel Matematik Soruları (Sonra) (0-1)	11	1 (0/1)	0,90±0,30	10	1 (0,5/1)	**0,95±0,15**
-Düşünme Sözel Matematik Soruları (Mediasyon) (1-5)	11	3,50 (1/5)	3,00±1,40	10	2,54 (1/5)	**2,40±1,41**
DLMTKD-Toplam (3-20)	14	15,48 (13,70/19,16)	15,90±1,69	14	17,19 (14,72/19,42)	**17,10±1,65**

4.1.3. Basınç ağrı eşik ölçümlerinin tedavi öncesi ve tedavi sonrasına ait tanımlayıcı verileri

Katılımcıların basınç ağrı eşik ölçümleri, basınç algometresi ile değerlendirildi. Tedavi öncesi ve tedavi sonrasındaki basınç ağrı eşik ölçümlerinden müdahale grubunun aldığı puanların tanımlayıcı bilgileri Tablo 4.4 ve kontrol grubunun aldığı puanların tanımlayıcı bilgileri Tablo 4.5'de gösterildi.

Tablo 4.4 Müdahale grubunun tedavi öncesi ve tedavi sonrasına ait basınç ağrı eşik ölçüm puanlarının tanımlayıcı verileri

Değişkenler	**Müdahale Grubu (n=11)**			
	Tedavi Öncesi		**Tedavi Sonrası**	
	Median(Min/Maks)	**Ort±Ss**	**Median(Min/Maks)**	**Ort±Ss**
Sağ Trapezius Maksimum	2,90 (1,80/6,40)	3,32±1,41	3,90 (2,30/15,30)	**5,35±3,84**
Sağ Trapezius Ortalama	2,90 (1,60/4,70)	2,95±1,00	3,70 (2,30/13,60)	**4,80±3,30**
Sol Trapezius Maksimum	2,60 (1,70/6,20)	3,12±1,49	3,60 (2,50/15,80)	**5,04±3,94**
Sol Trapezius Ortalama	2,50 (1,40/5,40)	2,65±1,25	3,20 (2,30/13,60)	**4,52±3,37**
Sağ Lateral Epikondil Maksimum	2,50 (1,10/5,80)	2,73±1,27	3,10 (1,60/9,40)	**4,70±2,98**
Sağ Lateral Epikondil Ortalama	2,30 (1,00/5,10)	2,50±1,15	2,80 (1,50/8,30)	**4,20±2,54**
Sol Lateral Epikondil Maksimum	2,40 (0,90/5,60)	2,74±1,27	2,90 (1,70/7,00)	**3,90±1,89**
Sol Lateral Epikondil Ortalama	2,30 (0,80/5,10)	2,51±1,15	2,80 (1,60/6,90)	**3,59±1,69**
Sağ Quadriceps Femoris Maksimum	3,40 (1,10/9,70)	4,02±2,57	4,90 (2,70/19,50)	**7,00±4,99**
Sağ Quadriceps Femoris Ortalama	3,10 (1,10/9,20)	3,77±2,45	4,70 (2,50/17,70)	**6,53±4,61**
Sol Quadriceps Femoris Maksimum	3,20 (1,40/9,20)	3,86±2,34	4,20 (3,10/12,60)	**6,14±3,45**
Sol Quadriceps Femoris Ortalama	2,90 (1,20/8,50)	3,43±2,10	3,90 (2,80/12,50)	**5,77±3,47**
Sağ Medial Diz Maksimum	2,30 (1,20/8,30)	2,60±2,00	3,40 (2,00/11,20)	**4,81±3,20**
Sağ Medial Diz Ortalama	2,10 (1,10/7,20)	2,36±1,72	3,20 (1,70/9,70)	**4,28±2,78**
Sol Medial Diz Maksimum	2,50 (0,80/6,00)	2,46±1,40	3,20 (1,60/15,00)	**4,87±3,94**
Sol Medial Diz Ortalama	2,20 (0,70/5,40)	2,14±1,26	3,00 (1,50/14,40)	**4,47±3,74**

Tablo 4.5 Kontrol grubunun tedavi öncesi ve tedavi sonrasına ait basınç ağrı eşik ölçüm puanlarının tanımlayıcı verileri

Değişkenler	**Kontrol Grubu (n=14)**			
	Tedavi Öncesi		**Tedavi Sonrası**	
	Median(Min/Maks)	**Ort±Ss**	**Median(Min/Maks)**	**Ort±Ss**
Sağ Trapezius Maksimum	4,50 (2,50/7,60)	4,35±1,49	4,00 (1,00/6,40)	**4,05±1,49**
Sağ Trapezius Ortalama	4,15 (2,40/7,30)	4,04±1,37	3,60 (0,80/5,40)	**3,62±1,31**
Sol Trapezius Maksimum	5,35 (2,90/7,70)	4,95±1,41	4,05 (0,60/6,70)	**4,14±1,62**
Sol Trapezius Ortalama	4,75 (2,60/6,80)	4,47±1,27	3,90 (0,60/5,70)	**3,82±1,41**
Sağ Lateral Epikondil Maksimum	2,90 (1,60/6,10)	3,16±1,11	3,05 (1,00/4,60)	**2,97±1,06**
Sağ Lateral Epikondil Ortalama	2,70 (1,40/5,80)	2,80±1,08	2,75 (0,70/4,20)	**2,62±1,02**
Sol Lateral Epikondil Maksimum	2,90 (1,80/5,50)	3,13±1,04	3,60 (0,80/4,50)	**3,27±1,04**
Sol Lateral Epikondil Ortalama	2,50 (1,50/5,10)	2,81±1,10	3,10 (0,70/3,60)	**2,75±0,93**
Sağ Quadriceps Femoris Maksimum	6,00 (3,50/9,50)	6,02±1,76	5,55 (0,60/8,50)	**5,07±2,16**
Sağ Quadriceps Femoris Ortalama	4,95(3,10/9,40)	5,37±1,82	5,05 (0,60/8,00)	**4,54±2,08**
Sol Quadriceps Femoris Maksimum	5.,5 (4,00/8,90)	5,90±1,61	5,25 (1,20/10,90)	**5,47±2,32**
Sol Quadriceps Femoris Ortalama	4,35 (3,00/7,90)	5,20±1,59	4,90 (0,90/9,70)	**4,90±2,05**
Sağ Medial Diz Maksimum	2,55 (1,10/5,50)	2,77±1,13	2,50 (0,60/4,40)	**2,50±1,13**
Sağ Medial Diz Ortalama	2,20 (0,80/4,90)	2,41±1,00	2,00 (0,60/4,10)	**2,18±1,04**
Sol Medial Diz Maksimum	3,00 (1,10/7,60)	3,34±1,59	2,35 (0,50/4,50)	**2,32±1,06**
Sol Medial Diz Ortalama	2,55 (1,00/6,70)	2,82±1,46	2,00 (0,50/3,50)	**1,96±0,84**

4.1.4. Delta puanlarının tanımlayıcı verileri

Delta puanları; tedavi sonrası puanlardan tedavi öncesi puanlardan çıkarılarak elde edildi. Müdahale grubu ve kontrol grubunun delta sonuç ölçüt puanlarının tanımlayıcı verileri Tablo 4.6'de ve delta basınç ağrı eşik ölçüm puanlarının tanımlayıcı verileri Tablo 4.7'da gösterildi.

Tablo 4.6 Delta sonuç ölçüt puanlarının tanımlayıcı verileri

Değişkenler	Delta Verileri					
	n	Müdahale Grubu (n=11)		n	Kontrol Grubu (n=14)	
		Median(Min/Maks)	Ort±Ss		Median(Min/Maks)	Ort±Ss
Fibromiyalji Etki Anketi	11	-18,33 (-56,26/-6,62)	-26,46±16,05	14	-12,33 (-30,34/10,81)	**-8,71±13,73**
Vizüel Analog Skalası	11	-3,00 (-7,00/0,50)	-2,77±2,38	14	-1,00 (-3,00/2,00)	**-0,96±1,35**
Yaygın Ağrı İndeksi	11	-6 (-14/-1)	-6,09±4,74	14	-0,50(-11/7)	**-1,64±4,58**
Semptom Şiddeti Ölçeği	11	-3(-7/3)	-3,18±3,37	14	-2(-6/3)	**-1,85±2,07**
Kısa Ağrı Envanteri- Ağrı Şiddet Skoru	11	-2,50(-5,00/0,75)	-2,05±1,81	14	-1,12(-3,75/1,00)	**-1,11±1,11**
Kısa Ağrı Envanteri- Ağrının Oluşturduğu Engeller Skoru	11	-1,57(-4,57/0,00)	-1,67±1,37	14	-0,72(-2,58/2,98)	**-,031±1,65**
Ağrıyı Felaketleştirme Ölçeği- Toplam	11	-4(-31/7)	-4,81±10,30	14	-4(-18/14)	**-3,57±10,18**
-Ağrıyı Büyütme	11	0(-5/6)	-0,09±2,87	14	-1(-5/2)	**-1,57±2,10**
-Ruminasyon	11	-1(-10/2)	-1,54±3,32	14	0(-9/4)	**-1,14±3,95**
-Çaresizlik	11	-2(-16/4)	-3,18±6,09	14	-2,50(-8/8)	**-1,14±5,09**
Tampa Kinezyofobi Ölçeği	11	-2(-11/5)	-3±4,26	14	1(-10/13)	**1,07±6,04**
Bilişsel Egzersiz Terapi Yaklaşımı Ölçeği	11	-13(-36/7)	-12,36±15,38	14	-8(-41/24)	**-6,92±17,27**
DLMTKD- Oryantasyon	11	0(0/0,13)	0,01±0,03	14	0(0/0,13)	**0,00±0,03**
- Görsel Algılama (Önce)	11	0,00(-0,34/0,34)	-0,03±0,18	14	0,00 (0,00/0,34)	**0,07±0,14**
- Görsel Algılama (Sonra)	6	0(-1/0)	-0,16±0,40	7	0(0/1)	**0,35±0,47**
- Görsel Algılama (Mediasyon)	6	0(0/2)	0,66±1,03	7	-1(-2/0)	**-0,85±0,69**
-Uzaysal Algılama (Önce)	11	0,09(-0,09/0,17)	0,04±0,07	14	0(-0,09/0,25)	**0,05±0,09**

Tablo 4.6 Delta sonuç ölçüt puanlarının tanımlayıcı verileri (Devamı)

Değişkenler	Delta Verileri					
	Müdahale Grubu (n=11)			Kontrol Grubu (n=14)		
	n	Median(Min/Maks)	Ort±Ss	n	Median(Min/Maks)	Ort±Ss
-Uzaysal Algılama (Sonra)	1	0(0/0)	0	3	0(0/0,50)	**0,16±0,28**
-Uzaysal Algılama (Mediasyon)	1	0(0/0)	0	3	-1(-1,50/2)	**-0,16±1,89**
-Praksis (Önce)	11	0(-0,25/0,17)	-0,01±0,16	14	0,12(-0,34/0,50)	**0,04±0,23**
-Praksis (Sonra)	10	0(0/0)	0	13	0(-1,50/0,50)	**-0,11±0,45**
-Praksis (Mediasyon)	10	-0,43(-1,50/1)	-0,33±0,81	13	-1(-1,75/1,25)	**-0,50±1,05**
-Görsel Motor Organizasyon (Önce)	11	0,14(-0,43/0,85)	0,18±0,39	14	0,43(-0,15/1,00)	**0,43±0,30**
-Görsel Motor Organizasyon (Sonra)	9	0(0/0,17)	0,03±0,06	11	0(-0,08/0,40)	**0,09±0,16**
-Görsel Motor Organizasyon (Mediasyon)	9	-0,16(-3,00/0,33)	-0,77±1,18	11	-0,16(-2,00/0,95)	**-0,56±1,05**
-Düşünme (Önce)	11	0,74(-0,45/1,50)	0,68±0,60	14	0,46(-0,57/1,29)	**0,45±0,51**
-Düşünme (Sonra)	10	0,33(-1,00/1,25)	0,26±0,67	14	0(-2,00/0,84)	**-0,15±0,77**
-Düşünme (Mediasyon)	10	-0,46(-2,00/1,16)	-0,36±0,94	14	-0,48(-1,75/1,00)	**-0,30±0,78**
-Düşünme Sözel Matematik Soruları (Önce)	11	0(-0,25/0,25)	0,02±0,17	14	0(-0,25/0,75)	**0,12±0,29**
-Düşünme Sözel Matematik Soruları (Sonra)	6	0(0/0,50)	0,16±0,25	9	0(0/0,50)	**0,05±0,16**
-Düşünme Sözel Matematik Soruları (Mediasyon)	6	1(-1,34/2)	0,61±1,14	9	-1,00(-3,00/2,75)	**-0,71±1,67**
DLMTKD-Toplam	11	1,33 (-0,64/1,67)	0,90±0,78	14	1,44 (-0,15/2,29)	**1,19±0,65**

Tablo 4.7 Delta basınç ağrı eşik ölçüm puanlarının tanımlayıcı verileri

Değişkenler	Delta Verileri			
	Müdahale Grubu (n=11)		Kontrol Grubu (n=14)	
	Median(Min/Maks)	Ort±Ss	Median(Min/Maks)	Ort±Ss
Sağ Trapezius Maksimum	1,00(-3,60/11,90)	2,02±3,99	0,20(-3,80/3,30)	-0,30±2,16
Sağ Trapezius Ortalama	0,80(-1,70/10,40)	1,85±3,25	0,05(-3,60/3,00)	-0,41±1,96
Sol Trapezius Maksimum	0,6(-3/14)	1,91±4,50	0,05(-4,70/1,40)	-0,81±1,76
Sol Trapezius Ortalama	0,60(-2,10/12,20)	1,87±3,83	0(-4/1,50)	-0,65±1,64
Sağ Lateral Epikondil Maksimum	0,5(-0,60/6,90)	1,97±2,60	0,25(-2,60/1,70)	-0,19±1,28
Sağ Lateral Epikondil Ortalama	0,5(-0,30/6,20)	1,69±2,30	0,20(-2,70/1,80)	-0,18±1,29
Sol Lateral Epikondil Maksimum	0,7(-0,4/4,80)	1,16±1,74	0,15(-2,10/2,10)	0,13±1,25
Sol Lateral Epikondil Ortalama	0,6(-0,30/5,00)	1,07±1,58	0,15(-2,00/1,90)	-0,05±1,14
Sağ Quadriceps Femoris Maksimum	1,2(-0,5/16,40)	2,97±4,71	-0,7(-5,80/3,00)	-0,95±2,55
Sağ Quadriceps Femoris Ortalama	1,4(-0,8/14,80)	2,76±4,28	-0,25(-5,50/2,90)	-0,82±2,61
Sol Quadriceps Femoris Maksimum	0,9(-0,9/9,40)	2,28±3,22	0,4(-4,9/2,9)	-0,43±2,62
Sol Quadriceps Femoris Ortalama	1,4(-0,8/9,70)	2,33±3,16	0,35(-4,8/2,70)	-0,30±2,32
Sağ Medial Diz Maksimum	1,4(-2,40/8,90)	2,20±3,26	-0,25(2,20/1,90)	-0,26±1,31
Sağ Medial Diz Ortalama	0,8(-1,9/7,20)	1,91±2,78	-0,15(-2,10/1,80)	-0,22±1,12
Sol Medial Diz Maksimum	1,7(-1,3/12)	2,40±3,73	-0,85(-5,40/1,70)	-1,01±1,74
Sol Medial Diz Ortalama	1,60(-0,8/11,60)	2,32±3,48	-0,6(-4,7/0,6)	-0,8±1,43

4.2. Sonuçlara İlişkin Bulgular

4.2.1. Grupların kendi içinde tedavi öncesi ve tedavi sonrası verilerinin analizi

Grupların kendi içinde tedavi öncesi ve tedavi sonrası verileri analiz edildiğinde; müdahale grubunda sonuç ölçütlerinden Fibromiyalji Etki Anketi, Vizüel Analog Skalası, Yaygın Ağrı İndeksi, Semptom Şiddeti Ölçeği, Kısa Ağrı Envanteri- Ağrı Şiddet Skoru, Kısa Ağrı Envanteri- Ağrının Oluşturduğu Engeller Skoru, Tampa Kinezyofobi Ölçeği, Bilişsel Egzersiz Terapi Yaklaşımı Ölçeği, DLMTKD'nın "Düşünme" kognitif alanında ve Toplam puanında istatistiksel açıdan anlamlı fark elde edilirken, Sol Trapezius Maksimum ve Sol Trapezius Ortalama dışında tüm basınç ağrı eşik ölçümlerinde istatistiksel açıdan anlamlı fark elde edildi ($p<0.05$) (Tablo 4.8).

Kontrol grubunda ise sonuç ölçütlerinden Fibromiyalji Etki Anketi, Vizüel Analog Skalası, Semptom Şiddeti Ölçeği, Kısa Ağrı Envanteri-Ağrı Şiddet Skoru, Ağrıyı Felaketleştirme Ölçeği-Ağrıyı Büyütme, DLMTKD'nın "Görsel Motor Organizasyon" ile "Düşünme" kognitif alanlarında ve Toplam puanında istatistiksel açıdan anlamlı fark görülürken; basınç ağrı eşik ölçümlerinde sadece Sol Medial Diz Ortalama skorunda istatistiksel açıdan anlamlı bir fark belirlendi ($p<0.05$) (Tablo 4.8).

Tablo 4.8 Grupların kendi içinde tedavi öncesi tedavi sonrası verilerinin analizi

Değişkenler	**Müdahale Grubu (n=11) p***	**Kontrol Grubu (n=14) p***
Fibromiyalji Etki Anketi	**0,003**	**0,022**
Vizüel Analog Skalası	**0,010**	**0,022**
Yaygın Ağrı İndeksi	**0,003**	0,207
Semptom Şiddeti Ölçeği	**0,018**	**0,011**
Kısa Ağrı Envanteri-Ağrı Şiddet Skoru	**0,009**	**0,005**
Kısa Ağrı Envanteri-Ağrının Oluşturduğu Engeller Skoru	**0,005**	0,505
Ağrıyı Felaketleştirme Ölçeği- Toplam	0,212	0,220
-Ağrıyı Büyütme	1,000	**0,022**
-Ruminasyon	0,151	0,443
-Çaresizlik	0,168	0,462
Tampa Kinezyofobi Ölçeği	**0,036**	0,575
Bilişsel Egzersiz Terapi Yaklaşımı Ölçeği	**0,033**	0,173
DLMTKD- Oryantasyon	0317	0,317
- Görsel Algılama (Önce)	0,091	0,177
-Uzaysal Algılama (Önce)	0,058	0,061
-Praksis (Önce)	0,798	0,379
-Görsel Motor Organizasyon (Önce)	0,137	**0,001**
-Düşünme (Önce)	**0,013**	**0,010**
-Düşünme Sözel Matematik Soruları (Önce)	0,655	0,121
DLMTKD-Toplam	**0,010**	**0,001**
Sağ Trapezius Maksimum	**0,037**	0,802
Sağ Trapezius Ortalama	**0026**	0,529
Sol Trapezius Maksimum	0,109	0,329
Sol Trapezius Ortalama	0,062	0,362
Sağ Lateral Epikondil Maksimum	**0,023**	0,900
Sağ Lateral Epikondil Ortalama	**0,018**	0,972
Sol Lateral Epikondil Maksimum	**0,036**	0,649
Sol Lateral Epikondil Ortalama	**0,018**	0,850
Sağ Quadriceps Femoris Maksimum	**0,007**	0,272
Sağ Quadriceps Femoris Ortalama	**0,011**	0,310
Sol Quadriceps Femoris Maksimum	**0,023**	0,552
Sol Quadriceps Femoris Ortalama	**0,013**	0,650
Sağ Medial Diz Maksimum	**0,026**	0,421
Sağ Medial Diz Ortalama	**0,026**	0,462
Sol Medial Diz Maksimum	**0,033**	0,052
Sol Medial Diz Ortalama	**0,017**	**0,020**

* Wilcoxon eşleştirilmiş iki örnek testi

4.2.2. Gruplar arasında delta verilerinin karşılaştırılması

Delta verileri, tedavi sonrasında elde edilen puanlardan tedavi öncesinde elde edilen puanlar çıkarılarak hesaplandı. Gruplar arasında delta verileri karşılaştırıldığında; sonuç ölçütlerinde Fibromiyalji Etki Anketi ve Yaygın Ağrı İndeksi'nde, basınç ağrı eşik ölçümlerinden ise Sağ Trapezius Ortalama, Sol Trapezius Maksimum, Sol Trapezius Ortalama, Sağ Quadriceps Femoris Maksimum, Sağ Quadriceps Femoris Ortalama, Sağ Medial Diz Maksimum, Sağ Medial Diz Ortalama, Sol Medial Diz Maksimum ve Sol Medial Diz Ortalama skorlarında müdahale grubu lehine istatistiksel açıdan anlamlı fark olduğu görüldü ($p<0.05$) (Tablo 4.9).

Tablo 4.9 Gruplar arasında delta verilerinin karşılaştırılması

Değişkenler	**Δ p***
Fibromiyalji Etki Anketi	**0,010**
Vizüel Analog Skalası	0,063
Yaygın Ağrı İndeksi	**0,024**
Semptom Şiddeti Ölçeği	0,127
Kısa Ağrı Envanteri- Ağrı Şiddet Skoru	0,138
Kısa Ağrı Envanteri- Ağrının Oluşturduğu Engeller Skoru	0,096
Ağrıyı Felaketleştirme Ölçeği- Toplam	0,891
-Ağrıyı Büyütme	0,101
-Ruminasyon	0,541
-Çaresizlik	0,546
Tampa Kinezyofobi Ölçeği	0,074
Bilişsel Egzersiz Terapi Yaklaşımı Ölçeği	0,511
DLMTKD- Oryantasyon	0,861
- Görsel Algılama (Önce)	0,143
-Uzaysal Algılama (Önce)	0,817
-Praksis (Önce)	0,347
-Görsel Motor Organizasyon (Önce)	0,070
-Düşünme (Önce)	0,324
-Düşünme Sözel Matematik Soruları (Önce)	0,476
DLMTKD-Toplam	0,273
Sağ Trapezius Maksimum	0,100
Sağ Trapezius Ortalama	**0,032**
Sol Trapezius Maksimum	**0,040**
Sol Trapezius Ortalama	**0,028**
Sağ Lateral Epikondil Maksimum	0,055
Sağ Lateral Epikondil Ortalama	0,059
Sol Lateral Epikondil Maksimum	0,198
Sol Lateral Epikondil Ortalama	0,106
Sağ Quadriceps Femoris Maksimum	**0,013**
Sağ Quadriceps Femoris Ortalama	**0,021**
Sol Quadriceps Femoris Maksimum	0,106
Sol Quadriceps Femoris Ortalama	0,079
Sağ Medial Diz Maksimum	**0,023**
Sağ Medial Diz Ortalama	**0,012**
Sol Medial Diz Maksimum	**0,002**
Sol Medial Diz Ortalama	**0,002**

* Mann Whitney U testi

5. TARTIŞMA

Bu çalışma Klinik Pilates Egzersizlerine ek olarak uygulanan TNE'nin FM'de ağrı, korku kaçınma inanışları, biyopsikososyal durum ve kognisyon açısından değişiklik oluşturup olmadığını incelemek amacıyla planlandı. Altı haftalık tedavi sonrasında tedavi öncesine göre Klinik Pilates Egzersizleri'nin tek başına FM'li bireylerde fonksiyonel durumu geliştirip, ağrıyı azalttığı, kognitif fonksiyonları geliştirdiği ve sol medial dizde ortalama basınç ağrı eşiğinde ilerleme sağladığı görülürken; Klinik Pilates Egzersizleri'ne ek olarak TNE uygulandığında ise FM'li bireylerde fonksiyonel durumun gelişmesine, ağrının azalmasına, kognitif fonksiyonların gelişmesine ilave olarak biyopsikososyal durumda gelişme, korku kaçınma inanışlarında azalma ve sol Trapezius hariç tüm maksimum ve ortalama basınç ağrı eşiklerinde ilerleme elde edildi. Grupların istatistiksel olarak birbirlerine üstünlüklerini incelemek amacıyla yapılan analiz sonucunda ise, fonksiyonel durumun geliştirilmesinde, ağrının azaltılmasında ve birçok bölgedeki (sağ ve sol Trapezius, sağ Quadriceps Femoris, sağ ve sol medial diz) basınç ağrı eşiklerinin arttırılmasında Klinik Pilates Egzersizleri'ne ek olarak yapılan TNE uygulamasının sadece Klinik Pilates Egzersizleri'ne göre anlamlı düzeyde daha etkin olduğu görüldü.

FM; yaygın kronik kas iskelet ağrısı ve yorgunluk, uyku problemleri, anksiyete, depresyon, kognitif fonksiyon ve konsantrasyon problemleri (zayıf konsantrasyon, enerji eksikliği, düşük verimlilik, unutkanlık) ile duygu durum bozukluğu gibi birçok semptomun bir arada görüldüğü kronik bir hastalıktır (Bennet vd 2007, Hauser vd 2008, Sirianni vd 2015). FM'li kişilerde kas asimetrisi ve antaljik postüral problemleri de bulunmaktadır (Mitani vd 2006). Jones vd (2009), FM'nin postüral kontrolünün periferik ve / veya merkezi mekanizmaları etkileyebileceğini göstermiştir. Bu şikayetlerin; günlük hayatı olumsuz yönde etkileyerek yaşam kalitesini azalttığı, sosyal hayatta aile ve çevre ile ilişkilerde problemlere neden olduğu ve kaygı düzeyinde artışa sebebiyet verdiği bilinmektedir (Madenci vd 2006, Van Koulil vd 2007).

FM tedavisinde amaç, semptomların azaltılması, ağrının kontrol edilmesi, fiziksel uygunluğun arttırılması, yaşam kalitesinin tekrar kazanılması ve günlük yaşama geri dönüşün sağlanmasıdır (Heymann vd 2010).

FM'nin tedavisi için mevcut olan güncel yaklaşımlar, farmakolojik tedavilerle birlikte nonfarmakolojik ve kişinin hastalığını kendisinin yönetmesine dayalı stratejilerini içermektedir (Fitzcharles vd 2013). Nonfarmakolojik tedavilerin ilk seçeneği olan egzersiz için, güçlü kanıtlar bulunmaktadır. Kas kuvvet ve germe egzersizleri kanıtlara dayalı olarak en fazla önerilen egzersiz çeşitleridir (Busch vd 2013, Fitzcharles vd 2013, Macfarlane vd 2017). Bu kapsamda Pilates metodu FM hastalarının tedavisi için iyi bir egzersiz seçeneğidir. Modifiye Pilates şu anda fizyoterapistler tarafından en yaygın kullanılan egzersiz yaklaşımıdır. Modifiye Pilates'in kullanımda pek çok avantajı bulunmaktadır. Bunlar; uygulayıcıya göre egzersizler ayarlanabilmektedir, ilerleme seviyelerine bölünmüşlerdir ve egzersizler sırasında omurganın normal eğriliği vurgulanmaktadır (Latey 2001).

Pilates egzersizleri, sağlıklı bir vücut, sağlıklı bir zihin ve sağlıklı bir yaşam oluşturmak amacıyla geliştirilmiştir. Felsefesi, zihin ve kas iskelet sisteminin entegre edilmesi üzerinedir. Germe ve kuvvetlendirme egzersizlerinden oluşan Pilates egzersizleri ile vücut farkındalığı, denge, kas kuvveti ve esnekliğin geliştirilmesi için kapsamlı bir eğitim verilir bu şekilde fiziksel ve mental kondisyon arttırılır (Blum 2002).

Pilates konsepti, vücut merkezini omurgaya yakın derin kaslarda konumlandırır ve dengeli bir sırt ve karın kas sistemi sağlayarak üst ve alt vücutta sağlam bir kas-iskelet yapısı oluşturmayı amaçlar (Muscolino ve Cipriani 2004). Gövde kuvvetine, postüre ve hareketle nefesin koordinasyonuna odaklanarak vücut esnekliğini ve genel sağlığı iyileştirir.

Pilates yönteminde core bölgesindeki kasların kontraksiyonu yoluyla; nöromuskuler fonksiyonlar ve oksijenlenme arttırılır, postür düzeltilir, kaslar gevşetilerek kontraktürleri azaltılır, fiziksel uygunlukta, esneklik ve eklem açıklığında kazanımlar elde edilir. FM'de Pilates kapsamında uygulanan düşük şiddetteki egzersizler ile; kişi vücut sınırları dahilinde bir bütün olarak desteklenir. Pilates egzersizleri fiziksel ve mental kondisyonlamayı geliştirdiği gibi stres ve anksiyeteden kurtulma olanağı da sağlar. (Burckhardt vd 2005, Souza 2013). Ayrıca, kapalı kinetik zincir egzersizlerini içeren Pilates, eklemleri ve kıkırdağı besleyen, dejenerasyon riskini azaltan kompresif ve dekompresif kuvvetlerin uygulanmasına olanak sağlamaktadır ve böylece kronik aksiyal kas iskelet ağrılarını azaltılmasına yardımcı olmaktadır (Schweinhardt 2008).

Pilates kas iskelet sistemi rehabilitasyonunda iyi düzeyde tavsiye edilen bir terapatik egzersiz şeklidir (Posadzki vd 2011, Cruz-Díaz vd 2018, de Araujo Cazotti 2018). Pilates yönteminin sağlık profesyonelleri tarafından yaygın olarak önerildiği ve reçete edildiği göz önüne alındığında, literatürde bu yöntemin FM'li hastalar üzerindeki etkilerini değerlendiren çok az çalışma olduğu görülmektedir (Altan vd 2009, Ekici vd

2017). Bu çalışmalar, çeşitli metodolojik problemler nedeniyle FM semptomlarının tedavisinde Pilates yönteminin etkinliğini gözlemlemek amacıyla metodolojik olarak daha iyi dizayn edilmiş yeni çalışmaların yapılmasını önermektedir.

Altan vd (2009) FM'li kadınlarda 12 haftalık Pilates egzersizlerinin etkilerini, germe ve gevşeme egzersizlerinden oluşan ev programını uyguladıkları kontrol grubu ile karşılaştırmışlardır. Ağrıyı değerlendirmek için Görsel Analog Skalasını, fonksiyon için Fibromiyalji Etki Anketi'ni kullanmışlardır ve 18 hassas nokta için algometre ile basınç ağrı eşik ölçümü yapmışlardır. Bu çalışmada hangi Pilates egzersizlerinin kullanıldığına dair detaylı bir bilgi bulunmamaktadır. Sadece destekleyici ekipman olarak, Pilates toplarının ve dirençli bantların kullanıldığı belirtilmiştir. Sonuç olarak Pilates grubunun ağrı ve fonksiyon açısından kontrol grubuna kıyasla istatistiksel açıdan üstün olduğu sonucuna varılmıştır. Pilates'i FM'li bireylerde etkili ve güvenli bir yöntem olarak önermişlerdir.

Palekar ve Basu (2014) 20 FM'li bireyde yaptıkları çalışmalarında Yogasana ve Pilates egzersizlerini karşılaştırmışlardır. Her iki tedavide; haftada 6 gün her seans bir saat olacak şekilde 4 hafta uygulanmıştır. Ağrının değerlendirilmesinde Görsel Analog Skalası kullanılmıştır. Uygulanan Pilates egzersizleri ile ilgili detaylı bilgi verilmemiştir. Çalışmanın sonunda her iki grupta da ağrı ve yorgunluk düzeyinde anlamlı azalma elde etmişlerdir. Grupları karşılaştırdıklarında ise Pilates egzersizlerinin Yogasana'dan daha etkin olduğu sonucuna varmışlardır

Komatsu vd (2016) yılında yaptıkları çalışmalarında, 20 FM'li kadını Pilates egzersiz grubu ve hiçbir müdahalenin yapılmadığı kontrol grubu olacak şekilde 2 gruba ayırmıştır. Katılımcıların ağrılı vücut bölgesi sayısını kaydetmişlerdir ve ağrının yoğunluğunu değerlendirmek için Görsel Analog Skalasını, fonksiyon için Fibromiyalji Etki Anketi'ni kullanmışlardır. Pilates egzersizleri haftada 2 gün 8 hafta boyunca 1 saatlik seanslar şeklinde uygulanmıştır. Hangi Pilates egzersizlerinin uygulandığına dair bilgi verilmemiştir. Pilates egzersizlerindeki ilerlemeler, katılımcıların toleransına göre her katılımcıda aynı olmayacak şekilde tekrar sayısının arttırılması şeklinde yapılmıştır. Çalışmanın sonucunda, Pilates egzersiz grubunda ağrılı bölge sayısında ve ağrı yoğunluğunda anlamlı azalma elde edilmiştir. Bu sonuçlara dayanarak Pilates egzersizlerinin FM'li hastaların ağrılarının tedavisinde güvenli bir fizik tedavi yöntemi olduğu belirtilmiştir.

Ekici vd (2017) 21 FM'li kadında yaptıkları çalışmalarında, Pilates egzersizlerini konnektif doku masajı ile karşılaştırmışlardır. Her iki tedavi yöntemi de haftada 3 gün 4 hafta boyunca uygulanmıştır. Değerlendirmeler arasında Görsel Analog Skalası, algometre ve Fibromiyalji Etki Anketi bulunmaktadır. Pilates egzersiz seansları bir saatliktir. Pilates egzersizlerindeki ilerleme; egzersiz sayılarının arttırılması, yeni ve bir

üst seviyedeki egzersizlerin programa eklenmesi şeklinde yapılmıştır. Hangi Pilates egzersizlerinin uygulandığına dair bilgi verilmemiştir. Sonuç olarak, tedavi sonrasında tedavi öncesine göre tüm parametrelerde iyileşme elde edilirken; gruplar karşılaştırıldığında basınç ağrı eşiklerinin Pilates egzersiz grubunda anlamlı düzeyde daha fazla arttığı belirlenmiştir. Yazarlar Pilates egzersizlerinin konnektif doku masajına göre daha etkin olduğunun görülmesi sebebiyle FM'li hastalarında tedavisinde tercih edilebileceğini belirtmişlerdir.

de Aguiar vd (2020) tarafından FM hastalarında Pilates yönteminin etkilerini incelemek amacıyla yapılan entegratif bir derlemede, Pilates yöntemi ile FM'li hastaların tedavisinin semptomatolojisinde çok sayıda fayda sağladığı belirtilmiştir. Pilates ile kas kuvvetinin arttırıldığı, genel ağrıda azalma sağlandığı, esnekliğin arttırıldığı, fiziksel uygunluğun, psikolojik fonksiyonların ve yaşam kalitesinin geliştirildiği, hastaların günlük aktivitelerini daha rahat gerçekleştirmelerine katkı sunduğu rapor edilmiştir.

de Medeiros vd (2020) 42 FM'li kadında yaptıkları randomize kontrollü olan 12 haftalık çalışmalarında, akuatik aerobik egzersizler ile mat Pilatesi karşılaştırmışlardır. Ağrıyı değerlendirmek için Görsel Analog Skalasını, fonksiyon için Fibromiyalji Etki Anketi'ni, korku kaçınma için Korku Kaçınma İnanışları Anketi'ni, ağrı katastrofisi için Ağrı ile İlgili Katastrofik Düşünceler Skalası kullanılmıştır. Bu çalışmada mat Pilates kapsamında her ay sonunda tekrar ve set sayısı arttırılacak şekilde her seansta ana kas gruplarına yönelik toplam 9 egzersiz yapılmıştır. Ayrıca her seansın sonunda stabilizasyon topu ile 3 gevşeme egzersizi yapılmıştır. Sonuçta her iki grupta da tedavi sonrasında tedavi öncesine göre hastalıkla ilgili semptomlarda gelişme elde edilse de, birbirlerine üstünlüklerinin olmadığı sonucuna varılmıştır. Mat Pilates'in FM'li kadınlarda ağrı ve fonksiyonu iyileştirmede etkin olduğu, egzersiz programı reçete edilirken hasta tercihlerinin dikkate alınması gerektiği ve Mat Pilates'in FM'li kadınların semptomları için bir tedavi seçeneği olarak düşünülebileceği belirtilmiştir.

Yukarıda detaylı olarak bahsettiğimiz literatürdeki çalışmaların sonuçlarına göre, Pilates egzersizleri FM hastalarının birçok semptomunun tedavisinde etkin rol oynamaktadır ve yazarlar tarafından güvenli bir egzersiz yöntemi olarak tanımlanmaktadır. Ben de altı yıldır romatolojik rehabilitasyon alanında çalışan bir fizyoterapist olarak, klinik tecrübelerimden ve hastalarımdan edindiğim geri bildirimler doğrultusunda Klinik Pilates egzersizlerinin FM hastalarında, eğer ki tedaviye uyumda herhangi aşılamayan bir problem ile karşılaşılmamışsa hastalık semptomlarında özellikle ağrıda önemli iyileşmeler elde edilmesine olanak sağladığı kanısındayım ve Klinik Pilates egzersizlerinin FM'li hastalarda semptomların iyileştirilmesinde hastanın

da istekleri doğrultusunda reçete edilebilecek egzersizlerin en başında gelebileceği düşüncesindeyim.

Biz bu çalışmamızda hem müdahale hem kontrol grubuna altı haftalık Klinik Pilates egzersizlerini uyguladık. Literatürle paralel olacak şekilde sadece Klinik Pilates egzersizleri uyguladığımız kontrol grubunda, tedavi sonrasında tedavi öncesine göre semptomların ve ağrının şiddetinde ve ağrıyı büyütmede azalma, fonksiyonel durumda ve kognitif fonksiyonlarda artış ve sol medial diz ortalama basınç ağrı eşiğinde artış elde ettik.

Egzersiz sırasında endojen opioid sistemin aktivasyonunun analjezik yanıt mekanizmasında anahtar bir rol oynadığı yaygın olarak kabul edilen bir hipotezdir. Ayrıca bazı araştırmacılar büyüme hormonu ve kortikotropin gibi diğer maddelerin aracılık ettiği nonopioid mekanizmaları içeren çoklu bir analjezik sistemin de egzersizle ağrının azaltılmasında rol oynayabileceğini vurgulamaktadırlar (Kjaer 1992, Ramsay vd 2000). Bizde Klinik Pilates egzersizleri sonrasında ağrının azaltılması hususunda elde ettiğimiz kazanımların, bu sistemlerin aktif hale gelmesi ile oluşabileceği inancındayız. Egzersiz; oluşturduğu analjezik etki kadar, hastaları egzersiz programlarına katılmaya teşvik ederek ağrı-hareketsizlik-ağrı kısır döngüsünü kırmalarına da yardımcı olabilmektedir (Meiworm vd 2000). Çalışmamızın sonucunda semptom ve ağrı şiddetinde azalma elde ederek ve FM'li katılımcılarımızın bu kısır döngüyü kırmalarına yardımcı olarak onların fonksiyonel durumlarını arttırdığımız kanısındayız. Ayrıca bu egzersizlerin, FM hastalarında görülen kas hipoksisini önleyerek katılımcılarımızın genel iyilik hallerini de arttırmalarına katkıda bulunduğu düşüncesindeyiz (Koltyn 2000).

Literatürde FM'li bireylerde Pilates egzersizlerinin etkinliğinin araştırıldığı çalışmalarda, önemli bir bilgi olduğunu düşündüğümüz uygulanan Pilates egzersizleri ile ilgili detaylı bilgi verilmemiştir. Sadece de Medeiros vd (2020) tarafından yapılan çalışmadaki egzersiz reçetesinin bilgisi detaylı olarak paylaşılmıştır. Ancak bu çalışmadaki egzersiz reçetesinin, bizim çalışmamızdaki Klinik Pilates egzersiz reçetesi ile karşılaştırıldığımızda, tüm ana kas gruplarını kapsaması açısından yetersiz kaldığı düşüncesindeyiz. Tedavi programının oluşturulması sırasında bizim egzersiz programımızdaki gibi çok daha fazla kas grubuna odaklanılması ile en önemli semptomu yaygın vücut ağrısı olan FM hastalarının iyilik hallerinin arttırılmasında daha etkin olunabileceği kanısındayız.

Klinik Pilates egzersizlerinin önemli avantajlarından biri, hareketler sırasında gereksiz kasların kullanımını gerektiren pozisyonlardan kaçınılması gerektiğini öğretmesidir. Böylece erken yorgunluğu azaltır, stabiliteyi ve iyileşmeyi arttırır (Muscolino ve Cipriani 2004). Bu bilginin katılımcılar tarafından öğrenilmiş olması,

çalışmamızdaki tüm katılımcıların fiziksel bir problem olmadan egzersiz programını bitirebilmelerine etkisi olabilecek önemli bir unsur olabilir.

Düşük kognitif fonksiyonlar; günlük yaşam aktivitelerindeki fonksiyonel kapasitenin azalması, disabilite ve düşük yaşam kalitesi ile ilişkilendirilmiştir (Plassman vd 2010, Batty vd 2016). Deneysel ve klinik çalışmalar fiziksel egzersizin, beyinde önemli biyolojik ve psikolojik faydalar sağlayan yapısal ve fonksiyonel değişiklikleri oluşturduğu için kognitif fonksiyonların korunmasında temel bir rol oynadığı belirtilmektedir (Gheysen vd 2018, Mandolesi vd 2018). Yapılan çalışmalarda fiziksel egzersiz ile frontal ve hipokampal bölgelerdeki gri madde hacminde, nörotrofik faktör seviyelerinde ve kan akışında artış elde edildiği, kognitif yeteneklerde gelişmeler sağlandığı (öğrenme ve hafıza, dikkat süreçleri ve yürütme süreçleri) rapor edilmiştir (Erickson vd 2011, Coelho vd 2013, Hötting vd 2016, Cabral vd 2017, Chieffi vd 2017, Fernandes vd 2017). Son zamanlarda, kognitif fonksiyonların korunmasında zihin-beden egzersizlerine dayalı fiziksel tedavi programları önerilmektedir (Hariprasad vd 2013, Sun vd 2015). Biz de zihin–beden bütünlüğüne dayanan Klinik Pilates Egzersizleri ile kognitif fonksiyonlarda gelişim elde ettik ve bu kognitif gelişimin özellikle DLMTKD'nin düşünme ile ilgili kognitif alanında gerçekleşmiş olması bize literatürde de belirtildiği gibi katılımcıların bellek yeteneklerinin, dikkat süreçlerinin ve yönetici-kontrol süreçlerinin verimliliğini geliştirmeleri sonucunda oluştuğunu düşündürmüştür (Pereira vd 2007, Winter vd 2007, Chieffi vd 2017).

Moldofsky ve Scarisbrick (1976)'in egzersiz ve uykusuzluk arasındaki ilişkiyi inceledikleri çalışmalarında, Evre IV'deki uyku problemlerinin sedanter bireylerde kas-iskelet sistemi semptomlarında artışa neden olduğunu, egzersiz ile bu uyku yoksunluğunun etkisinden kurtulabileceğini göstermişlerdir. Uyku yoksunluğunun, ağrıya olan duyarlılığı arttırdığı belirtilmektedir (Diaz-Piedra vd 2015). Sağlıklı kontrollere kıyasla FM hastalarında uykunun 3. ve 4. aşamalarında problemler yaşandığı bilinmektedir (Scheuler vd 1983, Choy 2015).Biz çalışmamızda katılımcıların uyku semptomları ile ilgili herhangi bir değerlendirme yapmadık, fakat hastalardan aldığımız geri dönüşlerde hepsinin olmasa bile önemli bir kısmının uykularının da düzene girdiği bilgisi mevcuttu. Bu nedenle, Klinik Pilates egzersizleri ile uykunun bu aşamasında olabilecek bir iyileşmenin, çalışmamızın sonucunda elde edilen ağrının şiddetindeki azalmaya katkıda bulunabilecek bir faktör olabileceği düşüncesi oluşmuştur.

Ağrı, oldukça karmaşık bir konudur ve gerçekte sadece doku yaralanmasının olduğu durumlarda ortaya çıkmamaktadır. Ağrı, kişi tarafından tehdit olarak algılanan bir durumda da meydana gelmektedir. Bir kişi tarafından ne kadar büyük bir tehdit algılanırsa, beyin tarafından vücudu savunmak ve korumak için o kadar fazla ağrı

üretildiği savunulmaktadır (Moseley 2003a, 2007). Tam tersi için ise, algılanan tehdit ne kadar azaltılırsa, beyin tarafından vücudu savunmak için o kadar az ağrı üretileceği öne sürülmektedir (Zusman 1998, 2013).

Önceden ağrılı bir deneyim sırasında, tek bir beyin bölgesinin aktifleştiği bilgisi mevcuttu. Fonksiyonel manyetik resonans görüntüleme ve pozitron emisyon tomografisi taramaları gibi teknolojilerin gelişmesi ile birlikte, ağrılı bir deneyim sırasında beynin birçok bölgesinin aktive olduğu görülmüştür. Bir durumun kişi tarafından tehdit (tehlike) olarak algılanmasında veya gerçek bir doku hasarı nedeniyle ağrı hissetme sürecinde; beyinde kullanılan tüm bu alanlar, kişinin ağrı haritasını göstermektedir (Peyron vd 2000, Moseley 2003a, 2005,) ve ağrı nöromatriksi olarak adlandırılmaktadır (Melzack 2001, Moseley 2003a, Puentedura ve Louw 2012). Ağrı hissetme sürecinde beyinde kullanılan alanların; anterior singulat korteks, premotor korteks, motor korteks, hipokampus, amigdala, duyusal korteks, serebellum, frontal ve pre-frontal korteks olduğuna inanılmaktadır (Melzack 2001b, Moseley 2003a, Puentedura ve Louw 2012).

Ağrılı bir deneyim sırasında birçok beyin bölgesinin çok yönlü aktivasyonu, kronik ağrının karmaşıklığını ve bazı bireysel faktörlerden nasıl etkilendiğini açıklamak için kullanılmıştır (Moseley 2007, Puentedura ve Louw 2012). Çünkü, bir kişinin genel ağrı deneyiminin, çeşitli bilişler (kognisyon) ve inançlardan etkilendiği iyi bilinmektedir (Louw vd 2012, Zimney vd 2013, Zusman 2013).

Komşu beyin bölgelerinin nöral aktivasyonunun, ağrının nöromatriksini etkileyerek ağrı deneyimi üzerinde olumlu veya olumsuz bir etkiye sahip olabileceği öne sürülmüştür. Örneğin, korku, felaketleştirme, ağrı ile ilgili inançlar, ağrının işlendiği beyin bölgelerine komşu bölgelerdir. (Moseley 2007, Puentedura ve Louw 2012). En iyi belgelenmiş genel ağrı deneyimini olumsuz etkileyen psikososyal faktörler arasında; korkudan kaçınma ve ağrıyı felaketleştirme bulunmaktadır (Cleland vd 2008a, 2008b, Garcia-Campayo vd 2009, Kovacs vd 2011). Yüksek korku seviyeleri; ağrıyı olumsuz olarak arttırabilmektedir ve iyileşmenin süresini uzatabilmektedir (George ve Zeppieri 2009, George vd 2009, Fritz ve George 2002).

Kronik ağrının sadece beyinde önemli fiziksel değişikliklere yol açmadığı, aynı zamanda ağrının işlenmesinin değişmesine ve katastrofinin aktivasyonuna da yol açtığı gösterilmiştir (Morley vd 1999, Lotze vd 2000, Peyron vd 2000, Moseley 2005, Garcia-Campayo vd 2009). Geçmeyen ağrı, başarısız tedaviler ve ağrıları için farklı açıklamalarda bulunulması, kronik ağrısı olan hastalar için durumlarının gerçekte olduğundan çok daha kötü görünmesine ve geleceğe umutsuz bakmalarına neden olabilmektedir (Turk 2001, Kerns vd 2005, Wallin ve Raak 2008). Hastaların

problemlerinin gerçekte olduklarından çok daha kötü olduğuna inandıkları şeklindeki bu düşünce, katastrofi olarak bilinir ve ağrının artışına yol açmaktadır (Louw vd 2011).

Ağrıdan muzdarip olan hastaların çoğunun, ağrının kaynağını bilmedikleri ve ağrıyla ilişkili mekanizmaları bilmeyen hastaların tipik olarak ağrının mekanizmalarını bilenlere göre ağrıyı daha tehdit edici bir unsur olarak değerlendirdikleri bildirilmiştir. Bu durum da daha düşük ağrı toleransı, daha fazla katastrofik düşünceler ve başa çıkma stratejilerine daha az uyum ile sonuçlanmaktadır (Jackson vd 2005). "Çaresizlik" ve "ruminasyon (tekrarlayıcı bir şekilde düşüncelerin zihinde dönüp durması)" ile ağrı arasında güçlü bir ilişki olduğu rapor edilmiştir (Nijs vd 2008). Bu sonucun, kronik ağrının yetersiz anlaşılması nedeniyle oluşabileceği, ayrıca bu ağrı bilişlerinin genellikle tedavide önemli engeller oluşturdukları yorumu yapılmıştır (Nijs vd 2008).

Hastalar ağrıyı doku sağlığının bir göstergesi olarak gördüğünden ve aktivitenin dokularına daha fazla zarar verebileceğini düşündüklerinden dolayı, azalan fiziksel hareketler mantıksal bir koruyucu mekanizma olarak görülebilir (Moseley vd 2004a). Mekanik olmayan birçok faktör ağrının şiddetinin artmasına neden olabilmektedir, bunlara örnek olarak; iyileşme sürecinde uygulanan başarısız tedaviler, geleceğe dair korkular ve farklı sağlık uzmanları tarafından yapılan farklı açıklamalar ya da internetten edinilen farklı bilgiler verilebilir. Bu çalışmaların sonuçları, ağrı algısının değişmesi ve mekanik olmayan faktörlerin daha iyi anlaşılması ile hastaların kendilerini aktivitelerini artırmaya daha yatkın olarak görmeye meyilli olabileceğini göstermektedir (Thomas ve France 2007, Cleland vd 2008b, Smeets 2009a, 2009b).

Özellikle fizik tedavi uygulamalarında hastanın aktif iş birliği gereklidir ve bu uyumsuz düşünce ve bilişler, terapiye uyumu ve etkinliğini azaltabilmektedir. Smeets ve arkadaşlarının da çalışmalarında belirttiği gibi, psikolojik değişkenlerin tedavideki sonucu önemli ölçüde belirlediği yaygın olarak bilinmektedir (Smeets vd 2009). Önceki çalışmalar, fizyoterapi tedavileri sonrasında ağrı yoğunluğunun (Woby vd 2007) ve fonksiyonel yetersizliğin (Crombez vd 1999, Woby vd 2004) azaltılmasında engelleyici prognostik faktörler olarak kinesiyofobi veya katastrofi tanımlamıştır. Bu nedenle, egzersiz müdahalelerinin sonuçlarının optimize edilmesinde bu faktörlerin eğitim programları (Chou vd 2007, Hansen vd 2010, Moseley ve Flor 2012) yoluyla olumlu yönde değiştirilmesi hususunda öneriler bulunmaktadır. Ağrının kişiler tarafından nasıl algılandığının, tedavinin etkinliğini ve tedaviye uyumu belirlediği bilgisi göz önüne alındığında; hastalara ağrı kavramını açıklamanın ağrıdan muzdarip kişilerin tedavisinde bir çözüm olabileceği vurgulanmaktadır (Jackson vd 2005).

Kişinin konu hakkında bilgi edinmesi sonucunda ağrı nöromatriksine komşu bölgeler, ağrı deneyimi üzerinde olumlu etki oluşturabilmektedir (Moseley 2003b, Moseley 2007). Örneğin, bir hastanın kendisine uygulanan tedavi hakkındaki bilgisi ve

o tedaviye olan bakış açısı; kişinin genel ağrı deneyimini olumlu ya da olumsuz olarak etkileyebilmektedir (Verbeek vd 2004, Puentedura vd 2012). Ağrı hakkındaki bilgi ya da ağrı ve doku yaralanmasının iki farklı konu olduğu hakkındaki bilgi; ağrı deneyimini olumlu yönde etkileyebilmektedir (Louw vd 2013). Plaseboda, herhangi bir uygulama olmadan bir kişinin kendisine uygulanan tedavinin işe yarayacağına dair olumlu beklentileri ile uygulamanın sonunda hastalık semptomlarında kazanım elde edilmesi; tedaviye olan bakış açısının olumlu yönde değiştirilmesinin ağrının azaltılması konusunda ne kadar önemli bir faktör olduğunun göstergesidir. Son zamanlarda plasebo; beyin ve merkezi sinir sisteminin endojen mekanizmalarının güçlendirilmesi olarak yeniden kavramsallaştırılmıştır (Moseley 2008).

Kronik bel ağrısı bulunan kişilerde yapılmış çalışmalarda, tedavi sırasında hastaların fiziksel olarak aktif olma şansı olmasa bile, olumlu yönde değişen ağrı algılamaları ile fiziksel olarak aktif olmaya başladıkları dönemdeki hareket performanslarının yüksekliği arasında doğrudan bir ilişki olduğu rapor edilmiştir (Moseley 2002, 2004). Bu, motor performansın doğrudan ağrı algıları ile sınırlanabileceğini anlamına gelmektedir. Gerçektende, kronik whiplash ile ilişkili bozuklukları olan hastaların bulunduğu bir vaka serisi çalışmasında da, hastalık algılarındaki gelişmeler, ağrı eşiklerinde ve hareket performansında iyileşmelere yol açmıştır (Van Oosterwijck vd 2011).

Korku, felaketleştirme, egzersiz ve ağrı hakkındaki olumsuz olan inanışlar ile ilgili bilişler (kognisyon) olumlu yönde değiştirilerek; ağrı azaltılabilmekte ve fonksiyonellik arttırılabilmektedir (Moseley 2003b, Puentedura ve Louw 2012).

Ağrıyı terapatik olarak tedavi etmeye yönelik yapılan son araştırmalar, TNE'nin kullanımında bir artış olduğunu göstermektedir (Ryan vd 2010, Louw vd 2011). Birçok TNE çalışması, TNE'nin korku, ağrı, ağrının felaketleştirilmesi, fiziksel hareket ve disabilite üzerindeki olumlu etkisini ayrıntılı olarak incelemiş ve belgelemiştir (Moseley 2003b, Moseley 2004, Moseley vd 2004b, Meeus vd 2010, Louw vd 2011, Van Oosterwijck vd 2011).

TNE eğitiminin amacı, hastanın kendini daha iyi tanıması konusunda yol göstererek hastalığının yönetiminde daha fazla sorumluluk almasına, sağlık uzmanlarına daha az bağımlı hale gelmesine ve egzersiz gibi aktif yaşam şekillerini daha fazla benimsemesine ve odaklanmasına yardımcı olmaktır (Louw vd 2012).

Ağrı nöromatriksi ve onun yeniden kavramsallaştırılması, TNE'nin temel köşe taşlarından birini oluşturmaktadır. Hareket temelli bir meslek olarak fizyoterapi, kronik ağrısı olan bir hastanın beyni için, muhtemelen önemli bir tehdit oluşturmaktadır. Kronik ağrısı olan hastaların tedavisinde, giderek ağrılı olarak deneyimledikleri hareket ve egzersize odaklanılmaktadır. TNE eğitimi, hassas sinir sistemlerinin sonucu olarak

kronik ağrısı bulunan hastaların, doku hasarı ve ağrı arasındaki farkı görmelerine yardımcı olabilmek için tasarlanmıştır (Louw vd 2011, Louw vd 2013). TNE, hastaların sinir sisteminin ve ağrı deneyimlerinin biyolojisini ve fizyolojisini anlamalarına yardımcı olmayı amaçlamaktadır (Moseley 2002, Moseley 2004, Moseley vd 2004b, Louw vd 2011). Beynin ağrıyı ve nosiseptif girdiyi nasıl işlediğinin ayrıntılı şekilde ağrısı bulunan kişiye açıklamaya çalışmaktadır (Moseley vd 2004b, Van Oosterwijck vd 2011). TNE'de bilinçli şekilde doku hasarı önemsenmez, nosisepsiyonun işlenmesine odaklanılır ve hastanın nosisepsiyon ile ağrının ilişkili olmadığına dair farkındalığını artırmak amaçlanır, yani tehdit algısını azaltılmaya çalışan bir mekanizması vardır, böylece hastada ağrı algısı azaltılmaya çalışılır (Moseley 2005, Nijs ve Van Houdenhove 2009).

FM hastalarında tipik olarak görülen santral sensitizasyon mekanizmasının önemi göz önüne alındığında, FM hastaları için yoğun ağrı ile ilgili bir Nörobilim Eğitimi önerilmektedir. FM'de nörofizyoloji ve santral sensitizasyon hakkında özel bir eğitimin verilmesi gerektiği savunulmaktadır, böylece olumsuz bilişlerin yeniden yapılandırılabileceği, ağrıya karşı korkunun ve dikkatin azaltılabileceği ve hastaların semptomlar açısından rahatlatılabileceği bildirilmektedir. Eğer hastaların ağrıya yönelik tutum ve davranışları olumlu yönde iyileştirilebilirse, daha aktif bir yaşam tarzını benimseyebilecekleri ve aktivite ve performans seviyelerini artırabilecekleri rapor edilmektedir (Nijs ve Van Houdenhove 2009).

Literatürde yapılan çalışmalarda TNE eğitimi farklı isimlerle geçmektedir. Bunlar; Ağrı Nörobilim Eğitimi, Nörobilim Eğitimi, Ağrı Nörofizyoloji Eğitimi, Nörofizyoloji Eğitimi, Ağrı Fizyoloji Eğitimi şeklindedir. Yaptığımız tarama sonucunda FM'li bireylerde TNE'nin etkinliğini inceleyen çok az çalışmaya rastladık. FM'li bireylerde tek başına TNE'nin hastalıkla ilgili şikayetleri azaltmada yetersiz kaldığı ve tedavi programına ilave olarak uygulanması gerektiği belirtilse de, yapılan bu az sayıdaki çalışmaların hepsinde TNE eğitimi tek başına uygulanmıştır (Malfliet vd 2017a). Kronik ağrısı olan hastaların tedavi programının; TNE ve egzersiz kombinasyonundan oluşması gerektiği çalışmalarda ve kılavuzlarda tavsiye edilmektedir (Moseley 2002, Busch vd 2007, Meeus vd 2007, Nijs ve Van Houdenhove 2009, Puentedura vd 2009, Ryan vd 2010). Literatürde TNE'nin kronik ağrı üzerindeki etkisinin incelendiği çalışmalar genellikle kronik bel ağrısı bulunan bireyler üzerinde gerçekleştirilmiştir.

Bu literatürdeki eksiklikler göz önüne alındığında FM'li hastalardan oluşan örneklemimizde kontrol grubuna sadece Klinik Pilates Egzersizleri, müdahale grubuna Klinik Pilates Egzersizleri'ne ilave olarak TNE eğitimi uyguladığımız bu çalışmamızın sonuçlarının literatüre önemli katkılar sağlayacağı ve FM'li hastaların tedavisi ile ilgilenen klinisyen ve araştırmacılar için önemli bir yönelim ve fikir oluşturacağı düşüncesindeyiz.

Van Ittersum vd (2013) yazılı Ağrı Nörobilim Eğitimi'nin FM'li bireyler üzerindeki etkilerini araştırdıkları çalışmalarında, 105 katılımcıyı iki gruba ayırmışlardır. Birinci gruba yazılı Ağrı Nörobilim Eğitimi (bir kitapçık ile) uygulamışlardır ve herhangi bir problemle karşılaştıklarında sorunu çözmek için bir telefon görüşmesi gerçekleştirmişlerdir. Diğer gruba ise yazılı gevşeme eğitimi (bir kitapçık ile) uygulamışlardır ve herhangi bir problemle karşılaştıklarında sorunu çözmek için bir telefon görüşmesi gerçekleştirmişlerdir. Sonuçta, yazılı gevşeme eğitimi ile karşılaştırıldığında yazılı Ağrı Nörobilim Eğitimi'nin FM'li hastalarda ağrı algısını geliştirdiğini; fakat hastalar tarafından algılanan diğer semptomlar, günlük yaşam ve katastrofi üzerinde herhangi bir etki oluşturmadığını belirlemişlerdir. Yazarlar FM hastalarında olumsuz kognisyonların ve algılanan sağlığın değiştirilmesi için yüz yüze Ağrı Nörobilim Eğitimi seanslarının gerekli olduğunu vurgulamışlardır.

Malfliet vd (2017a) Ağrı Nörobilim Eğitimi'nin olumlu etkilerine dair birçok kanıt bulunmasına rağmen, bazı hastaların neden diğerlerinden daha fazla yarar sağladığını ve bu eğitimin etkinliğinin daha da arttırmak için eğitimden az oranda yarar sağlayan hastaların özelliklerini araştırmayı amaçladıkları çalışmalarında; Kronik Yorgunluk Sendromu/FM'si bulunan 39 kişiye Ağrı Nörobilim Eğitimi uygulamışlardır. Çalışmanın sonunda, ağrıları konusunda endişelenme eğiliminde olan ve yüksek düzeyde kinezyofobisi bulunan Kronik Yorgunluk Sendromu/FM'si olan hastaların, Ağrı Nörobilim Eğitimi'ni sonrasında katastrofilerindeki azalma daha az olabilmektedir sonucuna varmışlardır. Tek başına Ağrı Nörobilim Eğitimi'nin ağrı ile ilgili katastrofik düşünceleri azaltmada yetersiz olduğu ve ek tedaviye ihtiyaç duyulduğunu bildirmişlerdir.

Cuenca vd (2019) farklı dozlardaki Ağrı Nörobilim Eğitimi'nin etkinliğini araştırdıkları çalışmalarında, 77 FM'li bireyi dört gruba ayırmışlardır. Birinci gruba, 45 dakikalık 6 seanstan oluşan yüksek doz Ağrı Nörobilim Eğitimi; ikinci gruba 45 dakikalık 2 seanstan oluşan düşük konsantre doz Ağrı Nörobilim Eğitimi; üçüncü gruba 15 dakikalık 6 seanstan oluşan seyreltilmiş düşük doz Ağrı Nörobilim Eğitimi; dördüncü gruba ise 45 dakikalık 2 seanstan oluşan biyomedikal eğitimi verilmiştir. Sonuçta, FM'li hastalarda, yüksek doz Ağrı Nörobilim Eğitimi, diğer Ağrı Nörobilim Eğitimi dozlarına ve biyomedikal eğitime göre üç aylık takipte ağrı şiddetinde daha büyük bir iyileşme sağlamıştır. Bununla birlikte, Ağrı Nörobilim Eğitimi, FM'li hastalarda santral nosiseptif işleme, disabilite veya psikolojik değişkenlerde (katastrofi ve ağrı anksiyetesi) biyomedikal eğitimden üstün olmadığı belirtilmiştir.

Moseley (2004) egzersiz yapma fırsatı olmayan orta derecede disabilitesi bulunan 121 kronik bel ağrılı hastaya tek bir birebir lomber omurga fizyolojisi veya ağrı fizyolojisi eğitimi vermiştir ve ağrı kognisyonu ile fiziksel performans arasında bir ilişki

olup olmadığını incelemiştir. Sonuçta, ağrı kognisyonundaki değişiklik ile düz bacak kaldırmadaki ve öne doğru eğilme hareketlerindeki değişiklik arasında güçlü bir ilişki olduğu rapor edilmiştir. Yazarlar tarafından bu sonucun, ağrının, doku hasarı ve katastrofi anlamına geldiği inancındaki değişiklikle elde edildiği bildirilmiştir. Ağrı kognisyonundaki değişimin, fiziksel olarak aktif olma fırsatı olmadığında bile, fiziksel performansta değişiklik oluşturabilidiği ve fiziksel değerlendirmeler yorumlarken olumsuz ağrı kognisyonlarının da dikkate alınması gerektiği vurgulanmıştır.

Moseley vd (2004b) kronik bel ağrısı bulunan 54 hastada yaptıkları çalışmalarında yoğun nörofizyoloji eğitiminin etkinliğini araştırmışlardır. Müdahale grubuna ağrı nörofizyoloji eğitimi verilirken, kontrol grubuna bel bölgesinin anatomi ve fizyolojisi ile ilgili eğitim verilmiştir. Tüm katılımcıların eğitim seansları, birebir seminer formatında, 20 dakikalık ara içeren 3 saatlik bir sürede yapılmıştır. Sonuçta nörofizyolojik eğitimin; ağrı hakkındaki inanışlar ve davranışları normalleştirmede, katastrofiyi azaltmada ve fiziksel performansı arttırmada önemli bir tedavi edici etkisi olduğu görüldü. Ancak algılanan disabilite üzerinde istatistiksel olarak anlamlı bir etki oluşturmasına rağmen, bu etkinin boyutu küçük ve klinik olarak anlamlı olmadığından, nörofizyoloji eğitiminin algılanan disabilitede bir değişiklik oluşturmak için tek başına yetersiz kaldığı sonucuna varılmıştır. Kronik bel ağrısı bulunan hastalarda, bel ağrı okulu eğitiminden ziyade ağrı nörofizyolojisi eğitimi gibi daha geniş bir ağrı yönetimi yaklaşımının tedaviye dahil edilmesi gerektiği belirtilmiştir.

Meeus vd (2010) kronik yorgunluk sendromu ve kronik yaygın ağrısı bulunan 46 hastada ağrı fizyoloji eğitiminin ağrı kognisyonu ve ağrı eşiğinde değişiklik oluşturup oluşturmadığını araştırmışlardır. Müdahale grubuna ağrı fizyolojisi eğitimi, kontrol grubuna ise kendi kendine yönetim eğitimi uygulanmıştır. Her iki eğitimde 30 dakikalık birebir interaktif bilgi oturumunu şeklinde yapılmıştır. Değerlendirmeler, eğitimden önce ve eğitimden hemen sonra uygulanmıştır. Sonuçta kontrol grubuna kıyasla müdahale grubunda orta ile yüksek düzeyde etki büyüklüğüne ulaşacak şekilde, anlamlı düzeyde ağrının nörofizyolojisinin daha iyi anlaşılmasında ve ruminasyonda azalma elde edilmiştir. Olumsuz ağrı bilişlerinin klinik önemi göz önüne alındığında, ağrı fizyolojisi eğitiminin kronik yorgunluk sendromu ve kronik yaygın ağrısı bulunan hastaların tedavisinde önemli bir terapatik yöntem olabileceği belirtilmiştir.

Louw vd (2011) tarafından yapılan sistematik bir derlemede; kronik kas iskelet ağrısında Nörobilim Eğitiminin etkisini incelemişlerdir. 6'sı yüksek kaliteli randomize kontrollü çalışma, 1'i psödo randomiza kontrollü çalışma ve 1'i karşılaştırmalı bir çalışma olan toplam 8 makale (401 kişi) değerlendirilmiştir. Kronik kas iskelet ağrısında ağrının nörofizyolojisi ve nörobiyolojisini ele alan bir eğitim stratejisinin; ağrı, disabilite,

katastrofi ve fiziksel performans üzerinde olumlu bir etkiye sahip olabileceğine dair ikna edici kanıtlar olduğu sonucuna varmışlardır.

Pires vd (2013) 62 kronik bel ağrılı hastada yaptıkları çalışmalarında eğitim grubuna su içi egzersiz ve ağrı nörofizyoloji eğitimi uygularken, kontrol grubuna sadece su içi egzersizleri uygulamışlardır. Su içi egzersizler haftada 2 gün 6 hafta boyunca, ağrı nörofizyoloji eğitimi ise toplam 2 seans uygulanmıştır. Değerlendirmeler başlangıçta, altıncı haftanın sonunda ve 3 aylık takipte yapılmıştır. Sonuçta, üç aylık takipte ağrı yoğunluğunda eğitim grubu lehine anlamlı azalma elde edilirken; hiçbir değerlendirme sonucunda fonksiyonel disabilite ve kinezyofobide gruplar arasında anlamlı düzeyde bir fark görülmemiştir. Bu çalışmanın sonuçlarının, su içi egzersize ilave olarak uygulanan ağrı nörofizyoloji eğitiminin klinik açıdan etkinliğini desteklediği bildirilmiştir.

Téllez-García vd (2014) 12 mekanik kronik bel ağrılı hastada yaptıkları çalışmalarında, müdahale grubuna tetik nokta kuru iğneleme ve nörobilim eğitimi uygularken, kontrol grubuna sadece tetik nokta kuru iğneleme yapmışlardır. Nörobilim eğitimi, 2 hafta boyunca haftada bir gün 30 dakikalık seanslar şeklinde yapılmıştır. Sonuçta olarak her iki grupta da ağrıda ve disabilitede azalma benzer orandadır, fakat müdahale grubunda kinezyofobide daha fazla azalma ve basınç ağrı eşiklerinde daha fazla bölgede artış görülmüştür. Tetik nokta kuru iğnelemeye ek olarak uygulanan nörobilim eğitimi ile kısa dönemde mekanik kronik bel ağrılı hastalarda ağrı, kinezyofobi ve disabilitede anlamlı düzeyde azalma elde edilirken, yaygın olarak ağrı basınç eşiğinde artış elde edilmiştir. Nörobilim eğitiminin, tetik nokta kuru iğnelemenin etkinliğini arttırdığı bildirilmiştir.

Malfliet vd (2017b) Ağrı Nörobilim Eğitiminin 120 kronik spinal ağrılı hastada etkinliğini araştırdıkları çalışmalarında, bir gruba Ağrı Nörobilim Eğitimi verilirken, diğer gruba biyomedikal odaklı sırt / boyuna ait spinal anatomi ve fizyolojiyi ele alan bir eğitim verilmiştir. Her iki uygulamada 2 haftada 3 seans şeklinde uygulanmıştır. Sonuçta, Ağrı Nörobilim Eğitiminin kronik spinal ağrılı hastalarda ağrı algısını ve kinezyofobiyi azalttığı sonucuna varılmış. Etki büyüklüğü düşük ile orta seviyede olduğu için, Ağrı Nörobilim Eğitimi'nin tek başına bir tedavi olarak kullanılmaması gerektiği, fakat kapsamlı aktif bir rehabilitasyon programının temel unsurlarından biri olarak kullanılması gerektiği vurgulanmıştır. Gelecek çalışmalarda, bir rehabilitasyon programına ilave edilmiş ve edilmemiş şekilde Ağrı Nörobilim Eğitimi'nin etkinliğinin araştırılması gerektiği belirtilmiştir.

Andias vd (2018) 43 kronik idiopatik boyun ağrısı bulunan adolesanda yaptıkları çalışmalarında müdahale gruba haftada 1 kez 4 hafta boyunca Ağrı Nörobilim Eğitimi ve egzersiz uygulamışlardır, kontrol grubuna hiçbir müdahalede bulunmamışlardır. Ağrı

Nörobilim Eğitimi için ayrılan süre 1. seansta 45 dakika iken giderek azaltılarak 4. seansa 15 dakikaya düşürülmüştür. Egzersizler ise derin boyun fleksör ve ekstansör ve skapular stabilizatör kaslara yönelik kuvvetlendirme ve endurans egzersizlerinden oluşmaktadır. Dördüncü haftanın sonunda, başlangıç değerlerine göre müdahale grubunda boyun ekstansör endurans kapasitesinde ve ağrının nörofizyolojik bilgisinde anlamlı düzeyde artış elde edilmiştir. Müdahale grubunun ağrı yoğunluğu, ağrı katastrofisi ve anksiyetenin ortalama değerlerinde yüksek miktarda azalma, skapula stabilizatörler endurans kapasitesinin ortalama değerlerinde yüksek miktarda artış görülse de, bu fark istatistiksel açıdan anlamlı düzeye ulaşmamıştır. Kronik idiopatik boyun ağrısı bulunan adolesanlarda Ağrı Nörobilim Eğitimi ve egzersizin potasiyel faydalarının bulunduğu belirtilmiştir.

Biz bu çalışmamızda müdahale grubunda altı haftalık Klinik Pilates egzersizlerine ilave olarak TNE uyguladık. Literatürle paralel olacak şekilde müdahale grubunda, tedavi sonrasında tedavi öncesine göre semptomların ve ağrının şiddetinde azalmanın yanı sıra ağrılı bölge sayısında ve ağrının oluşturduğu engellerde azalma; ayrıca fonksiyonel ve biyopsikososyal durumda ve kognitif fonksiyonlarda artış, kinezyofobide azalma ve tüm basınç ağrı eşiklerinde (sol trapez hariç) artış elde ettik.

Bu sonuçlara göre FM'de TNE'nin, Klinik Pilates Egzersizlerinin etkinliğini arttırdığı ve TNE'nin faydalı bir terapatik yöntem olduğu söylenebilir. Her iki grupta da ağrı ve semptom şiddetinde azalma elde edilse de sadece müdahale grubunda ağrılı bölge sayısında azalması ve neredeyse tüm basınç ağrı eşiklerinde artış görülmesi, FM'de TNE ile ağrının yeniden kavramsallaştırıldığı, böylece somatik hassasiyetin azaltıldığı ve ağrıya olan toleransın/ ağrı eşiğinin arttırıldığı düşüncesindeyiz. Çalışmamızın sonucunda sadece müdahale grubunda kinezyofobide azalma ve biyopsikososyal durumda artış elde edilmiştir. Bu bulgular, TNE ile bel ağrılı hastalardaki inanç ve tutumların etkili şekilde yönetilebildiğini destekleyen önceki çalışmaların sonuçlarına benzerdir (Louw vd 2011) ve FM'de de TNE ile hareket etme ve tekrar yaralanma korkusunun azaltılabildiğini göstermektedir. Tüm bu olumlu etkilerin sonucunda da katılımcıların egzersiz kapasitesilerinin ve aktivite seviyelerinin artması ile fiziksel performanslarında ve fonksiyonelliklerinde gelişim elde ettiğimiz (Watson vd 1997, Moseley ve 2004b) ve fonsiyonel olarak daha aktif hale gelen katılımcıların hayata daha fazla dahil olmaları ve bireysel ve sosyal görevlerini daha yüksek oranda gerçekleştirmeleri sonucunda biyopsikososyal durumlarının arttığı kanısındayız

Çalışmamızda grupları karşılaştırdığımızda ise, ağrının azaltılmasında, fonksiyonel durumun geliştirilmesinde ve birçok bölgedeki (sağ ve sol Trapezius, sağ Quadriceps Femoris, sağ ve sol medial diz) basınç ağrı eşiklerinin arttırılmasında

müdahale grubunun anlamlı düzeyde daha etkin olduğunu gördük. TNE ile merkezi sinir sistemindeki hiper eksitabilitede bir azalma gerçekleştirilebildiğine dair kanıtlar bulunmaktadır. Dorsal boynuzdaki santral sensitizasyon ile ilişkili nöroplastik değişikliklerin inhibisyonu ile sonuçlanan nosiseptif girdilerin ortadan kaldırılabilindiği öne sürülmektedir (Butler ve Moseley 2003, Louw vd 2011). Bu sonuçlarımızın literatürdeki TNE ile segmental ve santral sensitizasyon mekanizmaları üzerinde olumlu etkiler oluşturulabildiğine dair bulguları desteklediğini düşünmekteyiz (Dommerholt 2011, Chou vd 2012, Cagnie vd 2013). Bu nedenle, FM'li hastalarda potansiyel etkilerini artırmak için her iki terapatik müdahalenin aynı anda uygulanabileceğini tavsiye etmekteyiz.

Ağrı kognisyonlarının (katastrofi, ağrıyla başa çıkma, kaçınma davranışları gibi); ağrı yoğunluğu ile ilişkili olduğu gösterilmiştir ve tedavilerde önemli engellere neden olabilmektedir. Fizyoterapistler, düşük egzersiz toleransı ve egzersiz sonrası hastalarda görülen halsizlik nedeniyle ne yapacaklarını bilememektedirler ve bu durum tedavide uyumun ve tedavinin etkinliğinin azalmasına yol açabilmektedir. Daha aktif olan yöntemleri uygulamadan önce tedaviye TNE ile başlayarak, fonksiyonelliği engelleyen olumsuz inançların azaltılabileceği kanısındayız (Komaroff ve Buchwald 1991, Gibson vd 1993, Fukuda vd 1994).

Literatürde TNE'nin etkinliğinin araştırıldığı çalışmalarda, seansların süresi ve sıklığı oldukça farklıdır. Eğitim seanslarının süresi, dört saatten (Moseley 2003c) 30 dakikalık sürelere kadar çeşitlilik göstermektedir. Klinikte her hasta ziyaretinde klinisyenlerin karşılaştığı zaman problemlerinden dolayı dört saat gibi uzun seanslardan ziyade daha kısa seansların yapılması önerilmektedir. Daha güncel çalışmalarda genellikle 30 dakikalık seansların yapıldığı rapor edilmektedir (Meeus vd 2010, Van Oosterwijck vd 2011). Zamandaki bu azalma, klinisyenlerin 30 ila 45 dakika gibi kısa bir sürede TNE eğitimi ile birlikte, diğer fizyoterapi müdahalelerinin uygulanabilmesine olanak sağlamaktadır (Childs ve Whitman 2005, Murphy vd 2005, Dean 2009). Ayrıca, Cuenca vd (2019) FM'li bireylerde farklı dozlardaki Ağrı Nörobilim Eğitimi'nin etkinliğini araştırdıkları çalışmalarında, 45 dakikalık 6 seanstan oluşan Ağrı Nörobilim Eğitimi'nin uygulanmasını önermişlerdir.

Ayrıca eğitim seansları, bir (Moseley 2003b, 2003c, Moseley vd 2004b, Brox vd 2008, Meeus vd 2010, Ryan vd 2010) ya da daha fazla sayıda (Moseley 2002, 2003c, Van Oosterwijck vd 2011) yapılmaktadır. Tek seanstan ziyade iki hafta ya da daha uzun süren seansların klinik faydaları ortaya konmuştur ve önerilmektedir (Nijs vd 2011, Louw vd 2013). Birden fazla eğitim seansı uygulanan çalışmalarda, seanslar arasında verilen ara çoğunlukla bir haftadır (Moseley 2002, 2003c, Van Oosterwijck vd 2011).

Bugüne kadar TNE'nin etkinliğini araştırmak amacıyla yapılan çalışmalarda, grup seanslarına kıyasla bir fizyoterapistle bire bir sözel olarak yapılan seansların kişilere daha fazla fayda sağladığı bildirilmiştir (Louw vd 2011, Moseley 2003c). Ağrının bireysel ve karmaşık işleyişi düşünüldüğünde, bire bir eğitim seanslarının daha iyi sonuçlar vermesinin şaşırtıcı olmadığı bildirilmektedir (Moseley 2003a, 2003b).

Tüm bu literatürdeki önerileri göz önünde bulundurarak bizde çalışmamızda TNE seanslarını, eğitim için özel olarak ayrılmış bir odada, sadece bir katılımcı ve fizyoterapistin bulunduğu birebir yüz yüze görüşme yöntemi ile sözel olarak gerçekleştirdik. Eğitim, her bir seans yaklaşık olarak 45-60 dakika olacak şekilde haftada bir gün 6 hafta boyunca toplam 6 seans uygulandı.

Çalışmamızın güçlü yanlarından biri, literatürde FM'li bireylerde TNE'nin etkinliğinin araştırıldığı çok az sayıda çalışma bulunması ve TNE'nin bir egzersiz programına ilave olarak uygulanması gerektiği yönündeki güçlü tavsiyelere rağmen literatürdeki bu çalışmalarda TNE'nin tek başına uygulanmış olması sebebiyle, çalışmamız Klinik Pilates Egzerisizlerine ilave olarak uygulanan TNE'nin FM'deki etkinliğini araştıran ilk çalışmadır. Ayrıca, çalışmamız TNE için seans süresi, uzunluğu ve yapılma yöntemi açısından literatürde önerilen şekilde dizayn edilmiştir. Bir diğer güçlü yanı ise özellikle klinisyenler FM'da görülen kognitif disfonksiyonu artık ayrı bir klinik durum olarak ele almaya başlamışlardır (Koca 2015) ve FM hastalarının büyük bir çoğunluğu da kognitif disfonksiyon şikayetlerinden yakınmaktadır (Leavitt vd 2002). TNE'nin kognitif fonksiyonlar üzerinde etkin bir şekilde olumlu sonuçlar elde edilebilmesine olanak sağladığına dair raporlar bulunmasına rağmen, literatürdeki çalışmalarda kognitif disfonksiyonlar detaylı şekilde değerlendirilmemiştir. Biz bu çalışmada kognitif fonksiyonları DLMTKD gibi detaylı ve dinamik bir değerlendirmeye olanak sağlayan bir test bataryası kullanarak değerlendirdik. Bu kognitif fonksiyonlara yönelik detaylı değerlendirme sonuçlarının klinisyen ve araştırmacılar için önemli bir yönelim oluşturacağı kanısındayız.

Bu çalışmanın bir limitasyonu, uzun dönem takip çalışmasının yapılmamış olmasıdır. Semptomların belirli aralıklarla alevlendiği bir hastalık olan FM 'de tedaviden sonra katılımcıların karşılaştırtıkları zorluklarda öğrendikleri bilgileri kullanıp kullanamadıkları, kullanabildilerse ne kadar etkin olduğu ya da ileriki dönemlerde edindikleri bilgilerin ne kadarını unutup ne kadarını hafızalarında barındırdıkları ile ilgili bilgilere ulaşamadık. Bu bilgiler eğitimin etkinliği hakkında çok daha fazla bilgi sahibi olmamıza olanak sağlayabilirdi. Diğer bir limitasyonu ise, örneklem sayısının az olması sebebiyle DLMTKD sonuçlarında mediasyon skorları ve mediasyon sonrası skorlar istatistiksel analizler sırasında kullanılamamıştır. Bu verilerin analizi yapılabilmiş olsaydı, tedavi sonrasında tedavi öncesi göre ya da grupların karşılaştırılmasında FM'li

bireylerin mediasyona ihtiyaç duyma durumlarında bir fark olup olmadığı yedi kognitif alan ve toplam skorlar açısından değerlendirilebilirdi.

Gelecek çalışmalarda egzersize ilave olarak uygulanan TNE'nin FM'deki etkisi hakkında daha detaylı bilgi edinmemizi sağlayacağını düşündüğümüz uzun dönem takip çalışmalarının yapılmasını, DLMTKD test bataryası için mediasyon ve mediasyon sonrası skorların istatistiksel analizde kullanılabilmesi için örneklem sayısının arttırılmasını tavsiye etmekteyiz. Ayrıca, FM'de kognitif disfonksiyon için henüz standardize testler bulunmadığından dolayı (Dick vd 2008, Schmidt-Wilcke vd 2010), çalışmamızda kognitif fonksiyonları değerlendirmek için detaylı ve dinamik bir değerlendirmeye olanak tanıyan DLMTKD'yı kullanmayı tercih ettik. Yapılan değerlendirmeler sırasında FM'li katılımcıların en fazla DLMTKD'nin Düşünme ile ilgili kognitif alanında problem yaşadıklarını gözlemledik. Bu nedenle FM'ye spesifik kognitif disfonksiyonu belirlemede kullanılacak standardize testlerin geliştirilmesinde bu kognitif alanı daha detaylı ve kapsamlı değerlendirecek testlerin geliştirilmesini tavsiye etmekteyiz. Böylece klinisyenler ve araştırmacılar tedavilerin FM'de kognitif fonksiyonları ne ölçüde etkilediği konusunda daha doğru bilgiler edinebilir ve standize testler bulunmadığı için yeterli test yapılmayan ve kognitif fonksiyon açısından tedavileri yetersiz kalan FM'li bireyler daha etkin şekilde tedavi edilebilirler (Dick vd 2008, Schmidt-Wilcke vd 2010).

6. SONUÇLAR

Altı haftalık sadece Klinik Pilates egzersizleri uygulaması FM'li bireylerde semptomların (p=0,011) ve ağrının şiddetinde (p=0,005-0,022) ve ağrıyı büyütmede azalma (p=0,022), fonksiyonel durumda (p=0,022) ve kognitif fonksiyonlarda artış (p=0,001-0,010) ve sol medial diz ortalama basınç ağrı eşiğinde artış (p=0,020) sağlamıştır.

Zihin beden bütünlüğüne dayanan Klinik Pilates Egzersizleri ile FM'li bireylerde kognitif fonksiyonlarda gelişim elde edilmiştir ve bu kognitif gelişimin özellikle DLMTKD'nın düşünme ile ilgili kognitif alanında (müdahale grubu p=0,013, kontrol grubu p=0,010) gerçekleşmiştir.

Altı haftalık Klinik Pilates egzersizlerine ilave olarak yapılan TNE uygulaması sonrasında, FM'li bireylerde semptomların (p=0,018) ve ağrının şiddetinde azalmanın (p=0,009-0,010) yanı sıra ağrılı bölge sayısında (p=0,003) ve ağrının oluşturduğu engellerde azalma (p=0,005); ayrıca fonksiyonel (p=0,003) ve biyopsikososyal durumda (p=0,033) ve kognitif fonksiyonlarda artış (p=0,010-0,013), kinezyofobide azalma (p=0,036) ve tüm basınç ağrı eşiklerinde (sol trapez hariç) artış (p=0,007-0,037) elde edilmiştir.

FM'de TNE, Klinik Pilates Egzersizlerinin etkinliğini arttırmıştır ve TNE faydalı bir terapatik yöntemdir. Bu nedenle, FM'li bireylerde potansiyel etkilerini artırmak için her iki terapatik müdahalenin aynı anda uygulanabileceğini tavsiye etmekteyiz.

TNE için, sadece bir katılımcı ve fizyoterapistin bulunduğu sözel olarak gerçekleştirilen birebir yüz yüze görüşme yönteminin kullanıldığı seansları ve her bir seans yaklaşık 45-60 dakika olacak şekilde haftada bir gün 6 hafta boyunca uygulanmanın yapılmasını önermekteyiz.

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8. ÖZGEÇMİŞ

1988 yılında İzmir'de doğdu. İlk, orta ve lise öğrenimini İzmir'de tamamladı. 2011 yılında Pamukkale Üniversitesi Fizik Tedavi ve Rehabilitasyon YO'dan fizyoterapist ünvanıyla mezun oldu. 2011-2015 yılları arasında Ondokuz Mayıs Üniversitesi Hastanesi'nde ve Ege Üniversitesi Hastanesi'nde fizyoterapist olarak görev aldı. 2015 yılından itibaren Pamukkale Üniversitesi Fizik Tedavi ve Rehabilitasyon Yüksek Okulu'nda araştırma görevlisi olarak çalışmaktadır. 2015-2017 yılları arasında Pamukkale Üniversitesi Fizik Tedavi ve Rehabilitasyon Ana Bilim Dalı'nda yüksek lisans eğitimini tamamladı. 2017 yılında Pamukkale Üniversitesi Fizik Tedavi ve Rehabilitasyon Ana Bilim Dalı'nda doktora eğitimine başladı. Romatolojik Fizik Tedavi ve Rehabilitasyon alanında çalışmalara devam etmektedir. Evlidir. Bir kızı ve bir oğlu vardır.

9. EKLER

Ek-1

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VALIDATION STUDIES

Exploring the relation between impairment rating by DAS-28 and body function, activity participation, and environmental factors based on ICF hand core set in the patient with rheumatoid arthritis

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Abstract
Hand problems associated with rheumatoid arthritis lead to subjective impairment, activity limitation, and restrictions on participation. This relation is very complex. Assessment of individuals' activities is important to determine how hand problems affect not only body functions but also daily life activities. The aim of this study was to link and allocate items of disability questionnaires with ICF components based on ICF hand core set. The other objective was to examine the relationship between impairment and ICF components determined on the basis of disability questionnaires in participants with rheumatoid arthritis. Impairment was evaluated by use of Disease Activity Score-28. Disability questionnaires were Disabilities of Arm, Shoulder and Hand Questionnaire, Michigan Hand Outcomes Questionnaire, Duruoz Hand Index, and Arthritis Impact Measurement Scales 2 ($n = 100$). Items of disability questionnaires were linked with ICF hand core set as a result of three expert opinions. Michigan Hand Outcomes Questionnaire covered the highest number of body function categories and Arthritis Impact Measurement Scales 2 covered the highest number of ICF hand core set. For all questionnaires, while impairment (Disease Activity Score-28) had moderate correlation with subjective impairment (body function scores) and activity/participation; subjective impairment had high and moderate correlation with activity participation. Arthritis Impact Measurement Scale 2 is the most appropriate to perform a more comprehensive biopsychosocial assessment. Clinician's assessments and impairment levels reported by patients with rheumatoid arthritis are interrelated. Impairment levels reported by patients with rheumatoid arthritis are also affected by environmental factors.

Keywords Rheumatoid arthritis · Outcome measures · Disability · ICF · DAS28

Introduction

The rheumatoid arthritis (RA) is an inflammatory disease with systemic and chronic progress that is characterized by continuous synovitis of joints [1]. Pain, loss of joint range of motion, reduced force of grip, and decreased muscle power are basic factors resulting in loss of functions and disability of RA patients in the chronic period. During the chronic process, the RA leads to limitations on the ability to perform daily life activities at home and work, physical disability, and reduced quality of life. It also results in negative effects on the emotional components as well as physical components of quality of life related to health [2–5].

The qualitative scale of International Classification of Functioning, Disability and Health (ICF), where different health-related opinions from biological, individual, and social contexts can be properly combined and synthesized allows for listing patient's impairments, activity limitations, restriction on participation, and environmental factors in the clinical setting [6]. Clinically, it allows to identify needs, assess health conditions at different levels, compare interventions to specific medical conditions, and evaluate rehabilitation and outcomes [7].

ICF has two parts, each containing two different components. The part one includes functionality and disability,

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and its components are (1) body structure and functions and (2) activity and participation. The part two includes contextual factors containing environmental and individual factors. Disability and impairment of body structure and functions are a general term to describe health problems at different levels, such as restrictions on the ability to perform daily life activities and participate in society. An activity is described as performance of daily routine, and the participation is to become involved in the social life. This structure including contextual factors such as environmental factors increases the possibility of understanding all the effects of a disease in an individual [6].

If specific domains of medical condition criteria are systematically linked with relevant parts of ICF, we will have a common conceptual understanding of ICF and patient-oriented health criteria. It may also make clinical practices easy [8]. ICF consists of a total of 1454 categories. Of these categories, 393 are activity and participation, 493 are body functions, 310 are body structure, and 258 are environmental factors.

ICF Core Sets were developed for more practical use of ICF. ICF Core Sets are smaller versions of ICF in which categories applicable to a specific disease or condition are used [9–11]. The ICF hand core set was developed to provide comprehensive description of disability functionality of individuals with hand problems [12]. ICF hand core set has 117 categories. Of these categories, 38 are activity and participation, 37 are body structure and functions, and 42 are environmental factors.

The clinical studies use different methods for assessing disease activity to indicate level of impairment for RA [13]. These methods include Disease Activity Score-28 (DAS28), which has been widely used for clinical applications in recent years [14]. The patient's disease activity can be classified as remission–low–moderate–high [15].

The Disabilities of Arm, Shoulder and Hand Questionnaire (DASH) is an assessing scale that can be used for individuals with different clinical conditions and can differentiate specific to regions [16, 17]. The Michigan Hand Outcomes Questionnaire (MHQS) is internationally used to assess hand diseases [18]. The MHQS is particularly found useful for assessing rheumatic hand problems [19]. The Duruoz Hand Index (DHI) and the Arthritis Impact Measurement Scales 2 (AIMS 2) are the most commonly used questionnaires for RA.

In this study, we investigated the relation between impairment and disability scores [separated scores of impairment, activity participation and environmental factors for each assessment questionnaire (DASH, MHQS, DHI, and AIMS 2)] based on the clinical data of persons with RA.

We addressed the primary null hypothesis that there is no relation between activity-participation scores and impairment. Secondary study questions addressed the relation between the body function scores and the impairment. In addition, we also determined the relation between the objective and subjective impairment.

Methods

Participants

100 participants with RA were included in this study, who met inclusion criteria, were diagnosed with RA by a rheumatologist according to classification criteria of 2010 American College of Rheumatology/European League against Rheumatism for RA, and monitored at Rheumatology Clinic of Pamukkale University between February 2016 and December 2016. Figure 1 shows a flow chart of the study design. Inclusion criteria were: (a) diagnosed with RA; (b) being in the age range 18–65; and (c) absence of other diseases affecting functions (orthopedic, neurological, cardiovascular, and metabolic disease). Exclusion criteria were: (a) comorbidity affecting upper extremity and hand functions (carpal tunnel syndrome, trigger finger, impingement syndrome, thoracic outlet syndrome, lateral, and medial epicondylitis, hand osteoarthritis); (b) cognitive impairments; (c) pregnancy; and (d) illiteracy.

All the participants provided a verbal and written informed consent at the first interview. The Ethics Committee for Noninvasive Clinical Research of Pamukkale University decided that there were no ethical considerations to perform the study at the board meeting No. 01 on 12.01.2016.

Measures

The DAS28 was assessed by the same rheumatologist who had experience in rheumatology. The data were collected on the same day by the same physical therapist who were experienced in rheumatologic rehabilitation. The DASH,

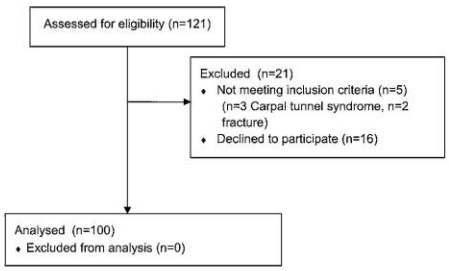

Fig. 1 Flow chart of study design

MHQS, DHI, AIMS 2, and questionnaires were, respectively, completed by the patients.

Disease Activity Score-28

This index is a combination of 28 swollen joints and 28 sensitive joints, assessment of patient's general medical condition and erythrocyte sedimentation rate. Swollen and sensitive were assessed for 28 joints—0: No and 1: Yes. These 28 joints included two shoulder, two elbow, two wrist, ten metacarpophalangeal joints, two interphalangeal thumbs, eight proximal interphalangeal joints, and two knee joints. DAS28 indicates current condition of the patient in the clinic. A high score represents a high disease activity. > 5.1 indicates a high disease activity, $3.2 < \text{DAS28} \leq 5.1$ indicates a moderate disease activity, ≤ 3.2 indicates a low disease activity, and < 2.6 indicates remission [15].

Disabilities of Arm, Shoulder, and Hand Questionnaire (DASH)

The Disabilities of Arm, Shoulder, and Hand Questionnaire was developed by "Work and Health Institute of Ontario and American Academy of Orthopedic Surgeons" to assess functional condition of patients with musculoskeletal problems in the upper extremity from their point of view. It contains 30 items concerning symptoms and daily life activities. All the items of questionnaire are scored 1–5 (1: No difficulty, 5: Unable). The total score ranges 20–100, and higher scores indicate more disability [20]. It was adapted to Turkish culture by Düger et al. and the internal consistency coefficient was 0.910 (95% CI 0.861–0.942) [21].

Michigan Hand Outcome Questionnaire (MHQS)

MHQS separately assesses two hands and includes 63 questions and 6 sections: general hand functions, daily life activities, work performance, pain, aesthetics, and patient satisfaction [22]. Each question is scored 1–5. A high score indicates a high satisfaction in total score. This questionnaire was found safe and valid to assess hand problems [23], and Turkish validity and safety study were carried out and the internal consistency coefficient (Cronbach's alpha) ranged from 0.85 to 0.96 for all subscale scores [24]. This questionnaire is preferred for hand problems over other questionnaires as it assesses hands in relation with hand dominance, contains a section that questions aesthetics—one of the ICF criteria—and includes questions especially related to hands [25].

Duruoz Hand Index (DHI)

The DHI was first developed in 1996 to assess restrictions on hand activities of patients with RA. It includes 18 items that are answered by the patient on the hand capabilities at kitchen, work, when getting dressed, providing personal hygiene and performing other general motions. The scores range 0–40 for kitchen works, 0–10 for getting dressed, hygiene and office works, and 0–20 for "others" category. The patients rate their own capabilities from 0 (no difficulty) to 5 (incapable). The questionnaire reaches a total score 0–90 and takes 3 min to complete. A high score represents a greater activity restriction and more difficulty. The intrarater and interrater reliabilities of the scale were 0.97 and 0.96, respectively [26].

Arthritis Impact Measurement Scales 2 (AIMS 2)

The AIMS 2 is the revised version of Arthritis Impact Measurement Scale, and a more comprehensive and precise measure to assess medical conditions of patients with RA. The AIMS 2 includes 78 questions with five answer options in 12 domains of medical condition. The scale questions the last 1 month. The questioned domains include level of mobility, walking and bending, hand and finger functions, arm functions, self-care, chores, social activities, family and friend support, joint pain, employment, stress, and mood. Turkish validity and safety study were performed for this scale and the internal consistency coefficient ranged from 0.68 to 0.91 [27].

Linking to ICF and distinction

ICF coding system is divided into two parts. The first part deals with the process of functioning and disability; b (body functions), s (body structures) d (activities and participation). The second part deals with environmental and personal factors; and e (environmental factors).

The questions of assessment questionnaires (DASH, MHQS, DHI, and AIMS 2) were linked with ICF hand core set codes by three experienced research physical therapists (UBA, BBÇ, and EGK). In the first step of linking, the research physical therapists individually established the link. In the second step, three investigators came together to reach a consensus on different codes. Each of the questions in the assessment questionnaires (DASH, MHQS, DHI, and AIMS 2) was linked with one ICF hand core set code, and the codes on which no consensus was reached were not linked. This link was based on the linking rules of Cieza et al. [28]. Then, three investigators conducted several meetings and reached a consensus on different ICF codes. Only one ICF hand core set code was generated for each linked question of each questionnaire. For each questionnaire, the linked questions were

classified into body function, activity, and participation or environmental factors, which are components of ICF.

Finally, the items were linked with ICF hand core set, and the original scoring of scales allocated to ICF components was used to calculate scores of subjective impairment, activity/participation, and environmental factors for each questionnaire in accordance with clinical data for 100 participants with RA. We considered the score of body function as subjective impairment and the score of DAS28 as objective impairment.

Statistical analysis

The data were analyzed by SPSS packet program. The Kolmogorov–Smirnov test was used to determine whether the continuous variables were normal distributions and the continuous variables were expressed as mean ± SD for normal distributions and median (minimum–maximum) for non-normal distributions. The categorical variables were expressed in numbers and percentage. Discriminative content analysis on DASH, MHQS, DHI, and AIMS 2 was carried out using Kappa statistics agreement [29]. Since the variable that is assessed for compliance in kappa statistics is categorical (nominal), the applied statistic is a nonparametric statistical type. The Kappa value usually ranges "0"–"1". "1" indicates perfect agreement, and "0" indicates that there is no agreement. If the Kappa coefficient is greater than 0.61, it is considered good agreement [30]. The score of each component was calculated through the original formula in scoring the DASH, MHQS, DHI, and AIMS 2. The extracted scores were under linking DASH, MHQS, DHI, and AIMS 2 items to ICF.

To measure association between body function, activity participation and environmental factors together and each of them with impairment score as well, bivariate analyses (Spearman or Pearson correlation) were performed. Correlation was categorized as low (*r* 0.10–0.49), moderate (*r* 0.50–0.69), or high (*r* 0.70–1.00) [31].

Results

86 women (86%) and 14 men were included in the study. Demographic characteristics of the patients are shown in Table 1.

The results for agreement in kappa analysis among three investigators: 0.90 for DASH, 0.842 for MHQS, 0.78 for DHI, 0.90 for AIMS 2, and 0.882 for the sum of four scales (Table 2). All the results show that the kappa value 0.61 (considered to be a good agreement) was exceeded.

Results of linking and allocating DASH, MHQS, DHI, and AIMS 2 items based on three expert opinions are shown in Supplementary Tables S1, S2, S3, and S4.

Table 1 Demographic characteristics of the patients

Variable	Median (minimum–maximum)
Age (years)	52 (20–65)
Body mass index (kg/m^2)	27.44 (17.76–58.82)
Disease duration (years)	6 (0.04–30)
Variable	***n* (%)**
Gender	
Female	86 (86)
Male	14 (14)
Job	
Housewife	66 (66)
Working	18 (18)
Student	4 (4)
Retired	12 (12)
DAS28 scores	
Remission	46 (46)
Low disease activity	16 (16)
Moderate disease activity	30 (30)
High disease activity	8 (8)

Table 2 Agreement between three researchers who associate ICF codes with disability questionnaires (Kappa analysis)

	Kappa value	*p*
DASH	0.90	0.001
MHQS	0.842	0.001
DHI	0.78	0.001
AIMS 2	0.90	0.001
Total	0.882	0.001

DASH Disabilities Arm Shoulder Hand Questionnaire, *MHQS* Michigan Hand Outcomes Questionnaire, *DHI* Duruoz Hand Index, *AIMS 2* Arthritis Impact Measurement Scales 2

ICF hand core set has 117 components of which 38 (32.47%) are activity and participation, 37 (31.62%) are body function, and 42 (35.89%) are environmental factors. According to the final decision of three investigators on linking, the DASH covered 6 (16.21%) of body functions and 15 (39.47%) of activity/participation in ICF hand core set, so it totally covered 21 (17.94%) components. The MHQS covered 8 (21.62%) of body functions and 10 (26.31%) of activity/participation in ICF hand core set, so it totally covered 18 (15.38%) components. The DHI totally covered 8 (21.05%) of activity/participation in ICF hand core set. The AIMS 2 covered 3 (8.10%) of body functions, 20 (52.63%) of activity/participation, 2 (4.67%) of environmental factors in ICF hand core set, so it totally covered 25 (21.36%) components (Table 3).

Table 3 Coverage percentages of the disability questionnaires for the ICF hand core set and the ICF hand core set components

	Body function *n* (%)	Activity participation *n* (%)	Environmental factors *n* (%)	ICF hand core set total *n* (%)
DASH	6 (16.21)	15 (39.47)		21 (17.94)
MHQS	8 (21.62)	10 (26.31)		18 (15.38)
DHI		8 (21.05)		8 (6.83)
AIMS 2	3 (8.10)	20 (52.63)	2 (4.76)	25 (21.36)

DASH Disabilities Arm Shoulder Hand Questionnaire, *MHQS* Michigan Hand Outcomes Questionnaire, *DHI* Duruoz Hand Index, *AIMS 2* Arthritis Impact Measurement Scales 2

Table 4 Descriptive statistics of ICF component scores of the disability questionnaires linked to ICF hand core set

	Median (min–max)
DASH B	39.28 (0.00–96.43)
DASH AP	35.32 (0.00–94.57)
MHQS B	54.53 (18.96–87.50)
MHQS AP	50.80 (8.21–75.00)
DHI AP	12.50 (0.00–90.00)
AIMS 2 B	13.19 (3.00–27.01)
AIMS 2 AP	22.89 (0.00–56.47)
AIMS 2 E	0.00 (0.00–10.84)

DASH Disabilities Arm Shoulder Hand Questionnaire, *MHQS* Michigan Hand Outcomes Questionnaire, *DHI* Duruoz Hand Index, *AIMS 2* Arthritis Impact Measurement Scales 2, *B* body function, *AP* activity participation, *E* environmental factors

Based on these results, the MHQS had the highest rate to cover the body functions in ICF hand core set with 8 (21.62%). The AIMS 2 had the highest rate to cover body functions with 3 (8.10%), activity/participation with 20 (52.63%), environmental factors with 2 (4.76%) in ICH hand core set, so it totally covered 25 (21.36%) components.

For the participants, descriptive statistics of ICF component scores of the disability questionnaires linked to ICF hand core set are shown in Table 4.

In the Spearman correlation analysis among ICF components of DAS28 and DASH, the objective impairment was moderately correlated with activity/participation and subjective impairment, whereas subjective impairment was highly correlated with activity/participation (Table 5).

In the Spearman correlation analysis among ICF components of DAS28 and MHQS, the objective impairment was moderately correlated with activity/participation and subjective impairment. In the Pearson correlation analysis among ICF components of DAS28 and MHQS, subjective impairment was highly correlated with activity/participation (Table 5).

In the Spearman correlation analysis among ICF components of DAS28 and DHI, the objective impairment was moderately correlated with activity/participation (Table 5).

Table 5 Correlation between study variables of DASH, MHQS, DHI, and AIMS 2

	Components	1	2	3	4
DASH					
1	Impairment				
2	Subjective impairment	**0.646****[a]			
3	Activity participation	**0.620****[a]	**0.740****[a]		
MHQS					
1	Impairment				
2	Subjective impairment	**− 0.678****[a]			
3	Activity participation	**− 0.675****[a]	**0.787****[b]		
DHI					
1	Impairment				
3	Activity participation	**0.619****[a]			
AIMS 2					
1	Impairment				
2	Subjective impairment	**0.569****[a]			
3	Activity participation	**0.594****[a]	**0.635****[a]		
4	Environmental factors	0.127[a]	**0.291****[a]	0.119[a]	

Body structure and body function scores considered as subjective impairment

1 Impairment score rated by DAS28, *2* subjective impairment, *3* activity-participation score, *4* environmental factors score, *DASH* Disabilities Arm Shoulder Hand Questionnaire, *MHQS* Michigan Hand Outcomes Questionnaire, *DHI* Duruoz Hand Index, *AIMS 2* Arthritis Impact Measurement Scales 2

Significant values are in bold

*$p<0.05$

**$p<0.01$

[a]Spearman correlation analysis

[b]Pearson correlation analysis

In the Spearman correlation analysis among ICF components of DAS28 and AIMS 2, the objective impairment

was moderately correlated with activity/participation and subjective impairment but was not correlated with environmental factors. The subjective impairment was moderately correlated with activity/participation and poorly correlated with environmental factors. The activity/participation was not correlated with environmental factors (Table 5).

Discussion

The aim of this study was to link the items of four scales used for assessment of disability with ICF's body functions, activity/participation and environmental factors as well as with categories of ICF hand core set. Based on the results of our study, the MHQS was the questionnaire that covered the most the body function categories of ICF hand core set with 8, and the AIMS 2 covered 3 of body functions, 20 of activity/participation, and 2 of environmental factors, so it totally covered 25 categories in ICF hand core set. The four scales assessed in this study appear to cover environmental factors minimum, and to further cover body functions and activity/participation, which are components of ICF.

The disability associated with RA can be defined as subjective impairment, activity limitation and restrictions on participation [32]. Although hand problems lead to activity limitations, this relation is very complex [33]. Assessment of individuals' activities is important to determine how hand problems affect not only body functions but also daily life activities [34, 35].

The increased number of scales developed in recent years has made difficult for healthcare professionals to choose an appropriate result measure in documenting health intervention outcomes and organizing research information [8, 11, 36]. The linking of ICF with result measures may facilitate generation of an international database for functionality tests in order to help choosing the most appropriate method for healthcare services [36].

30 items and 4 optional items of DASH were linked with 63 categories and 11 parts of ICF by Drummond et al. [37]. 15 of these 63 categories were for body functions of ICF and 48 were for activity and participation. None of the items were linked with body structure and environmental factors. Dixon et al. [38] linked 38 items of DASH with ICF through 24 peers, and as a result they reported that 5 items were linked with impairments, 19 were linked with activity limitations, 3 items were linked with restrictions on participation, and 7 were linked with both activity limitations and restrictions on participation.

Two of seven questionnaires assessed by Farzad et al. [39] were DASH and MHQS. DASH was linked with 16 of activity/participation categories of ICF hand core set, and the MHQS was linked with 10 of activity/participation categories of ICF hand core set, so the MHQS had the highest rate to cover activity/participation categories of ICF hand core set. 30 of a total of 38 items of DASH and 20 of a total of 37 items of MHQS were linked with activity/participation categories of ICF hand core set. It was reported that relation between the impairment and activity limitation and restriction on participation might indicate the effectiveness of treatment.

Forget and Higgins [40] examined 13 indexes in 15 articles for a literature review of participants with musculoskeletal problem in the upper extremity. Two of these indexes were DASH and MHQS. 4 items of DASH were linked with body functions, 12 items were linked with activity/participation, so a total of 16 items of DASH were linked with ICF hand core set, but 1 item was not linked with ICF hand core set. 32 items of MHQS were linked with body functions, 38 items were linked with activity/participation, so a total of 70 items of MHQS were linked with ICF hand core set, but 26 items were not linked. They concluded that none of the scales included all of the categories recommended by ICF hand core set. For example, the MHQS was reported to cover the recommended categories the most.

In our study, the DASH was linked with 6 of body function categories and 15 of activity/participation categories of ICF hand core set, so it was linked with a total of 21 (17.94%) categories. The MHQS was linked with 8 (21.62%) of body function categories, and 10 (26.31%) of activity/participation categories, so it was with a total of 18 (15.38%) categories. We found linkage between the DASH and body function and activity/participation categories of ICF hand core set. We consider that DASH might be an assessment scale that could indicate functional restrictions on RA patients and describe activity and participation problems related to functional insufficiency. It is common that hand is functionally affected in terms of musculoskeletal system in RA patients. The MHQS is able to individually assess two hands in detail. Based on such linking, the MHQS can provide the most comprehensive assessment of body functions.

A study investigated linking of DHI with ICF and reported that DHI was linked with 11 categories of ICF [41]. The present study found that DHI was linked with 8 (21.05%) of activity/participation categories of ICF hand core set. We consider that this difference might be due to use of ICF hand core set for the linking. Therefore, we suggest to reassess DHI for these parameters, because patients with RA do not reflect body functions and environmental factors, and there is a low linking for activity/participation.

Stucki and Cieza [32] assessed the Health Assessment Questionnaire, Short Form-36 and AIMS 2, and reported that AIMS 2 was the most comprehensive scale specific to disease in participants with RA. ICF hand core set was used for linking of RA. 31 items of AIMS 2 were linked with 6 body function categories of ICF hand core set, and 49

items were linked with 38 activity/participation categories of ICF hand core set. In this study, the AIMS 2 was linked with 3 (8.10%) of body function categories, 20 (52.63%) of activity/participation categories, 2 (4.76%) of environmental factor categories of ICF hand core set, so it was linked with a total of 25 categories (21.36%). The AIMS 2 was the most comprehensive scale among disability scales that we chose, because it had the highest match for activity/participation and was the only scale to assess environmental factors. We consider that AIMS 2 is the most appropriate for assessment of activity/participation in patients with RA.

Cieza et al. [11] commented that there were no items aimed at structural components of ICF, and the content of scales was not intended to provide information on medical condition rather than assessing individuals' aspects related to functionality. The reason why the scales do not include environmental factors might be a limitation of their content. It is important not to overlook this external component of functionality, because this information is significant for assessment process.

In our study, we also used the original scoring of scales of which items were linked with ICF hand core set and allocated to ICF components in order to calculate the scores of subjective impairment, activity/participation and environmental factors in accordance with clinical data for 100 participants with RA.

Fransen et al. [42] found a good correlation of impairment measures (DAS28) with outcomes of scales that represent activity limitation. Farzad et al. [39] reported a significant but low correlation of objective impairment with outcomes representing activity and participation, and a high correlation of subjective impairment (scores for body functions) with outcomes representing activity and participation.

In our study, the objective impairment (DAS28) was moderately correlated with outcomes representing activity and participation in all of the scales. The subjective impairment (scores for body functions) was highly correlated with outcomes representing activity and participation for DASH and MHQS, and was moderately correlated with AIMS 2. Furthermore, in our study, the objective impairment (DAS28) was moderately correlated with outcomes (scores for body functions) representing subjective impairment, and the subjective impairment (scores for body functions) was poorly correlated with scores representing environmental factors.

These results show that assessment of clinicians is associated with levels of patient-reported impairment, and the levels of patient-reported impairment were also affected by environmental factors. The interaction between the subjective impairment and the environmental factors was significant, and low correlation found in this study might be due to use of only one questionnaire and a few questions in this questionnaire.

Limitations

The limitations of this study are that investigators that established the link were from the same discipline.

Conclusions

In summary, the MHQS was the scale that was linked with body function categories of ICF hand core set the most, and the AIMS 2 was found to be the most linked scale with categories of activity/participation and environmental factors. Therefore, the AIMS 2 was found to be the most comprehensive scale among four assessed disability scales for ICF hand core set. We identified that impairment (DAS28) was moderately correlated with subjective impairment (scores for body functions), and the subjective impairment (scores for body functions) was moderately correlated with outcomes representing environmental factors; so we concluded that healthcare professionals are able to sufficiently assess the sense of impairment felt by the patients, and patient-reported impairment might be affected by environmental factors.

The findings of this study may guide to assess functionality, to generate a patient profile using their biopsychosocial aspects, and to use patient-reported outcome measures by the healthcare professionals and investigators in clinics, and may inspire the future studies to investigate the link between the ICF components.

DASH, MHQS, DHI and AIMS 2 do not include several domains and categories of ICF hand core set. Such restrictions of scales may be overcome with concurrent use of other scales, considering the intended content, or such studies may identify restrictions of scales to improve existing scales, or such restrictions may be considered for scales to be developed in order to have more improved scales for more comprehensive assessment of patients in all aspects. Therefore, the clinicians and investigators would be enabled to use one scale rather than several scales in line with their intention, which will save us time.

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Author contributions EGK, UBA, and BBC designed the study. MT and VC searched databases and performed the selection of studies; EGK, UBA, and BBC wrote the manuscript; EGK, UBA, and BBC analyzed the data; and UBA, BBC, and VC contributed to writing and critically uprising the manuscript and approved the last version.

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Compliance with ethical standards

Conflict of interest Author Elif Gur Kabul, Author Ummuhan Bas Aslan, Author Bilge Başakcı Calik, Author Murat Tasci, and Author Veli Cobankara declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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The efficiency of inspiratory muscle training in patients with ankylosing spondylitis

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Abstract
Ankylosing spondylitis (AS) is an inflammatory rheumatic disease affecting mainly the axial skeleton and sacroiliac joints. The aim of the current study was to investigate the effects of inspiratory muscle training (IMT) on respiratory muscles and functional exercise capacity, as well as on the specific outcomes of the disease in AS patients. A total of 32 AS patients (mean age 37.37 ± 10.41 years) were randomly assigned as the Training Group (TG) ($n = 16$, mean age = 35.62 ± 8.18 years) who received IMT + conventional exercise, and the Control Group (CG) ($n = 16$, mean age = 39.12 ± 12.26 years) who only performed the conventional exercise program. All the subjects were evaluated at baseline and at the end of the 8th week. Respiratory muscle strength was assessed by measuring the maximal inspiratory pressure (PImax) and maximal expiratory pressure (PEmax). Functional exercise capacity was measured using the 6-min walk test (6MWT). The Bath AS Disease Activity Index (BASDAI), Bath AS Disease Function Index and Bath AS Metrology Index were used for activity, function and basic measurements of the disease. A statistically significant improvement was determined in the PImax ($p = 0.000$), PEmax ($p = 0.002$), 6MWT ($p = 0.041$) and BASDAI ($p = 0.049$) values in the TG after training. There was a significant difference between baseline and after conventional exercise in terms of PEmax ($p = 0.017$) in the CG. The PEmax ($p = 0.001$) and the 6MWT ($p = 0.053$) values were significantly better in the TG. The results of this study demonstrated that IMT in addition to conventional exercises increased inspiratory muscle strength, functional exercise capacity and positively affected the disease activity in AS.

Keywords Ankylosing spondylitis · Exercise training · Respiratory muscle training · Outcome measures

Introduction

Ankylosing spondylitis (AS) is an inflammatory rheumatic disease affecting mainly the axial skeleton and sacroiliac joints [1]. In AS, the inflammation of the thoracic and costovertebral joints results in gradual fusion and ossification over time and this negatively affects the mobility of the costa and thoracic expansion. This leads to increased dorsal kyphosis, thorax rigidity and permanent chest wall movement limitation in some patients [2–6]. Decreased

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expansion and lung volume as a result of mechanical constriction caused by ankylosis of the thoracic joints explain the restrictive respiratory pattern in these patients. In addition, previous studies have shown that the inflammatory process of the disease contributes to a reduction in pulmonary function by causing pain and stiffness in the thoracic joints [2, 7, 8].

It has been reported that the reduction of respiratory muscle strength in AS patients may be due to a weakened respiratory intercostal muscle [9]. Electromyographic measurements of the diaphragm and intercostal muscles have revealed that inspiratory muscle fatigue developed during exercise in AS patients, and respiratory muscle strength decreased due to intercostal muscle atrophy [9, 10]. It has been reported that respiratory muscle strength is lower in AS patients and that respiratory and respiratory muscle endurance, especially maximal inspiratory pressure, may be the determinants of exercise capacity in these patients [11, 12]. It is thought that inspiratory muscle strengthening could prevent or delay the complications that may occur due to inspiratory muscle weakness [13].

Changes in the respiratory pattern in AS patients may affect the pH level of the body by altering respiratory gas exchange, especially partial end-tidal carbon dioxide ($PetCO_2$) [14, 15]. Changes in respiratory-induced pH are associated with a decrease in cerebral blood flow and result in different symptoms such as dizziness, headache, visual disturbances, dyspnea, palpitations, fatigue, muscle tetany, thoracic pain, paresthesia and increased neuronal excitability [14]. Therefore, reduced respiratory function can be shown to be both a symptom and a causative factor for AS. It is thus thought that inspiratory muscle training in individuals with AS may provide benefits in many respects.

Previous studies in the literature have examined the effectiveness of inspiratory muscle training in different disease groups [16–18]. In only one study of patients with AS was the effect examined of inspiratory muscle training on pulmonary functions and aerobic capacity [19]. The aim of the current study was to investigate the effects of inspiratory muscle training in AS patients on respiratory muscles and functional exercise capacity, as well as on the specific outcomes of the disease.

Methods

In this randomized, controlled parallel group study, the effects of inspiratory muscle training on AS individuals were assessed by comparisons with the control group. The evaluations before and after the training program were performed by two physiotherapists who were experts in their field. Specific assessments of AS and conventional exercise training were given by a specialist physiotherapist (EGK), and the respiratory muscle assessment and inspiratory muscle training were given by another experienced and certified physiotherapist (HT) in this field.

Participants

The study included 32 patients (mean age 37.37 ± 10.41 years) diagnosed with AS according to the Modified New York Criteria of the Rheumatology Clinic of the PAU Medical Faculty Hospital. Using the closed envelope randomization method, the participants were randomly divided into two groups. The flow chart of the study is shown in Fig. 1. Conventional exercises were given to all participants as home-based exercises. The training group ($n = 16$), (mean age $= 35.62 \pm 8.18$ years) performed inspiratory muscle training and conventional exercise, and the control group ($n = 16$), (mean age $= 39.12 \pm 12.26$ years) only performed the conventional exercise program. The demographic data are shown in Table 1.

The inclusion criteria for the inspiratory muscle training group and the control group:

- A diagnosis of AS according to the Modified New York criteria
- Participating voluntarily in the study
- Aged 20–65 years
- Stable drug (NSAID or TNF inhibitors) use for at least 3 months or longer.

Exclusion criteria for the inspiratory muscle training group and the control group

- A history of surgery within the last 6 months.
- Any active disease period (active arthritis in the joints, enthesitis) in the last 3 months.
- Communication problems
- Any respiratory disease or other neuromuscular disease that may affect the respiratory muscles.

The criteria for withdrawal during the study;

- Those who cannot complete all the tests
- Those with any other disease (diabetes, cardiovascular disease, acute renal failure) during the study period
- Individuals who cannot complete the training

Approval for the study was granted by the Pamukkale University Ethics Committee for Non-Interventional Clinical Investigations (decision no: 60112787-020/81274, dated 12/29/2016). Informed consent was obtained from all participants.

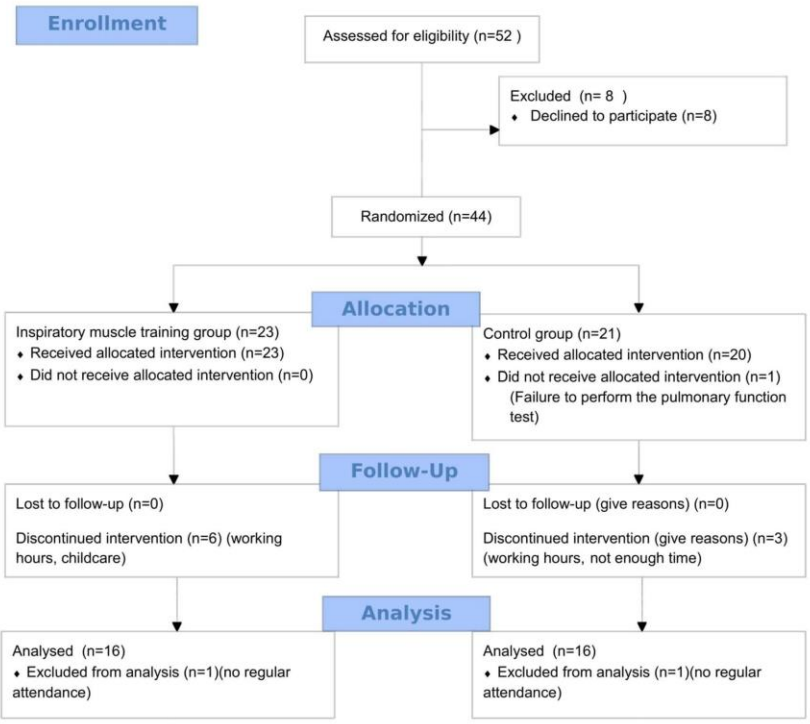

Fig. 1 Flow chart of the progress through the phases of the study according to the CONSORT statements

Table 1 Characteristics of the study participants

Characteristic	IMTG (*n*:16)		CG (*n*:16)		*p* value
	M	SD	*M*	SD	
Age (years)	35.62	8.18	39.12	12.26	0.350*
Body mass (kg)	77.81	18.54	69.25	15.11	0.163*
Body height (m)	1.65	0.09	1.64	0.09	0.884*
Body mass index (kg/m^2)	28.52	8.23	25.65	6.07	0.276*
Disease duration	7.87	7.23	8.03	7.56	0.742*
Sex (f/m)	9/7		9/7		1.000**
Drugs NSAID/Anti-TNF	8/8		9/7		1.000**

f female, *m* male, *M* mean, *SD* standard deviation, *IMTG* inspiratory muscle training group, *CG* control group

*Independent *t* test, **Chi-square tests

Measures

All evaluations at baseline and at the end of the 8th week were performed by the same physiotherapists according to the standardized test protocols in the same conditions. The demographic data, habits and information about the disease were recorded on a registration form during face-to-face interviews (Table 1). The Bath AS Disease Activity Index (BASDAI), Bath AS Disease Function Index (BASFI) and Bath AS Metrology Index (BASMI) were used for activity, function and basic measurements of the disease and respiratory muscle strength measurements were taken. Functional exercise capacity was measured using the 6-min walk test (6MWT).

Bath AS Disease Activity Index (BASDAI)

The Bath AS Disease Activity Index (BASDAI), which was developed to assess disease activity, consists of six VAS

measurements of fatigue, spinal and peripheral joint pain, sensitivity and morning stiffness. The patients responded to each item indicating a point on the 10 cm line considering their status during the last week only. Since items 5 and 6 were both related to morning stiffness, the average score of these two items was calculated and added to the scores of the first 4 items. The final average score, a value between 0 and 10, was calculated by dividing the total by 5. This index is sensitive to change and reproducibility, and can be completed quickly. Validity and reliability of the Index have been proven [20].

Bath AS Disease Function Index (BASFI)

The functional capacity of the patient during the previous week was measured using the BASFI. This index consists of eight questions related to daily activities and two questions about the ability of the patient to cope with daily life. The patients mark the 10-cm VAS scale according to the difficulty of undertaking the indicated tasks. The average score of the ten questions is calculated to give a total score between 0 and 10 [21].

Bath AS Metrology Index (BASMI)

The Bath AS Metrology Index (BASMI) was developed by evaluating the clinical evaluation methods and selecting the five with the highest validity, reliability, reproducibility and change sensitivity features. There is also a strong association between BASMI and radiological evaluation, and it is an appropriate method for evaluating axial involvement due to its sensitivity for response to treatment. In a study evaluating the validity and reliability of forward spinal motion measurements in conjunction with disease activity and quality of life parameters, the modified Schober test determined that hand–foot distance and cervical rotation were the best estimates of disease-related changes [22].

The BASMI index values were obtained by measuring cervical rotation, tragus to wall distance, lumbar side flexion, modifed Schober test, intermalleolar distance, and scoring the limitations for each criterion between 0 and 2. The total score ranged from 0 to 10 [23].

Measurement of respiratory muscle strength

Respiratory muscle strength was assessed by measuring the maximal inspiratory pressure (PImax) and maximal expiratory pressure (PEmax) using a portable spirometry with an additional flanged mouthpiece pressure-measuring device (COSMED Pony FX). The subjects were encouraged to use maximum strength and coordination in the PImax and PEmax measurements. The manoeuvers were performed three times and the best of measurements was recorded. To avoid short-term fatigue of the respiratory muscles, a rest break of 1 min was given between the measurements. The PImax measurement was performed using the residual volume, whereas the PEmax was performed using the total lung capacity [24].

Six-minute walk test (6 MWT)

Exercise capacity was measured using the 6-min walk test (6MWT). The test was performed in a 30-m corridor in accordance with the testing guidelines [25]. Prior to the test, perceived resting heart rate, resting peripheral oxygen saturation, and resting blood pressure were measured. The distance walked by the patient in 6 min was recorded.

Inspiratory muscle training (IMT)

The method most commonly used for inspiratory muscle training (IMT) is the inspiratory threshold, first described by Nickerson and Keens [26]. The Threshold-IMT provides consistent and specific pressure for inspiratory muscle strength. A flow-independent one-way valve is suitable for all patients. When the subject generates sufficient vacuum pressure by breathing through the mouthpiece, the spring-loaded valve is opened and airflow is initiated. The amount of resistance can be set in 2-cm H_2O increments from 7 to 41 cmH_2O by changing the compression of the spring-loaded valve [27].

Inspiratory muscle training increases MIP and Vimax. Strengthening training requires repetitive maximal inspiratory effort against the closed glottis. Inspiratory training to increase Vimax is achieved by repeating the maximal inspiratory effort. Inspiratory muscle training to increase both MIP and Vimax requires intense pressure or inhalation of flow-through external resistance [28, 29].

In the IMT group, after the MIP and MEP measurements, training was carried out with threshold loading by taking the criteria of the inspiratory muscle pressure value using the 'Threshold Inspiratory Muscle Trainer' (Respironics New Jersey Inc.). IMT was started at an intensity of 50% of the PImax as determined in the baseline assessment and increased in increments of 2 cmH_2O daily, according to patient tolerance. For the IMT, the subjects were asked to perform a strong inspiration in a comfortable seated position, at the adjusted pressure, followed by a normal expiration. With each session consisting ten breaths, three sessions were performed per day, 5 days a week for a total of 8 weeks [30]. The first 4 weeks of the training were administered under the supervision of a physiotherapist and the patients were invited to the clinic for pressure control at the beginning of each week. The subjects were also recommended to use an incentive spirometer without supervision for the next 4 weeks.

Conventional exercises

All patients were given a conventional exercise regimen which consisted of 20 exercises: motion and flexibility exercises of the cervical, thoracic, and lumbar spine; stretching of the erector spine muscle, hamstring muscles, and shoulder muscles; and chest expansion exercises, controlled abdominal, and diaphragm breathing exercises [31].

Statistical analysis

It was estimated that when 32 subjects were included in the study as a result of the power analysis performed (16 patients in each group), 95% confidence and 80% power would be obtained. The data were analyzed using SPSS version 21.0 software. The Kolmogorov–Smirnov test was used to determine whether continuous variables conformed to normal distribution. If the data distribution was normal, the paired samples *t* test was used within groups and the independent *t* test was used between groups. If the data distribution was not normal, the Wilcoxon signed-rank test was used within groups and the Mann–Whitney *U* test was used between groups. Continuous variables were shown as mean ± standard deviation, and categorical variables were given as number and percentage. The data at baseline and at the end of 8 weeks were compared using the paired samples *t* test or the Wilcoxon signed-rank test within the groups and the independent *t* test or the Mann–Whitney *U* test were used to compare delta values between the groups. The statistical significance level in the statistical test results was accepted as $p \leq 0.05$.

Results

During this study of 32 participants, no problems related to the evaluations and training were reported. There was no statistical difference between the demographic data of the groups ($p > 0.05$), (Table 1).

Results of in-group assessments before and after training

In the IMT group in comparison with the pretraining values, the maximum inspiratory pressure ($p = 0.000$), maximum expiratory pressure ($p = 0.002$), 6MWT ($p = 0.041$) and BASDAI ($p = 0.049$) results were statistically significantly improved after training. In the control group, there was a significant difference between baseline and after the home-based exercises in respect of the maximum expiratory pressure measurements ($p = 0.017$). No other results were significant in either group (Table 2).

The inter-group comparison after training

When the differences between pre- and posttraining were compared between the groups, the maximum inspiratory pressure ($p = 0.001$) and the 6MWT ($p = 0.053$) values were statistically significantly better in the training group (Table 3).

Discussion

This study is the first randomized controlled study to have examined the effect of inspiratory muscle training in AS, in addition to conventional exercise, on respiratory muscle

Table 2 The comparison of pre- and post-treatment results of groups

Variables	IMTG (*n*:16)		*p* value	CG (*n*:16)		*p* value
	Pre	Post		Pre	Post	
	M ± SD	*M* ± SD		*M* ± SD	*M* ± SD	
PImax	64.52 ± 18.68	87.33 ± 16.52	**0.000***	63.72 ± 11.07	69.58 ± 14.54	0.117*
PEmax	76.62 ± 29.73	92.47 ± 32.07	**0.002***	66.58 ± 20.25	72.87 ± 18.61	**0.017***
6MWT	513.41 ± 52.67	532.27 ± 63.61	**0.041***	496.46 ± 66.17	486.02 ± 92.53	0.465*
BASFI	3.17 ± 2.13	2.88 ± 2.28	0.481*	3.13 ± 2.98	2.61 ± 2.25	0.170*
BASDAI	4.52 ± 2.75	3.57 ± 2.77	**0.049****	4.48 ± 3.17	3.25 ± 2.34	0.083**
BASMI	3.37 ± 1.40	2.81 ± 1.64	0.070*	2.93 ± 1.48	2.43 ± 0.96	0.088*

Significant values are shown in bold

M mean, *SD* standard deviation, *IMTG* inspiratory muscle training group, *CG* control group, *PImax* maximum inspiratory pressure, *PEmax* maximum expiratory pressure, *6MWT* six-minute walk test, *BASFI* Bath Ankylosing Spondylitis Functional Index, *BASDAI* Bath Ankylosing Spondylitis Disease Activity Index, *BASMI* Bath Ankylosing Spondylitis Metrology Index

*Paired sample *t* test, **Wilcoxon test

Table 3 Comparison of delta values to groups

Variables	IMTG (*n*:16) Δ	CG (*n*:16) Δ	*p* value
PImax	22.81 ± 12.99	5.85 ± 14.07	**0.001***
PEmax	15.85 ± 17.25	6.28 ± 9.39	0.070**
6MWT	17.16 ± 29.56	− 10.44 ± 55.67	**0.053****
BASFI	− 0.29 ± 1.61	− 0.51 ± 1.42	0.895**
BASDAI	− 0.95 ± 2.22	− 1.23 ± 2.29	0.910**
BASMI	− 0.56 ± 1.15	− 0.50 ± 1.09	0.875**

Significant values are shown in bold

IMTG inspiratory muscle training group, *CG* control group, Δ post-training–pretraining, *PImax* maximum inspiratory pressure, *PEmax* maximum expiratory pressure, *6MWT* six-minute walk test, *BASFI* Bath Ankylosing Spondylitis Functional Index, *BASDAI* Bath Ankylosing Spondylitis Disease Activity Index, *BASMI* Bath Ankylosing Spondylitis Metrology Index

*Independent *t* test, **Mann–Whitney *U* test

strength, functional exercise capacity and disease activity. The results of this study demonstrated that inspiratory muscle training in addition to conventional exercises increased inspiratory muscle strength, functional exercise capacity and positively affected the disease activity in AS.

Inspiratory muscle strength was seen to significantly increase with inspiratory muscle training in this study. Previous comparative studies in the literature have shown that respiratory muscle strength decreases in individuals with AS [9, 32]. There have been few exercise studies with inspiratory muscle training on patients with AS. The first study in the literature which aimed to increase respiratory muscle strength in AS individuals was conducted by Draogi et al. [19]. Inspiratory muscle training was applied in addition to conventional exercise in one group, while the other group performed conventional exercise only. When differences between the groups were compared at the end of 8 weeks, the inspiratory muscle training group showed improvements in FVC% value and VO_{2max} amount but no difference was determined in FEV1% value. In the current study, inspiratory muscle training was applied in addition to conventional exercises but unlike the Dragoi study, respiratory muscle strength was measured, the lack of which was reported as a weakness in the study by Dragoi.

A case study of AS with inspiratory muscle training also showed the positive effects on training of respiratory changes and respiratory muscle strength [33]. Ortancil et al. found that inspiratory and expiratory muscle strength significantly increased after a 6-week home-based exercise program [34]. It is known that regular exercise in AS is beneficial for maintaining and improving mobility of the spine and peripheral joints, strengthening the muscles of the trunk, legs, back, abdomen and increasing the functional capacity and quality of life, but, studies evaluating the effects of exercises on respiratory functions, especially on respiratory muscle strength are limited. Exercise was reported to increase vital capacity and forced expiratory volume. In one study, significant improvements in the chest expansion and vital capacity after 3 months of multimodal exercise program (an aerobic, stretching, and pulmonary exercise program) in patients with AS [35]. As the inspiratory and expiratory muscles can be developed in AS individuals, this demonstrates that these patients are affected by the disease process. Therefore, by primarily evaluating the inspiratory and expiratory muscle strength, the inspiratory muscle training program was applied to strengthen these muscles. As a result of the study, a significant improvement was determined in the MIP value in the training group after inspiratory muscle training when the differences between the groups were compared, and similar to previous findings in the literature, it was demonstrated that the inspiratory muscle strength could be improved by training. Consequently, respiratory muscle strength can be considered to be reduced in AS individuals, and inspiratory muscle training, which is a cheap, easily obtainable and effective method, can help to improve this strength.

The current study is the first study to have examined the effect of inspiratory muscle training on functional exercise capacity in addition to inspiratory muscle strength and the results show that inspiratory muscle training improved the functional exercise capacity. A number of studies have shown that functional exercise capacity is reduced in AS individuals. In a comparative study with healthy subjects, it was found that aerobic capacity and forced vital capacity decreased in AS individuals, while there was a correlation between aerobic capacity, vital capacity, thoracic expansion and functional level [36]. In a study conducted in 2011, it was thought that exercise intolerance caused by decreased aerobic capacity in AS individuals may be due to impaired respiratory function [37]. Abnormally high load on the respiratory muscles occurs during (maximal) exercise, especially when chest wall compliance is reduced. In the study of van der Esch et al. it was suggested that respiratory pressure and respiratory muscle endurance, in particular maximal inspiratory pressure, may be determinants of exercise capacity in patients with ankylosing spondylitis [12].

Based on this information, the current study aimed to investigate whether or not functional exercise capacity could be developed with the application of inspiratory muscle training in addition to conventional exercises in AS individuals. Dragoi et al. [19]. showed that the VO_{2max} could improve in AS patients with the addition of inspiratory muscle training to conventional exercises. In a case study by Wong et al. [33]. in which IMT was applied, exercise capacity was evaluated by VO_{2max}. and an increase in VO_{2max}. was reported after training. In the current study, the 6MWT was used to assess functional exercise capacity.

When the differences between the groups were compared after training, the difference was found to be significant in

favor of the inspiratory muscle training group. The training was thought to increase the inspiratory muscle strength, improve the respiratory system, cause more efficient use of the oxygen consumed at the same workload, and therefore, be reflected in the increase in functional exercise capacity, resulting in an improvement in fatigue level.

ASAS absolutely recommends the use of BASMI, BASDAI and BASFI assessment methods in the evaluation and follow-up of AS patients [38]. Therefore, the specific results of the patients with AS in this study were evaluated with these methods. The group applied with inspiratory muscle training in addition to conventional exercise showed a significant improvement in disease activity after training, but there was no significant difference between the groups. This difference after training demonstrated that inspiratory muscle training resulted in improvements in the BASDAI, by which the patients were evaluated for fatigue, pain, enthesis, and severity and duration of morning stiffness, which are very important symptoms for these patients. However, the fact that both groups exercised to develop spinal mobility and general muscle strength could be the reason that there was no difference between the groups. In the only previous randomized controlled study where inspiratory muscle training was applied, only BASMI and BASDAI were evaluated and no analysis was carried out to examine the effect of IMT on these parameters [19].

The current study can be considered to be strong in the following aspects: this is one of only a limited number of studies of inspiratory muscle training applied to AS patients. Unlike other studies, respiratory muscle strength was measured and disease activity was evaluated in the current study.

The limitation of this research is that the long-term effect of inspiratory training in AS patients was not assessed.

Decreased chest wall mobility in AS patients has a negative effect on lung compliance, which activates the diaphragm and accessory respiratory muscles. This inactivity in the rib cage is compensated by the diaphragm. The development of inspiratory muscle strength with IMT contributes to the increase in thoracic mobility and hence the oxygenation process in individuals with AS. This can be considered to lead to an increase in functional exercise capacity by reducing the fatigue level of the individual. In addition, the increase in oxygenation may have a positive influence on the inflammatory process, leading to the development of positive results in disease activity.

The pragmatic results of this study can be summarized as follows:

- The assessment of the respiratory muscle strength of AS individuals and determination of the level of influence is important.
- In individuals with AS, IMT improves inspiratory muscle strength.
- IMT improves functional exercise capacity in AS individuals
- In AS individuals, IMT makes a positive contribution to reducing disease activity.
- Future studies are needed to investigate the effects of respiratory muscle training in AS individuals.
- The addition of an inspiratory muscle training protocol to the rehabilitation program of AS patients can be recommended for improving inspiratory muscle strength.

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Author contributions BBC, EGK, HT, OTA and UBA designed the study. MT, FB and AIY searched databases and performed the selection of studies; BBC and OTA wrote the manuscript; BBC, EGK, HT, OTA and UBA analyzed the data; BBC, OTA and UBA contributed to writing and critically uprising the manuscript and approved the last version.

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Compliance with ethical standards

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Conflict of interest Author Bilge Basakcı Calık, Elif Gur Kabul, Harun Taskın, Orcin Telli Atalay, Ummuhan Bas Aslan, Murat Tascı, Fahrettin Bıcakcı, Ali Ihsan Yıldız declare that they have no conflict of interest.

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ORIGINAL ARTICLE

Reliability and Validity of the Turkish Version of the ABILHAND Questionnaire in Rheumatoid Arthritis Individuals, Based on Rasch Analysis

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ABSTRACT

Objectives: This study aims to assess the reliability and validity of the Turkish version of the ABILHAND questionnaire in individuals with rheumatoid arthritis (RA) [ABILHAND-RA (TR)] using the Rasch analysis.

Materials and methods: A total 90 individuals (15 males, 75 females; mean age 51.8±10.9 years; range, 20 to 65 years) diagnosed as RA according to the criteria of the American College of Rheumatology were included. The ABILHAND-RA (TR) was used to determine manual ability, while disease activity was evaluated by the use of Disease Activity Score 28 (DAS28). Jamar hand dynamometer and pinch-meter were used to examine grip and pinch strength of the participants. Nine Hole Peg Test (NHPT) and Duruoz Hand Index (DHI) measured hand disability level. Nottingham Health Profile (NHP) was used to assess quality of life. ABILHAND-RA (TR) results were analyzed using the Rasch analysis method.

Results: Item 20 was excluded from the 27-item ABILHAND-RA (TR) as 96% of the individuals rated this item as "easy". The new set of 18 items (7 subtests and 11 items) were found to sustain item invariance and fit to the Rasch model. Significant relationships were found between ABILHAND-RA (TR) and DAS28, bilateral grip strength, NHPT dominant side results, DHI, and NHP.

Conclusion: Turkish version of the ABILHAND-RA was found to be clinically valid, reliable, and sensitive enough to be used in clinical evaluations, rehabilitation interventions, and for progression follow-up in individuals with RA.

Keywords: Activities of daily living, questionnaires, rheumatoid arthritis, upper extremity.

Rheumatoid arthritis (RA) is a chronic and systemic inflammatory disease with accompanying articular and extraarticular symptoms.[1] It is the most common chronic inflammatory polyarthritis in adults affecting 1% of the population.[2] According to a study conducted in 2006, prevalence of RA in Turkey was found to be 0.36%.[3]

Rheumatoid arthritis may affect joints with symmetrical involvement; however, it was reported that relatively small joints such as phalangeal joints and wrist may be affected more frequently in early phases.[4] It is thought that hand and wrist are the mainly affected joints in 80 to 90% of the individuals with RA; representing symptoms of inflammation, mild to severe deformities, pain, muscle weakness, and range of motion limitation that eventually lead to functional loss.[5]

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It is considered that in addition to hand grip, pinch grip, and range of motion as objective measurements, the most reliable way to assess functional capacity of an individual is to evaluate perceived functional level using targeted tools as Nine Hole Peg Test (NHPT) and Duruoz Hand Index (DHI).[6] During the last decade, various evaluation tools (i.e., arthritis impact measurement scale, disability of the arm, shoulder and hand questionnaire, and Michigan hand outcome questionnaire) have commonly been used in clinical research for measuring the outcomes of related interventions. The aim of using evaluation tools is defined as to identify the overall difficulty in performing daily activities that is usually referred to as disability.[7] However, mostly, these generic tools were not designed to assess rheumatoid hand by focusing on the functional outcome of an intervention targeted to rehabilitate hand skill and/or to increase functional capacity of an individual.

ABILHAND questionnaire was developed as a hand skill measurement tool based on individuals' perceptions. It was initially developed and validated for persons with RA[8] and then for persons with chronic stroke[9] as well as for several other diagnoses.[10-13] ABILHAND questionnaire focuses on inventories that best represent hand activities. Some of the items were chosen from current tools, whereas others were designed to enrich the variety of hand activities. ABILHAND questionnaire, which was not designed to evaluate hand function specific to RA, originally contains 56 items. Following a successive Rasch analysis conducted by Durez et al.,[14] the number of items was reduced to 27, which were found to be much more sensitive and appropriate for assessing and discriminating hand skills.

Manual ability may be defined as the capacity of performing daily activities that require the use of upper extremities. Manual ability is evaluated by questionnaires that determine the perceived difficulties during activity performance. Linear measurement of manual ability is possible only with the help of obtained raw scores that are suitable for a given Rasch model.[9] Recently, the tendency to use Rasch models has increased due to its ability to ease the development and validation of outcome measurement tools.[15] Rasch analysis helps to convert ordinal scores into linear measurements and gather psychometric data that are otherwise impossible to obtain by using classical test theories.[9,16,17] The most significant advantage of linear measurements is their ability to provide equally distributed units that allow obtaining correct results while performing inter- and/or intra-individual comparisons.[18] Equivalent scores show the level of equivalency of the measured construct in different populations, which is a necessity to represent the cultural stability of a given measure.[19] Therefore, in this study, we aimed to assess the reliability and validity of the ABILHAND-RA (TR) using the Rasch analysis.

MATERIALS AND METHODS

A total of 90 individuals (15 males, 75 females; mean age 51.8±10.9 years; range 20 to 65 years) with RA were recruited between September 2016 and June 2017 from Pamukkale University Faculty of Medicine Rheumatology Outpatient Clinic. RA diagnosis was established according to the classification criteria of the American College of Rheumatology.[20] *Inclusion criteria* were *(i)* being aged between 20-65 years, *(ii)* having stable medical treatment for the last six months prior to the study, and *(iii)* being fluent in Turkish language. *Exclusion criteria* were *(i)* having a neurological condition affecting hand functions (peripheral nerve lesion, prior trauma and/or surgery, or cerebrovascular condition), *(ii)* having any psychiatric condition that may affect cooperation, or *(iii)* having heart failure and/or pulmonary pathology that may affect the performance in daily activities. The study protocol was approved for non-interventional clinical investigations by the Pamukkale University Faculty of Medicine Ethics Committee (decision no: 60116787-020/2755, dated 01 November 2017). A written informed consent was obtained from each participant. The study was conducted in accordance with the principles of the Declaration of Helsinki. Demographic characteristics of the individuals were collected via a structured interview. All participants were evaluated in the outpatient clinic by the same researcher. Disease activity was calculated using Disease Activity Score 28 (DAS28).[21] Functional tests were performed in a single session that lasted about 45 to 60 minutes.

Manual ability was evaluated using the ABILHAND-RA (TR), an inventory of 27 common manual activities, rated as: 0= impossible,

1= difficult, 2= easy. The volunteer was asked to evaluate the ease of performing the activities of daily living regardless of the limb(s) actually used and the strategy used.[8]

Maximum voluntary handgrip, fingertip grip, lateral grip, and tripod grip force were measured using the Jamar dynamometer and a pinch-meter according to the procedure explained by Mathiowetz et al.[22] Manuel dexterity was assessed using the NHPT.[23] All tests were performed for both hands starting from the less affected hand defined by the individuals themselves.

To evaluate disability of the hand, individuals completed the DHI that comprises of 18 questions. DHI consists of questions that are divided into five categories as kitchen, dressing, hygiene, in the office, and other activities. Answers are structured and scored as: "Yes, without difficulty" (=0), "Yes, with a little difficulty" (=1), "Yes, with some difficulty" (=2), "Yes, with much difficulty" (=3), "Nearly impossible to do" (=4), "Impossible" (=5). Total score is the sum of all answers and ranges from 0 to 90. Higher score indicates disrupted hand functions.[24]

The health related quality of life was evaluated by using the Nottingham Health Profile (NHP). NHP is comprised of 38 items where each item is answered as "Yes" or "No". Six categories were evaluated within NHP as energy level, pain, emotional reactions, sleep, social isolation, and physical skill. Total score ranges between 0 and 100. A higher score indicates lower quality of life.[25] Kucukdeveci et al.[26] conducted the Turkish version study of NHP previously.

During ABILHAND questionnaire's cross-cultural adaptation process, previously recommended procedures were followed in five stages.[27,28] Firstly, the questionnaire was translated from English to Turkish by two different independent translators, whose native language was Turkish, and then both translations were synthesized into one. Secondly, other two independent translators (native in English language) who were unaware of the original items performed back-translations of the previously obtained Turkish translation of the questionnaire. After the translations were completed, four physiotherapists experienced in RA, who did not participate in the translation processes, held a consensus meeting and prepared the pre-final version. Lastly, the pre-final version of ABILHAND-RA (TR) was administered to 10 individuals with RA to evaluate comprehensibility and to determine other linguistic fine-tuning. During these interviews, no conflicts were obtained related to the comprehension or clarity of the items. The 27-item ABILHAND-RA (TR) was provided in Appendix 1.

Statistical analysis

Internal construct validity and external construct validity (convergent validity) were determined by using the Rasch analysis (partial credit Rasch model) and Spearman's rank correlation coefficient (rho), respectively.[29-31] If any significant relationship was identified, the rho value was determined as "no relationship" or "insignificant relationship" between the values p=0.00-0.19, "weak (low) relationship" between p=0.20-0.39, "average relationship" between p=0.40-0.69, "strong (high) relationship" between p=0.70-0.89 and "very strong relationship" between p=0.90-1.0.[32] The relationship between questionnaire score and demographical data was analyzed using the appropriate Mann-Whitney U test or Spearman's rho. Wilcoxon signed-rank test results were provided for grip test comparisons.

Reliability was investigated by using person separation index (PSI).[33,34] Validities over 0.70 and over 0.85 were accepted as sufficient for group level and individual level analysis, respectively.[35] Intra-class correlation coefficient (ICC, one-way random model) was used to evaluate test-retest reliability.[36] The interpretation of ICC score was as follows: under 0.50=poor reliability, between 0.50-0.75=moderate reliability, between 0.76-0.90=good reliability, over 0.90=excellent reliability.[37]

The IBM SPSS version 21.0 software (IBM Corp., Armonk, New York, USA) and Rasch Unidimensional Measurement Model 2020 program (RUMM, Perth, Western Australia) was used to perform statistical analyses and calculations. Statistical significance value was set at $p<0.05$.

Investigation of Rasch model assumptions[38,39]

- The threshold ordering of polytomous items was investigated with the help of threshold graphs.

- *Local independence of items:* Residual item correlation over 0.3 or higher was accepted as local dependence.

Table 1. Demographic characteristics of participants (n=90)

Variables	n	%	Mean±SD	Median	Min-Max
Age (year)			51.8±10.9	54	20-65
Gender					
Female	75	83.3			
Male	15	16.7			
Dominant hand					
Right	81	90.0			
Left	9	10.0			
Body mass index (kg/m^2)			28.1±6.1	27.4	17.8-58.8
Disease activity score 28 (n=64)			2.90±1.41	2.76	0.96-6.40
Disease duration (year)			8.8±6.8	7.0	0.3-30.0
Morning stiffness (minute)			30.6±46.8	10.0	0.0-180.0

SD: Standard deviation; Min: Minimum; Max: Maximum.

- *Tests of model fit (misfit):* In the tests of model fit, insignificant results of chi-square test with Bonferroni adjustment (item-trait interaction statistics) indicated that the data set fits to the Rasch model and verified the property of invariance across the trait. For residuals within the range of ±2.5 and with chi-square values below 10, the items were accepted to fit to the Rasch model.

- *Unidimensionality:* Whether the model sustained the assumption of unidimensionality or not was investigated by comparing the two subdimensions, which were formed as a result of residual principal component analysis and had a threshold of at least.[12] The lack of any difference between the average of the two subdimensions and a confidence interval (CI) of 0.05 indicated unidimensionality.

- *Differential item functioning (DIF):* Two-way analysis of variance was used to test if there was any difference in the possibility of providing different answers to the same item by the individuals in different groups. The invariance in the item difficulty hierarchy among subgroups formed was based on age, sex, disease duration, and DAS28. Subgroups were: age (≤median age of 54 years ≥median), sex (female-male), disease duration (≤median duration of seven years ≥median) and DAS28 (≤median DAS28 of 2.76 years ≥median).

- The measurement's item and person detection were evaluated by comparing the mean person location level and the average item difficulty. In multiple tests for fit and DIF statistics, Bonferroni adjustment was applied.[40]

RESULTS

Demographic characteristics of the participants were presented in Table 1. Median Jamar grip strength of the dominant hand and non-dominant hand were measured as 15.4 kg (range, 2.7 to 39.3) and 14.6 kg (range, 0.0 to 36.7), respectively (Table 2). Grip strength of the

Table 2. Results of dominant hand and non-dominant hand

	Dominant			Non dominant				
	Mean±SD	Median	Min-Max	Mean±SD	Median	Min-Max	Z	p^*
Jamar grip strength (kg)	16.1±7.8	15.4	2.7-39.3	15.0±6.8	14.6	0.0-36.7	2.959	0.003
Pinch grip (kg)	3.2±1.7	2.83	0.50-10.00	3.1±1.6	2.83	0.00-8.66	1.627	0.104
Lateral grip (kg)	5.2±2.3	4.75	0.90-11.33	4.9±2.2	4.73	0.00-10.90	2.794	0.005
Tripod grip (kg)	4.0±1.8	3.58	1.00-9.50	3.7±1.5	3.48	0.00-8.36	2.586	0.010
Nine Hole Peg Test (sec)	21.7±4.2	20.86	15.06-41.33	22.2±4.8	21.20	0.00-38.66	2.652	0.008

SD: Standard deviation; Min: Minimum; Max: Maximum; * Wilcoxon signed-rank test.

Table 3. Descriptive data of scales applied

Scales	Mean±SD	Median	Min-Max
Duruoz Hand Index	18.4±17.6	11.50	0.00-67.00
Nottingham Health Profile total	252.4±154.3	236.27	0.00-543.76
Energy level	63.7±36.1	63.20	0.00-100.00
Pain	50.0±37.3	42.69	0.00-100.00
Emotional reactions	40.3±32.0	40.60	0.00-100.00
Sleep	28.4±3.0	19.75	0.00-100.00
Social isolation	39.2±31.9	38.82	0.00-100.00
Physical skill	30.8±19.8	21.99	0.00-78.70

SD: Standard deviation; Min: Minimum; Max: Maximum.

dominant hand was higher compared to non-dominant side (z=2.959; p=0.003). Similarly, significant differences were found in favor of the dominant side in the aspects of lateral grip, tripod grip, and NHPT results (p<0.05).

Internal consistency coefficient (Cronbach's alpha) value was identified as 0.953 for DHI. Identifiers related to the subdimensions of DHI and NHP were provided in Table 3.

The 27-item ABILHAND-RA scale was found to verify item invariance χ^2=36.476; standard deviation (SD)=27; p=0.105]. For the items 14 and 20, item function differences were detected with respect to DAS28. In items 7, 16, and 20, order of the thresholds was problematic (disordered threshold). In the scale that fulfilled the unidimensionality assumption, residual correlations were quite high between some items. In order to resolve local dependence issue and to increase the fit to the Rasch model, subtests were formed using these items (Appendix 2). Item 20, which 96% of the individuals marked "easy", was excluded (disordered threshold, uniform DIF and DAS28).

The remaining 18 items (7 subtests and 11 items) were found to sustain item invariance and fit to the Rasch model (χ^2=19.288; SD=18, p=0.374, with Bonferroni correction, 0.003 significance level). Fit residuals were identified (range, -1.752 to 1.065) and items were found to fit to the model. Mean item fit residual value and mean person fit residual value were

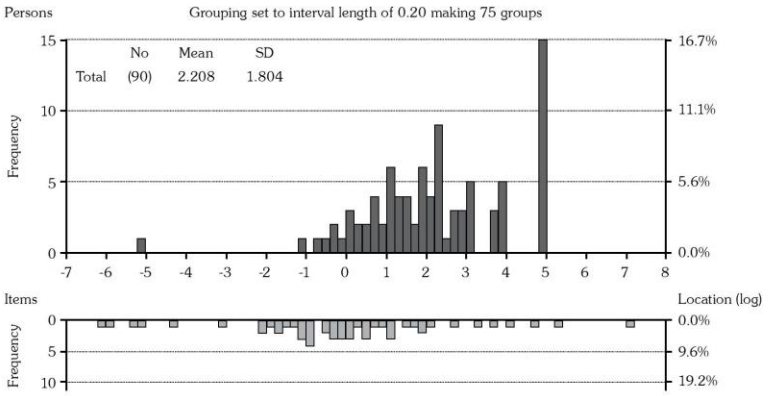

Figure 1. Person-item threshold distribution of Turkish version of ABILHAND questionnaire in individuals with rheumatoid arthritis.

-0.225±0.830 and -0.221±0.807, respectively. The obtained residual standard errors were at an acceptable level (<1.4). Item difficulty level was determined as minimum -1.700 logit and maximum 2.627 logit. An elevated logit value is an indicator for a more difficult item. Mean person location was 2.243±1.794 and mean item location was 0.000±1.066 (Figure 1). When residual correlations were analyzed, there was a borderline correlation only between item 9 and item 22 and no other values above 0.3 between the remaining items. There were no differences between the subsets identified after residual basic components analysis (set 1: SubTest (ST) 017, ST010, ST011, ST04, ST05, ST013; set 2: ST02, ST07, ST009, ST016, ST06) (t=5.393; proportion of significant tests: 5.6%, 95% CI: 1.0%-10.4%). Unidimensionality assumption was fulfilled. There was no differential item functioning among the items in the aspects of age, sex, disease duration or DAS28 (at a significance level of 0.001 with Bonferroni correction).

Item difficulty levels and model fit statistics for the items that were used to determine the fit to the Rasch model for the ABILHAND-RA (TR) questionnaire were provided in Appendix 2. PSI was found as 0.808 for ABILHAND-RA (TR) questionnaire. It was demonstrated that reliability is sufficient enough for group comparisons.

In the ABILHAND-RA (TR) questionnaire, impossible was coded as "0", difficult as "1", and easy was coded as "2". In the 18-item ABILHAND-RA (TR) questionnaire, lower score indicates a more influenced hand. The correlations between demographic characteristics, dominant and non-dominant side grip strength scores, DHI score, NHP score, and the results of ABILHAND-RA (TR) questionnaire were provided in Table 4.

For females, the scores obtained from ABILHAND-RA (TR) were lower compared to males indicating more influence on females (z=2.552; p=0.011). ABILHAND-RA (TR) scores were not correlated to age, hand dominancy, or duration of the disease (p>0.05). There was an average but significant negative correlation between DAS28 and ABILHAND-RA (TR) (rho= -0.651; p<0.001). As the severity of the disease increased, ABILHAND-RA (TR) scores seemed to decrease presenting more influence.

As the grip strength increased, ABILHAND-RA (TR) scores significantly increased for both dominant and non-dominant sides (p<0.05). As the NHPT hand function test duration increased, the ABILHAND-RA (TR) score decreased only for the dominant side (p=0.021). However, the statistical difference was not significant for the non-dominant side (p>0.05).

As expected, a very strong, linear, and negative correlation was found between DHI and ABILHAND-RA (TR) scores (rho= -0.884; p<0.001). As the individuals' DHI scores increased,

Table 4. Relationship between demographic and clinical variables and Turkish version of ABILHAND questionnaire in individuals with rheumatoid arthritis score (n=90)

Variables	Z; rho	*p*
Age	rho= -0.038	0.720
Gender (F<M)	z= -2.552	0.011
Dominant hand (right~left)	z= -0.888	0.374
Disease duration	rho= -0.152	0.154
DAS28 (n=64)	rho= -0.651	<0.001
Grip strength		
Dominant hand		
Jamar grip strength	rho= 0.632	<0.001
Pinch grip	rho= 0.468	<0.001
Lateral grip	rho= 0.479	<0.001
Tripod grip	rho= 0.475	<0.001
NHPT	rho= -0.244	0.021
Non dominant hand		
Jamar grip strength	rho= 0.588	<0.001
Pinch grip	rho= 0.434	<0.001
Lateral grip	rho= 0.407	<0.001
Tripod grip	rho= 0.439	<0.001
NHPT	rho= -0.093	0.384
Duruoz Hand Index	rho= -0.884	<0.001
NHP total	rho= -0.616	<0.001
Energy level	rho= -0.532	<0.001
Pain	rho= -0.600	<0.001
Emotional reactions	rho= -0.505	<0.001
Sleep	rho= -0.352	0.001
Social isolation	rho= -0.428	<0.001
Physical skill	rho= -0.511	<0.001

DAS28: Disease Activity Score 28; NHPT: Nine Hole Peg Test; NHP: Nottingham Health Profile; Z: Mann-Whitney U test; rho: Spearman's rank correlation coefficient.

they obtained lower scores in ABILHAND-RA (TR) indicating a more influenced hand.

The relationship between NHP and ABILHAND-RA (TR) scores were average and the direction of the correlation was inverse (rho= -0.616; p<0.001). Individuals with a higher NHP score indicating a lower level of health related quality of life also had lower ABILHAND-RA (TR) score, again representing a more influenced hand.

In order to analyze test-retest reliability of ABILHAND-RA (TR) questionnaire, the correlation between the scores of two consecutive (at least seven days between the interviews) interviews was analyzed. Results indicated an excellent test-retest reliability (ICC: 0.921, 95% CI: 0.882-0.947; p<0.001).

DISCUSSION

The current study was conducted to test the validity and reliability of the ABILHAND-RA (TR). Following the exclusion of one item (item 20) and combining of highly correlated item couples (subsets), it was determined that the 18-item ABILHAND-RA (TR) questionnaire sustains item invariance and fits to the Rasch model.

It is thought that the reason for the 96% "easy" answer given for the highly correlated "Handling a four-color ballpoint pen with one hand" item is that this activity is commonly performed using thumb interphalangeal joint, though in RA, first carpometacarpal joint is more frequently involved than the former.[41] As a result, item 20 in ABILHAND-RA (TR) is insufficient to differentiate hand skills of patients.

While manual ability is a measure that deals with a complex characteristic of human behavior, no one can expect all items and individuals to fit in a strictly mathematical model such as Rasch model. In ABILHAND-RA (TR) questionnaire, residual correlations were detected to be rather high. Thus, to resolve local dependence issue and to increase the fit to the Rasch model, subtests were formed using these items.[42] Items with similar difficulty levels compared to other items are excluded as they show potential item redundancy.[15] Based on our clinical expertise, these item couples (subsets) provide very little information related to the manual ability of an individual as they question activities that have similar difficulty level. For example, participants reported that the items "peeling onions" and "peeling potatoes with knife" and the items "taking a coin out of the pocket" and "grasping a coin on the table" were very similar.

Another observation related to these combined item couples (subsets) during the assessment of individuals with RA is that participants throughout their daily life performed them rarely. For example, female participants who constitute the majority of the participants in our sample reported that they rarely perform the items "using a screwdriver" and "screwing a nut on" in daily life; instead, they usually ask their partners to perform these activities.

In our study, ABILHAND-RA (TR) scores of female participants were significantly lower compared to males, likewise females were reported to be more affected than males.[43,44] In the literature, a relationship was also expressed between disease activity and patient ability.[45] Similar to the literature, DAS28 and ABILHAND-RA (TR) scores were inversely correlated at a moderate level. Furthermore, factors like age and handedness were also found to be correlated to the manual ability perceived by the individuals.[46,47] The significant relationship between manual ability and grip strength presented in this study was also reported in a previous study.[14] However, no relationship was detected between disease duration and ABILHAND-RA (TR) scores.

Measurements assessing functional disability in RA are increasingly used to evaluate treatment outcomes and disease progression.[48,49] It is easier to monitor an individual's status quantitatively using purposeful activities which are meaningful for the individual when the measurements' items fulfill the necessary requirements of unidimensional measures. Most functional tests have no standards. They are commonly individual-centered measures and are devised to measure the perception of patients in a specific region. In assessing manual ability, ABILHAND targets patient skills decently.[14] It is able to expose activities that are present in real life and important for the patients, but hard to detect in laboratory conditions.[9] ABILHAND creates a possibility to behaviorally measure the

ability in carrying out manual activities of the participants regardless of the pattern they use.[14]

Even though upper extremity disorders are significantly related to manual ability, the perceived difficulty in performing activities depends on other factors such as motivation and psychological condition.[48] It should be noted that as a self-reported questionnaire, ABILHAND-RA (TR) gathers subjective that and may include personal attitudes and beliefs that may cause bias and modify the real situation. The answer alternatives in the questionnaire -easy, difficult, impossible- are not very sensitive and the difference between is obscure. This issue makes it harder to implement the questionnaire and affects measurement variability. Other investigators also pointed out to this disadvantage previously.[13,50,51] In addition, a recent study has advocated that items that are more difficult to perform should be included in the questionnaire.[50] The ABILHAND-RA (TR) questionnaire is not particularly sensitive to the answers. If ABILHAND-RA (TR) is made more sensitive by addition of a new section to the response section in the evaluation of manual ability, it may become more appropriate to differentiate the progression of individuals even in small sample sizes to show the efficacy of intervention methods in longitudinal studies.

Keeping these limitations in mind, the available items in ABILHAND-RA (TR) seem to work fairly well. The intra-class correlation coefficient (ICC=921) obtained from test-retest validation analysis is high which indicates that ABILHAND-RA (TR) questionnaire is sufficiently sensitive and appropriate enough to detect differences between individuals with RA who exhibit a wide range of functional levels. The observed invariance supports utilization of ABILHAND-RA (TR) in clinical settings (in clinical assessments, rehabilitation interventions, and evaluation of recovery). Our sample represents the population well enough as it includes individuals with RA having different levels of functional status. Following this validation, future work is needed to investigate whether item hierarchy is sustained throughout the rehabilitation process.

In conclusion, the Rasch analysis conducted in this study allowed to develop an 18-item ABILHAND-RA (TR) questionnaire presenting unidimensionality and appropriate internal construct validity. ABILHAND-RA (TR) was found to be clinically valid, reliable, and sensitive enough to be used in clinical evaluations, rehabilitation interventions, and for progression follow-up in individuals with RA.

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Appendix 1. Turkish version of ABILHAND questionnaire in individuals with rheumatoid arthritis

	Aşağıdaki aktiviteler ne kadar ZOR?	Mümkün değil	Zor	Kolay	Fikrim Yok
1	Kurşun kalemi açmak				
2	İğneye iplik geçirmek				
3	Bıçakla patates soymak				
4	Soğan soymak				
5	Kavanozun kapağını açmak				
6	Et kesmek				
7	Masanın üstünde duran bir bozuk parayı almak				
8	Anahtar deliğindeki anahtarı çevirmek				
9	Bir cümle yazmak				
10	Çerez paketini açmak				
11	Hediye paketlemek				
12	Çıtçıtı kapatma (mont, çanta vb.)				
13	Birinin tırnaklarını kesmek				
14	Birinin tırnaklarını törpülemek				
15	Birinin saçını fırça ile taramak				
16	Ampul takmak				
17	Tornavida kullanmak				
18	Somunu çevirerek sıkıştırmak				
19	Zımba kullanmak				
20	Basmalı tükenmez kalemi kullanmak				
21	Musluk açmak				
22	Bir teneke kutuyu almak (kola kutusu gibi)				
23	Birinin saçını taramak				
24	Cepten bozuk para çıkarmak				
25	Bir ceketin fermuarını çekmek				
26	Bir şişenin kapağını açmak				
27	Çivi çakmak				

Appendix 2. Fit of Turkish version of ABILHAND questionnaire in individuals with rheumatoid arthritis items for Rasch model (18 items)

Item	ABILHAND-RA Items	Location logits	Standard error	Individual item fit residual	χ^2	*p*
ST03	12 Çıtçıtı kapatma (mont. çanta vb) 25 Bir ceketin fermuarını çekmek	-1.700	0.205	0.119	0.069	0.793
ST012	8 Anahtar deliğindeki anahtarı çevirmek	-1.281	0.314	-0.811	0.447	0.504
ST05	7 Masanın üstünde duran bir bozuk parayı almak 24 Cepten bozuk para çıkarmak	-1.207	0.192	0.069	0.409	0.522
ST06	15 Birinin saçını fırça ile taramak 23 Birinin saçını taramak	-1.069	0.198	-0.291	0.043	0.836
ST017	22 Bir teneke kutuyu almak (kola kutusu gibi)	-0.868	0.281	-1.053	2.787	0.095
ST008	1 Kurşun kalem açmak	-0.653	0.357	-1.596	2.406	0.121
ST013	9 Bir cümle yazmak	-0.489	0.275	-1.125	0.773	0.379
ST015	11 Hediye paketlemek	-0.256	0.275	-1.752	2.330	0.127
ST01	3 Bıçakla patates soymak 4 Soğan soymak	0.136	0.151	-0.483	0.020	0.887
ST014	10 Çerez paketini açmak	0.189	0.223	0.647	0.985	0.321
ST07	17 Tornavida kullanmak 18 Somunu çevirerek sıkıştırmak 21 Musluk açmak	0.341	0.205	0.138	0.650	0.420
ST009	2 İğneye iplik geçirmek	0.346	0.216	1.065	2.501	0.114
ST04	19 Zımba kullanmak 27 Çivi çakmak	0.433	0.326	-0.207	0.306	0.580
ST02	13 Birinin tırnaklarını kesmek 14 Birinin tırnaklarını törpülemek	0.524	0.185	0.602	1.532	0.216
ST016	16 Ampul takmak	0.724	0.268	1.061	1.452	0.228
ST018	26 Bir şişenin kapağını açmak	0.890	0.199	0.002	0.638	0.424
ST011	6 Et kesmek	1.312	0.211	-0.688	1.513	0.219
ST010	5 Kavanozun kapağını açmak	2.627	0.207	0.250	0.427	0.513

ABILHAND-RA: ABILHAND questionnaire in individuals with rheumatoid arthritis; χ^2: Individual item fit statistic; ST: SubTest.

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Clinical Trial

The effectiveness of 10-Tai Chi movements in patients with ankylosing spondylitis receiving anti-tumor necrosis factor α therapy: A randomized controlled trial

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ABSTRACT

Introduction: Ankylosing Spondylitis (AS) is a chronic inflammatory rheumatic disease characterized by pain, functional deformities, negatively affecting quality of life. A previous study showed that Tai Chi had a positive effect on disease activity and flexibility of patients with AS. The aim of this study was to investigate the effect of Tai Chi exercises on disease activity, functionality, spinal mobility, quality of life and inflammatory markers in patients with AS.

Methods: This randomised controlled trial allocated 36 patients with AS to either a Tai Chi or a home exercise group using the block randomization. Both groups received a 1-h exercise program twice a week for 10 weeks and encouraged to practice at home. Outcome measures included: The Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), Bath Ankylosing Spondylitis Functionality Index (BASFI), Bath Ankylosing Spondylitis Metrology Index (BASMI), Ankylosing Spondylitis Quality of Life (ASQoL) scales and Erythrocyte Sedimentation Rate (ESR) and C-reactive protein (CRP).

Results: After training, there was a statistically significant difference within groups for the Tai Chi and the home exercise groups for all parameters (p:0.00). When the delta values were compared between the groups, BASDAI (p:0.00), cervical rotation (p:0.02), and ASQoL (p:0.00) were found to be significantly in favor of the Tai Chi group. No side-effects were noted during or after the exercise programs.

Conclusion: Tai Chi should be considered for inclusion in rehabilitation programs as a safe alternative type of exercise to reduce disease activity, improve spinal mobility and quality of life in patients with AS.

Trial registration: https://clinicaltrials.gov/ct2/show/NCT03807180.

Clinical trial number: NCT03807180.

1. Introduction

Ankylosing Spondylitis (AS), primarily affects the sacroiliac joint and spine; it is a chronic inflammatory rheumatic disease characterized by pain, structural and functional deformities, negatively affecting quality of life, and causing decreased mobility [1,2]. The C-reactive protein (CRP) level and erythrocyte sedimentation rate (ESR) may reflect the severity, clinical progression, and response to treatment of AS. Both are important laboratory markers in the AS clinic. CRP is a plasma protein known to rapidly increase in serum during inflammation as part of an acute phase reaction. CRP is an important marker for clinical remission in the treatment of AS [3,4].

There are several pharmacological and non-pharmacological therapeutic methods to alleviate symptoms, slow the progression of the disease and treat deformities in AS [1]. Tumor necrosis factor alpha (TNF-α) inhibitors, together with non-stereoid anti-inflammatory drugs (NSAID), are the cornerstones of pharmacological methods used to increase functionality and reduce disease activity in the treatment of AS [5].

Traditionally, pharmacological treatment and exercise are used together to overcome these difficulties in AS, and this method is more effective in AS than in other types of arthritis [6]. Although there are studies in literature which have examined the efficacy of home exercises with anti-TNF α therapy [7,8], to the best of our knowledge, no

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study has examined the effects of Tai Chi in patients with AS receiving anti-TNF-α treatment.

Although there is a consensus on the role of exercise in the treatment of AS, when the literature is reviewed, it can be seen that precise guidelines on the type and frequency of the exercises have not yet been defined. There is no defined protocol on which exercise method is specific for AS. It has been stated in the literature that more information is needed about the various exercise methods related to intensity, frequency and duration to determine the optimal activity for the disease [1,6,9,10].

Tai Chi Chuan is a traditional exercise method that has been practised in China for centuries. It is a set of exercises originating from Chinese medicine and martial arts and is defined as a meditative martial art [11,12]. This combination of physical exercise and relaxation techniques is used to improve the mental and physical health of people. It has been reported in literature that it develops factors such as balance, strength, flexibility, cardiovascular and respiratory function, mood, depression and anxiety, self-efficacy, pain reduction and quality of life. It has also been shown to have a positive effect on symptoms associated with chronic rheumatic diseases, such as rheumatoid arthritis, osteoarthritis and fibromyalgia [11–14]. To the best of our knowledge, there is only one study in the literature examining the efficacy of Tai Chi in AS patients. According to the results of that study, Tai Chi had a positive effect on disease activity and flexibility of patients with AS [15] and it was suggested that Tai Chi could be a complementary therapy approach for patients with AS [13]. It has been recommended that further studies are conducted to examine the effects of Tai Chi on pain, quality of life, mobility, psychological variables, and physical functional development of patients with AS [15].

The aim of this study was to investigate the effect of Tai Chi exercises on disease activity, functionality, spinal mobility, quality of life and inflammatory markers in patients with AS receiving anti-TNFα.

2. Materials and methods

2.1. Study design

In this randomized controlled parallel group study, the effects of Tai Chi in patients with AS were compared with a home exercise group. Approval for the study was granted by the Non-Interventional Clinical Research Ethics Committee of Pamukkale University (decision no: 60116787-020/55441). Informed consent was obtained from all study participants and assurances were given of the confidentiality of the information. The study was registered in the clinical trials database (registration number: NCT03807180). A flowchart of the study is shown in.

2.2. Participants

A total of 50 participants diagnosed with AS according to the modified New York criteria in the Rheumatology Clinic of Antalya Training and Research Hospital were initially enrolled in the study. Of these, 6 were excluded from the study because they declined to participate in the study. Following the baseline assessment, 44 patients were randomly allocated into two groups, a Tai Chi group (n: = 22) and a home exercise group (n:22) using the block randomisation by age and gender. The randomization was performed by a statistician who had no contact with the patients. In the Tai Chi group, 4 individuals were excluded from the study because they could not get leave from work (n: 2) and did not want to continue exercising (n: 2). In the home exercise group, 4 individuals were excluded from the study because they did not want to continue. The study was completed with a total of 36 participants, as 18 in the Tai Chi group (9 females, 9 males, mean age: 46.88 ± 10.46 years) and 18 in the home exercise group (8 females, 10 males, mean age: 44.66 ± 8.02 years). A flowchart of the study design is shown in Fig. 1.

The demographic and health-related data of the participants were recorded before the assessment (Table 1).

The study inclusion criteria were the diagnosis of AS according to the modified New York criteria, voluntary participation in the study, age 20–65 years, stable drug use for at least 3 months. Patients were excluded from the study if they had been performing regular aerobic training and strengthening exercises for at least 3 days a week for the past three months, if they had cardiovascular, pulmonary, orthopedic or neurological problems that could interfere with the exercise, had experienced an active disease period in the last three months, had communication problems, or if they had previously participated in the Tai Chi exercise program. The data of patients who made any changes in drug treatment during the study were not included for evaluation and the participation of that patient was terminated.

All patients meeting the inclusion criteria were informed verbally about the assessments and interventions, and signed written consent forms were obtained from each subject.

2.3. Outcome measures

All evaluations at baseline and at the end of 10 weeks were performed by the same experienced physiotherapist according to standardized test protocols and in the same conditions. Before starting the evaluations, the physiotherapist who was to make the evaluations informed the patients about the methods.

The demographic and health-related data of the participants were recorded on the registration form in a face-to-face interview (Table 1). The Bath AS Disease Activity Index (BASDAI), Bath AS Disease Function Index (BASFI) and Bath AS Metrology Index (BASMI), were used to assess activity, function and baseline measurements of the disease, respectively. The Ankylosing Spondylitis Quality of Life Questionnaire (ASQoL) was used to assess quality of life. A peripheral blood sample of 10 − 20 ml (1–2 tubes) was withdrawn from each subject and Erythrocyte Sedimentation Rate (ESR) and C-reactive protein (CRP) values of the participants were measured.

The Bath AS Disease Activity Index (BASDAI), which was developed to evaluate disease activity, consists of 6 VAS measurements to assess fatigue, spine and peripheral joint pain, sensitivity and morning stiffness [16].

The Bath AS Disease Function Index (BASFI) measures the patient's functional capacity during the last week. This index consists of 8 questions about daily activities and 2 questions evaluating the patient's ability to cope with daily life. Patients mark the degree of difficulty when performing the specified tasks on a 10 cm VAS scale. The total score was obtained as the average score of the 10 questions [17].

The Bath AS Metrology Index (BASMI) has 5 components (lateral lumbar flexion, tragus-to-wall distance, lumbar flexion (modified schober), maximal intermalleolar distance, and cervical rotation) selected as having the highest validity, reliability, reproducibility and sensitivity to change. Each component is scored and the total score is obtained as the average [18].

The Ankylosing Spondylitis Quality of Life Questionnaire (ASQoL), which was developed to evaluate the patient's quality of life in AS, has been shown to be a valid, reliable tool that can be used in both clinical applications and scientific research. It is a scale that questions the quality of life of patients according to yes-no responses to 18 questions. The total score is obtained as the total of the 'yes' responses [19].

2.4. Interventions

2.4.1. Tai Chi exercise program

The training was supervised by a certified physiotherapist experienced in Tai Chi (SYC). The Tai Chi exercises to be assigned to the patients were selected from the short form of the 24 forms of the Yang style and were assigned as the 10 basic Tai Chi forms (Beginning, Parting the Horse's Mane, Stork Spreading Its Wings, Brushing Your

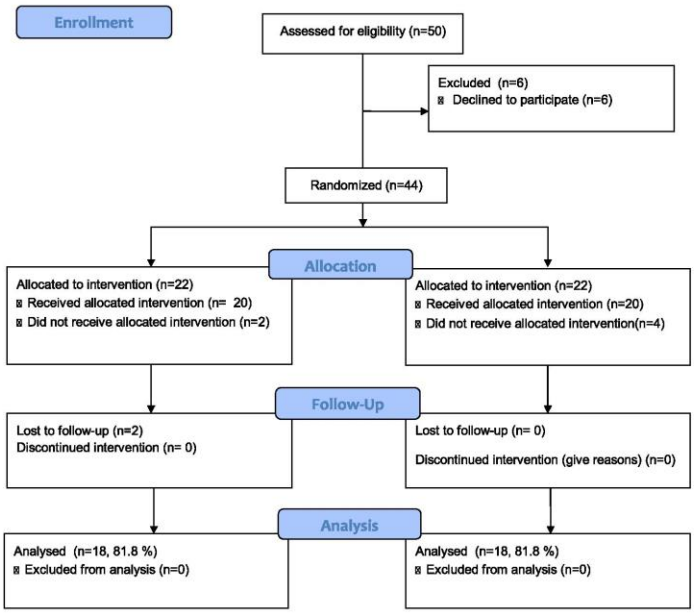

Fig. 1. Flow chart of the study phases.

Table 1
Demographic and health related characteristics of the patients.

Variables	Tai Chi Group (n = 18) M ± SD	Home-Exercise Group (n = 18) M ± SD	p
Age (years)	46.88 ± 10.46	44.66 ± 8.02	0.480*
Body weight (kg)	76.27 ± 9.31	70.27 ± 10.58	0.080*
Height (cm)	168.61 ± 10.78	163.88 ± 8.33	0.246**
BMI (kg/m^2)	34.93 ± 8.02	30.66 ± 8.65	0.134*
Disease duration (year)	8.83 ± 4.69	7.42 ± 5.27	0.403*
Gender	n (%)	n (%)	
Male	9 (50)	8 (45)	0.465*
Female	9(50)	10 (55)	0.679*
Drug use	n(%)	n(%)	
Etanercept	4	3	
Golimumab	3	3	
Adalimumab	6	8	
Sertolizumab	3	3	
Infiliksimab	2	1	

M mean, *SD* standard deviation.
* Independent Sample T Test, ** Mann-Whitney *U* test.

Knees and Stepping, Playing The Pipes, Fending Off the Monkey, Grasping the Sparrow's Tail Left and Right, Simple Whip and Moving Hands Like Clouds-Conclusion) [20,21]. The forms are made with slow, continuous and circular movements, with balance provided in different directions (forwards-backwards, laterally or a combination) from one leg to the other with full weight transfer [21]. Each session took 1 h (15 min for warm-up exercises, 30 min of Tai Chi exercises, and 15 min for cooling down exercises). The 18 AS patients in this group were divided into three groups of 6. All the Tai Chi forms were demonstrated before the training started. Each week one form was performed and combined with the previous week's form. The AS patients performed the forms 10 times in each session. In the final week, all the forms were combined and performed. During each session, the patients were carefully taught the necessary postures for each form. As the exercises were performed in groups accompanied by the trainer, when the patients made mistakes during the exercise, the mistakes were instantly determined and corrected. Exercises were performed in the exercise room. No side-effects were noted during or after the exercises. The patients were only encouraged to try the Tai Chi forms at home, and the exercises were not given as a home program.

2.4.2. Home exercise program

The home exercise group performed 20 exercises for cervical, thoracic and lumbar flexibility, stretching for shoulder circumference, hamstring and erector spinal muscles, and strengthening for abdominal, back and proximal muscles, with 10 repetitions of each exercise in a session lasting 1 h, 2 days a week. The exercises were stretching muscles of anterior, posterior, lateral neck, wrist extensors, hamstring, gluteal, lumbar flexion, quadriceps, gastrocnemius, hip adductor, lateral flexion of the trunk, pelvic tilt, backbend, plank, straight and reverse shuttle, seated thoracic extension, quadriped arm and leg raise (same side and cross), and breathing in quadripedal position. The home exercise program was created based on the exercises used by Aytekin et al. [22]. The exercises were performed 2 h a week for one hour at the same time as the Tai Chi group. Each of the exercises was explained and shown to the participant in detail by the physiotherapist. The home exercise group only did their exercises at home twice weekly. Compliance with the exercise program was checked on a checklist in a weekly telephone call and in a monthly face-to-face interview.

2.5. Sample size

According to the reference study results, they had a large effect size (d = 1.09) from "BASDAI" results [23]. Assuming we can achieve an

effect size level at this level, a power analysis was performed before the study. Accordingly, when at least 24 participant (at least 12 for each group) were included in the study, that would result in 80 % power with %95 confidence level (%5 type 1 error rate). Considering that there may be loss of participant, it was planned to include 50 % more subjects in the study and the study was organized with 36 participants.

2.6. Statistical analysis

Data obtained in the study were analyzed statistically using SPSS vn. 22.0 software. Descriptive statistics were presented as mean ± standard deviation (SD) values, or number (n) and percentage (%). The conformity of the data to normal distribution was examined using the Shapiro-Wilk test. To compare the results before and after the training within the groups, the Paired Samples *t*-test was used when parametric test assumptions were provided, otherwise the Wilcoxon signed rank test was used. When parametric test assumptions were met, the Independent Samples *t*-test was used to compare independent group differences, and when parametric test assumptions were not provided, the Mann-Whitney *U* test was used. A value of $p < 0.05$ was accepted as statistically significant.

3. Results

The Consolidated Standards of Reporting Trials (CONSORT) diagram of the participants is shown in Fig. 2. This randomized controlled study was conducted on 36 individuals with AS (Tai Chi group n:18, 46.88 ± 10.46 years; home exercise group n:18, 44.66 ± 8.02 years). Of the 44 participants included in the study and randomized, 36 completed the study with an 81.8 % response rate. In both exercise groups, 18.1 % individuals were excluded from the study at the beginning or during the study. The rate of participation in the exercise sessions was 97.2 % for the Tai Chi group and 99.4 % for the home exercise group. No side-effects were reported during the evaluations and training. There was no statistically significant difference between the groups in respect of demographic and health-related data (age, gender, height, weight, BMI and disease duration) ($p > 0.05$, Table 1).

When the pre-treatment and post-treatment intra-group evaluation results were examined, there was a statistically significant difference in all parameters in the Tai Chi group compared to pre-treatment ($p < 0.05$); in the home exercise group, there was a significant difference in all evaluation methods except the CRP and ESR parameters ($p < 0.05$, Table 2).

Delta (Δ) values were calculated to examine the difference between the groups after treatment. When the delta values were compared between the groups, BASDAI ($p = 0.000$), cervical rotation sub parameter of BASMI ($p = 0.001$) and ASQoL ($p = 0.000$) were significant in favor of the Tai Chi group (Table 3).

4. Discussion

The results of this study demonstrated that both forms of exercise had positive effects on functionality, disease activity, spinal mobility and quality of life. In addition, Tai Chi exercise training was found to be superior to home exercises in terms of disease activity, cervical rotation and quality of life and provided additional benefit to the patients. The CRP and ESR values, which are objective indicators of disease activity, were also seen to decrease significantly after the Tai Chi program.

There was no difference between the groups in terms of age, gender, height, weight, BMI and disease duration. The results of the statistical analyses showed that the Tai Chi and home exercise groups were homogeneous in respect of demographic and health-related data.

Home exercises, including stretching, strengthening and flexibility, provide additional benefit to patients with AS in reducing and maintaining disease activity [24]. It has also been reported that home exercise has a positive effect on disease activity in patients with AS receiving anti-TNF α [7,8]. In controlled studies by Lee et al. [15] it was shown that Tai Chi exercises had a positive effect on disease activity. In the current study, inflammatory markers were evaluated together with BASDAI as an objective outcome indicator in the evaluation of disease activity. While Tai Chi exercises improved disease activity and inflammatory marker results positively, home exercises maintained the stability of the condition and did not increase disease activity. Therefore, both exercise methods were seen to be effective in terms of disease activity, although the Tai Chi exercises were more beneficial than home exercises.

The physical functionality index (BASFI) in AS represents an ankylosis-related functional impairment, which increases with disease duration, and therefore becoming more stable over time (24). Different exercise types have been observed to reduce BASFI scores in patients with AS using anti TNF-α [25–27]. Verhoeven et al. [28] reported that aerobic exercise did not change the physical function. In the current study, both exercise methods improved physical functions positively.

It has been reported that exercise methods improve spinal mobility in individuals with AS [29,30]. In the current study, while both exercise methods contributed to the development of spinal mobility, the Tai Chi exercise program provided additional benefit in terms of increasing cervical rotation. Tai Chi forms involve circular movements and require strong rotation, especially in the upper extremities, in all forms except the beginning and finale forms. Since the eyes usually follow hand

Table 2
The comparison of baseline and end of 10 weeks results with groups.

Variables	Tai Chi Group (n = 18)			Home-Exercise Group (n = 18)		
	Baseline M ± SD	End of 10 weeks M ± SD	p	Baseline M ± SD	End of 10 weeks M ± SD	p
BASDAI	4.57 ± 1.80	1.98 ± 0.85	**0.000***	4.30 ± 1.98	3.85 ± 1.79	**0.017***
BASFI	2.97 ± 2.02	1.66 ± 1.25	**0.000***	3.71 ± 1.98	1.55 ± 0.96	**0.000***
BASMI	2.58 ± 1.22	1.61 ± 1.18	**0.000****	2.92 ± 1.37	1.87 ± 0.95	**0.000***
- -Lateral lumbar flexion	12.48 ± 5.84	15.70 ± 5.24	**0.001***	11.05 ± 4.18	13.51 ± 4.09	**0.006***
- -Tragus-to-wall distance	14.55 ± 4.14	11.92 ± 4.53	**0.006****	12.35 ± 2.29	11.06 ± 1.77	**0.002***
- -Lumbar flexion (modified Schober)	23.72 ± 5.35	27.66 ± 6.14	**0.000***	20.83 ± 3.64	23.52 ± 2.81	**0.001***
- -Maximal intermalleolar distance	114.61 ± 12.86	122.11 ± 10.26	**0.000***	107.83 ± 7.23	112.66 ± 5.83	**0.000***
- -Cervical rotation	57.83 ± 20.16	72.16 ± 14.50	**0.000****	59.50 ± 10.03	64.50 ± 11.13	**0.000***
ASQoL	7.38 ± 4.77	2.66 ± 2.91	**0.000***	7.16 ± 4.73	5.88 ± 3.78	**0.002***
ESR	31.00 ± 24.59	23.11 ± 17.75	**0.006****	18.72 ± 7.05	17.50 ± 9.14	0.615
CRP	11.35 ± 14.24	6.25 ± 9.04	**0.007****	5.31 ± 6.01	4.98 ± 5.00	0.651

Significant values are shown in bold.
M mean, *SD* standard deviation, * Paired Simple T Test, ** Wilcoxon Test.
BASDAI = Bath Ankylosing Spondylitis Disease Activity Index, BASFI = Bath Ankylosing Spondylitis Functional Index, BASMI = Bath Ankylosing Spondylitis Metrology Index, ASQoL = Ankylosing Spondylitis Quality of Life,CRP = C-reactive protein, ESR = erythrocyte sedimentation rate.

Table 3
Comparison of delta values to groups.

Variables	Tai Chi Group (n = 18) Δ M ± SD	Home-exercise Group (n = 18) Δ M ± SD	p	95 % CI
BASDAI	2.58 ± 1.49	0.45 ± 0.72	**0.00***	1.33 – 2.93
BASFI	1.31 ± 1.05	2.15 ± 1.44	0.05*	−1.70 – 0.01
BASMI	0.97 ± 0.56	1.04 ± 0.75	0.76*	−0.51 – 0.38
- Lateral lumbar flexion	−3.22 ± 3.36	−2.45 ± 3.32	0.49*	−3.02 – 1.50
- Tragus-to-wall distance	2.60 ± 3.35	1.28 ± 1.48	0.13*	−0.41 – 3.10
- Lumbar flexion (modified Schober)	−3.94 ± 3.61	−2.69 ± 2.80	0.23**	–
- Maximal intermalleolar distance	−7.50 ± 5.31	−4.83 ± 4.34	0.72**	–
- Cervical rotation	−14.33 ± 9.65	−5.00 ± 3.30	**0.00***	−14.22- -4.44
ASQoL	4.72 ± 2.94	1.27 ± 1.48	**0.00****	–
ESR	7.88 ± 10.19	1.22 ± 11.25	0.11**	–
CRP	5.10 ± 7.78	0.32 ± 6.00	0.20**	–

Significant values are shown in bold.
M mean, *SD* standard deviation, Δ = (pre-treatment-post-treatment).
*Independent Sample T Test, ** Mann-Whitney *U* test.
BASDAI = Bath Ankylosing Spondylitis Disease Activity Index, BASFI = Bath Ankylosing Spondylitis Functional Index, BASMI = Bath Ankylosing Spondylitis Metrology Index, ASQoL = Ankylosing Spondylitis Quality of Life,CRP = C-reactive protein, ESR = erythrocyte sedimentation rate, CI:confidence interval.

movements, head and trunk rotation is also needed [31]. Therefore, cervical rotation can be considered to increase more in the Tai Chi group.

Since Tai Chi is a complex multi-component mind-body therapy, it can be used to improve the quality of life in chronic rheumatic diseases such as RA, OA and fibromyalgia [14]. This study is the first to have examined the biopsychosocial aspect and quality of life of Tai Chi exercises in patients with AS. It was found that both exercise methods support biopsychosocial development and increase the quality of life in patients, and Tai Chi exercises have additional benefits in terms of these parameters. Tai Chi exercises provide positive interaction by giving a sense of belonging and support within the community [11]. It is also thought to be important that Tai Chi exercises are performed in groups and involve body-mind integrity. All these factors can be considered to increase the biopsychosocial support of the individual and have a positive effect on quality of life. In chronic diseases such as AS, biopsychological conditions such as chronic pain, stiffness, depression, anxiety, fatigue and sleep disorders decrease the participation of individuals in activities and lead to socially negative conditions. Therefore, an exercise method such as Tai Chi that provides body-mind integrity can support the individual from a biopsychosocial point of view and overcome the above-mentioned negative symptoms, resulting in improved quality of life.

It has been reported in literature that there are positive effects on inflammatory markers such as CRP and ESR after different exercise methods in AS [32–34]. In a study comparing home exercise and calisthenic exercises in AS, ESR and CRP values were examined post-exercise and a decrease in ESR levels was recorded in the home exercise group [35]. The current study is the first to investigate inflammatory markers such as ESR and CRP after Tai Chi exercises in AS. The literature states that Tai Chi improves both cell-mediated immunity and antibody response in the immune system, but it is necessary to discuss whether changes in immune parameters are sufficient to prevent infection [36]. In this study, inflammatory markers decreased after Tai Chi. In the control group, there was some decrease in these values after home exercises, but it was not significant. As mentioned in the previous Tai Chi study in patients with AS, the placebo effect of Tai Chi should also be considered [15]. The ESR and CRP values alone are not enough to conclude that Tai Chi has an anti-inflammatory effect. There is a need for further studies to evaluate the anti-inflammatory effects of Tai Chi through examinations of different laboratory results (TNF alpha, cytokine level etc.) and hormone levels.

Limitations of this study can be said to be the lack of homogeneous disease duration of the patients in the exercise groups, and the lack of financial support. It can be recommended that the effects of Tai Chi exercises on cytokine levels in the blood be investigated in future studies. There is also a need for this study to be repeated with larger sample sizes and using other Tai Chi forms. The third limitation of the study is that the exercise program which we created should not be considered as a routine care group, since the study did not include a control group that did not receive exercise. Another limitation was that when comparing the Tai Chi exercise program with the home exercise program, qualitative data were not collected which could be help in evaluating additional benefits which may be experienced when practicing Tai Chi [37]. A final limitation was that evaluations were not conducted at different time intervals throughout the study, so it was not possible to determine from which week the effectiveness of the exercise emerged. Future studies should consider the above limitations when designing trials in Tai Chi.

5. Conclusion

The results of this study showed that Tai Chi and home exercises have a positive effect on functionality, disease activity, spinal mobility and quality of life in patients with AS. Thus, this study emphasized once again the positive effects of exercise on AS patients. It was also shown that the 10-week Tai Chi exercise program with anti TNF-α treatment has an effect by playing a role in reducing inflammatory markers such as ESR and CRP with medical treatment. This study can be considered to make a significant contribution to literature by showing the intensity, frequency and duration of the Tai Chi exercise program for AS patients in detail. In order to reduce disease activity, spinal mobility and improve quality of life in patients with AS, it can be recommended that Tai Chi is included in rehabilitation programs as an alternative type of exercise.

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Data availability

From the author on request

CRediT authorship contribution statement

S. Yaprak Cetin: Conceptualization, Methodology, Software, Formal analysis, Investigation, Writing - original draft. **Bilge Basakci Calik:** Methodology, Validation, Formal analysis, Resources, Supervision, Writing - review & editing. **Ayse Ayan:** Investigation,

Resources, Visualization, Investigation, Software, Writing - review & editing. **Elif Gur Kabul:** Software, Formal analysis, Writing - review & editing.

Declaration of Competing Interest

There is no conflict of interests associated with the study. All authors signed the Declaration of Competing Interest statement.

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A COMPARISON OF DIFFERENT QUADRICEPS FEMORIS ISOMETRIC STRENGTHENING METHODS IN HEALTHY YOUNG WOMEN

ORIGINAL ARTICLE

ABSTRACT

Purpose: This study was planned to compare the effectiveness of high voltage pulsed galvanic (HVPG) stimulation, Russian current and isometric exercise on quadriceps femoris (QF) isometric muscle strength in healthy young women.

Methods: Forty-six healthy young women were included in the study. Before and after the training, the dominant side QF isometric muscle strength of participants was assessed with the isokinetic dynamometer. The peak torque and average torques of the participants were recorded after the test. The training was planned as HVPG current group (n=16), Russian current group (n=15) and isometric strengthening group (n=15). All treatments were performed under physiotherapist supervision for a total of 15 sessions for three days a week for five weeks.

Results: The quadriceps isometric muscle strength was significantly increased in all groups in terms of peak torque and average torque values after training compared to pre-training values ($p<0.05$). No statistical difference was found between the groups when the peak torque and average torque delta values were compared ($p>0.05$).

Conclusion: The highest rate of change belongs to the HVPG group in terms of increasing the QF isometric muscle strength. Therefore, we recommend using it in clinical practice.

Key Words: Exercise; Torque; Quadriceps Femoris; Electrical Stimulation.

SAĞLIKLI GENÇ KADINLARDA FARKLI QUADRİSEPS FEMORİS İZOMETRİK KUVVETLENDİRME YÖNTEMLERİNİN KARŞILAŞTIRILMASI

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Bu çalışma sağlıklı genç kadınlarda yüksek voltajlı galvanik stimülasyon, Rus akımı ve izometrik egzersizin quadriseps femoris (QF) izometrik kas kuvveti üzerine etkinliğini karşılaştırmak amacıyla planlandı.

Yöntem: Kırkaltı sağlıklı genç kadın çalışmaya dahil edildi. Eğitimden önce ve sonra, katılımcıların dominant taraf QF izometrik kas kuvveti izokinetik dinamometre ile değerlendirildi. Katılımcıların zirve tork ve ortalama tork değerleri test sonrası kaydedildi. Eğitim YVGS akım grubu (n=16), Rus akım grubu (n=15) ve izometrik kuvvetlendirme grubu (n=15) olarak planlandı. Tüm uygulamalar haftada üç gün beş hafta boyunca toplamda 15 seans fizyoterapist gözetimi altında gerçekleştirildi.

Sonuçlar: QF izometrik kas kuvveti, antrenman öncesi değerlere göre antrenman sonrası zirve tork ve ortalama tork değerleri bakımından tüm gruplarda anlamlı olarak arttı ($p<0,05$). Zirve tork ve ortalama tork değerleri karşılaştırıldığında gruplar arasında herhangi bir istatistiksel fark bulunmadı ($p>0,05$).

Tartışma: QF izometrik kas kuvvetini arttırma açısından en yüksek değişim oranı YVGS grubuna aittir, bu nedenle klinik uygulamada tercih edilmesini önermekteyiz.

Anahtar Kelimeler: Egzersiz; Kuvvet; Quadriseps Femoris; Elektrik Stimülasyonu.

INTRODUCTION

Neuromuscular electrical stimulation (NMES) is a non-invasive treatment modality that stimulates motor neurons with low-amplitude electrical currents to induce voluntary muscle contractions (1,2). Healthy muscle strength can be improved by active exercise against resistance or by NMES. There are many articles in the literature about increasing muscle strength, whether exercise is more effective than electrical muscle stimulation or electrical muscle stimulation than exercise and no clear consensus has been reached on which is more effective (3-6). In many studies, electrical stimulation was applied either alone or combined with exercise to improve quadriceps femoris (QF) muscle strength of healthy subjects (7-11).

Faradic current, Russian current, and high voltage pulsed galvanic (HVPG) currents are frequently used clinically to strengthen the healthy muscle by electric stimulation. If the frequency of the current is high enough, tetanic muscle contraction can be obtained, the same as in maximal voluntary contraction by stimulation (12). According to a study by Kots, high-intensity currents have been claimed to provide 10-30% more contractions than voluntary muscle contractions. Faradic current is not preferred in our study because of the length of the transition period (1000 μs) and the short number of pulses (1-60 pulses). In this study, the Russian current and another high-intensity current, HVPG current, were selected from the high-intensity currents as Kots proposed, in order to strengthen the healthy muscle (13).

Russian currents are a high-frequency current of 2500 Hz and reduce the resistance of the skin, and it would penetrate deeper and reach deeper motor nerves. Kots has stated that in professional athletes, Russian current practice can increase the maximal voluntary contraction of the muscle by 40%. This technique provides maximum strength gain without fatigue due to long rest period (13).

The HVPG current is a new form of neuromuscular electrical stimulation. This current began to be widely used in the 1970s (14). It has been shown that when the voltage is increased and the transition period of the electric current is reduced, deeper tissues can be excited without undergoing damage (15). In the case of HVPG current applications, there is less tissue resistance or reaction capacity than low voltage applications. This feature is the theoretical explanation for that HVPG is more effective and can be better tolerated. The most significant advantage of the HVPG current is that it has a higher electrical motion gain than other methods. Due to low impedance, it penetrates the skin more quickly and depolarizes the nerve fibers and provides continuity of tissue healing (16,17). When compared to other neuromuscular stimulators, the intermittent high-voltage current has the advantage of high electrical mobility, which is the voltage. Its low impedance enables for more quick penetration to skin and better toleration. Because of the high voltage, skin resistance reduces spontaneously (11).

Isometric or static strength training is exercises performed without joint movement and changing muscle length during muscle contraction. Strength increase depends on the amount and duration of contraction, the intensity of contraction, the intensity of training, and the joint angle (18,19). Isometric training can increase strength in specific muscle or muscle groups. In addition to gains in muscle strength, isometric exercises can also lead to an increase in muscle mass and improvements in bone strength (20). It has been reported that the contraction should be continued for 3-10 seconds in order to increase the strength (19,21).

When we review the literature, we see that NMES and different exercise programs are widely used to strengthen QF muscles in healthy individuals. However, these studies differ from our study. Baskan et al. applied isometric exercise training and Russian flow to strengthen the QF muscle and assessed the strength increase as a concentric force in the isokinetic system while Silva et al. has performed isometric and eccentric force evaluation in isokinetic system after eccentric training with NMES and NMES alone (7,8). Romero et al. found that isometric muscle strength increased by 31% in the isokinetic system after electrical stimulation in healthy subjects (22). However, we did not find any study evaluating the isometric strength increase of the QF muscle with the isokinetic system

by applying two different NMES and isometric exercise methods. For this reason, we used methods of Russian current, HVPG current, and isometric exercise to increase QF muscle strength in healthy women and evaluated isometric force using the isokinetic system.

METHODS

Subjects

Forty-six healthy women (age=21.02±1.27 years) were included in the study between 18-30 years of age. Participants' QF isometric muscle strength (torque measurements) was assessed twice before and after training using the Isokinetic Dynamometer (Humac Norm Testing Rehabilitation system, CSMI Medical Solutions, USA). The controlled clinical trial with three intervention groups was conducted according to the standards of the Declaration of Helsinki (Figure 1). The training was performed on the dominant side QF muscle. The training was planned as HVPG current for the first group (n=16), as Russian current for the second group (n=15) and as isometric strengthening for the third group (n=15). HVPG current was applied for 20 minutes. Russian current was applied for 10 minutes for the second group. The strengthening exercises in the third group were applied as 10 maximal contractions of 10 seconds and 10 seconds between each contraction. Both exercise and stimulation applications were performed after the body and knee were positioned and stabilized at 75° flexion and 60° flexion angle, respectively. All treatments were performed under physiotherapist supervision for a total of 15 sessions for three days a week for five weeks. Demographic data are given in Table 1.

Inclusion criteria for the study were a willingness to participate in the study, not having knee complaints such as pain, lockout, morning arrest, swelling, difficulty in walking, not having any orthopedic or neurological disability. Exclusion criteria were exercising regularly for the last six months, presence of cardiovascular, pulmonary, orthopedic, and neurological problems which may prevent exercise. The criteria for dismissing from the study were unable to complete the assessment, having any disease status in the evaluation and training process, starting to do sport regularly during the training period, having incomplete data, and unable to participate in 75% of the training.

The ethical approval of the study was taken at the Ethics Committee of Non-Interventional Clinical Researches of Pamukkale University (Approval Date: 06.06.2017 and Approval Number: 2017-8). All participants were informed verbally, and an informed consent form was signed.

Procedures

Muscle Strength, Isokinetic Strength Measurement

The dominant side QF isometric muscle strength (torque measurements) of the participants was assessed with the Isokinetic Dynamometer (Humac Norm Testing Rehabilitation System, CSMI Medical Solutions, USA). Before the test, participants were subjected to a standard warm-up of 5 minutes, and evaluations were carried out using a standard seat. The back of the seat was angled 105° backward to provide 75° flexion at the body. The knee was positioned at an angle of 60° and was fixed with bands around the body, waist, hip, and ankle. Participants had no previous experience with isokinetic dynamometer testing. Therefore, it was started with a trial whose protocols were the same with QF isometric muscle strength measurement protocols. Then, participants' QF isometric muscle strength was measured by three 10-second maximal isometric contractions. Rest periods of 3 seconds between each contraction were given. Each participant held the sides of the seat with both hands during the test. Verbal encouragement was made throughout the whole test to obtain maximum strength from the participants. The peak torque and average torques of the participants were recorded after the test.

High Voltage Pulsed Galvanic Current

The HVPG was applied by using Endomed 982 (Enraf Nonius Sonic Unit, the Netherlands). The instrument was automatically set to a pulse rate of 100 µs while the pulse frequency was set to 60 pulses/s. In order to avoid fatigue, the intermittent form of the current was selected, and the transition time/rest time was set to 4 s impulse/12 s. The total output voltage of the device ranged from 0 to 500 volts, and the current intensity was increased until the sensible contraction of the applied muscle

was achieved without causing too much sense of discomfort. Stimulation was performed after the body and knee were positioned and stabilized at 75° flexion and 60° flexion angle, respectively. One of the 6x8 cm carbonated electrodes was placed in the distal portion of vastus medialis muscle, while the other one was placed in the proximal portion of the vastus lateralis muscle. This placement was intended to stimulate a large proportion of the muscle fibers of the QF muscle (23). The HVPG was applied for a total of 20 minutes. The amplitude was increased until a contraction can be seen without any discomfort to the patient (24).

Russian Current

In the treatment with the Russian current, a protocol developed by Kots, also known in the literature as "Russian Technique," was used. In the treatment with the Russian movement, a protocol developed by Kots, also known as "Russian Technique," was used in the literature. There were 10 muscle contractions per treatment session in this protocol. Each contraction lasted for 10 seconds, and resting time of 50 seconds was given for the next contraction (transition: rest ratio was 1/5) (13). Russian current Endomed 982 (Enraf Nonius Sonic Unit, the Netherlands) was applied using a model device at a frequency of 2500 Hz with a transition time of 400 μs. The position of the participants in the application and the placement of the electrodes were the same as the other application. The current intensity was increased until tetanic muscle contraction was obtained.

Isometric Exercise

Isometric exercises can be performed without the need for equipment. Compared to concentric contraction, the force that is released during maximum isometric contraction is greater than the force that occurs during the maximum concentric contraction. The most crucial advantage of isometric exercises is that the angle of articulated joint gains strength in the range of ±10° (25).

The body and knee of the participants in the isometric exercise group were positioned and stabilized at 75° flexion and 60° flexion angle, respectively as in the stimulation groups. Participants were asked to do 10 repetitions as 10 seconds of maximum voluntary contractions and 10 seconds of rest (11). Moreover, participants were performed isometric contractions by pushing against the other leg with maximum effort in the supine position.

Statistical Analysis

It was estimated that when 42 subjects were included in the study because of the power analysis performed (14 subjects in each group), 95% confidence and 90% power would be obtained. The data were analyzed using SPSS (SPSS Statistics for Windows, version 21.0 (SPSS Inc., Chicago, IL. , USA) program. The Shapiro Wilk test was used to test whether the data was appropriate for normal distribution. Continuous variables were given as mean±standard deviation, and categorical variables were given as number and percentage. Wilcoxon test was used for the data obtained at baseline and the end of the fifth week, and the Kruskal Wallis test was used to compare delta values. Significance level was accepted as $p<0.05$ in statistical test results.

RESULTS

The study included 46 young women with a mean age of 21.02±1.27 years, which was planned to compare the efficacy of HVPG, Russian currents, and exercise on quadriceps muscle strength enhancement in healthy women. However, 32 women completed the protocol (Figure 1). No

Table 1: Subject Characteristics.

Variables	HVPG (n=11) Mean±SD	Russian Current (n=11) Mean±SD	Isometric Exercise (n=10) Mean±SD	p
Age (Years)	20.63±1.68	21.09±0.94	21.20±1.13	0.074
Weight (kg)	59.18±12.15	56.45±8.39	58.10±9.67	0.776
Height (m)	1.64±0.59	1.63±0.51	1.61±0.69	0.603
BMI (kg/m²)	21.82±4.09	20.99±2.60	22.31±3.65	0.845

HVPG: High Voltage Pulsed Galvanic, BMI: Body Mass Index.

Table 2: Intragroup Analysis for Pre-Post Quadriceps Isometric Muscle Strength.

Variables	HVPG (n=11)			Russian Current (n=11)			Isometric Exercise (n=10)		
	Pre-Training	Post-Training	p	Pre-Training	Post-Training	p	Pre-Training	Post-Training	p
Peak Torque	157.00±25.13	172.18±27.41	**0.013***	147.63±30.21	157.18±29.79	**0.029***	156.60±26.90	164.10±28.38	**0.014***
Average Torques	138.54±28.30	154.81±27.92	**0.007***	130.54±29.45	141.45±30.72	**0.006***	137.50±26.00	148.90±28.22	**0.007***

*p<0.05. Wilcoxon Signed Rank Test. HVPG: High Voltage Pulsed Galvanic.

injuries were reported related to training. The participation rate in the treatment sessions was 95%. There was no statistically significant difference between the demographic data of the groups (p>0.05) (Table 1).

Results of comparison of post-training and delta values of groups

The quadriceps isometric muscle strength was significantly increased in all groups in terms of peak torque and average torque values after training compared to pre-training values (p<0.05) (Table 2). When comparing the peak torque and average torque delta values, it was found that there was no statistical difference between the groups in terms of peak torque (p=0.691) and average torque (p=0.901) delta values. The highest increase was found in the HVPG stimulation group (Table 3).

DISCUSSION

We found that three different methods were effective in increasing isometric muscle strength, but not superior to each other, in the result of this study evaluated by isokinetic method on isometric QF muscle strength of three different methods, HVPG, Russian currents and isometric exercise in healthy women participants.

In the literature, electrical stimulation in healthy individuals provided an increase in muscle strength (7-10,26-30). It has been determined that type II muscle fiber is selectively increased following muscle stimulation by electrical stimulation. Type II muscle fibers have more specialized resistance than type I muscle fibers, and selective increase in type II muscle fiber increases general muscle strength. In addition, a high amount of activity can be loaded into the muscles by activating large-scale motor units during muscle activation with electrical stimulation (31). Isometric exercise increase the motor unit synchronization 5%. Therefore, a higher power increase can be provided by increasing muscle potency (32).

Strength training can cause additional complications such as muscle spasms, fatigue and delayed muscle pain. It has been reported in the literature that 10 applications may be performed 2 or 3 times a week to reduce possible side effects (21). It has also been reported that in a study examining the effect of the frequency of exercise on muscle strength increase, three times a week, electrical stimulation was caused a significant increase (33). We planned our treatment to reduce these side effects to be three days a week with 10 repetitions.

When the efficiency of electrical stimulation to muscular functions is examined, the characteristic of the current is an important criterion. When the effect of the biophysical current and the Russian current applied on QF muscle on knee extension torque was compared, it has been found that they created similar effects (34). In another study, Currier et al. (1983) performed 15 sessions of

Table 3: Intragroup Analysis for Maximum Torque and Average Torque Change Values.

Variables	HVPG (n=11) Δ%	Russian Current (n=11) Δ%	Isometric Exercise (n=10) Δ%	p
Peak Torque	-10.14±11.54	-7.11±9.22	-4.00±4.85	0.691
Average Torques	-13.25±17.58	-8.99±9.77	-8.46±6.10	0.901

Kruskal- Wallis Test. HVPG: High Voltage Pulsed, Galvanic Δ%: Percentage Change.

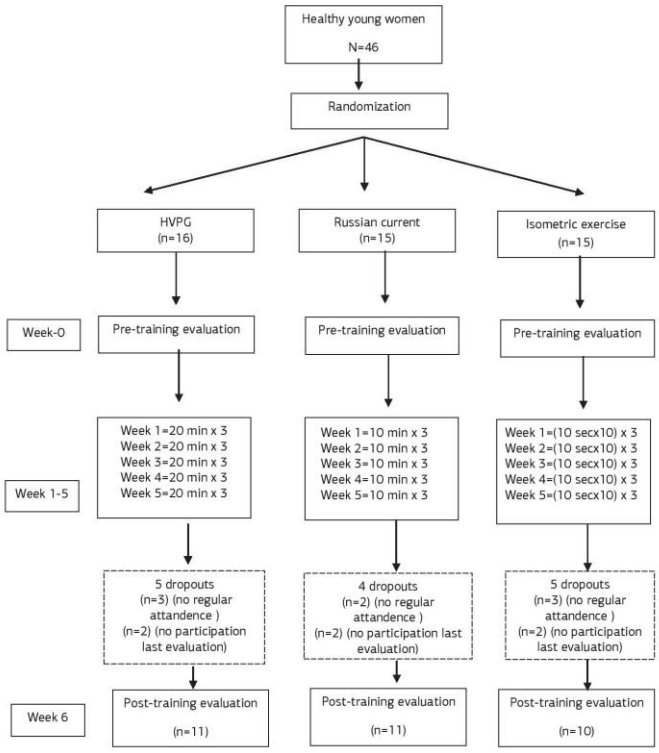

Figure 1: Flowchart of the Study. HVPG: High Voltage Pulsed Galvanic.

three sessions per week for five weeks in total to investigate the effects of electrical stimulation and isometric exercise on QF muscle of healthy individuals. The increase in strength was found in each training groups after the training. However, groups did not have any advantage over each other (3). The effectiveness of strength training on QF muscle with electrical stimulation and voluntary muscle contraction in Mayo Clinic Biomechanical laboratory, and the results were reported to be similar (10).

Taspinar et al. emphasized that electrical stimulation alone is not enough to increase muscle strength and that training programs involving voluntary muscle activation should be included in the rehabilitation program while there are studies in the literature reporting that electrical stimulation and exercise practices have similar effects (9).

In studies that the evaluations were performed with the isokinetic system, Bircan et al. applied strength training on QF muscle strength with interferential current and low frequency biphasic symmetrical current and have reported after four weeks of training that there was an increase in strength in both groups but no difference between the groups (35). Unlike our study, low and medium frequency currents were used in this study, and the change in isotonic muscle strength was evaluated with the isokinetic system. Baskan et al. obtained progression in terms of muscular strength, performance and isotonic muscle strength in the isokinetic system in both groups after Russian current and maximal voluntary isometric exercise on healthy QF muscle and have reported that both applications had no superiority to each other (7). The stimulation and exercise method used in this

study is similar to ours; however, despite isometric training was given in order to increase strength, it was seen that isotonic strength in the isokinetic system was evaluated. In addition, in a recent study in the literature, eccentric training with and without NMES has been applied to improve the healthy QF muscle and isometric and eccentric strength increases in the isokinetic system have been evaluated (9). In our study, we evaluated the effect of 5-week isometric exercise and two different neuromuscular electrical stimulation applications on isometric force with the isokinetic system. Electrical stimulation may increase the isometric strength at different levels (4,36).

In the literature, it is seen that NMES and exercise applications are used to increase the strength in healthy QF, and the results created by NMES and exercise were similar. Our results are also parallel to this similarity.

We believe that the individual's current situation and needs are essential in deciding between the choice of NMES or exercise. For example, we believe that the use of NMES may be the reason for preference in preserving the functional state of the muscles in some cases such as surgical or traumatic conditions that require the immobilization process, in young children and older adults who are difficult to communicate, cannot properly concentrate on exercise. Isometric exercise has some advantages such as not requiring equipment, providing an increase in strength without adding the burden on joints in the early period after the injury, prevention of atrophy in long immobilization situations, especially in elderly individuals.

In the literature, it seems appropriate to use the HVPG current among the other currents to increase muscle strength due to the fact that it creates less variation compared to other currents on the biophysical properties of the skin such as skin temperature and elasticity (11). In our study, we did not obtain superiority between the two currents we used, Russian and HVPG. However, HVPG group has the highest rate of change in QF isometric muscle strength increase. Therefore; we recommend using it in clinical practice. The fact that our applications were made for five weeks, and the number of repeats in isometric exercise may be a limitation to show which groups are superior. We believe that it is necessary to plan studies with more sessions to determine the superiority of the applications relative to each other.

We determined the isometric strength increase in healthy QF by both HVPG and Russian current applications and isometric exercise method as a result of our study, and we see that these three applications have similar effects in terms of isometric muscle strength. Increased isometric muscle strength is an important parameter to maintain joint stability and to maintain muscle strength during injuries or early postoperative period and should be included in training and assessment methods..

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Original Article

Effects of clinical Pilates exercises in individuals with fibromyalgia: A randomized controlled trial

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Abstract

Objective: This study aimed to investigate the effects of clinical Pilates exercises in patients with fibromyalgia (FM) and to compare the effects of one-to-one and group-based exercise methods.
Methods: A total of 42 women (mean age, 50.90±7.78 years) with FM were included. The participants were randomly divided into 2 groups (one-to-one exercise, n=16; group-based exercise, n=26). Disease impact was evaluated with the FM Impact Questionnaire, functional status with the Health Assessment Questionnaire, anxiety with the Beck Anxiety Inventory, quality of life with short form-36, and biopsychosocial status with the Bilişsel Egzersiz Terapi Yaklaşımı-biopsychosocial questionnaire. All the evaluations were performed pre- and post-treatment. Clinical Pilates exercises were carried out 2 days a week for 6 weeks.
Results: When the pre- and post-treatment data were compared, significant improvement was seen in all parameters in the group-based exercise group; in the one-to-one exercise group, improvement was noted in disease impact, quality of life, and biopsychosocial status. When post-treatment data were compared, only disease impact was significant for the one-to-one exercise group. Effect size results were found to be moderate and high for both methods.
Conclusion: For clinical Pilates exercise in FM, one-to-one method was suggested to have high disease impact and low quality of life, whereas group-based exercise method showed high anxiety.
Keywords: Fibromyalgia, exercise, quality of life, anxiety

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Introduction

Fibromyalgia (FM) is a chronic disease characterized by widespread pain in the body accompanied by other symptoms, including fatigue, sleep disturbances, depression, cognitive dysfunction, irritable bowel syndrome, and headache (1, 2). The pain, which is the most common symptom of FM, is variable (hyperalgesia or allodynia) and is associated with physical and emotional stress and therefore causes psychological problems, such as depression and anxiety, and decreases the quality of life (3, 4). It has been estimated that FM affects 2.7% of the population and occurs more often in women than in men (5).

The management of FM usually aims to reduce pain and fatigue and improve sleep quality and functionality. A multidisciplinary approach with the combination of non-pharmacologic and pharmacologic treatments according to symptoms is often suggested (6). Furthermore, it has been seen that exercise, which is one of the non-pharmacologic treatment methods, is particularly emphasized (7, 8).

Pilates, originally known as "Contrology," was developed in the early 1900s by Joseph H. Pilates and has become quite popular in the recent years. In the early 2000s, Pilates exercises were adapted to the clinic by Australian physiotherapists, and this method was called the "clinical Pilates" or "modified Pilates" method The clinical Pilates method can be used as an exercise method for healthy people as well as for various patient populations (9).

The clinical Pilates method is a form of mind-body exercises, based on 6 principles— centering, concentration, control, precision, breath, and flow. It aims to coordinate the quality of movement along with breathing and active movement. Pilates exercises focus on spinal stabilization and are designed to ensure muscular strength, flexibility, balance, proprioception, and body awareness. These are low-impact exercises that can be performed in various positions, including standing, supine, prone, or sitting. During these exercises, breathing and muscular control reduce pain and enhance posture (10-12). These exercises are often used as

a treatment method in patients with low-back pain (13). There are only 4 pilot studies on the effects of Pilates exercises in individuals with FM. In these studies, Pilates was found to be better than short-term home exercises and connective tissue massage on pain-pressure threshold and anxiety, similar to yoga with no intervention in the control group (11, 14-16). Although the modified Pilates method was preferred to aerobic training in 1 of the 2 most recent protocol studies on the effectiveness of Pilates (17), another study has reported that mat Pilates and aquatic aerobic exercise had similar effects, in terms of pain and disability in individuals with FM (18). Beltrán-Carrillo et al. (19) also indicated that taking part in a group-based exercise program of individuals with FM may be effective in coping with FM and provide psychosocial benefits in addition to its physical benefits.

Although some studies have highlighted that Pilates is an effective method in reducing disease-related findings, there is a lack of information on whether one-to-one and group-based exercise methods for clinical Pilates have superiority over each other and which exercise method (one-to-one or group-based exercise) should be preferred when the possibilities are favorable. This study aimed to investigate the effectiveness of clinical Pilates exercises in patients with FM and to compare the effects of one-to-one and group-based exercise methods.

Methods

In this study, which was planned as a randomized controlled parallel group, one-to-one and group-based exercise methods were evaluated. Randomization was carried out by a researcher through a computer program, IBM Statistical Package for the Social Sciences version 22 (IBM SPSS Corp.; Armonk, NY, USA) in charge of allocation. Assessments (pre- and post-treatment) and training were carried out by different physiotherapists. The study was planned as single-blind, and the physiotherapist performing the evaluation was blinded to the study. Clinical Pilates exercises were performed by an experienced and certified physiotherapist in this field.

Main Points

- The one-to-one exercise method had a greater effect on disease impact and quality of life.
- The group-based exercise method had a greater effect on functional status and anxiety.
- Both methods had a similar effect on biopsychosocial status.

Participants

A total of 42 volunteers (women with mean age 50.90±7.78 years) were included in the study. They were diagnosed with FM by the same rheumatologist according to the American College of Rheumatology (ACR) 2016 criteria and referred to the Rheumatologic Physiotherapy and Rehabilitation clinic and were screened for eligibility. The one-to-one exercise group had 16 participants (mean age, 55.93±8.03 years), and the group-based exercise group had 26 participants (mean age, 47.80±5.87 years).

Demographic data of the participants were recorded before the evaluations. Demographic data are shown in Table 1.

The inclusion criteria were as follows: (a) having FM diagnosis according to the ACR 2016 criteria; (b) aged 20-65 years; (c) stable drug use for at least 3 months or more; and (d) volunteering to participate in this study.

The exclusion criteria were as follows orthopedic and cardiopulmonary diseases (which would prevent patients from doing exercise); neurological disorders; unstable endocrine system diseases; malignancy; pregnancy; and severe psychological diseases.

This study was approved by the Ethics Committee for Non-Interventional Clinical Research of Pamukkale University (Approval Date: September 10, 2019; Approval Number: 60116787-020/62191).

All the participants were informed verbally, and informed consent forms were signed.

Assessments

All individuals were evaluated by the same physiotherapist according to standardized test protocols and in the same conditions at baseline and at the end of the 6th week. Disease impact was evaluated with the FM Impact Questionnaire (FIQ), functional status with the Health Assessment Questionnaire (HAQ), anxiety with the Beck anxiety inventory (BAI), quality of life with the short form-36 (SF-36), and biopsychosocial status with the Bilişsel Egzersiz Terapi Yaklaşımı-biopsychosocial questionnaire (BETY-BQ).

FIQ

FIQ is a questionnaire that includes 10 items (physical impairment, days felt good, work missed, work impairment, pain, fatigue, morning tiredness, stiffness, anxiety, and depression), ranging from 0 to 10, evaluating the health status and physical function of the individuals diagnosed with FM. Higher scores indicate a lower functionality on the disease (20, 21).

HAQ

Functional status of patients is evaluated with HAQ, which includes 20 questions and 8 subscales, such as dressing, grooming, rising, eating, hygiene, reach, grip, and activity. Each question is scored from 0 (without difficulty) to 3 (unable to do), and the highest score of each subscales is added (22, 23).

BAI

This questionnaire, developed by Aeron Beck that includes 21 questions, is used to evaluate the level of anxiety. Each question is rated between 0 (not at all) and 3 (severely). Higher scores indicate a severe anxiety level in patients (24, 25).

SF-36

This is the most commonly used quality of life scale and includes 36 questions on 8 subscales; physical functioning, role limitations because of physical health, body pain, social functioning, role limitation owing to emotional health, vitality, mental health, and general health perceptions. The total score ranges from 0 to 100. Higher scores indicate that the quality of life is good (26, 27).

BETY-BQ

BETY-BQ is an original questionnaire that was developed by Unal et al. (28) in 2017 to evaluate the biopsychosocial status of patients with

Table 1. Demographic characteristics of the patients.

Variables	One-to-one exercise group (n=16) M±SD	Group-based exercise group (n=26) M±SD	p*
Age (years)	55.93±8.03	47.80±5.87	0.001
Body weight (kg)	75.62±13.61	78.15±13.22	0.555
Height (m)	1.57±0.068	1.60±0.65	0.159
BMI (kg/m²)	30.76±6.15	30.50±5.03	0.883

*Independent samples test.
M: mean; SD: standard deviation; BMI: body-mass index.

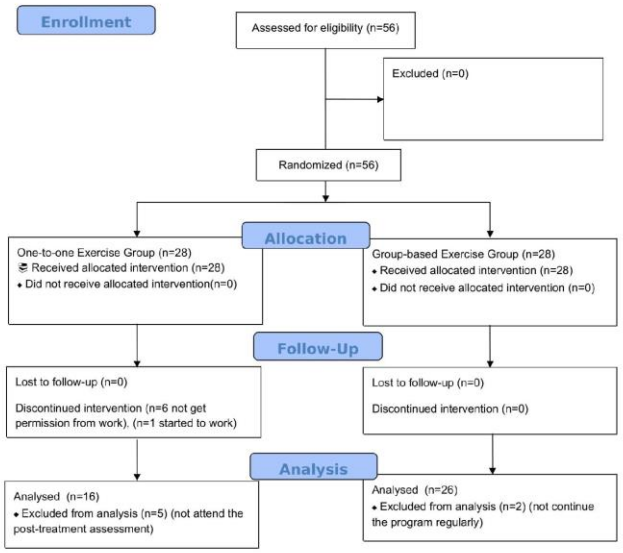

Figure 1. Flowchart of the progress through the phases of the study according to the Consolidated Standards of Reporting Trials.

rheumatic diseases. It includes 30 questions that are answered using a 5-point Likert-type scale. Higher scores indicate "bad" biopsychosocial status of the patients.

Intervention

Clinical Pilates exercises were performed by a certified and experienced physiotherapist in 2 different methods (one-to-one and group-based) 2 times a week for 6 weeks.

One-to-one exercise group

Before starting the clinical Pilates exercise program, 5 key elements of clinical Pilates exercises were taught to all the patients breathing; focus; and placement of the rib cage, shoulder, head, and neck. Patients were encouraged to use these 5 key elements not only during exercises but also in their daily routines and activities. During clinical Pilates sessions, exercises were repeated until the correct posture was achieved in different positions according to the key elements taught on the 1st day. First, the physiotherapist demonstrated the exercises and then asked the patients to perform the exercise correctly. In addition, the aim of each exercise was explained to the patients, and they were asked to try to make it functional in their daily life. Each exercise was performed for 8-10 repetitions and was performed on a mat in the supine/side-lying/prone and sitting positions. Increasing the number of repetitions, changing the position to level, stability balls, and therabands were used for the progression of exercises. Each patient's stabilization ball was personal, and it was 55-65 cm in height so as to achieve a 90° angle at the hips and knees (29). The program for both the methods lasted 60 minutes, including warm up (10 minutes), clinical Pilates exercises (40 minutes), and cool down (10 minutes).

Group-based exercise group

The group-based exercise program was the same as the exercise program applied to the one-to-one exercise group. However, it was performed in the form of group sessions with 6-8 people together.

Statistical analysis

Through power analysis, it was calculated that 32 patients enrolled in this study (16 patients in each group) would have 80% power with 95% confidence interval. Data were assessed using the IBM Statistical Package for the Social Sciences version 21.0 (IBM SPSS Corp.; Armonk, NY, USA). Continuous variables were stated as average, standard deviation, and percentage. The Kolmogorov-Smirnov test was used to determine whether the continuous variables showed normal distributions. P value <0.05 was considered as statistically significant. Effect size was measured with the Cohen's d coefficient. An effect size greater than 0.8 was considered as large, approximately 0.5 as moderate, and less than 0.2 as small (30).

Results

A total of 56 volunteers who met the inclusion criteria were randomly divided into 2 groups; the one-to-one exercise group (n=28) and the group-based exercise group (n=28) with SPSS 21.0 package program. In the one-to-one exercise group, 6 people left the training because they could not get permission from work, 3 people did not continue the program regularly, 2 people did not attend the post-treatment assessment, and 1 person could not continue the program because she started work after starting treatment. In the group-based exercise group, 2 people did not continue the program regularly, thus all these patients' data were excluded. This study was completed with a total of 42 participants; 16 women (mean age, 55.93±8.03 years) in the one-to-one exercise group and 26 women (mean age, 47.80±5.87 years) in the group-based exercise group. Figure 1 shows a flowchart of the study design. There were no adverse events reported with the program. The rate of participation in the treatment sessions was 90%. The demographic data are shown in Table 1. When pre-treatment data of outcome measures were compared statistically, there was no difference ($p>0.05$).

Statistically significant improvement was observed in FIQ, physical and mental components of SF-36, and BETY-BQ scale in both the groups when pre- and post-treatment outcomes were compared ($p=0.001$, $p=0.000$; $p=0.003$, $p=0.000$; $p=0.022$, $p=0.004$; and $p=0.038$, $p=0.001$, respectively). There was also a significant improvement in the HAQ ($p=0.006$) and BAI ($p=0.004$) scores of the group-based exercise group (Table 2).

When the pre-treatment data were compared, there was no difference between the groups ($p>0.05$). When both the groups were compared post-treatment, only FIQ was significantly in favor of the one-to-one exercise group ($p=0.041$) (Table 3).

Both the exercise methods had moderate and high levels of effect for all parameters ($0.46\leq d\leq 1.38$). FIQ ($d=1.38$), SF-36 physical component ($d=1.06$), and SF-36 mental component ($d=0.66$) in the one-to-one exercise method and HAQ ($d=0.68$) and BAI ($d=0.63$) in the group-based exercise method had a greater effect; the 2 groups had a similar effect in terms of BETY-BQ ($d=0.77$, $d=0.76$) (Table 3).

Table 2. Pre-treatment and post-treatment results within groups.

Variables	One-to-one exercise group (n=16)			Group-based exercise group (n=26)		
	Pre-treatment M±SD	Post-treatment M±SD	p*	Pre-treatment M±SD	Post-treatment M±SD	p*
Fibromyalgia Impact Questionnaire	55.04±18.48	32.80±22.19	0.001	62.44±17.80	46.39±22.26	0.000
Health Assessment Questionnaire	0.85±0.70	0.58±0.66	0.063	1.02±0.63	0.67±0.55	0.006
Beck Anxiety Inventory	21.12±12.85	16.75±13.41	0.108	26.57±12.54	20.88±10.09	0.004
Short form-36						
Physical component	145.83±67.39	196.50±95.37	0.003	138.07±74.46	196.82±81.94	0.000
Mental component	177.33±96.07	231.77±109.07	0.022	159.22±79.61	208.98±95.69	0.004
Bilişsel Egzersiz Terapi Yaklaşımı-biopsychosocial questionnaire (0-120)	35.60±20.03	25.62±17.67	0.038	41.88±19.64	31.53±19.90	0.001

*Wilcoxon test.
M: mean; SD: standard deviation.

Table 3. Comparison of post-treatment and effect size results with groups.

Variables	p*	One-to-one exercise group (n=16) Cohen's d	Group-based exercise group (n=26) Cohen's d
Fibromyalgia Impact Questionnaire	0.041	1.385300659	1.140676071
Health Assessment Questionnaire	0.491	0.518116833	0.686457102
Beck Anxiety Inventory	0.186	0.465364091	0.633333277
Short form-36			
Physical component	0.935	-1.061124271	-0.964980518
Mental component	0.516	-0.662695446	-0.625877193
Bilişsel Egzersiz Terapi Yaklaşımı-biopsychosocial questionnaire (0-120)	0.437	0.772958735	0.760591624

*Mann-Whitney U test.

Discussion

In this study, clinical Pilates exercises were performed as one-to-one and group-based methods in patients with FM. Our results have shown that after treatment, group-based exercise methods improved all parameters, whereas one-to-one exercise method improved all parameters, except functional status and anxiety. When the post-treatment data were compared, the groups did not show superiority to each other in any other parameters. Therefore, effect size analysis was performed, which showed that one-to-one exercise method had a greater effect on disease impact and quality of life, whereas group-based exercise method had a greater effect on functional status and anxiety, and both the methods had a similar effect on biopsychosocial status. Consequently, one-to-one exercise method has helped individuals to improve disease impact and quality of life by solving individual physical problems. Group-based exercise method helps the participants to get together and socialize. Furthermore, it helps them psychologically by seeing other individuals who have similar problems as their own, thus improving the anxiety score. Moreover, we believe that group-based exercise motivates the participants by them seeing another person being able to perform the exercises and hence supports functionality.

It has been reported in the literature that physical exercise is a low-cost, safe, and effective method in patients with FM that plays a role in reducing the pain severity and number of painful tender points, improving the quality of sleep and life, as well as reducing the symptoms of depression by supporting them psychologically (31-34).

Modified Pilates is a different and useful exercise method that increases spinal mobility, flexibility, and muscle strength in the treatment of FM (17). It has been reported that Pilates can lead to good adherence because it uses equipment and exercises divided into levels of progression (35). It has been indicated that Pilates exercises may cause less muscle pain, may be more enjoyable and stimulating and could be an easy and alternative method in patients with FM who tend to be resistant to exercise (17).

Some studies have been performed on Pilates and examined its effect in patients with FM. In the first clinical trial by Altan et al. (14), Pilates, performed as a group method, was found to be more effective on pain and disease impact than home-based relaxation/stretching exercises in patients with FM. In parallel with this study, our study has shown that the exercise of both groups, which were performed as supervised by the physiotherapist, increased adherence of individuals and had a positive effect on quality of life, biopsychosocial status, functional status, and anxiety in addition to disease impact. Korkmaz (16) has reported that the 12-week Pilates program had a positive effect on weight control, anthropometric parameters, social-physical concern, pain, and depression in patients with FM. Ekici et al. (11) have shown that group-based Pilates exercises were more effective on anxiety and pain-pressure threshold than connective tissue massage in patients with FM. In our study, the group-based exercise method was found to have a greater effect on anxiety and functional level. We believe that this may be owing to the group-based method providing social interaction and motivation within the groups. This motivation has also contributed to the improvement of functional outcomes by increasing the individual's willingness to exercise and by continuing the

exercise as seen numerically in the flowchart. The group-based exercise method showed a higher impact on anxiety; therefore, in future studies, it could be of interest to compare the 2 group of patients in terms of other factors that may influence this aspect, such as specific drugs intake, psychotherapy, duration of the disease, and so on, or to evaluate the effect of group-based exercises on anxiety in patients previously treated with one-to-one exercise method. In the protocol study by Silva et al. (18), which compared 12-week group-based mat Pilates exercises with aquatic aerobic exercises in patients with FM, both methods have shown beneficial effects on pain and disability but did not show superiority over each other. In another protocol study, which compared the effects of modified Pilates exercises with aerobic exercises, modified Pilates has been reported to be more effective than aerobic exercises in improving symptoms and this improvement could be sustained in the medium and long term (17). In our study, clinical Pilates was performed instead of traditional Pilates. In clinical Pilates exercise, all movements are under the patient's control. The exercises are protective against injury and proceed to an upper level only when the patients adapt to the key elements, which is why we chose it as clinical Pilates would be safer and more practical for our patients with FM.

In the literature, there are some studies that have compared different treatment methods in different patient populations. A systematic review by Robertson and Harding (36) has shown that both group-based and one-to-one treatment methods had a similar effect on the quality of life, functional disability, and low-back pain. Furthermore, both the methods had a similar effect on incontinence severity and amount of loss of urine in urinary incontinence. Allen et al. (37) have reported that group-based therapy was not superior to one-on-one treatment in terms of pain, function, and performance in patients with knee osteoarthritis. In a study in which constraint-induced movement therapy was applied in patients with stroke, it has been reported that group-based treatment showed a more significant improvement in upper limb function and a longer lasting effect than individual treatment (38). In the studies comparing the effectiveness of the Pilates method in individuals with FM, it has been observed that group-based exercise method was often preferred (11, 14-18). However, our study compared whether clinical Pilates exercises made a difference when performed as one-to-one and group-based methods. We observed that clinical Pilates performed as group-based and one-to-one methods had beneficial effects in patients with FM, but these 2 different methods were not superior to each other.

In our study, clinical Pilates exercises were performed by a certified clinical Pilates instructor and a physiotherapist experienced in rheumatology. This was the strength of our study. The limitation of this study was the lack of long-term follow-up to obtain the effectiveness of clinical Pilates exercises in individuals with FM. Another limitation was the difference between the groups in terms of age at baseline because we did not use a stratified *randomization technique*. Although the average age of the group-based exercise participants was lower, pre-treatment data were similar in terms of outcome measures. Hence, we think that negative situations that could occur owing to age differences did not affect the results of our study.

The sample loss was 25% in our study. The reason for the participants not continuing the exercise program was related to their private life; therefore, we did not examine it in detail. In future studies, we recommend that the effect of FM on the individual's life should be examined in more detail in terms of adaptation to exercise.

Another detail in this study was that the participants' body-mass index (BMI) values were high, which is a common problem in individuals with FM. The increased BMI leads to a decreased pain threshold and an increased sensitivity and causes pain to be felt more (39). We also think that the relationship between obesity and exercise will be detailed in future studies.

In conclusion, we found that the one-to-one method of the clinical Pilates exercises helped the patients with FM who had high disease impact and low quality of life, whereas the group-based method helped those with a high anxiety level. It is important to know which exercise method (one-on-one or group-based exercise) should be preferred according to pre-treatment evaluation data for effectiveness of treatment. Therefore, the results of our study are quite remarkable in terms of comparing these 2 methods. When treating FM, 1 of the 2 treatment methods deemed appropriate by the physiotherapist per the patient's needs and wishes can be chosen.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee for Non-Interventional Clinical Research of Pamukkale University (Approval Date: September 10, 2019; Approval Number: 60116787-020/62191).

Informed Consent: Informed consent was obtained from the patients who participated in this study.

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RESEARCH ARTICLE

The Relationship Between Disease Activity, Demographic and Characteristic Features in Individuals with Rheumatoid Arthritis

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Abstract

Background: This study was planned to investigate the relationship between disease activity and demographic and characteristic features of a group of Turkish individuals with Rheumatoid Arthritis.

Methods: A total of 143 participants (120 females, 23 males, mean age = 50.32 ± 12.14 years) diagnosed with Rheumatoid Arthritis (RA) according to the American College of Rheumatology 2010 criteria, were included in the study. Demographic features (gender, body mass index) and disease-related characteristics features (duration of disease, morning stiffness, presence of deformity, presence of nodules, dry eye, nail abnormalities, Raynaud's phenomenon, osteoporosis, dyspnea at rest, exertional dyspnea) of the participants were recorded. Disease activity was calculated using Disease Activity Score 28 (DAS28). According to DAS28, the participants were divided into 3 groups as remission, low disease activity and moderate-high disease activity. Pearson Chi-square test was used to analyze the statistical difference between the disease activity and demographic and possible characteristics features of individuals with RA.

Results: In the analysis of the data, significant difference between remission and moderate-high disease activity was observed in morning stiffness, presence of deformity, presence of nodule, osteoporosis and exertional dyspnea; whereas statistically significant difference between low and moderate-high disease activity was observed in osteoporosis and dyspnea at rest ($p < 0.05$). In terms of demographic and characteristic features where the difference occurs, It was obtained that osteoporosis, exertional dyspnea, presence of nodüle, presence of deformity and morning stiffness poses a 1.97, 1.64, 1.62, 1.56 and 0.53-fold higher risk for moderate-high disease activity compared to the remission, respectively. It was obtained that osteoporosis and dyspnea at rest poses a 1.52 and 1.40--fold higher risk for moderate-high disease activity compared to the low disease activity, respectively.

Conclusion: It was observed that osteoporosis and dyspnea pose a risk for the active period of RA. According to these results, we think that the risk of developing dyspnea and decrease in bone quality in RA individuals in the active period is high due to inactivity. Therefore, we suggest that RA patients should be encouraged to continue their physical activities and increase their participation in the exercise to reduce their complaints of dyspnea and osteoporosis.

Keywords

Rheumatoid arthritis, Osteoporosis, Dyspnea, Disease, Risk

Objectives

Rheumatoid arthritis (RA) is the most common type of inflammatory arthritis causing pain and destruction, especially in peripheral joints [1]. Although it is a clinical picture characterized by symmetrical polyarticular pain and swelling, prolonged morning stiffness, weakness and fatigue, it shows in systemic involvements. These systemic involvements pose an important risk for the progression of the disease. Rheumatoid nodules, vasculitis, anemia, fatigue, weakness, weight loss, respiratory problems, lung and cardiac involvements may accompany [2-4].

In individuals with RA, symptoms such as pain, fatigue, decreased range of motion, joint damage, morning stiffness, decreased muscle mass, decreased muscle

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strength and endurance cause a decrease in physical activity and physical fitness levels [5].

Rheumatoid arthritis is also a chronic inflammatory disease that progresses with progressive joint deformity, causing osteoporosis and death, causing multiple organ damage [6,7].

Pulmonary manifestations is a very common condition in RA [8]. It has been reported that many drugs used in rheumatoid arthritis can also cause lung involvement [9].

RA can cause significant disability and functional limitations. It is also a great burden for the individual with RA, society and health system. In order to reduce the negative effects of RA on quality of life and socio-economic burden, it should be better understood in every respect. Therefore, there is a need for clinical information on risk factors, comorbidities, epidemiological data and complications. This information is necessary in determining the most appropriate management approach for individuals with RA [10-12]. In recent years, clinical and demographic characteristics features of individuals have been recorded in many countries for better understanding of RA [13-16].

The prevalence of RA in Turkey, according to a study made in 2006 is 0.36% [17]. It is known that RA shows various characteristics features according to the population affected by it. Most of the available information about RA was obtained from studies conducted in Europe and the United States [18,19]. There are very few studies on the Turkish population [20]. Therefore, information regarding demographic and clinical characteristics features of RA individuals in Turkey is not sufficient.

This study was planned and conducted to examine the relationship between disease activity and demographic and characteristic features of a group of Turkish individuals with RA.

Methods

Participants

A total of 143 participants (120 females, 23 males, mean age = 50.32 ± 12.14 years) diagnosed with Rheumatoid Arthritis (RA) according to the American College of Rheumatology 2016 criteria, were included in the study. The inclusion criteria were as follows: (a) Having RA diagnosis according to ACR 2016 criteria [21]. (b) Aged 18-65. (c) Being volunteer to participate in this study. The exclusion criteria were as follows: (a) Having other diseases affecting functions (orthopedic, neurological, cardiovascular and metabolic disease). (b) Comorbidity affecting upper extremity and hand functions (carpal tunnel syndrome, trigger finger, impingement syndrome, thoracic outlet syndrome, lateral and medial epicondylitis, hand osteoarthritis). (b) Cognitive impairments. (c) Pregnancy. (d) Illiteracy.

The ethics of the study was approved by local ethics committee. All individuals were informed verbally and informed consent forms were signed.

Outcome measures

The data were collected by the same rheumatologist and by the same physiotherapist in the same day face to face interview method in approximately 40 minutes.

Evaluations included disease activity and demographic features (gender, body mass index) and disease-related characteristics features (duration of disease, morning stiffness, presence of deformity, presence of nodules, dry eye, nail abnormalities, Raynaud's phenomenon, osteoporosis, dyspnea at rest, exertional dyspnea).

Disease Activity Score 28 (DAS28) was used to evaluate disease activity. This index is a combination of 28 swollen joints and 28 sensitive joints, assessment of patient's general medical condition and C reactive protein rate. Swollen and sensitive were assessed for 28 joints (0 = No and 1 = Yes). These 28 joints included 2 shoulder, 2 elbow, 2 wrist, 10 metacarpophalangeal joints, 2 interphalangeal thumbs, 8 proximal interphalangeal joints, and 2 knee joints. DAS28 indicates current condition of the patient in the clinic. A high score represents a high disease activity. (> 5.1 high disease activity; 3.2 < DAS28 ≤ 5.1 moderate disease activity; 2.6 < DAS28 ≤ 3.2 low disease activity; ≤ 2.6 remission) [22].

Participant were divided into 3 groups as "remission", "low disease activity" and "moderate-high disease activity" according to DAS 28.

Participants were divided into two groups as "normal" and "owerweight" according to BMI, as "early stage (≤ 2 years)" and "late stage (> 2 years)" according to duration of disease and as "≤ 60 sec" and " > 60 sec" according to morning stiffness.

The presence of deformity, presence of nodules, dry eyes, nail abnormalities, Raynaud's phenomenon, osteoporosis, dyspnea at rest, exertional dyspnea were recorded as "yes" or "no".

Statistical analysis

The data was analyzed by SPSS packet program. Continuous variables were given as mean ± standard deviation and categorical variables as numbers and percentages. Pearson Chi-square test was used to define the statistical difference between DAS28 and demographic and characteristic features. P value < 0.05 in the 95% confidence interval was considered as statistically significant.

Results

One hundred and forty-three participants (female = 120, male = 23) participating in the study; average age was 50.32 ± 12.15 years. Descriptive data of the demo-

graphic and disease-related characteristics features of the participants are shown in Table 1.

Descriptive data of the three groups in which the participants were separated according to DAS 28 and are shown in Table 2. Descriptive data of the groups formed according to the demographic and disease-related characteristics features of the participants and are shown in Table 3.

Table 1: Descriptive data of the participants' demographic and disease related characteristics features.

Variables	Min.-Max.	X ± SD
Age (years)	20 - 65	50.32 ± 12.14
Body height (m)	1.34 - 1.78	1.61 ± 0.07
Body mass (kg)	45 - 170	72.98 ± 15.16
Body mass index (kg/m^2)	17.76 - 58.82	28.08 ± 5.72
Duration of disease (years)	0.04 - 30.00	7.98 ± 7.17
Morning stiffness (sec)	0.00 - 180.00	32.90 ± 44.38

In the analysis of the data, significant difference between remission and moderate-high disease activity was observed in morning stiffness, presence of deformity, presence of nodule, osteoporosis and exertional dyspnea; whereas statistically significant difference between low and moderate-high disease activity was observed in osteoporosis and dyspnea at rest ($p < 0.05$). In terms of demographic and characteristic features where the difference occurs, It was obtained that osteoporosis, exertional dyspnea, presence of nodüle, presence of deformity and morning

Table 2: Distribution and descriptive data of the participants according to Disease Activity Score 28.

Disease Activity Score 28	n (%)	Min. - Max.	X ± SD
Remission	67 (46.9)	0.96 - 4.17	1.78 ± 0.53
Low disease activity	24 (16.8)	2.62 - 3.19	2.94 ± 0.19
Moderate-high disease activity	52 (36.5)	3.24 - 6.52	4.36 ± 0.93

Table 3: Descriptive data of the groups allocated according to the demographic and disease-related characteristics features of the participants.

	Total n (%)	Remission n (%)	Low DA n (%)	Moderate-High DA n (%)
Gender- Female	120 (83.9)	54 (80.6)	19 (79.2)	47 (90.4)
-Male	23 (16.1)	13 (19.4)	5 (20.8)	5 (9.6)
BMI - Normal	45 (31.5)	26 (38.8)	5 (20.8)	14 (26.9)
-Owerweight	98 (68.5)	41 (61.2)	19 (79.2)	38 (73.1)
Duration of disease (years) -Early stage (≤ 2 years)	41 (28.7)	18 (26.9)	6 (25.0)	17 (32.7)
-Late stage (> 2 years)	102 (71.3)	49 (73.1)	18 (75.0)	35 (67.3)
Morning stiffness (sec) -≤ 60 sec	124 (86.7)	63 (94.0)	20 (83.3)	41 (78.8)
> 60 sec	19 (13.3)	4 (6.0)	4 (16.7)	11 (21.2)
Presence of deformity -Yes	49 (34.3)	17 (25.4)	9 (37.5)	23 (44.2)
-No	94 (65.7)	50 (74.6)	15 (62.5)	29 (55.8)
Presence of nodules -Yes	24 (16.8)	8 (11.9)	2 (8.3)	14 (26.9)
-No	119 (83.2)	59 (88.1)	22 (91.7)	38 (73.1)
Dry eye -Yes	65 (45.5)	30 (44.8)	9 (37.5)	26 (50.0)
-No	78 (54.5)	37 (55.2)	15 (62.5)	26 (50.0)
Nail abnormalities -Yes	39 (27.3)	18 (26.9)	6 (25.0)	15 (28.8)
-No	104 (72.7)	49 (73.1)	18 (75.0)	37 (71.2)
Raynaud's phenomenon -Yes	30 (21.0)	9 (13.4)	7 (29.2)	14 (26.9)
-No	113 (79.0)	58 (86.6)	17 (70.8)	38 (73.1)
Osteoporosis -Yes	43 (30.1)	15 (22.4)	4 (16.7)	27 (51.9)
-No	97 (67.8)	52 (77.6)	20 (83.3)	25 (48.1)
Dyspnea at rest -Yes	28 (19.6)	11 (16.4)	2 (8.3)	15 (28.8)
-No	115 (80.4)	56 (83.6)	22 (91.7)	37 (71.2)
Exertional dyspnea -Yes	64 (44.8)	24 (35.8)	10 (41.7)	30 (57.7)
-No	79 (55.2)	43 (64.2)	14 (58.3)	22 (42.3)

DA: Disease activity.

Table 4: Investigation of risk factors associated with the demographic and disease-related characteristics features of RA individuals who are in the active period (low or moderate-high disease activity) according to DAS 28.

Variables	Remission and low disease activity		Remission and moderate-high disease activity		Low and moderate-high disease activity	
	OR (95% CI)	p*	OR (95% CI)	p*	OR (95% CI)	p*
Gender (Female/Male)	0.93 (0.40 - 2.16)	0.880	1.67 (0.77 - 3.63)	0.139	1.42 (0.75 - 2.69)	0.179
BMI (Normal/Owerweight)	0.50 (0.21 - 1.23)	0.111	0.72 (0.45 - 1.17)	0.173	1.10 (0.79 - 1.53)	0.569
Duration of disease (Early stage/late stage)	0.93 (0.41 - 2.06)	0.859	1.66 (0.76 - 1.78)	0.489	1.11 (0.82 - 1.52)	0.497
Morning stiffness (≤ 60 sec/> 60 sec)	0.48 (0.21 - 1.06)	0.112	**0.53** (0.36 - 0.79)	**0.013**	0.91 (0.64 - 1.30)	0.648
Presence of deformity (Yes/No)	1.50 (0.75 - 2.99)	0.259	**1.56** (1.05 - 2.32)	**0.031**	1.09 (0.80 - 1.47)	0.581
Presence of nodules (Yes/No)	0.73 (0.20 - 2.67)	0.628	**1.62** (1.08 - 2.42)	**0.037**	1.38 (1.05 - 1.80)	0.065
Dry eye (Yes/No)	0.80 (0.392 - 1.63)	0.537	1.12 (0.74 - 1.69)	0.571	1.17 (0.86 - 1.58)	0.310
Nail abnormalities (Yes/No)	0.93 (0.41 - 2.06)	0.859	1.05 (0.67 - 1.65)	0.811	1.06 (0.76 - 1.47)	0.727
Raynaud's phenomenon (Yes/No)	1.93 (0.96 - 3.86)	0.082	1.53 (1.02 - 2.31)	0.065	0.96 (0.68 - 1.37)	0.839
Osteoporosis (Yes/No)	0.80 (0.31 - 2.05)	0.634	**1.97** (1.32 - 2.94)	**0.001**	**1.55** (1.15 - 2.09)	**0.006**
Dyspnea at rest (Yes/No)	0.54 (0.14 - 2.04)	0.331	1.45 (0.95 - 2.19)	0.104	**1.40** (1.08 - 1.82)	**0.046**
Exertional dyspnea (Yes/No)	1.19 (0.60 - 2.39)	0.611	**1.64** (1.08 - 2.48)	**0.017**	1.22 (0.89 - 1.68)	0.193

OR: Odds Ratio, CI: Confidence Interval, *Pearson Chi-square test.

stiffness poses a 1.97, 1.64, 1.62, 1.56 and 0.53-fold higher risk for moderate-high disease activity compared to the remission, respectively. It was obtained that osteoporosis and dyspnea at rest poses a 1.52 and 1.40-fold higher risk for moderate-high disease activity compared to the low disease activity, respectively (Table 4).

Discussion

As a result of our study, although it was determined that the increase in disease activity in individuals with RA was affected in many ways, it was observed that it posed the most risk in terms of osteoporosis and dyspnea.

There are contradictory results in the literature regarding the possible effect of gender and sex-dependent variables on the phenotype, severity and prognosis of RA. While some studies have reported that the number of women in remission is lower than men compared to DAS28, which is the predictive factor for the prognosis of RA [23-25]; some studies have reported that the severity of clinical disease activity, structural damage and deformities were similar in both sexes and there was no statistically significant difference in radiographic results between genders in RA [26-29]. When we examined the effect of gender, we found that disease activity was not more severe in women and we think that gender is not a determining factor in the severe course of the disease.

When Albrecht, et al. (2016) evaluated the three major RA cohorts in terms of BMI, they reported that most of them were overweight [30]. Tembe, et al. (2008) also showed that these patients had marginal weight gain [31]. Although it was observed that our RA individuals had high BMI, it was determined that BMI had no effect on disease activity. It has been shown in the literature that increased BMI in RA has an effect on many morbidity. Comparing normal and overweigt RA patients, it was concluded that the rates of rheumatoid cachexia and osteopenia increased significantly in overweight patients [32]. High BMI with RA has been associated with worse scores in patients and has been reported to negatively affect treatment [33,34]. It has been reported that increased BMI in RA should be treated and the solution is not just to lose weight [35]. We think that better results can be obtained by doing diet programs and exercise applications together in controlling increased weight gain in individuals with RA.

Yazıcı, et al. reported that the duration of morning stiffness reflects functional limitations and increased pain scores [36]. While the duration of morning stiffness was found to be significantly associated with DAS28 in the study by Orange, et al. [37]; Boers, et al. reported a low correlation in their study [38]. In parallel with the literature, we have seen that the increase in disease activity in individuals with RA is effective on the duration of morning stiffness.

Although direct evidence is limited, there is evidence between disease activity, functional status, and radiographic damage, and persistent synovitis in the hands has been reported to be a parameter associated with erosive changes [39,40]. In their study with 62 RA patients, Karaçavuş, et al. found that patients with high DAS28 scores had more peripheral joint involvement (mean 11/8 joints) than the patients with low disease activity [41]. In our study, we have concluded that the presence of deformity in RA poses a risk for the active

period of the disease. In order to obtain this result, there is a need for further investigation on which of the parameters used in the calculation of DAS28 (the number of swollen joints and/or the number of sensitive joints and/or patient's general medical condition and/or CRP) is more effective.

From studies evaluating demographic and clinical characteristics in individuals with RA, Mota, et al. reported the presence of rheumatoid nodules 15.38% and Bal, et al. 3.2% [24,20]. Corbett, et al. and Mota, et al. have associated the increase in the incidence of rheumatoid nodules with the active period [24,42]. They reported that nodules were more common in severe RA and they tended to disappear with the regression of articular involvement [43]. While we determined the presence of nodules as 16.8% in our study, we obtained that the presence of nodules poses 1.62-fold higher risk for moderate-high disease activity compared to the remission, Bal, et al. declared eye involvement as 4.8% in their study examined demographic and clinical characteristics of patients with RA in Turkey; Mota, et al. noticed the symptoms of sikka as 13.84% [20,24]. We determined the dryness of the eyes as 45.5% in the sample group of our study.

The first case-controlled study to identify nail changes significantly related to the disease in RA was conducted by Michel, et al. In our study, we identified nail abnormalities as 27.3% in individuals with RA [44]. We believe that information on this subject is lacking in the literature and more research is needed.

RA is not frequently reported among the underlying causes of secondary Raynaud's phenomenon; however, some studies have shown that the Raynaud's phenomenon occurs much more in RA patients than thought [45]. Among the studies evaluating demographic and clinical characteristics features in individuals with RA, Mota, et al. found that 18.46% had a Raynaud's phenomenon; Saraux, et al. found that 54 of 332 RA individuals (17.2%) had a Raynaud's phenomenon [24,46]. When the patients with Raynaud's phenomenon are examined, it is revealed that the RA rate is between 5 and 7% [46]. We have found the presence of Raynaud's phenomenon in patients with RA at a high rate, such as 21.0%.

It has been reported that axial and appendicular bone loss starts from the first 6 months of RA. Clinical inflammation usually progresses with bone erosion, leading to functional limitations. Synovial osteoclastic formation results in bone erosion [47,48]. Osteoporosis is one of the major complications encountered in RA and there are studies reporting that individuals with RA have an increased risk of bone fracture in the literature [49-51]. According to the results of our study, osteoporosis is seen at 30.1% in RA. We obtained that the osteoporosis poses 1.97-fold higher risk for moderate-high disease activity compared to remission and poses 1.52-fold higher risk for moderate-high disease activity compared to low disease activity. It is known that the effect of physical activity is quite high in the prevention of osteoporosis [52]. The World Health Organization emphasizes that sufficient calcium and vitamin D, as well as strengthening exercises, are important for preventing osteoporosis [53]. It has been reported in the literature that exercise increases bone density, reduces the risk of fractures and significantly improves quality of life [54]. In addition to sunbathing and calcium supplementation, exercise is also recommended to prevent falls against osteoporosis, which is common in RA [55].

In a study by Doyle, et al. it was reported that 12% of individuls had hypoxia in lung involvement in RA [56]. People often avoid breathing-causing activities in order not to increase their symptom severity and maintain their current status. Fear of movement due to dyspnea leads to a decrease in physical activity levels and functional capacities, and not performing daily living activities. Zu Wallack and his colleagues defined the "dyspnoea-inactivity vicious circle" in their work [57]. In the systematic review conducted by Tierney, et al. It was found that physical activity level in RA patients was lower compared to healthy individuals [58]. According to the results of our study, dyspnea was the second parameter that posed the highest risk for the active period in RA.

Exercise therapy is recommended as a part of non-pharmacological treatment in rheumatic diseases [59]. In a review that examines the relationship between exercise and inflammation, exercise has been shown to produce anti-inflammatory responses, and positive adaptation to the muscles has been demonstrated if exercise is continued regularly [60,61]. It has been reported in the literature that exercise is effective in reducing the level of dyspnea and fatigue [62]. It has been shown that regular exercise increases aerobic capacity and physical fitness in RA patients [63,64]. In addition, exercise is recommended in RA treatment by being effective in coping with the disease [65,66].

Conclusion

In our study, it was observed that osteoporosis and dyspnea pose a high risk in the active period of RA. According to these results, we think that the risk of developing dyspnea and decrease in bone quality in RA individuals in the active period is high due to inactivity. Therefore, we suggest that RA patients should be encouraged to continue their physical activities and increase their participation in the exercise to reduce their complaints of dyspnea and osteoporosis. We also recommend that exercise be made a part of life and be done regularly.

Conflicts of Interest

The author reports no conflicts of interest in this work.

Author Contributions

EGK, UBA, and BBC designed the study. EGK and CK searched databases and performed the selection of studies; EGK and MT collected data; EGK and BBC analyzed the data; EGK, CK and BBC wrote the manuscript; UBA and VC contributed to writing and critically uprising the manuscript and approved the last version.

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Original Investigation

The efficacy of clinical Pilates exercises in children and adolescents with juvenile idiopathic arthritis: A pilot study

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ABSTRACT

Objectives: Our study was planned to investigate the effect of Clinical Pilates exercises in children and adolescents with Juvenile Idiopathic Arthritis (JIA).
Methods: Fifteen participants diagnosed with JIA (mean age = 12.00 ± 3.40 years) were included. The participants were randomly divided into two groups as Clinical Pilates exercise group ($n = 6$), and home exercise group ($n = 9$). Clinical Juvenile Arthritis Disease Activity Score (cJADAS), Wong Baker Face Scale, Bruninks-Oseretsky Test of Motor Proficiency Second Edition Short Form (BOT-2 SF), Juvenile Arthritis Biopsychosocial Scale (JAB-Q scale), and Pediatric Quality of Life Inventory (PedsQL) 3.0 Arthritis Module was used for evaluation before and after treatment. Exercises were performed by both groups 3 times a week for 6 weeks.
Results: In the analysis of the before and after treatment results, a significant difference was observed in cJADAS ($p = .027$), manual dexterity ($p = .020$), running speed and agility ($p = .027$) subtests of BOT-2 SF, total score of BOT-2 SF ($p = .042$) and daily activity ($p = .043$) subtests of PedsQL child form in the Clinical Pilates exercise group. While there was statistically significant differences in manual dexterity ($p = .024$), running speed and agility ($p = .041$) and upper limb coordination ($p = .034$) subtests of BOT-2, and parent form of JAB-Q ($p = .041$) in home exercise group. When the delta values were compared, the difference was significant in the upper limb coordination subtest of BOT-2 SF ($p = .008$), and daily activities subtest of PedsQL child form ($p = .003$) in favour of the Clinical Pilates exercise group.
Conclusions: Clinical Pilates exercises are a safe and useful method for children/adolescent with JIA.

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La eficacia de los ejercicios de pilates clínicos en niños y adolescentes con artritis idiopática juvenil: un estudio piloto

Palabras clave:
Ejercicio
Artritis
Juvenil
Dolor
Calidad de vida

RESUMEN

Objetivos: Nuestro estudio fue planeado para investigar el efecto de los ejercicios de pilates clínico en niños y adolescentes con artritis idiopática juvenil (AIJ).

Métodos: Se incluyeron 15 participantes diagnosticados con AIJ (edad media = 12,00 ± 3,40 años). Los participantes fueron divididos al azar en 2 grupos como grupo de ejercicio de pilates clínico (n = 6) y grupo de ejercicio en el hogar (n = 9). Para la evaluación antes y después del tratamiento se utilizó la puntuación de actividad de la artritis juvenil clínica (cJADAS), la escala Wong-Baker FACES®, la prueba Bruninks-Oseretsky de proficiencia motora en su segunda edición (BOT-2 SF), la escala biopsicosocial de artritis juvenil (escala JAB-Q) y el inventario de calidad de vida pediátrica (módulo PedsQL® 3.0) de artritis. Se realizaron ejercicios a ambos grupos, 3 veces por semana, durante 6 semanas.

Resultados: Cuando se analizaron los resultados, antes y después del tratamiento, se observó una diferencia significativa en las subpruebas de cJADAS (p = 0,027), destreza manual (p = 0,020), velocidad y agilidad en la carrera (p = 0,027) de BOT-2 SF, puntuación total de BOT-2 SF (p = 0,042) y actividad diaria (p = 0, 043) subpruebas de PedsQL® forma infantil en el grupo de ejercicio de pilates clínico, mientras que hubo una diferencia estadísticamente significativa en la destreza manual (p = 0,024), la velocidad y la agilidad en la carrera (p = 0,041) y la coordinación de las extremidades superiores (p = 0,034) subpruebas de BOT-2 SF y forma parental de JAB-Q (p = 0,041) en el grupo de ejercicio en casa. Cuando se compararon los valores delta, la diferencia fue significativa en la subprueba de coordinación de los miembros superiores de BOT-2 SF (p = 0,008) y en la subprueba de actividades diarias de la forma infantil de PedsQL® (p = 0,003) a favor del grupo de ejercicio de pilates clínico.

Conclusiones: Los ejercicios de pilates clínico son un método seguro y útil para niños/adolescentes con AIJ.

Introduction

Juvenile Idiopathic Arthritis (JIA); is a chronic autoimmune disease of unknown origin with arthritis in one and/or more joints for at least 6 weeks before the age of sixteen.[1] JIA is chronic arthropathy with the highest prevalence in children and adolescents.[2]

Arthritis, pain, muscle weakness, functional novelties and inactivation are the most important problems in children with JIA. Pain, as with other rheumatic diseases, is one of the symptoms causing disability in JIA.[3,4] It is stated that physical activity deficiency due to pain over time leads to fatigue, loss of function and motor control disorders.[5] It is known that increasing physical activity is necessary for normal muscle and joint health and can provide protection against inflammatory conditions.[6]

Children and adolescents with JIA have been reported to be at risk from a psychosocial perspective as well as physical deficiencies.[7,8] Since JIA gives different clinical findings, it is emphasized that the physical therapy and rehabilitation model to be applied should be holistic. In the biopsychosocial model, which has been focused on since the 1970s, a holistic approach is adopted to address the mind-body and spirit triad of the patient. Clinical pilates exercises are examples of this area. The foundations of Pilates were laid by the merger of theories of mind-body-spirit with theories of motor learning and core stabilization.[7,9]

Clinical Pilates exercises, which are preferred as a biopsychosocial approach in the exercise choices of adult rheumatic patients, are also fun for the JIA population, make the child active, can be done in groups and exercise habit, such as the role of positive characteristics will be considered appropriate.[10]

In the literature two studies examining the effectiveness of pilates exercises in children and adolescents with JIA have been found.[10,11] In these studies show that, Pilates exercises can be considered as a reliable model and provides a positive physical and psychosocial effects in children with JIA and should be supported in future studies with more objective parameters.

Many studies with adult individuals have shown the anti-inflammatory effects of regular exercise.[12] Although, these studies have not been done in children with JIA, prevailing opinion is exercise will have similar effects in children as adults.[13]

Our study was planned and performed to investigate the effect of Clinical Pilates exercises on disease activity, pain, motor skills, psychosocial status and quality of life in children and adolescents with JIA.

Material and method

Our study was planned as a randomized controlled parallel group and the effects of Clinical Pilates exercise in children/adolescents with JIA were evaluated by comparison with the control group. Participants were randomly divided into Clinical Pilates exercise and home exercise groups. The Clinical Pilates exercises were conducted under the supervision of a physiotherapist. The participants in the home exercise group were told in detail about the home exercise program by the same physiotherapist and were asked to do the exercises at home.

Participants

Of the 27 individuals diagnosed with JIA initially included, 2 individuals were excluded from the study due to intraarticularsteroid injection to the knee joint in the last 3 months, and 5 individuals refused to participate in the study. The 20 volunteer individuals who met the inclusion criteria of the study were randomly divided into two groups with the SPSS program: Clinical Pilates exercise group ($n = 10$) and the home exercise group ($n = 10$). From the Clinical Pilates exercise group; 2 individuals had to give up exercise because their family had to move out of the city, 2 individuals were excluded from the study because they did not come to treatment regularly. From home exercise group; 1 individual did not come to the final evaluation because his exam period began. The study was completed with a total of 15 individuals with JIA including 6 individuals (6 girls, mean age = 12.50 ± 4.03 years) in Clinical Pilates exercise group and 9 individuals (4 girls, 5 boys, mean age = 11.66 ± 3.12 years) in home exercise group. Fig. 1 shows a flow chart of the study design.

The demographic information of the participants was recorded prior to the evaluations. Demographics are shown in Table 1.

Inclusion criteria in the study: (a) To be diagnosed with JIA according to ILAR classification. (b) Being in the 6–16 age range. (c) Volunteering to participate in the study. (d) To be stable in drug use for at least 3 months or longer.

Exclusion criteria in the study: (a) Presence of active synovitis or arthritis. (b) The presence of cardiovascular, pulmonary, orthopaedic and neurological problems that may interfere with exercise. (c) Intraarticularsteroid injections to the knee and ankle joint in the last 3 months. (d) Having been exercising regularly for the last three months. (e) Having undergone any surgical operation in the last six months. (f) Not being able to participate in at least 75% of the education.

If there were participants of the child/adolescent who could not adapt to the exercise, the exercise would be terminated for these participants and these participants would be followed up in our clinic.

Outcome measures

Evaluations were done before and after the treatment. cJADAS was evaluated by the same rheumatologist blinded to all interventions. All other evaluations were performed by the same experienced physiotherapist blinded to all interventions, according to standardized testing protocols and in the same environment where the same conditions were met.

Demographic data and disease information of the participants were recorded using the face-to-face interview method. Then, disease activity was evaluated with Clinical Juvenil Arthritis Disease Activity Score (cJADAS), pain with Wong Baker Faces scale, motor skill with Brunininks-Oseretsky Test of Motor Proficiency Second Edition Short Form (BOT-2SF), biopsychosocial aspect with clinician, family and child forms of Juvenile Arthritis Biopsychosocial Scale (JAB-Q scale) and disease-related quality of life with Pediatric Quality of Life Inventory (PedsQL) 3.0 arthritis module.

Clinical Juvenil Arthritis Disease Activity Score (cJADAS)

In 2009, "Juvenil Arthritis Disease Activity Score (JADAS)" was defined to assess disease activity in children. This scale consists of 4 sections: Doctor-Visual Analog Scale, Patient-Visual Analog Scale, number of active joints (71, 27, 10 joints) and evaluation of sedimentation between 0 and 10. Recently, Mc Erlane et al. developed a clinical three-point version of the score that excludes ESR.[14] It is called the acronym cJADAS, i.e. clinical JADAS.[15] cJADAS which used to evaluate 27 active joints were used in our study.

Wong Baker Face Scale

This scale is rated between 0 and 10. 0 is the absence of pain, 10 is the most severe pain and the condition of pain is explained by facial expressions in response to numerical data on the scale.[16]

Brunininks-Oseretsky Test of Motor Proficiency Second Edition Short Form (BOT-2SF)

The scale assesses motor skill and consists of 8 subtests and 14 items. Subtests were fine motor precision, fine motor integration, manual dexterity, bilateral coordination, balance, running speed and agility, upper limb coordination, and strength. Motor skill increases as score increases.[17]

Juvenile Arthritis Biopsychosocial Scale (JAB-Q)

This is a questionnaire prepared in Turkish language with JIA children between 6 and 18 years of age in order to evaluate JIA patients biopsychosocially. It has 3 forms: child, parents and clinician. In our study, evaluation was made using this 3 questionnaire forms. The answer to each question is yes/no/sometimes. The "yes" answer to the questions is indicates a bad psychosocial situation.[18]

Pediatric Quality Of Life Inventory (PedsQL) 3.0 Arthritis Module

The PedsQL 3.0 arthritis module includes subtests; "Pain and Hurt "(4 items)," Daily activities "(5 items)," Treatment "(7 items)," Worry "(3 items), and" Communication" (3 items). It consists of a total of 22 items. High scores mean high quality of life. In this study, 5–7 years old, 8–12 years old, 12–18 years

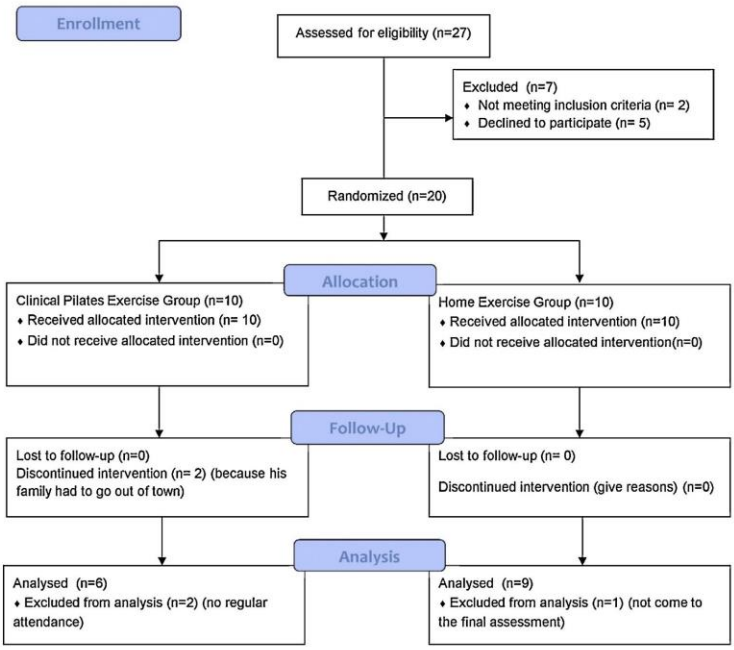

Fig. 1 – Flow chart of the progress through the phases of the study.

Table 1 – Demographic characteristics of the participants.

Variables	Clinical Pilates Exercise Group ($n=6$) Median (min–max)	Home Exercise Group ($n=9$) Median (min–max)	p^*
Age (years)	14.00 (7.00–16.00)	12.00 (8.00–16.00)	0.765
Body weight (kg)	62.50 (20.00–86.00)	33.00 (21.00–90.00)	0.262
Height (m)	1.63 (1.25–1.68)	1.39 (1.20–1.89)	0.288
BMI (kg/m^2)	23.80 (12.80–31.98)	19.22 (13.44–25.59)	0.289
Year of diagnosis	4.00 (0.50–6.00)	4.00 (0.33–8.00)	0.810
Variety of JIA	*n* (%)	*n* (%)	
Oligoarticular JIA	4 (66.67)	7 (77.78)	
Enthesitis related JIA	1 (16.67)	2 (22.22)	
Systemic JIA	1 (16.67)	–	

* Mann Whitney U Test.

old child and parent forms were used to evaluate the quality of life of the patients.[19,20]

Intervention

Clinical Pilates Exercises

Clinical Pilates training was performed 3 times a week for 6 weeks by a physiotherapist trained in clinical mat pilates and experienced in the field. Each session was contain 10 min of warm-up phase, 40 min of Clinical Pilates exercises and 10 min of cool down phase. Before starting the clinical pilates program, a 1-hour meeting session was held to allow participants to meet each other and to have parents know about Clinical Pilates. After the meeting session, participants were taught 5 key elements of Clinical Pilates and the program was started. These key elements; respiration, focus, rib cage placement, shoulder placement, head and neck placement. Participants were encouraged to use these 5 basic elements not only during exercises but also in daily routines. It was aimed to create awareness by explaining the neutral spine position to each participant by using age-appropriate imagery methods. In addition, participants were taught the Pilates resting position before beginning to exercises. Throughout the

Table 2 – The details the Clinical Pilates treatment program.

Warm up phase	Cool down phase
Shoulder flexion/extension (contralateral)	Shoulder flexion/extesion (contralateral)
Roll down	Roll down
Mini squat	Mini squat
Side bending	Side bending
Clinical pilates exercises (0–3weeks)	(3–6 weeks)
One leg stretch	Hundreds with stabilization ball
Scissors	Double Leg Stretch
Shoulder bridge	Leg Push with stabilization ball
Hip twist	Shoulder bridge/level 2
Arm openings	Hip twist/level 2
Clam	Arm openings/level 2
Swimming	Clam/level 2
One leg kick	Shoulder Bridge 1 with stabilization ball
	Side kick in Lying (beginner) with stabilization ball
	One Leg Kick with stabilization ball
	Swimming 1 with stabilization ball

Clinical Pilates training, exercises were repeated until correct posture was achieved in different positions in line with the elements taught on the first day. For the correct implementation of exercises, the physiotherapist did the clinical pilates exercises and asked the participants to do. In addition, the aim of each exercise was explained to the participant and it was tried to make it functional in daily life. Each exercise for the first three weeks was performed 8–10 repetitions. The exercises were performed on the mat in supine, side-lying, prone and sitting positions, respectively. The next 3 weeks, increase in the number of repetitions, a change of position to suit the level, and stabilization balls were used to for advance the exercises. Each participant's stabilization ball was personalized and 55 or 65 cm in height, so as to achieve 90° flexion angle on the hips and knees.[21] The details of the Clinical Pilates exercises are given in Table 2.

Home exercises

A total of 12 exercises were applied to the home exercise group, consisting of stretching and strengthening exercises for the whole body, which lasted approximately 40 min for 6 weeks, including 3 times a week. In patients who were eligible to participate in the study after the initial evaluation, a session was conducted together and the accuracy of movement were taught. The brochure which containing the names and descriptions of the exercises with the visual was given to the participant or parent. Follow-up of patients was provided with a home follow-up schedule and reminders were made by contacting parents over the phone. Advanced level exercises were explained to the participants in the first session and on the third week high level exercises started by the phone call.

Statistical analysis

The data was analyzed with the SPSS (version 21.0) package program. Continuous variables were given as median (minimum-maximum) and categorical variables as number and percentage. To compare independent group differences, Mann–Whitney *U* test was used in accordance with low sample size. Within group comparisons, Wilcoxon test was used in accordance with low sample size. The statistical significance level was considered $p < 0.05$.

Results

In our study with 15 participants, no problems were reported during evaluations and training. Our study was completed with 85% continuity. There was no statistical difference between the demographic data of the groups ($p > 0.05$, Table 1).

When before and after treatment data were compared, there was a significant improvement in, cJADAS ($p = 0.027$), manual dexterity ($p = 0.020$) and running speed-agility ($p = 0.027$) subtests of BOT-2 SF, total score of BOT-2 SF ($p = 0.042$) and daily activities ($p = 0.043$) subtest of PedsQL child form in the Clinical Pilates exercise group. In the home exercise group, showed statistically significant differences in manual dexterity ($p = 0.024$), running speed-agility ($p = 0.041$) and upper limb coordination ($p = 0.034$) subtests of BOT-2 SF and parent form of JAB-Q scale ($p = 0.041$) (Table 3).

The Delta values of the participants were calculated by subtracting the pre-treatment result from the post-treatment result. When the delta values were compared, difference was significant in upper limb coordination subtest of BOT-2 SF ($p = 0.008$) and daily activities subtest of PedsQL child form ($p = 0.003$) in favor of Clinical Pilates exercise group (Table 4).

Discussion

As a result of our study, Clinical Pilates exercises in individuals with JIA reduced disease activity and also increased dexterity, running speed-agility, upper limb coordination, general motor skills and daily activity. Home exercises, on the other hand, increased dexterity, running speed- agility, upper limb coordination and had positive effects on both the child and the family.

In the literature, few studies examined the effectiveness of pilates exercises in children with JIA.[10,11] In their pilot study, Unal et al. investigated the effects of clinical pilates exercises on functional status, general health perception and pain. In addition to Clinical Pilates exercises, dance therapy and body imagery exercises are included in the treatment program. There is no control group in which the results were compared in this study. As a result of the study, the positive effects of Clinical Pilates exercises on decreased pain, improved function and overall understanding of health were recorded. Also it has been reported that Clinical Pilates exercises can be considered a reliable exercise model for children with JIA.[10]

The other study on clinical pilates in individuals with JIA belongs to Mendonca et al., the primary objective of the study was to determine the effect of Clinical Pilates exercises on

Table 3 – The comparison of pre and post treatment results within groups.

Variables	Clinical Pilates Exercise Group ($n=6$)			Home Exercise Group ($n=9$)		
	Pretreatment Median (min–max)	Posttreatment Median (min–max)	p^*	Pretreatment Median (min–max)	Posttreatment Median (min–max)	p^*
cJADAS	7 (3–9)	3 (0–8)	**0.027**	5 (0–9)	5 (0–21)	0.859
Wong Baker Face Scale	0.50 (0–3)	0 (0–3)	0.317	0 (0–3)	1 (0–3)	1.000
BOT-2 SF						
Fine motor precision	14 (11–14)	14 (13–14)	0.180	14 (10–14)	14 (12–14)	0.581
Fine motor integration	10 (8–10)	10 (9–10)	0.655	10 (9–10)	9 (8–10)	0.257
Manual dexterity	5.50 (4–8)	7 (5–9)	**0.020**	5 (4–7)	6 (4–9)	**0.024**
Bilateral coordination	7 (6–7)	7 (6–7)	0.564	7 (6–7)	6 (4–7)	0.109
Balance	8 (7–8)	8 (8–8)	0.317	8 (7–8)	8 (7–8)	1.000
Running speed and agility	5 (0–7)	8 (7–8)	**0.027**	4 (2–7)	7 (3–9)	**0.041**
Upper limb coordination	11.50 (0–12)	12 (11–12)	0.102	12 (12–12)	11 (10–12)	**0.034**
Strength	8.50 (7–9)	7.50 (4–9)	0.168	8 (6–10)	9 (6–12)	0.131
Total	70 (47–74)	73.50 (66–76)	**0.042**	68 (62–71)	70 (59–75)	0.088
JAB-Q Clinician	2.50 (1–8)	2 (1–2)	0.197	2 (0–5)	1 (0–4)	0.748
Child	23.50 (8–40)	15.50 (7–38)	0.140	31 (10–78)	32 (8–63)	0.594
Parents	14.50 (8–22)	11 (5–16)	0.207	18 (5–29)	16 (5–24)	**0.041**
Total	43.50 (24–60)	26 (25–52)	0.116	39 (24–101)	48 (20–85)	0.953
PedsQLChild						
Pain and hurt	56.25 (37.50–100)	65.62 (43.75–100)	0.063	87.50 (6.25–100)	75 (50–100)	0.865
Daily activities	77.50 (20–100)	100 (65–100)	**0.043**	100 (75–100)	90 (45–100)	0.068
Treatment	74.99 (39.28–100)	85.71 (50–100)	0.223	75 (35.71–92.85)	78.57 (25–92.85)	1.000
Worry	66.66 (16.66–100)	74.99 (33.33–100)	0.109	66.66 (0–83.33)	83.33 (0–100)	0.079
Communication	75 (25–100)	79.16 (33.33–100)	0.577	100 (33.33–100)	83.33 (41.66–100)	0.167
Total	71.08 (30.61–96)	77.34 (47.58–100)	0.116	80.65 (55.89–89.05)	84.64 (44.83–95.24)	0.441
PedsQL Parent						
Pain and hurt	56.25 (37.50–100)	65.62 (37.50–93.75)	0.197	90.62 (18.75–100)	78.12 (41.66–100)	0.348
Daily activities	82.50 (65–100)	100 (45–100)	0.276	95 (55–100)	97.50 (50–100)	1.000
Treatment	60.71 (53.57–96.42)	80.35 (50–91.66)	0.225	81.98 (28.57–100)	78.56 (50–100)	0.686
Worry	37.50 (0–100)	58.33 (16.66–100)	0.223	87.49 (0–100)	79.16 (25–100)	0.786
Communication	66.66 (50–100)	66.66 (33.33–100)	1.000	83.33 (50–100)	91.66 (75–100)	0.400
Total	56.17 (51.21–91.78)	72.52 (39.83–92.86)	0.075	81.90 (47.55–98.51)	81.84 (53.33–93.99)	0.866

Significant values are shown in bold.
cJADAS = Clinical Juvenile Arthritis Disease Activity Score, BOT-2 SF = Brunininks-Oseretsky Test of Motor Proficiency Second Edition Short Form, JAB-Q = Juvenile Arthritis Biopsychosocial Scale, PedsQL = Pediatric Quality of Life Inventory 3.0 Arthritis Module.
* Wilcoxon Test.

health-related quality of life, while the secondary objective was to determine the effects of joint pain intensity, disability and joint status.[11] Participants were randomized into conventional exercise or Pilates exercise groups. Both treatment methods were applied for 6 months. The Canadian Stott-Pilates method was applied to the Pilates exercise group. The method includes floor exercise, exercises with the Reformer, Stability Chair, Cadillac, and Ladder Barrel exercises. The authors concluded that the physical and psychosocial effects of pilates exercises in children and adolescents with JIA were more positive. Pilates exercises should be considered part of the rehabilitation program for patients with JIA and in the future, these positive developments should be supported with studies conducted using more objective parameters.

Disease activity scores are the most important determinants in determining whether treatments are effective on the disease. To our knowledge, this study is the first to assess the impact of Clinical Pilates exercises on disease activity in individuals with JIA and cJADAS were used in the assessment. We believe that the significant improvement in cJADAS scores in this study, will contribute significantly to the literature on the applicability of Clinical Pilates exercises as part of safe rehabilitation programs and shape the perspectives of clinicians and researchers.

It is stated that JIA leads to loss of function and motor control disorders in individuals.[5] In 50% of children with JIA, muscle weakness occurs, especially in the upper extremity and most often with reduction in hand strength.[22] JIA causes motor symptoms such as swelling of joints, effusion, tenderness, limitation of joint movements caused by pain, muscle weakness and atrophy, balance and gait disorders.[23] In this study, individuals with JIA were evaluated with BOT-2 SF in detail in motor skills and significant improvements were obtained in both exercise groups. We believe that significant improvements in manual dexterity, running speed-agility, upper limb coordination and general motor skills are the result of increased proximal muscle strength and stabilization by exercise and this increase is reflected positively to the distal joints of the extremities. Thus, we believe that an increase in motor skills can be achieved.

In this study, we evaluated the effect of Clinical Pilates exercises on the quality of life of children/adolescents with

Table 4 – The comparison of delta values with groups.

Variables	Clinical Pilates Exercise Group ($n=6$) Δ Median (Min/Max)	Home Exercise Group ($n=9$) Δ Median (Min/Max)	p^*
cJADAS	−2.50 (−5/−1)	−1 (−5/13)	0.212
Wong Baker Face Scale	0 (−1/0)	0 (−1/2)	0.622
BOT-2 SF			
Fine motor precision	0 (0/2)	0 (−2/2)	0.653
Fine motor integration	0 (−1/2)	0 (−2/1)	0.423
Manual dexterity	1 (1/3)	1 (0/4)	0.423
Bilateral coordination	0 (−1/1)	0 (−3/0)	0.504
Balance	0 (0/1)	0 (0/0)	0.221
Running speed and agility	2.50 (1/7)	1 (−1/5)	0.370
Upper limb coordination	0.50 (0/12)	−1 (−2/0)	**0.008**
Strength	−1.5 (−4/1)	0 (−1/4)	0.082
Total	3.50 (0/19)	2 (−3/7)	0.304
JAB-Q Clinician	−0.50 (−6/1)	0 (−2/2)	0.364
Child	−2.5 (−20/4)	1 (−17/23)	0.316
Parents	−3 (−15/4)	−2 (−5/2)	0.678
Total	−12 (−29/2)	4 (−19/18)	0.111
PedsQLChild			
Pain and hurt	6.25 (0/12.50)	0 (−25/56.25)	0.187
Daily activities	22.50 (0/45)	0 (−30/0)	**0.003**
Treatment	5.36 (−3.57/25)	−3.57 (−35.71/42.86)	0.214
Worry	4.16 (0/25)	16.67 (−16.67/58.34)	0.438
Communication	4.16 (−25/25)	0 (−25/16.67)	0.276
Total	10.48 (−4.71/19.11)	4.35 (−18.56/13.39)	0.289
PedsQL Parent			
Pain and hurt	6.25 (−12.50/31.25)	−9.37 (−45.84/31.25)	0.151
Daily activities	10 (−20/30)	0 (−5/40)	0.252
Treatment	10.71 (−7.14/27.38)	0 (−21.13/28.57)	0.395
Worry	16.66 (−16.67/41.66)	0 (−50/25)	0.169
Communication	4.16 (−16.67/16.67)	4.17 (−25/50)	0.603
Total	13.96 (−11.38/19.75)	1.45 (−21.73/17.17)	0.197

Significant values are shown in bold.
cJADAS = Clinical Juvenile Arthritis Disease Activity Score, BOT-2 SF = Brunininks-Oseretsky Test of Motor Proficiency Second Edition Short Form, JAB-Q = Juvenile Arthritis Biopsychosocial Scale, PedsQL = Pediatric Quality of Life Inventory 3.0 Arthritis Module, Δ = Posttreatment–pretreatment.
* Mann–Whitney *U* Test.

JIA and the results we obtained from PedsQL were in line with the literature. With increased of the mobility level of the child/adolescent, the child/adolescent became more active in daily activities and this enabled us to achieve positive improvements in quality of life.

We think that there are few studies about the effectiveness of exercise in individuals with JIA in the literature and more information is needed about home exercise program which is one of the exercise methods.

Sandstedt et al. studied the effects of exercise on muscle strength, physical fitness, and well-being in children with JIA. The study included 54 JIA and the exercises were administered as a home program (exercise 3 days a week and 12 weeks as rope jumping, muscle strength exercises, body stabilization exercises and arm strengthening exercises with weights). As a result of the study, there was little change in quality of life scores as a result of exercise therapy as a home program, and significant improvement in strength of hip flexors and knee extensors. The authors reported that the given home exercise program was well tolerated by participant.[24]

Tarakçı et al. conducted a study to investigate the effect of home exercise program on pain, functional ability and quality of life in individuals with JIA. 81 children with JIA were included in the study, randomized in the exercise (4 days a week with 1 day in hospital for 12 weeks) or the control group (no intervention). As a result of the study, the authors reported that a 12-week individually planned home exercise program resulted in an increase in physical function and quality of life in children with JIA.[25]

Strengths of this study are the comparison of the effectiveness of Clinical Pilates exercises with the control group, and this is the first study to evaluate the impact of Clinical Pilates exercises on disease activity in individuals with JIA.

Limitations

Limitation of this study is small sample size.

Conclusions

As a result, we believe that the significant improvement in cJADAS scores achieved by Clinical Pilates exercises in individuals with JIA will contribute significantly to the literature on the applicability of Clinical Pilates exercises as part of safe rehabilitation programs. In addition, we think it will shape the perspectives of clinicians and researchers. In addition, Clinical Pilates exercises made children/adolescent with JIA more active in daily activities by increasing mobility. This has enabled us to achieve positive improvements in quality of life. We believe that significant improvements of BOT-2 SF in manual dexterity, running speed-agility and upper limb coordination subtests and general motor skills are the result of increased proximal muscle stabilization through exercise and this increase is reflected positively to the distal joints of the extremities. And so we believe that an increase in motor skills has been achieved.

In these positive developments obtained with Clinical Pilates exercises, We think that it is effective to apply exercise as a supervisor and as a group. Should the practice method of Clinical Pilates exercises in children/adolescent with JIA be supervised or one-to-one? We recommend investigating which method is more effective in future studies.

Ethical approval

The ethical approval of the study was obtained from local ethics committee at the board meeting dated 02.07.2019 and numbered 12. All individuals were informed verbally and informed consent forms were signed.

Funding

No funding was received.

Conflict of interest

No potential conflict of interest was reported by the authors.

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Ek-9

Clinical research

Orthopedics and Traumatology

The Turkish version of the Neck Bournemouth Questionnaire in patients with chronic neck pain: a cultural adaptation, reliability, and validity study

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Abstract

Introduction: The cultural adaptation of a self-report measurement in different languages is important for developing common strategies for evaluation and treatment. The Neck Bournemouth Questionnaire (NBQ), which was developed to evaluate patients with neck pain, was adapted from the Bournemouth Questionnaire in accordance with the International Classification of Functioning, Disability and Health (ICF) categories. The aim of this study was to conduct the Turkish cultural adaptation, validity and reliability study of the NBQ.
Material and methods: The study included 119 patients (93 females, 26 males; mean age: 37.2 ±11.8 years) with chronic nonspecific neck pain. The NBQ, Neck Disability Index (NDI) and Nottingham Health Profile (NHP) questionnaires were administered to all the subjects. Test-retest reliability (intraclass correlation coefficient) and the internal consistency (Cronbach's α) were the methods used for the reliability study. The relationship between NBQ, NDI and NHP was investigated for concurrent validity. Exploratory and confirmatory factor analysis was used for construct validity.
Results: The Neck Bournemouth Questionnaire showed good internal consistency ($\alpha = 0.87$). The test-retest reliability coefficient was 0.913 (95% CI: 0.875–0.940). The correlations between NBQ and NDI and NHP were significant ($p < 0.05$). The questionnaire was found to have one factor and the explained variance was 59.084% as a result of factor analysis.
Conclusions: The Neck Bournemouth Questionnaire is a valid and reliable scale for patients with chronic neck pain in the Turkish population.

Key words: validity and reliability, pain, outcome measures.

Introduction

Neck pain is an important health problem that is very common in society. Lifetime prevalence has been reported to vary between 14.2% and 71% [1]. Symptoms recur within 1–5 years in 50–85% of the patients [2]. It was found to cause disability in 5% of the population in a study conducted in Canada [3]. Neck pain decreases the quality of life of the patients with the disability and the activity limitation it causes can also lead to economic and societal costs due to significant health care use and labor loss [4–6].

Although the pain itself is the most important symptom that requires treatment in spinal pain, it is a multidimensional individual experience with sensory, affective, cognitive, and social aspects [7]. It is therefore more appropriate to consider a biopsychosocial model rather than a medical model when identifying the assessment and treatment approaches [4].

The sensitivity of the Functional Outcomes Questionnaire which has been developed specifically for the region is much greater than the general health scales [7, 8]. Some pain and disability questionnaires were developed specifically for neck pain patients. Validity and reliability studies have been conducted in various languages including Turkish for the Neck Disability Index (NDI) [8, 9], the Neck Pain and Disability Scale (NPDS) [10, 11], the Northwick Park Neck Pain Questionnaire (NPQ) [12, 13] and the Copenhagen Neck Functional Disability Scale (CNFDS) [14] that have been developed for this purpose. In a systematic review published in 2010 the validity and reliability of the NDI, NPDS and the Neck Bournemouth Questionnaire (NBQ) were reported as excellent [15].

The Neck Bournemouth Questionnaire (NBQ), which was developed to evaluate patients with neck pain, was adapted from the Bournemouth Questionnaire in accordance with the International Classification of Functioning, Disability and Health (ICF) categories [5]. It includes 7 core items evaluating patients with neck pain based on a biopsychosocial approach. The NBQ was originally developed in English but studies have also been conducted on German, French, Italian, Dutch and Brazilian Portuguese language versions [5, 6, 16–20]. The cultural adaptation of a self-report measurement in different languages is important for developing common strategies for evaluation and treatment [6]. The Turkish version study of this questionnaire, which is easy to implement and can be completed in a short duration, has not yet been conducted.

The aim of planning this study was to conduct the Turkish version of the Neck Bournemouth Questionnaire, which is a multi-dimensional pain assessment tool, in Turkish-speaking people with neck pain.

Material and methods

Permission was obtained via e-mail to conduct this study from the author who developed the original questionnaire [5]. The study was carried out at Denizli Servergazi State Hospital and Pamukkale University. Participants were diagnosed by a specialist doctor as having a nonspecific chronic neck pain problem. Informed consent was obtained from all participants included in the study. Approval for the study was also obtained from the Pamukkale University Non-Interventional Clinical Studies Ethics Committee (601167787-020/54425).

One hundred and nineteen patients (93 females, 26 males; mean age: 37.2 ±11.8 years) suffering from neck pain for at least 3 months were included in the study. The inclusion criteria were: (1) aged 18-65 years, (2) a minimum of 5 points from the Neck Disability Index, (3) able to speak and read Turkish fluently. The exclusion criteria were: (1) patients who underwent spinal surgery, (2) specific neck pain such as a malignancy, fracture or systemic rheumatoid disorder, (3) systemic diseases, (4) pregnancy, (5) subjects who cannot answer the questionnaires due to inability to understand and/or answer, (6) subjects receiving treatment such as physiotherapy or drugs at the time of the study.

Questionnaires

The Neck Bournemouth Questionnaire

Based on the biopsychosocial disease model, the questionnaire consists of a total of 7 questions: (1) pain intensity; (2) disability in activities of daily living; (3) disability in social activities; (4) anxiety; (5) depression; (6) fear avoidance behavior and (7) pain locus of control. Each question consists of an 11-point numerical rating scale. The total score from the questionnaire ranges between 0 and 70 [5, 6, 18]. Increase in the score indicates worsening of the patient's condition.

Neck Disability Index

The scale consists of ten sections in total (pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation). The total score varies from 0 (no disability) to 50 (total disability) [8, 9].

Nottingham Health Profile

The Nottingham Health Profile (NHP) is a general health condition scale that evaluates the problems perceived by the patient in 6 different aspects (physical mobility, pain, sleep, emotional reactions, social isolation, and energy level). The maximum score in each section is 100 and the total score of the questionnaire is between 0 and 600 [21, 22].

Translation

Guidelines developed by Beaton *et al.* were used for the translation and cross-cultural adaptation process [23]. For forward translation two different people whose native language is Turkish and who speak English at a very good level translated the questionnaire in English into Turkish (T1 and T2). One of the translators was a physiother-

apist and was aware of the purpose of the study. This was to ensure the equivalence from a clinical perspective, instead of a literal equivalence. The other translator was an English teacher and was a blinded for the purpose of the study. This made it possible to reflect the language used by the population and to emphasize equivocal meanings in the original questionnaire. Later, translations by two translators were synthesized into a single global translation (T12). In the back translation stage, the synthesized T12 translation was translated into English again by two people who were not informed about the purpose of study, whose native language is English and who speak Turkish at a good level (BT1 and BT2). To achieve cross-cultural equivalence, an expert committee consisting of four translators and three physiotherapists came together to form the prefinal state of the questionnaire for field testing. For the prefinal test, 33 patients with neck pain were asked to indicate the expressions they were unable to understand for each item during the questionnaire response. The final version of the NBQ was created by the committee considering the feedback from the patients and the validity and reliability study was started.

Table I. Matching of the subscales between the NBQ, NHP and NDI

NBQ subscale	NHP subscale	NDI subscale
Pain intensity	Pain	Pain intensity
Physical function	Physical activity	Personal care Lifting Reading Driving Recreation
Social function	Social isolation	Recreation
Anxiety	Emotional reaction Energy level	
Depression	Emotional reaction Energy level	
Cognition		Work
Pain locus of control	Pain	Pain intensity

NBQ – Neck Bournemouth Questionnaire, NHP – Nottingham Health Profile, NDI – Neck Disability Index.

Table II. Demographic and clinical characteristics of patients (n = 119)

Parameter	Mean ± SD	Min.–max.
Age [years]	37.2 ±11.8	20–65
BMI [kg/cm²]	25.9 ±5.2	16.6–44.1
Pain duration [months]	23.3 ±24.6	3–84
VAS [cm]	5.4 ±1.8	1–9

BMI – body mass index, VAS – visual analog scale, SD – standard deviation.

Statistical analysis

The data were analyzed with the SPSS software, version 21.0. Continuous variables were presented as mean ± standard deviation and categorical variables as number (percentage).

Reliability

Test-retest reliability and internal consistency analyses were done to determine the reliability of the questionnaire. In the test-retest reliability analysis the intraclass correlation coefficient (ICC) (95% confidence interval) and Spearman correlation coefficient were used. ICC values range from 0.00 to 1.00. Above 0.80 shows excellent reliability and 0.60–0.80 means good reliability [8, 24]. NBQ was administered to the same patients again 7 days later for the test-retest reliability. For determining the internal consistency Cronbach's α coefficient was used. Item total correlation and item-deleted Cronbach's α coefficient were calculated during this analysis. If this value is above 0.80, it indicates excellent reliability [25].

Validity

For the construct validity exploratory and confirmatory factor analyses were applied. Prior to the exploratory factor analysis, the adequacy of the sample was determined by the Kaiser-Meyer-Olkin test and Bartlett's test of sphericity was used for the suitability. Whether NBQ was unidimensional as in the original structure was shown with the help of various conformity indexes during confirmatory factor analysis. For concurrent validity the correlation coefficient between NBQ, NDI and NHP was examined. Table I shows the matching of the various subscales on the NHP and NDI questionnaires with the seven subscales on the NBQ. The relationship was evaluated with Spearman correlation analysis [26].

Results

The mean duration of pain and pain intensity were 23.3 ±24.6 months and 5.4 ±1.8 cm respectively for a total of 119 patients. Demographic and clinical data of the patients are presented in Table II.

Reliability

The test-retest reliability coefficient was 0.913 (ICC 95% CI: 0.875–0.940). ICC values for each question ranged from 0.807 to 0.888. The results of our study and the correlation coefficients are presented in Table III.

The Cronbach's α value of the scale was 0.87. This result means that the internal consistency of the scale was excellent. In Table IV it is shown that the Cronbach's α value decreased when each question was deleted.

Construct validity

The results were 0.846 for the Kaiser-Meyer-Olkin test and for Bartlett's test of sphericity $p < 0.001$. The questionnaire was found to have one factor and the explained variance was 59.084% as a result of factor analysis (cmin/df: 1.661, GFI: 0.952, AGFI: 0.887, RMSEA: 0.075, χ^2: 19.936, $p = 0.068$). Factor loading values were between 0.63 and 0.845. Item 7 had the lowest factor loading value.

Concurrent validity

Concurrent validity results showed a correlation between NBQ total score and NDI total score ($r = 0.318$) and also between NBQ total score and NHP total score ($r = 0.581$). When the relationship between the subscales of NBQ, NDI and NHP and the total scale scores was analyzed, NBQ was found to show correlation values between 0.206 and 0.597 with these scales (Table V).

Discussion

The aim of this study was to conduct the Turkish cultural adaptation, validity and reliability study of the Neck Bournemouth Questionnaire in patients with chronic neck pain. Our results showed that the questionnaire is a valid and reliable measurement method in Turkish speaking patients with chronic neck pain.

The ICF is a standard framework approved by the World Health Organization (WHO) that measures health and disability at the individual and population level [15, 19, 27]. The positive and negative aspects of functioning from a biological, personal and social point of view are expressed with the terms functioning and disability. Performing version studies of ICF-based self-report measurements that provide a general language for disability in different cultures will be helpful in the evaluation of musculoskeletal pain and in the generation of common solutions for interpretation of treatment outcomes [27].

Ferreira *et al.* reported that NBQ, NDI and NPDS have demonstrated a well-balanced distribution of items across the ICF components [15]. Therefore, it is important to present the Turkish version of the NBQ in the literature for using it in clinical practice and research. For the questionnaire validation studies, it is recommended to select the questionnaires which are validated, considered to be the gold standard and context specific if possi-

Table III. Test-retest correlation coefficient values of Neck Bournemouth Questionnaire (NBQ)

NBQ	ICC (95% CI)	*r*
Total	0.913 (0.875–0.940)**	0.847**
Item 1	0.854 (0.791–0.899)**	0.772**
Item 2	0.888 (0.839–0.922)**	0.820**
Item 3	0.858 (0.796–0.901)**	0.770**
Item 4	0.868 (0.810–0.908)**	0.779**
Item 5	0.853 (0.789–0.898)**	0.752**
Item 6	0.828 (0.753–0.880)**	0.725**
Item 7	0.807 (0.723–0.866)**	0.678**

*ICC – intraclass correlation coefficient. All other correlations are significant at **p < 0.001, r – Spearman corelation coefficient.*

Table IV. Internal consistency of the Turkish version of the Neck Bournemouth Questionnaire (NBQ)

NBQ item	Cronbach's α if item deleted
Item 1	0.863
Item 2	0.854
Item 3	0.850
Item 4	0.850
Item 5	0.874
Item 6	0.846
Item 7	0.877

Table V. External longitudinal construct validity of items of the Neck Bournemouth Questionnaire (NBQ)

NBQ item	Counterpart measure	*r*
1	NDI Pain intensity	0.557**
	NHP Pain	0.461**
2	NDI Personal care	0.430**
	NDI Lifting	0.361**
	NDI Reading	0.397**
	NDI Driving	0.329**
	NDI Recreation	0.389**
	NHP Physical activity	0.313**
3	NDI Recreation	0.429**
	NHP Social isolation	0.206*
4	NHP Emotional reaction	0.479**
	Energy level	0.400**
5	NHP Emotional reaction	0.597**
	Energy level	0.424**
6	NDI Work	0.380**
7	NDI Pain intensity	0.223*
	NHP Pain	0.454***
Total	NDI Total	0.318**
	NHP Total	0.581**

*r – Spearman correlation coefficient, *correlation is significant at 0.05 level, **correlation is significant at 0.01 level, ***correlation is significant at 0.001 level.*

ble [25]. Therefore, one of the questionnaires that we chose in the validation study of the NBQ was the NDI, in which the Turkish validity and reliability study was conducted [24]. The other questionnaire was the NHP, which was in conformity with the subparameters of the NBQ and a validity and reliability study had been done in Turkish [22].

There are two types of reliability: internal consistency and test-retest reliability. Test-retest reliability measures over-time stability of measurements made at two different times [28]. In this analysis, it is recommended that an amount of time should pass for the patients to forget the answers in the initial assessment. However in this period of time, not having a change in the current status of patients associated with the disease is important [25]. Marx *et al.* [29] reported no difference between test and retest at an interval between 2 days and 2 weeks. It was seen that in the literature, different time intervals are preferred for the application of retest of the NBQ; and in some studies the time interval is not even specified. The test-retest time interval appears to be 2 h (hours) in the German version, 24 h in the French version and 1 h in the Brazilian Portuguese version [17, 18, 20]. It was determined that the original NBQ developed by Bolton and Humphreys had an ICC total score of 0.65 and that it changed between 0.50 and 0.63 for each questionnaire [5]. In the German version of the study it was reported that the total ICC value was 0.99 and it varied between 0.91 and 0.98 for seven questions [17]. In the Dutch version, it was determined that the ICC value varied between 0.83 and 0.99 for each question [19]. In the French version of the study, the total ICC value of the questionnaire was found to be 0.97 [18]. The test-retest reliability value of the Turkish NBQ with a week interval was determined as 0.913 for the total score, ranging from 0.807 to 0.913 for each question. According to the results of this study, the test-retest reliability of the Turkish version of the questionnaire showed stability over time.

The Cronbach's α value is widely used for internal consistency reliability analysis of questionnaires in different language versions [28]. In the study of Bolton and Humphreys, developers of the NBQ, they found Cronbach's α values of the survey to be 0.87, 0.91 and 0.92, respectively in pre-treatment, retest and post-treatment administration [5]. Pre- and post-treatment Cronbach's α values in the German version were 0.79 and 0.80 [17], respectively, whereas it was found to be 0.98 in the Brazilian Portuguese version [20]. In the Turkish version study of the NBQ, we found that the Cronbach's α value was 0.87, similarly to literature. This result shows that the Turkish version of the questionnaire is reliable.

According to the Kaiser-Meyer-Olkin and Bartlett's tests, the Turkish version of the NBQ has a one-factor questionnaire. Before our study, in the Italian version of the NBQ, the questionnaire was found to be two-factor [6]. Similarly to our results for the Turkish version of the questionnaire for back pain it was found to be one-factor [25]. The authors commented that even though it addresses multiple situations, the Bournemouth Questionnaire may be one-factor because of the small number of questions.

The concurrent validity analysis results showed the NBQ to be correlated with NDI and NHP total scores and items in chronic neck pain. The two lowest correlations were between NBQ/third question- NHP/social isolation and NBQ/seventh question-NDI/first question. The third question of the NBQ concerned social activity participation associated with neck pain, whereas the social isolation part of the NHP was not associated with pain. This difference may be the reason for the low correlation. Synchronizing the pain locus of control, the seventh question of the NBQ, with the subordinate items of NDI and NHP, is actually very difficult. Despite this, we wanted to analyze the correlations between this item and the pain-related part of the other two questionnaires. In the German version, the correlation between pain locus of control and NPDS pain control was also found to be low. The authors stated that it is impossible to make a match between NBQ/pain locus of control and NDI [17]. Similarly to our results, also in the validity studies of the NBQ in other languages, it was found that there was a correlation at varying levels [6, 20].

In conclusion, the studies among adult populations show that the prevalence of chronic pain is higher in all countries [30]. Musculoskeletal system pain is being studied in a wide range from non-specific pain to pain as a result of an underlying pathological condition such as chronic renal failure [31]. It is known that chronic neck pain, which is very common, affects the quality of life of the patient negatively in physical, social and psychological aspects [5]. Therefore, multidimensional analysis and determination of the factors that cause chronic neck pain are very important for taking the necessary preventive measures and determining appropriate treatment strategies. Translation of the self-report measures with proven validity and reliability to different languages is very important in terms of seeking common solutions in pain related problems.

The Neck Bournemouth Questionnaire evaluates chronic neck pain as multidimensional, can be completed in a short duration in the clinical setting and is easily understood by the patients. In conclusion, this study showed that the Turkish version of the NBQ is a valid and reliable measurement method.

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Conflict of interest

The authors declare no conflict of interest.

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ORIGINAL ARTICLE

Investigation of the effectiveness of aerobic exercise training in individuals with ankylosing spondylitis: Randomized controlled study

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ABSTRACT

Objective: To investigate the effect of the addition of aerobic training to spinal mobility exercises on disease-specific outcomes and functional exercise capacity, aerobic capacity and respiratory muscle strength of ankylosing spondylitis (AS) patients.

Methods: The study included 31 volunteers (mean age: 44.90 ± 11.52 years) diagnosed with AS. The demographic characteristics and disease-related data of all subjects were recorded, then, the Bath AS Disease Activity Index (BASDAI), Bath AS Metrology Index (BASMI) and Bath AS Disease Function Index (BASFI), the 6-minute walk test, the Bruce Treadmill Test and spirometry were used, respectively. The intervention group attended a 12-week program of aerobic exercise sessions, plus supervised spinal mobility exercises, 3 days a week. The control group performed the supervised spinal mobility exercises only, 3 times a week, for 12 weeks.

Results: There was a significant improvement in BASDAI ($p = .002$), BASMI ($p = .021$), 6 DYT ($p = .036$), VO_2 max ($p = .000$), MIP ($p = .005$) and MEP ($p = .022$) results in the intervention group after 12 weeks of training. In the comparisons of the pre-treatment and post-treatment differences, BASDAI ($p = .032$) decreased and VO_2 ($p = .001$) max increased, showing significant improvements in the intervention group and these values were maintained.

Conclusion: It is striking that improvements in all parameters except BASFI were achieved in the aerobic training group. These results demonstrate that an aerobic exercise program should be included in an individual exercise prescription for the management of AS.

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Aerobic exercise; ankylosing spondilitis; functional exercise capacity; respiratory muscle strength; spinal mobility exercise

Introduction

Ankylosing spondylitis (AS) is a chronic, systemic, inflammatory rheumatological disease affecting axial skeleton and sacroiliac joints, causing low back pain and limitations in spinal mobility and various degrees of structural and functional disorders [1].

Appropriate medication and exercise for the management of AS are the cornerstones of treatment [2]. Due to the characteristic features of the disease, the exercises that have been proposed focus on improving and maintaining spinal mobility. However, recent studies have emphasized the importance of the risk of cardiovascular morbidity associated with AS [3]. In the light of this information, exercises for AS patients should also improve other parameters of physical fitness [4]. In the study of Halvorsen et al. (2012), it was reported that in comparison with controls, patients with AS had reduced cardiorespiratory fitness and flexibility. Moreover, the researchers observed an inverse association between disease activity and both cardiorespiratory fitness and muscular capacity [5].

Aerobic capacity is known to be lower in AS patients than in healthy control subjects. This condition is thought to be due to muscle atrophy caused by inflammation, peripheral muscle weakness, fatigue, a low level of physical activity, negatively affected respiratory functions, peripheral arthritis, and decreased chest expansion and respiratory muscle strength [6]. It has been reported that impaired respiratory function in individuals with AS may be the result of exercise intolerance due to the reduced aerobic capacity [7].

In patients with AS, pain caused by thoracic spine fusion, costavertebral joint involvement, and enthesitis decreases thoracic cage mobility and chest wall expansion, thereby reducing the ability to reach potential vital capacity [8,9]. This negative effect in the respiratory system will reduce the amount of oxygen to the striated muscles and cause fatigue and adversely affect aerobic capacity [5]. In addition, respiratory pressure, respiratory endurance, especially maximal inspiratory pressure, respiratory and peripheral muscle strength are determinants of exercise capacity [10,11].

A review of the literature showed that there are no clear protocols regarding the effectiveness of aerobic exercise programs for AS patients and there is no consensus on this issue [12,13]. Therefore, the aim of this study was to investigate the effect of adding an aerobic exercise program to

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spinal mobility exercises on disease-specific outcomes (BASDAI, BASMI, BASFI) and functional exercise capacity, aerobic capacity and respiratory muscle strength. Evaluation was also made of whether the gains were maintained up to the third month (early term) after the end of the treatment protocol.

Materials and methods

In this randomized, controlled parallel group study, the effects of aerobic exercise in AS patients were compared with a control group. The exercise test and prescription guide prepared by the American College of Sports Medicine (ACSM) in 2011, recommends a combination of aerobic, resistant and stretching exercises for patients with arthritis [14]. Therefore, the intervention group in this study received a program of aerobic exercise together with spinal mobility exercises, and the control group received spinal mobility exercises alone. Evaluations before and after the treatment were made by physiotherapists who are experts in their fields. The exercises were conducted under the supervision of an experienced physiotherapist. The specific evaluations of AS and exercises were performed by a physiotherapist (EGK), and the evaluation of respiratory muscles was performed by another physiotherapist (HT) experienced and certified in this field. The Bruce Treadmill Test, which is one of the submaximal exercise tests, and the specific prescription of the aerobic exercise program for each patient were applied by another physiotherapist (OTA) experienced in this field.

Participants

The study included a total of 31 volunteers with a mean age of 44.90 ± 11.52 years, who had been diagnosed with AS according to the modified New York criteria. The intervention group comprised 17 participants (9 females, 8 males, age: 46.58 ± 11.94 years) and the control group comprised 14 participants (10 females, 4 males, age: 42.85 ± 11.07 years). The demographic data of all participants were recorded before the evaluations (Table 1).

Participation criteria: (a) AS diagnosis according to the modified New York criteria (b) voluntary participation in the study (c) age 20–65 years (d) regular use of disease-modifying anti-rheumatic drugs, including methotrexate, sulfasalazine and anti-tumor necrosis factor (TNF) agents, for 3 months or more, or non-steroidal antiinflammatory drugs (NSAIDs) and/or corticosteroids, at a stable dosage for at least 4 weeks. Exclusion criteria: (a) exercising regularly during the previous 3 months (b) the presence of cardiovascular, pulmonary, orthopedic and neurological problems that may prevent exercise (uncontrollable hypertension, heart attack or history of coronary revascularization, history of syncope or exercise-related arrhythmia, decompensated type 1 diabetes mellitus, history of hip and/or knee arthroplasty) (c) having undergone any surgery in the previous 6 months for both groups (d) having undergone a period of active illness in the previous 3 months for both groups (e) communication problems for both groups (f) any other respiratory or neuromuscular disease that may affect the respiratory muscles (g) inability to participate in at least 75% of the exercises (h) the presence of severe comorbidity that may affect the kidneys, liver, lungs and heart.

During the course of the study, any subject making any changes to the drug treatment was withdrawn from the study and the data of that patient were not included in the analyses.

Approval for the study was granted by the Non-Interventional Clinical Research Ethics Committee of Pamukkale University (decision no: 60116787-020/49880, dated 01.08.2017). Informed consent was obtained from all the study participants. We conducted our studies in compliance with recognized the principles of the Declaration of Helsinki and statement of Human and Animal Rights.

Outcome measures

Evaluations were made before and after treatment and at the third month after treatment. All evaluations were performed by the same experienced physiotherapists according to standardized test protocols and in the same conditions. Before starting the tests, the participants were allowed to adapt by the same therapists.

Demographic data, lifestyle habits and disease information were recorded on the registration form using the face-to-face interview method (Table 1). The Bath AS Disease Activity Index (BASDAI), Bath AS Metrology Index (BASMI) and Bath AS Disease Functional Index (BASFI) were used for the activity-related disease, function and baseline measurements of the participants, respectively. The 6-minute walk test was used to measure functional exercise capacity, the Bruce Treadmill Test to measure aerobic capacity and spirometry to measure respiratory muscle strength.

Table 1. Demographic characteristics of the patients.

Variables	Intervention Group ($n = 17$) M ± SD	Control Group ($n = 14$) M ± SD	*p Value
Age (years)	46.58 ± 11.94	42.85 ± 11.07	.330
Body weight (kg)	82.47 ± 12.35	74.14 ± 13.36	.099
Height (m)	1.63 ± 0.09	1.64 ± 0.06	.765
BMI (kg/m^2)	30.75 ± 4.51	27.60 ± 6.08	.21
Drugs NSAID/Anti-TNF	8/9	7/7	1.000**

M: mean, SD: standard deviation.
*Mann–Whitney *U* Test, **Chi-Square Tests.

***Bath AS Disease Activity Index (BASDAI)*:** This index, which was developed to evaluate disease activity, consists of 6 VAS measurements. These are fatigue, spine and peripheral joint pain, sensitivity and morning stiffness measurements [15].

***Bath AS Metrology Index (BASMI)*:** BASMI was developed by selecting the 5 clinical evaluation methods with the highest validity, reliability, repeatability and sensitivity to change. It has 5 components (lateral lumbar flexion, tragus-to-wall distance, lumbar flexion (modified Schober test), maximal intermalleolar distance, cervical rotation). The score for each component is defined as between 0 and 10, then the total score is divided by 5 [16].

***Bath AS Disease Functional Index (BASFI)*:** BASFI measures the functional capacity of the patient in the previous week. This index consists of 8 questions about daily activities and 2 questions evaluating the patient's ability to cope with daily life. The degree of difficulty felt by the patient in performing specified tasks is marked on a 10 cm VAS. The average of the total score obtained from 10 questions is calculated for use in the analysis [17].

***Six-minute walk test (6 MWT)*:** Exercise capacity was measured using the 6-min walk test (6MWT). The test was performed in a 30 m corridor in accordance with the test guidelines [18]. Prior to the test, perceived resting heart rate, resting peripheral oxygen saturation, and resting blood pressure were measured. The distance walked by the patient in 6 min was recorded.

***Bruce Treadmill Test*:** Developed by Robert A. Bruce (1963), the Bruce protocol treadmill test is now widely used in non-invasive measurement of the estimated VO_2 max, which expresses the ability to maintain exercise based on aerobic capacity. It is defined as the amount of oxygen (ml) used per minute per unit mass (kg). It is calculated with the formula; VO_2 max (ml/kg/min) = 132,853 − (0.0769*body weight (pounds)) − (0.3877*age) + (6,315*sex (Female: 0; Male: 1)) − (3,2649*time) (min)) − (0,1565*heart rate).

The Bruce Treadmill Test Protocol is a maximal exercise test where the oxygen consumption of the person is calculated from a formula instead of the air used. It is a multi-step protocol, and each stage consists of 3-minute periods that allow the 'steady state' to be reached before the workload is increased. Initially, the slope starts at 10% and the speed starts at 2.74 km/h [19,20].

***Measurement of respiratory muscle strength*:** Respiratory muscle strength was assessed by measuring the maximal inspiratory pressure (PImax) and maximal expiratory pressure (PEmax) using a portable spirometer with an additional flanged mouthpiece (COSMED Pony FX). The subjects were encouraged to use maximum strength and co-ordination in the PImax and PEmax measurements. The manoeuvres were performed three times and the best measurement was recorded. To avoid short-term fatigue of the respiratory muscles, a rest break of 1 min was given between the measurements. The PImax measurement was performed using the residual volume, whereas the PEmax was performed using the total lung capacity [21].

Intervention

Control group: (Spinal mobility exercises): Participants in this group were given 20 different spinal mobility exercises lasting approximately 30 min for spine mobility and flexibility. These 20 different spinal mobility exercises consisted of cervical, thoracic and lumbar spine flexibility, stretching of shoulder circumference, hamstring, quadriceps and erector spinal muscles, strengthening of abdominal, back and proximal muscles and diaphragmatic breathing and chest expansion exercises. The entire program was performed under the supervision of a physiotherapist. The exercises were performed 3 days a week for 12 weeks.

Intervention Group (Aerobic Exercise + Spinal Mobility Exercises): Participants in this group performed aerobic exercise on the treadmill for 40 min at a severity of 55–80% of the maximal heart rate, which was specifically determined for each participant using the Bruce Treadmill Test protocol. The aerobic exercise was planned as 5 min warm-up, 30 min loading and 5 min cooling. Under the supervision of a physiotherapist experienced in this field, the walking speed was gradually increased, depending on the tolerance and compliance of the patients, but did not exceed 80% of the maximal heart rate. Heart rate and oxygen saturation were recorded using a pulse oximetry device at rest before starting the aerobic exercise, every 5 min during exercise and at the 5th min of recovery at the end of the test. Afterwards, 20 different spinal mobility exercises, which lasted approximately 30 min in the same protocol as the exercises applied to the control group, were also performed by these participants. The entire program was performed under the supervision of a physiotherapist. The exercises were performed 3 days a week for 12 weeks.

Statistical analysis

Data obtained in the study were analyzed using SPSS vn. 21.0 software. Continuous variables were stated as mean ± standard deviation and categorical variables as number and percentage. When parametric test assumptions were met, the significance test of the difference between the two means was used to compare the differences between the groups, and the Mann–Whitney *U* Test was used to compare the differences between groups when parametric test assumptions were not met. In dependent group comparisons, when parametric test assumptions were met, the significance test of the difference between two peers was used, and when parametric test assumptions were not met, the Wilcoxon Paired Samples test was applied.

Results

The 44 volunteers were randomly separated into two groups as the intervention group ($n = 22$) and the control group ($n = 22$) according to the inclusion criteria of the study. A total of 5 patients in the intervention group were excluded: 2 patients could not obtain permission from work to attend the sessions and so the exercise was abandoned, 1 did not

attend the program regularly, and 2 did not want to participate in the exercise after the evaluations. In the control group, 8 patients were excluded: 4 did not attend the program regularly, and 4 did not attend for the final evaluation. The study was completed with a total of 36 participants, as 17 in the intervention group (9 females, 8 males, age: 46.58 ± 11.94 years) and 14 in the control group (10 females, 4 males, age: 42.85 ± 11.07 years). Figure 1 shows a flow chart of the study design.

No problems were reported during the evaluations and exercise sessions. There was no statistical difference between the demographic data of the groups ($p > .05$) (Table 1). There was no significant difference between the groups before treatment ($p > .05$).

Pre and post treatment results of in-group evaluation

There was a significant improvement in BASDAI ($p = .002$), BASMI ($p = .021$), 6MWT ($p = .036$), VO_2 max ($p = .000$), MIP ($p = .005$) and MEP ($p = .022$) results in the intervention group after 12 weeks of exercises. Only the improvement of BASFI ($p = .068$) was not at a statistically significant level. In the control group, no improvement after exercise was found to be statistically significant ($p > .05$) (Table 2).

Post-treatment differences between the groups: When the difference between pre-treatment and post-treatment differences was compared, BASDAI ($p = .032$) decreased and VO_2 ($p = .001$) max increased, showing a significant difference in favor of the intervention group (Table 2).

Comparison of follow-up results at the 3 months after treatment: When the follow-up of the treatment was evaluated at 3 months, the decrease in BASDAI ($p = .002$) and increase in VO_2 ($p = .004$) max values were maintained in favor of the intervention group (Table 3).

Discussion

The aim of this study was to investigate the effect of aerobic exercise in addition to spinal mobility exercises applied to patients with AS on disease-specific outcomes (BASDAI, BASMI, BASFI) and functional exercise capacity, aerobic

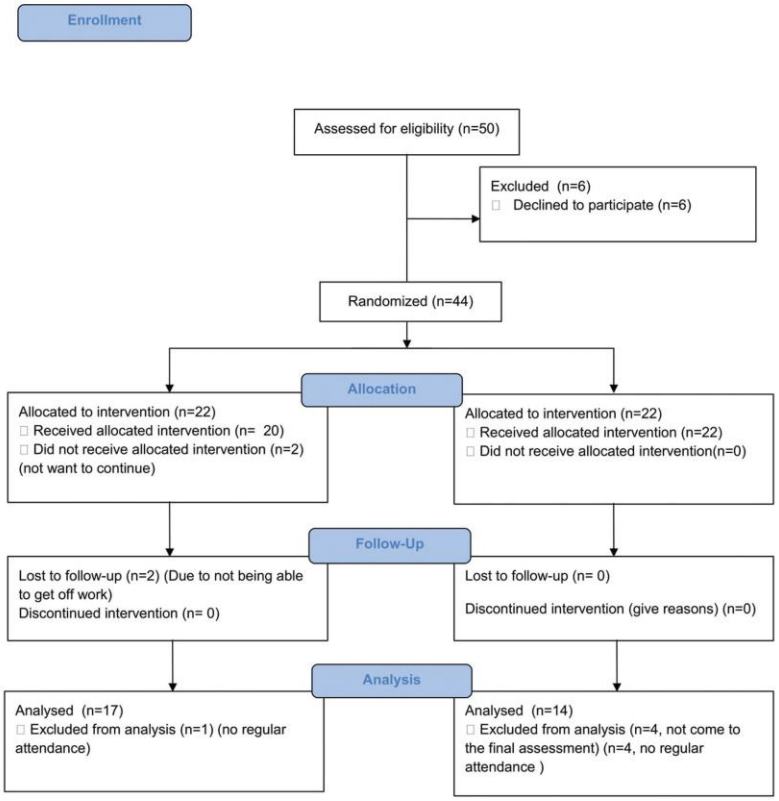

Figure 1. Flow chart of the progress through the phases of the study.

Table 2. The comparison of pre and post treatment results within groups and Delta values with group.

Variables	Intervention Group ($n = 17$)			Control Group ($n = 14$)			Δ
	Pre treatment M ± SD	Post treatment M ± SD	*p Value	Pre treatment M ± SD	Post treatment M ± SD	*p Value	**p Value
BASDAI	4.52 ± 1.50	2.21 ± 1.44	**.002**	4.22 ± 2.15	3.81 ± 1.60	.397	**.032**
BASMI	3.32 ± 1.49	2.90 ± 1.42	**.021**	2.88 ± 1.08	2.74 ± 1.01	.485	.279
BASFI	3.19 ± 2.40	2.15 ± 1.84	.068	3.03 ± 2.63	2.56 ± 2.30	.382	.544
6MWT	519.38 ± 77.87	551.37 ± 53.08	**.036**	488.63 ± 98.85	471.83 ± 120.47	.972	.377
BruceTreadmil Test	27.00 ± 7.54	35.74 ± 8.63	**.000**	24.90 ± 11.93	24.82 ± 11.20	.213	**.001**
Plmax	85.52 ± 23.75	92.97 ± 23.48	**.005**	68.21 ± 22.75	68.06 ± 20.84	.552	.262
PEmax	101.19 ± 33.36	115.62 ± 34.82	**.022**	84.42 ± 26.52	84.85 ± 23.55	.900	.071

Significant values are shown in bold.
BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; BASMI: Bath Ankylosing Spondylitis Metrology Index; BASFI: Bath Ankylosing Spondylitis Functional Index; 6MWT: Six-minute walk test; M: mean; Plmax: Maximum inspiratory pressure; PEmax: Maximum expiratory pressure; SD: standard deviation; Δ= Posttreatment − Pretreatment.
*Wilcoxon Test, **Mann–Whitney *U* Test.

Table 3. The comparison of pretreatment, posttreatment and third month follow-up results within groups.

Variables	Intervention Group ($n = 17$)				Control Group ($n = 14$)			
	Pretreatmant M ± SD	Posttreatment M ± SD	3-month follow-up	*p Value	Pretreatmant M ± SD	Posttreatment M ± SD	3-month follow-up	*p Value
BASDAI	4.52 ± 1.50	2.21 ± 1.44	3.11 ± 1.87	**.002**	4.22 ± 2.15	3.81 ± 1.60	4.67 ± 1.73	.669
BASMI	3.32 ± 1.49	2.90 ± 1.42	2.91 ± 1.55	.532	2.88 ± 1.08	2.74 ± 1.01	2.40 ± 0.73	.612
BASFI	3.19 ± 2.40	2.15 ± 1.84	2.33 ± 1.97	.321	3.03 ± 2.63	2.56 ± 2.30	4.27 ± 1.46	.299
6MWT	519.38 ± 77.87	551.37 ± 53.08	559.71 ± 59.67	.066	488.63 ± 98.85	471.83 ± 120.47	550.01 ± 50.89	.237
Bruce Treadmil Test	27.00 ± 7.54	35.74 ± 8.63	33.30 ± 8.51	**.004**	24.90 ± 11.93	24.82 ± 11.20	22.42 ± 7.49	.985
Plmax	85.52 ± 23.75	92.97 ± 23.48	89.85 ± 17.07	.584	68.21 ± 22.75	68.06 ± 20.84	69.49 ± 12.07	.660
PEmax	101.19 ± 33.36	115.62 ± 34.82	124.33 ± 38.45	.209	84.42 ± 26.52	84.85 ± 23.55	83.38 ± 13.55	.945

Significant values are shown in bold.
BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; BASMI: Bath Ankylosing Spondylitis Metrology Index; BASFI: Bath Ankylosing Spondylitis Functional Index; 6MWT: Six-minute walk test; M: mean; Plmax: Maximum inspiratory pressure; PEmax: Maximum expiratory pressure; SD: standard deviation.
*Kruskal Wallis Test.

capacity, respiratory muscle strength and whether the benefits gained were maintained in the third month (early period).

After 12 weeks of a moderate-high-intensity aerobic exercise program in addition to spinal mobility exercises under supervision, positive improvements were determined in disease activity, spinal mobility, functional capacity, aerobic capacity, and inspiratory and expiratory muscle power consumption, although these improvements were not seen in physical function. In the control group, where only spinal mobility exercises were performed, no improvement was observed after the exercises.

When the groups were compared, there was determined to be an effective improvement on disease activity and VO_2 max consumption in favor of aerobic exercise and this effect was maintained in the early 3-month follow-up period. These results showed that the addition of aerobic exercise to spinal mobility exercises is an effective exercise option to decrease disease activity and improve the oxygen capacity of individuals with AS.

Supervised exercises have been previously reported to be superior to a home program in terms of pain, physical function and spinal mobility in the management of AS [22]. Therefore, supervised exercises were applied to individuals with AS in both groups of the current study.

The first study investigating the effectiveness of aerobic exercise in individuals with AS was reported by Crabon et al. (1996) [23]. However, there have been few subsequent studies in this field and the effect of aerobic exercise on individuals with AS remains controversial.

Verhoven et al. (2019) reported that aerobic exercise did not provide any beneficial effect on disease activity, physical function, or biological parameters compared to control groups in review studies comparing aerobic exercise with a standard physiotherapy method. However, it was stated that aerobic exercise does not lag behind standard physiotherapy and should be used to manage cardiovascular risks, as in the general population. [13].

Beside increasing joint mobility and decreasing disease severity scores, exercise training was reported to be associated with increased serum levels of the anti-inflammatory cytokine tumor growth factor-beta1 (TGF-β1) in AS patients according to the results of previous studies [12,24,25]. BASDAI is an indicator of major symptoms in individuals with AS [26] and is generally used as a measure of disease activity outcome in studies examining the effects of drugs or exercise in patients with AS [27,28]. Although it has been reported that aerobic exercise does not change disease activity in individuals with AS, there are also studies with results consistent with those of the current study [13,26,29,30]. Karapolat et al. (2009) examined the effect of aerobic exercise on disease activity and applied the two different aerobic exercises of swimming and walking. As a result of the study, improvement in disease activity was observed in the swimming group, but no change was observed in the walking group [12]. Günendi et al. (2010) compared a 3-week supervised exercise program with a home program including strengthening, flexibility and aerobic exercise and reported that the short-term supervised exercise program reduced disease activity [22]. Sveaas et al. (2014) compared a

strengthening and high intensity aerobic exercise program with a control group. Due to the improvement observed in BASDAI, high-intensity exercise was determined to be an effective support to pharmacological intervention [31]. Rosu et al. (2014) compared a classical kinetic program with Heckscher exercises and the McKenzie method, in which aerobic exercises are applied together with pilates exercises. In that study, since the aerobic exercise was not targetting the cardiopulmonary system, the intensity of the exercise was not determined according to the heart rate. As a result of the study, improvements in disease activity were reported in both groups [32]. One of the most striking results of the current study was the decrease in disease activity, remission and maintenance of this condition in the early follow-up period in the group applied with aerobic exercise in addition to spinal mobility exercises. It was stated that regular physical activity which includes aerobic and strengthening exercise, has a long-term anti-inflammatory effect in inflammatory rheumatic diseases, and therefore participants should be encouraged to participate in aerobic exercise with progression starting from low intensity [33]. In the conclusion of a recent Cochrane review, it was emphasized that exercise might cause a reduction in disease activity in patients with rheumatoid arthritis (RA) [34]. Also, decreases in erythrocyte sedimentation rate, pain, and morning stiffness in patients with RA were reported [35,36]. Although RA and AS are different in terms of etiology and clinical features, both diseases are inflammatory rheumatic diseases, so it is explainable that the benefits of exercise also might occur in patients with AS. In a systematic review [37] it was reported that exercise can decrease systemic inflammation in some other group of patients with chronic heart failure and type 2 diabetes mellitus, as well as leading to a reduction in inflammatory biomarkers (e.g. interleukin 6, C-reactive protein, and adhesion molecules) in adults without rheumatic diseases as shown in several observational and experimental reports [38,39]. We share the same view and the current study results can be considered to make a significant contribution to the literature.

In the aerobic exercise group, the BASMI parameter improved after treatment. Mobility (flexibility) exercises have been reported to improve spinal mobility, physical function and well-being in individuals with AS [40]. Exercise for spinal mobility alone was insufficient to reduce disease activity. However, in addition to spinal mobility exercises, the addition of aerobic exercise program to the treatment has changed the result positively. Therefore, it can be recommended that aerobic exercise should be included in the exercise program of individuals with AS.

In the current study, no significant improvement was determined in BASFI, which is an indicator of physical function. Some of the aerobic exercise studies have also reported that BASFI has not changed [12,16,17,41]. In the aerobic exercise group, the mean BASFI value decreased after treatment but was not statistically significant. This result may have been due to the high mean functional level (3.19 ± 2.4) in the individuals participating in this study.

Physical activity and aerobic exercise are recommended by international guidelines for the prevention of cardiovascular diseases [42,43]. As physical fitness increases, cardiovascular risks also decrease [15]. A positive minimal change in the cardiovascular system significantly reduces morbidity and mortality [44]. Since cardiovascular diseases have been reported as the primary cause of death in spondyloarthropathies [45], aerobic exercise and aerobic capacity should be the main target.

In the literature, positive results of aerobic exercise applications in individuals with AS on oxygen consumption and walking distance have been shown [12,15–17,24], and the current study results are parallel to the literature in this respect.

Sveaas et al. (2014) compared a 12-week strengthening exercise program under the supervision of a physiotherapist and high-intensity aerobic exercise with a control group where no intervention was performed. In the intervention group, improvements were determined in arterial stiffness, resting heart rate and VO_2 peak, which are important parameters for decreasing cardiovascular risk [31]. Karapolat et al. (2009) compared two different aerobic activity programs of moderate-intensity swimming and walking, with conventional exercises consisting only of stretching, flexibility and breathing exercises. All the exercises were planned as home programs and improvements were reported in VO_2 max and 6 MWT in both aerobic exercise groups [12].

Hiesh et al. (2014) applied stretching exercises to both groups in their controlled studies. In the intervention group, moderate Nordic walking was added, and in the control group, coping strategies were applied. In the evaluation of aerobic capacity, physical work capacity was calculated using a cycling ergometer for the submaximal exercise test. The results demonstrated a greater improvement in physical work capacity in the Nordic walking group [26].

Analay et al. (2003) compared group exercise with home exercise which included aerobic exercise in both groups. An improvement was reported in VO_2 max as a result of group exercise [24].

A methodologically similar study in literature was conducted by Jennings et al. Stretching exercises were applied to both groups 3 days a week for 12 weeks, and 50 minutes of walking training was added to the intervention group. Aerobic capacity was evaluated with an ergo spirometer on a treadmill and at the end of the treatment, aerobic capacity and 6 MWT distance were significantly higher in the intervention group compared to the control group [30].

In the current study, a moderate-intensity aerobic exercise program was applied to individuals with AS in addition to spinal mobility exercises under the supervision of a physiotherapist 3 times a week for 12 weeks. Similar to previous findings in literature, the 6MWT and VO_2 max values, which are indicators of cardiorespiratory compliance, increased, and VO_2 max was also maintained at 3 months.

An increase in VO_2 peak of 3.5 ml/kg/min has been reported to contribute to a significant reduction of cardiac events [46]. Sveaas et al. reported that the average VO_2 peak difference of 3.7 ml/kg/min could be improved by high-

intensity aerobic exercise in individuals with AS, and that cardiorespiratory compliance could be improved and contributed to the prevention of CVD [31]. In the current study, there was seen to be an average increase in indirectly measured VO_2 max values of 8.7 ± 5.5 ml/kg/min after moderate-intensity aerobic activity training and ±7.9 ml/kg/min in the third month follow-up after treatment. The development of VO_2 max is an important clinical outcome in terms of increasing oxygenation in the individual [47]. Fatigue is an important symptom in individuals with AS [48,49]. It is therefore important to increase the O2 capacity to cope with fatigue [50]. The individual becomes more willing to do physical activity when not tired. Inactivity, lack of muscle strength, atrophy and decreased physical activity participation cause anxiety and depression, leading to a vicious cycle [51]. In order to break this vicious cycle, the aerobic exercise program, which will improve the VO_2 max capacity of the individual, should be added to the treatment program.

In patients with AS, inspiratory muscle fatigue develops during exercise [24] and a decrease in respiratory muscle strength due to intercostal muscle atrophy has been observed as a result of electromyography measurements of the diaphragm and intercostal muscles [52]. From a scan of literature, it was seen that MIP and MEP values have not been examined in other studies where an aerobic exercise program was applied to individuals with AS. Although the studies reported that these values may develop with respiratory muscle training, the current study is the first to have examined the effects of aerobic exercise on MIP and MEP values and demonstrated that it is effective.

The strengths of the current study are the one-to-one supervision of the exercises and the individual planning of the aerobic exercise program by evaluating the participants before treatment. However, limitations of the study can be said to be that VO_2 max cannot be measured directly and that not all individuals could be reached for follow-up. Also, in our study, laboratory data associated with disease activity (CRP, ESR etc. …) and the assessment of imaging progression were not considered as outcomes in the study design. We suggest to evaluate the effects of aerobic exercises on these parameters in further studies.

The most striking result of the current study was that aerobic exercise provided improvement in all parameters except BASFI, whereas the control group showed no improvement after the exercise. From these results it can be understood that spinal mobility exercises alone are not sufficient in the treatment of individuals with AS.

In conclusion, it can be recommended that an aerobic exercise program should be included in individual exercise prescription in the management of AS.

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Approval for the study was granted by the Non-Interventional Clinical Research Ethics Committee of Pamukkale University (decision no:: 60116787-020/49880 dated 01.08.2017). Informed consent was obtained from all the study participants. Also, we conducted our studies in compliance with recognized the principles of the Declaration of Helsinki.

Conflict of interest

None.

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ORIGINAL ARTICLE

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The efficacy of manual soft-tissue mobilization in ankylosing spondylitis: A randomized controlled study

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Abstract

Aim: The aim of this randomized controlled study was to investigate the effect of soft-tissue mobilization in patients with ankylosing spondylitis (AS).

Method: Twenty-one patients (mean age 44.57 ± 10.40 years) were randomly divided into two groups. There were 13 patients (11 females, 2 males, age 43.69 ± 9.94 years) in the intervention group and 8 patients (5 females, 3 males, age 46.00 ± 11.67 years) in the control group. In the intervention group, soft-tissue mobilization therapy and 20 spinal mobility exercises were applied. The control group received only 20 spinal mobility exercises. The Bath AS Disease Activity Index (BASDAI), Bath AS Functional Index (BASFI), and Bath AS Metrology Index (BASMI) were used for assessment of disease activity, functional level, and mobility, respectively. Nottingham Health Profile (NHP) for quality of life and Roland Morris Disability Questionnaire (RMDQ) were used to determine disability levels.

Results: We found significant differences between pretreatment and post-treatment scores of BASDAI ($P = 0.049$); BASFI ($P = 0.009$; lateral lumbar flexion ($P = 0.005$), maximal intermalleolar distance ($P = 0.001$) and total score ($P = 0.001$) of BASMI; pain subtest ($P = 0.036$) and total score ($P = 0.036$) of NHP; and RMDQ score ($P = 0.004$) in the intervention group. However, in the control group the BASMI score ($P = 0.049$) was observed to worsen significantly. Delta values were compared and differences in BASFI ($P = 0.039$), and in lateral lumbar flexion ($P = 0.027$), maximal intermalleolar distance ($P = 0.045$) and total score ($P = 0.001$) of BASMI were significant in favor of intervention group. Only tragus-to-wall distance ($P = 0.039$) of BASMI was observed to worsen significantly in the control group.

Conclusion: We recommend the use of soft-tissue mobilization in addition to the exercises to treat AS patients.

KEYWORDS

ankylosing spondylitis, exercise, manual therapy

1 | INTRODUCTION

Ankylosing spondylitis (AS) is a chronic immuno-inflammatory disease characterized by inflammation of sacroiliac joints and inflammatory back pain, mainly affecting the axial skeleton by causing pain and limitations in thoracic and spinal mobility.[1,2]

Structures and soft tissues in the low back, hip, and pelvic region are suitable areas for the occurrence of symptoms in AS.[3] The

most common and characteristic symptom of AS is insidious onset inflammatory low back pain. It is usually felt in the deep gluteal and sacroiliac region.[4] Sacroiliac pain can also cause pain in the back, buttocks, groin, and lower extremity areas. Pain may initially be unilateral or intermittent, but later becomes continuous and bilateral.[5]

The progression of AS occurs with progressive stiffness in the spine, decrease in lumbar lordosis, and increase in thoracic kyphosis. Some patients with AS complain of a feeling of musculotendinosis stiffness and/or sensitive points. Pathological changes occur in tendons, attachment points of ligaments to bone, and cartilaginous and synovial joints.[5] The thoracic and spinal joints become stiffer, meld, and progressively lose their mobility. As a result of all these influences, disability increases.[6,7]

Physiotherapy interventions have an essential role in the treatment of AS and in the prevention of musculoskeletal deformities. The aim of physiotherapy interventions in AS is to maintain and/or improve overall functionality and quality of life.[8] In many studies, with physical therapy, it has been emphasized that many patients with AS have had adequate reduction in symptoms (decreased pain and stiffness, maintained or improved posture and muscle strength), improved mobility, functionality, and overall health.[9-14]

One of the commonly used physiotherapy interventions is manual therapy. The term manual therapy covers joint manipulation/mobilization, myofascial relaxation techniques, soft tissue mobilization, and various massage treatments.[15] Manual treatment techniques are performed to increase soft-tissue flexibility and joint movement, mobilize soft tissues, relieve pain, and reduce swelling and inflammation in soft tissues, and are applied with hands. They are characterized by soft, rhythmic, passive or active assisted movements for each spinal segment.[16,17]

A review in Cochrane points out that randomized controlled trials on physiotherapy interventions other than exercise, such as manual therapy in AS, are few and insufficient. It is recommended that other commonly used physiotherapy interventions, such as manual therapy, should be compared with exercise in future studies.[18]

The aim of this randomized controlled trial was to examine the effect of soft-tissue mobilization applied in addition to exercise on disease activity, functional level, mobility, quality of life, and disability level in patients with AS.

2 | MATERIALS AND METHODS

The effects of soft-tissue mobilization in patients with AS were compared with the control group in our study, which was planned as a randomized controlled parallel group. The participants were randomly divided into the intervention group and the control group. Randomization was carried out by a researcher through a computer program (SPSS.v.22; IBM, Armonk, NY, USA) in charge of allocation. The intervention group underwent 20 spinal mobility exercises and soft-tissue mobilization therapy for the problems of soft tissue as a result of the individual evaluation of each participant in this group. The control group underwent only 20 spinal mobility exercises. All treatment was performed 3 days a week and for 4 weeks for a total of 12 sessions. All evaluations were performed before and after treatment. The disease-specific outcome measures were conducted by a physiotherapist who is specialized in rheumatological rehabilitation. Soft-tissue assessment was performed separately for each participant and for the problems seen as a result of this evaluation, each participant was treated by another physiotherapist experienced in soft-tissue mobilization therapy. Spinal mobility exercises were performed under the supervision of another physiotherapist experienced in rheumatological rehabilitation.

2.1 | Participants

In all, 21 volunteer patients (mean age 44.57 ± 10.40 years) were included in the study. Participants were diagnosed with AS by the same rheumatologist according to the modified New York criteria and referred to the Rheumatological Physiotherapy and Rehabilitation Clinic. In the clinic, participants were screened for eligibility.

Inclusion criteria were: (a) being diagnosed with AS according to the Modified New York criterion; (b) being volunteer for the study; (c) being aged between 20 and 65 years; and (d) regular use of disease-modifying anti-rheumatic drugs, including methotrexate, sulfasalazine, and anti-tumor necrosis factor agents, for 3 months or more, or non-steroidal anti-inflammatory drugs and/or corticosteroids, at a stable dosage for at least 4 weeks. In order not to affect the results of the study, attention was paid to the regular use of the drugs.

Exclusion criteria were: (a) exercising regularly during the last 3 months; (b) the presence of a history of osteoporosis or fracture secondary to osteoporosis; (c) the presence of cardiovascular, pulmonary, orthopedic, and neurological problems that may interfere with exercise (uncontrollable hypertension, heart attack or history of coronary revascularization, history of syncope or exercise-related arrhythmia, decompensated type 1 diabetes mellitus, hip and/or knee arthroplasty); (d) having undergone any surgery in the last 6 months for both groups; (e) communication problems for both groups; and (f) not being able to participate in at least 75% of the treatment. The data of the patients who made any changes in drug treatment during the study were not included in this study and the treatment of the participant was terminated.

Ethical approval of the study was obtained from the local ethics committee. All patients were informed verbally and informed consent forms were signed. The followed procedures were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 1983.

2.2 | Evaluations

Evaluations were performed before and after treatment. All evaluations were performed by the same experienced physiotherapists, according to standardized testing protocols and in the same environment where the same conditions were provided. Before starting the tests, patients were allowed to adapt by the same therapists.

Demographic data, habits and disease information of the patients were recorded on the assessment form using the face-to-face interview method. Then, Bath AS Disease Activity Index (BASDAI), Bath AS Functional Index (BASFI), and Bath AS Metrology Index (BASMI) were used to assess disease activity, functional level, and mobility, respectively. Nottingham Health Profile (NHP) was used to assess quality of life and Roland Morris Disability Questionnaire (RMRS) was used to determine disability levels. In addition, the soft-tissue assessment of pelvic, spinal, and neck regions was performed for each patient in the intervention group.

2.2.1 | Bath Ankylosing Spondylitis Activity Disease Activity Index (BASDAI)

This index, developed to assess disease activity, consists of six VAS measurements. These are measurements of fatigue, spine and peripheral joint pain, sensitivity, and morning stiffness.[19]

2.2.2 | Bath Ankylosing Spondylitis Functional Index (BASFI)

This index consists of eight questions about daily activities and two questions that evaluate the patient's ability to cope with daily life. Patients mark the degree of difficulty they experienced in performing the specified tasks on the 10-cm VAS. The total score is calculated by taking the average of the score from 10 questions ranging from 0 to 10.[20]

2.2.3 | Bath Ankylosing Spondylitis Metrology Index (BASMI)

The BASMI has five components (lateral lumbar flexion, tragus-to-wall distance, lumbar flexion (modified Schober), maximal intermalleolar distance, cervical rotation). The scale score for each component ranges from 0 to 10. Then the total score is divided by five.[21]

2.2.4 | Nottingham Health Profile (NHP)

This consists of six subtests that assess the emotional, social, and physical health problems perceived by the patient. The survey consists of a total of 38 questions that require a yes/no answer. Positive answers to questions have a predetermined score, and the sum of these scores gives the total score. The total score of each subtest is 100. The sum of the subtest scores can be given as a profile.[22,23]

2.2.5 | Roland Morris Disability Questionnaire (RMDQ)

In the questionnaire that consists of 24 sentences, patients are asked to answer each sentence in the form of yes if it fits their situation and no if it does not. A total score of 0-24 is calculated by giving 1 point to "yes" answers and 0 points to "no" answers in the evaluation form, which consists of 24 items related to functional inadequacies. A high score expresses further disability.[24,25]

2.2.6 | Soft-tissue assessment (pelvic, spinal, and neck regions)

Soft-tissue assessment was performed in the prone and/or supine positions as the muscles could be palpated more easily. It was first started from the pelvic area. Muscles located in this region, such as m. gluteus maximus, m. gluteus medius and m. piriformis were evaluated with palpation for pain, spasm, and sensitivity. Evaluation continued by palpation of lumbar region paravertebral muscles, m. quadratus lumborum, and m. iliopsoas. Lumbosacral fascia mobility was assessed. Thoracic and cervical paravertebral muscles, m. rhomboideus, m. levator scapulae, and m. trapezius were assessed by palpation for pain, spasm, and sensitivity. Cervico-thoracic fascia was assessed for mobility. Following spinal evaluation, the lower and upper extremity muscles were evaluated with palpation for pain, spasm, and sensitivity. Hamstring muscles and iliotibial band were evaluated for tonus and sensitivity in tendon points.

2.3 | Intervention

2.3.1 | Control group (spinal mobility exercises)

Patients in this group underwent 20 spinal mobility exercises, lasting approximately 30 minutes, aimed solely at spine mobility and flexibility. These 20 spinal mobility exercises consisted of cervical, thoracic, and lumbar spine flexibility exercises, shoulder complex, hamstring, quadriceps, and erector spinal muscle stretching and abdominal, back, and proximal muscle strengthening with diaphragmatic breathing and chest expansion exercises. All sessions were conducted under the supervision of a physiotherapist. The exercises were conducted 3 days a week for 4 weeks.

2.3.2 | Intervention group (soft-tissue mobilization + spinal mobility exercises)

Patients in this group were prescribed soft-tissue mobilization treatment that lasted 30 minutes for each patient for problems seen as a result of the individual soft-tissue evaluation. According to manual therapists, manual mobilization techniques were applied to increase spinal mobility.[17] During the course of treatment, the patient's current condition was improved by ensuring the equilibrium between increased pain and increased mobility. As described by Chamberlain, Cyriax's friction massage technique was applied to muscles that were found to be painful, under spasms or sensitive.[26] Friction massage was applied transversely to the specific tissue-involving muscles. Superficial massage (fascial stretch) was applied to fascia fibers longitudinally as described by Manheim.[27] Lewit and Simon's post-isometric relaxation techniques were applied for muscles, such as paravertebral muscles, m. Trapezius, and m. iliopsoas.[27] Active stretching was applied for long muscles, such as hamstring.[28] These patients also performed 20 spinal mobility exercises, which lasted approximately 30 minutes, following the same protocol as the training applied to the control group. All sessions were conducted under the supervision of a physiotherapist. The treatment was conducted 3 days a week for 4 weeks.

2.4 | Statistical analysis

The data were analyzed with the SPSS (version 21.0) package program. Continuous variables were given as mean ± standard deviation and categorical variables were given as numbers and percentages. Independent *t* test test was used to compare the differences between the two averages when parametric test assumptions were provided, while the Mann-Whitney *U* test was used to compare the differences between the groups when parametric test assumptions were not provided. In dependent group comparisons, paired sample *t* test was used when parametric test assumptions were provided; and the Wilcoxon signed-rank test was used when parametric test assumptions were not provided. A *P* value less than 0.05 was accepted for statistical significance.

3 | RESULTS

This study started with 32 patients with AS. Four patients declined to participate. A total of 28 patients with AS who met the inclusion criteria of the study were randomly separated into two groups as the intervention group (n = 14) and the control group (n = 14). One patient from the intervention group stopped treatment because his wife had given birth prematurely. In the control group, two patients could not get permission from work and dropped out, three patients dropped out because the distance between the treatment place and the house was too much, and one patient did not continue treatment because he was a teacher and had a lot of classes. The study was therefore completed with a total of 21 patients, 13 patients (11 women, 2 men, age = 43.69 ± 9.94 years) in the intervention group and 8 patients (5 women, 3 men, age = 46.00 ± 11.67 years) in the control group. Figure 1 shows a flow chart of the study design.

The demographic information of the patients was recorded before the evaluations. Demographics are shown in Table 1.

In this study with 21 patients, no problems were reported during evaluations and training. There was no statistical difference between the demographic data of the groups except for height (in meters), because of the higher presence of females in the intervention group ($P > 0.05$) (Table 1).

In the comparison of the data between pretreatment and post-treatment, the difference in BASDAI ($P = 0.049$), BASFI ($P = 0.009$), and lateral lumbar flexion ($P = 0.005$), maximal intermalleolar distance ($P = 0.001$) and total score ($P = 0.001$) of BASMI, pain subtest ($P = 0.036$) and total score ($P = 0.036$) of NHP and RMDQ score ($P = 0.004$) were significant in the intervention group. In the control group, the BASMI score ($P = 0.049$) was found to worsen significantly (Table 2).

The delta values of the participants were calculated by subtracting the pretreatment result from the post-treatment result. Delta values were compared and the differences in BASFI ($P = 0.039$) and lateral lumbar flexion ($P = 0.027$), maximal intermalleolar distance ($P = 0.045$), and total score ($P = 0.001$) of BASMI were significant in favor of intervention group. Tragus-to-wall distance ($P = 0.039$) of BASMI worsened significantly in the control group (Table 3).

4 | DISCUSSION

At the end of a short period of 4 weeks, soft-tissue mobilizations in addition to the spinal mobility exercises provided positive improvements in quality of life by increasing mobility and functional level and reducing disease activity and disability. It was observed that spinal mobility exercises alone were insufficient in preventing and / or correcting the negative clinical picture caused by AS, especially in terms of mobility.

A systematic review reported that there is insufficient evidence to support or refuse the application of physiotherapy interventions involving manual therapy.[29] There was only one controlled study examining the efficacy of manual therapy in patients with AS, and the other studies were mostly case reports. Manual therapy involves joint manipulation / mobilization, myofascial relaxation techniques, and various massage treatments.[15] In these studies, manual therapy was applied in combination with soft-tissue mobilization, spine and joint mobilization, or / and manipulation. To the best of our knowledge, our study is the first study that examines the effectiveness of soft-tissue mobilization techniques in the treatment of AS.

In the only controlled study examining the efficacy of manual therapy in the literature, 16 sessions of self and manual mobilization were compared with the control group without any treatment. Initially, they applied vibratory and gentle mobility exercises to the

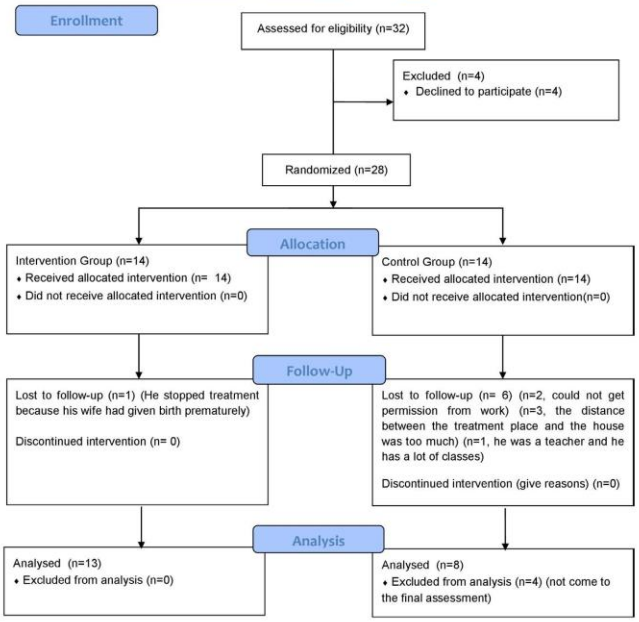

FIGURE 1 Flow chart of the progress through phases of the study [Colour figure can be viewed at wileyonlinelibrary.com]

soft tissues of the back muscles, followed by active and passive mobility exercises for the joints in the spinal column and chest wall. They then used the contracting-relaxing method for stretched tight muscles, and finally a manual massage of the soft tissues of the neck after relaxation exercises. In addition, three exercises, which can be prescribed individually, were given to the patients as a home program. As a result, improvement in chest expansion measured from processus xiphoideus level was achieved in the self and manual mobilization group, but no change in vital capacity was observed. Therefore, the authors stated that they partially confirmed the hypothesis that treatment could improve chest expansion in patients with AS because they could not improve pulmonary function. The authors also stated that patients had more accurate postures and increased mobility of the spine in the flexion direction rather than extension by achieving improvement in the neutral position in the thoracic and lumbar spine.[30]

Gyurcsik et al conducted an individualized complex physical exercise program in 10 AS patients. This program included general posture reeducation, manual mobilization exercises of the spine, pelvis, and upper and lower extremities, stretching with joint prevention strategies, and functional exercises. After 3 months of individualized complex physical therapy, improvement was achieved in several subjective and functional parameters. Pain intensity and spine stiffness in particular were reduced with this treatment. The authors reported that this program may be useful in AS patients in order to maintain and increase spine mobility, preserve functional capacity, and decrease pain and stiffness.[31]

Mengshoel and Robinson applied 12 sessions of specific spinal mobilization techniques to the area that presents stiffness, identified as a result of clinical evaluations in six AS patients. As a result, spinal stiffness and perceived stiffness decreased in five of the six patients and improvement was obtained in BASFI in one patient. In the light of the findings, it was stated that specific spinal mobilization can reduce spinal stiffness. However, it has been reported that this has different meanings for the patients and that the experiences and learnings of the individuals during the therapy process are the main points. It was also suggested that more patients should be studied to obtain more generalizable results.[32]

In the case series study in which Cornelson et al treated three patients with chiropractic care, the first had neck pain and stiffness, the second had low back and left hip pain, and the third had low back pain. Chiropractic care consisted of instrument-assisted spinal manipulation, diversified spinal and soft-tissue manipulation, interferential electric stimulation, trigger point therapy, and Cox flexion-distraction. Stretching and rehabilitation exercises were also assigned to patients. As a result, pain reduction and improvement in daily activities were achieved in all three patients. It has been reported that chiropractic manipulation and rehabilitation are beneficial in reducing symptoms and improving musculoskeletal function, and it is a potential method for additional treatment or complementary therapy in similar situations.[33]

McDermaid and Mior treated a patient (one of two AS patients) with sacroiliac, back, and low back pain and stiffness by applying soft-tissue therapy to the lumbar spine and gluteal musculature

TABLE 1 Demographic characteristics of the patients

Variables	Intervention group (n = 13) Mean ± SD	Control group (n = 8) Mean ± SD	*P* value
Age (years)	43.69 ± 9.94	46.00 ± 11.67	.634[b]
Body weight (kg)	76.30 ± 15.02	80.12 ± 10.61	.539[b]
Height (m)	1.59 ± 0.08	1.66 ± 0.08	**.029**[a]
Body mass index (kg/m^2)	30.19 ± 5.61	29.44 ± 6.12	.776[b]
Duration of disease (years)	7.87 ± 8.39	6.88 ± 8.06	.860[a]
Education duration (years)	10.60 ± 3.97	10.37 ± 4.62	.913[b]
Morning stiffness (min)	38.50 ± 37.86	33.33 ± 49.32	.442[a]
	n	n	
Gender			
Female/Male	11/2	5/3	.248[c]
Family history			
Yes/No	11/2	5/3	.248[c]
Type of drug used			
NSAIDs/DMARD/Anti-TNF	8/2/3	0/3/5	.019[c]

Abbreviations: Anti-TNF, anti-tumor necrosis factor; DMARD, disease-modifying anti-rheumatic drugs; NSAIDs, non-steroidal antiinflammatory drugs; SD, standard deviation.

[a]Mann-Whitney *U* test; significant values are shown in bold.

[b]Independent samples test.

[c]χ^2 test.

and a self-directed exercise program. As a result, symptoms decreased. There is a lack of knowledge of manual therapy in AS, so it is emphasized that careful documenting of treatment results is needed.[34]

Rose and Kim applied manipulation (grade 5) to thoracic spine and mobilization (grade 3) to lumbar and cervical spine in a physical therapy program for 12 weeks to a 30-year-old man with moderate to severe local back and neck pain and limited mobility. As a result, improvement of quality of life and spinal flexibility was obtained. Some temporary localized soreness has been reported as a side effect after treatment. The aim of this study was to develop practical treatment protocols for field practitioners who try to improve quality of life and prevent disability. Chiropractic treatment, including manipulation and mobilization, was shown to have some positive effects in advanced AS. The authors used Short Form-36 for assessment of quality of life and a tape measure to determine spinal mobility. They stated that their limitation was not using outcome measures, such as BASDAI, which enables a more comprehensive evaluation of patients with AS. They reported that in order to better determine the effectiveness of these treatments, future studies are needed in which BASDAI, developed specifically for AS, is used as outcome measure.[35]

In a case report by Rutherford et al, the treatment of AS patients with complaints of upper back pain and stiffness and low back pain was started with soft-tissue treatment of the cervical and thoracic paraspinal muscles and spinal manipulation of the lower cervical, thoracic, and lumbar spine. Then, diversified rotary manual procedures were used for rib mobilizations and manipulations, interferential current, and lower cervical and lumbar spine manipulation. As a result of the study, improvement was achieved in disease activity (BASDAI), functional index (BASFI), spinal flexibility, and chest expansion. These results have been reported to be favorable and a noteworthy outcome for longstanding AS patients. The authors also reported that the use of outcome measures developed and validated specifically for function and disease activity in AS provides unprecedented support in the investigation of the effectiveness of manipulative therapy and improves the assessment of the results obtained from the studies. As the results of these studies guide the clinical management of AS more accurately, more intensive research using these instruments on patients with AS undergoing manipulative therapy was suggested by the authors.[36]

In a case study conducted by Chunco (2011), soft-tissue massage, kneading, stretches, proprioceptive neuromuscular facilitative stretching, and mobilization of non-ankylosed joints are proposed as appropriate therapy. The reduction in morning stiffness and increased mobility in this case study were the most prominent gains.[37]

In studies investigating the effectiveness of new treatment options in patients with AS, the use of disease-specific validated instruments may increase the validity and reliability of the results obtained.[35,36] Taking into account the recommendations in the literature, in this study, in which we examined the effectiveness of soft-tissue mobilization in patients with AS, we used validated and reliable disease-specific BASFI, BASMI, and BASDAI instruments to evaluate the efficacy of treatment in AS. We applied soft-tissue mobilization therapy, which is one of the manual treatment methods, as an additional method to exercise therapy. We

TABLE 2 The comparison of pretreatment and posttreatment results within groups

	Intervention group (n = 13)			Control group (n = 8)		
	Pretreatment	Post-treatment		Pretreatment	Post-treatment	
Variables	Mean ± SD	Mean ± SD	*P* value	Mean ± SD	Mean ± SD	*P* value
BASDAI	4.59 ± 1.73	3.52 ± 1.88	**.049**[a]	4.83 ± 2.69	4.16 ± 1.73	.354[a]
BASFI	4.32 ± 2.20	2.38 ± 1.95	**.009**[b]	4.20 ± 3.13	3.71 ± 2.45	.212[a]
BASMI total	3.44 ± 0.98	2.72 ± 0.97	**.001**[a]	3.94 ± 2.87	4.15 ± 2.55	**.049**[a]
Lateral lumbar flexion	4.69 ± 2.05	3.46 ± 2.06	**.005**[b]	4.71 ± 2.81	4.87 ± 2.94	.581[b]
Tragus-to-wall distance	2.53 ± 1.56	2.15 ± 1.46	.187[b]	2.62 ± 3.15	3.12 ± 2.53	.157[b]
Lumbar flexion (modified Schober)	2.92 ± 1.75	2.38 ± 2.02	.252[a]	4.57 ± 3.86	4.87 ± 3.87	.172[a]
Maximal intermalleolar distance	3.00 ± 1.35	2.30 ± 1.18	**.001**[a]	3.85 ± 3.02	3.75 ± 3.10	1.000[a]
Cervical rotation	4.07 ± 1.32	3.30 ± 1.10	.077[b]	4.14 ± 3.02	4.12 ± 2.79	.736[a]
NHP total	292.38 ± 170.02	218.90 ± 125.01	**.036**[a]	207.57 ± 154.33	226.80 ± 137.12	.271[a]
Energy level	65.60 ± 42.68	49.13 ± 41.83	.206[b]	60.53 ± 38.35	62.00 ± 28.73	.774[a]
Pain	67.71 ± 37.39	43.07 ± 37.55	**.036**[a]	48.32 ± 42.85	54.00 ± 42.40	.278[a]
Emotional reactions	45.37 ± 34.59	34.46 ± 26.84	.117[a]	26.22 ± 34.01	23.99 ± 28.59	.659[a]
Social isolation	35.31 ± 43.69	33.63 ± 43.01	.180[b]	10.77 ± 26.40	19.21 ± 24.50	.655[b]
Sleep	42.30 ± 35.23	33.03 ± 31.07	.369[a]	36.70 ± 34.26	36.78 ± 30.97	.287[a]
Physical abilities	36.08 ± 26.28	25.55 ± 17.96	.141[a]	25.00 ± 15.84	30.80 ± 20.62	.660[a]
RMDQ	15.58 ± 5.80	9.66 ± 6.78	**.004**[b]	12.00 ± 9.59	12.00 ± 6.44	.246[a]

Abbreviations: BASDAI, Bath Ankylosing Spondylitis Disease Activity Index; BASFI, Bath Ankylosing Spondylitis Functional Index; BASMI, Bath Ankylosing Spondylitis Metrology Index; NHP, Nottingham Health Profile; RMDQ, Roland-Morris Disability Questionnaire; SD, standard deviation.

[a]Wilcoxon test, significant values are shown in bold.

[b]Paired simple *t* test.

did not do this study only at the level of the case report but using an increased sample number.

In a recent literature review, Sharan and Rajkumar proposed a four-step rehabilitation protocol, phase one including pain reduction and improving mobility, and phase two including restoring flexibility and postural re-education.[38] It has been suggested that hip joint, hamstrings, and low back can be supported by mobilization and stretching in AS. In AS, fibrotic changes may be greater than expected because of atrophy in the paraspinal muscles.[39] Metrology measures, such as spinal flexion, and occiput-to-wall distance, are measures related to disease severity and deformity rather than disease activity.[17]

In addition to spinal mobility exercises, we used only soft-tissue mobilization in the intervention group, which was one of the manual therapy techniques, and we started the treatment from the pelvic region and applied to certain muscles and fascia of the spine including the neck. Because of the presence of pain and other symptoms in soft tissues in the deep gluteal, low back, hip, and sacroiliac regions in patients with AS,[3,4] we focused on these areas mostly in soft-tissue mobilization treatment. As a result of our treatment in the intervention group; we observed increased mobility in the lateral lumbar flexion and maximal intermalleolar distance components of BASMI, which evaluated the mobility of the tissues and joints in the hip, gluteal, low back, and sacroiliac regions, and the total score. This increased activity increases functionality and decreases disease activity; hence, we believe that as patients' disability decreases, their active participation in life increases, with an overall positive effect on quality of life. Nava underlined the mechanism of postural changes over time because the pathology of AS influences a sensory input and creates a new postural equilibrium. We think that the sensory input we provide with fascia stretches and the post-isometric relaxation techniques that we apply within the scope of manual therapy techniques will be effective in regulating this improper postural equilibrium.[40]

Contrary to the use of combined joint mobilization / manipulation and soft-tissue mobilizations in the literature, we believe that the positive results obtained by investigating the effectiveness of only soft-tissue mobilization will contribute to the literature.

Patients with AS have acute inflammatory joints and chiropractic practice guidelines have reported that manipulation should not be used in acute inflammatory joints.[41] Osteoporosis can occur in the early stages of AS and this makes patients more prone to vertebral compression and the formation of traumatic spinal cord fractures of the cervical spine.[42] In addition, it is estimated that the risk of traumatic spinal cord compression is 11 times higher in the AS population compared with the healthy population.[43] There are two case reports that report paraplegia[44] and incomplete quadriplegia[45] after chiropractic manipulation in a patient with AS. In our study, where

TABLE 3 The comparison of delta values between groups

Variables	Intervention group (n = 13) ΔMean ± SD	Control group (n = 8) ΔMean ± SD	*P* value
BASDAI	−1.34 ± 2.21	−0.66 ± 1.89	.481[a]
BASFI	−1.94 ± 1.95	−0.49 ± 1.01	**.039**[a]
BASMI total	−0.72 ± 0.51	0.25 ± 0.27	**.001**[a]
Lateral lumbar flexion	−1.23 ± 1.01	0.28 ± 1.49	**.027**[b]
Tragus-to-wall distance	−0.38 ± 0.96	0.50 ± 0.92	**.039**[b]
Lumbar flexion (modified Schober)	−0.53 ± 1.61	0.28 ± 0.48	.138[b]
Maximal intermalleolar distance	−0.69 ± 0.48	0.00 ± 0.81	**.045**[b]
Cervical rotation	−0.76 ± 1.36	0.14 ± 1.06	.144[a]
NHP total	−73.48 ± 106.52	−29.68 ± 58.79	.367[a]
Energy level	−16.46 ± 34.51	−4.66 ± 37.68	1.000[b]
Pain	−24.64 ± 35.78	−9.65 ± 19.42	.357[a]
Emotional reactions	−10.90 ± 22.20	−2.69 ± 14.07	.639[b]
Social isolation	−1.67 ± 5.57	0.40 ± 13.50	.607[b]
Sleep	−9.26 ± 34.27	−10.96 ± 22.57	.914[a]
Physical abilities	−10.52 ± 22.99	−2.10 ± 11.01	.639[b]
RMDQ	−5.91 ± 4.46	−2.60 ± 4.27	.090[b]

Abbreviations: BASDAI, Bath Ankylosing Spondylitis Disease Activity Index; BASFI, Bath Ankylosing Spondylitis Functional Index; BASMI, Bath Ankylosing Spondylitis Metrology Index; NHP, Nottingham Health Profile; RMDQ, Roland-Morris Disability Questionnaire; SD, standard deviation.

[a]Independent samples test.

[b]Mann-Whitney *U* Test, Δ, post-treatment-pretreatment, significant values are shown in bold.

soft-tissue mobilizations were used rather than risky manipulation applications, significant improvement was achieved in disease activity (BASDAI), functional level (BASFI), mobility (BASMI), quality of life, and disability. These results have shown that soft-tissue mobilization is an effective and useful treatment in AS, and that the severity of the disease as well as deformities can be preserved and / or improved with this treatment. We think that soft-tissue mobilization techniques are safer than and preferable to chiropractic spinal manipulation.

ASAS/EULAR (2017) and the American College of Rheumatology / Spondylitis Association of America / Spondyloarthritis Research and Treatment Network (2019) strongly recommended physical therapy and regular exercise in their recommendations for AS treatment. However, there is no consensus on which exercise method is more effective in the treatment of AS.[46,47] As a result of our study, we found that spinal mobility exercises consisting of stretching and strengthening exercises alone were not sufficient in the treatment of AS or in stopping the progression of symptoms. We think that a physical therapy program planned for AS treatment may consist of spinal mobility exercises and soft-tissue mobilization techniques, instead of spinal mobility exercises only.

The strengths of our study are that in the literature, although combined treatments were performed in addition to exercise in patients with AS, we examined the effectiveness of only soft-tissue mobilization therapy.

The main limitation of our study is the low number of samples in the control group. Another limitation is that while investigating the therapeutic effect of soft-tissue mobilization, no evaluation was made with the modified Stoke Ankylosing Spondylitis Spinal Score (mSASSS), which determines radiographic severity. In future studies, we recommend the use of mSASSS to examine the effect of soft-tissue mobilization on radiological findings.

In our study, the groups were heterogeneous in terms of the types of drugs the participants used (disease-modifying anti-rheumatic drugs, anti-tumor necrosis factor, non-steroidal anti-inflammatory drugs). We think that in future studies, it could be investigated whether the use of different types of drugs makes any difference in the effectiveness of soft-tissue mobilization in addition to the spinal mobility exercises.

5 | CONCLUSION

We found that spinal mobility exercises consisting of stretching and strengthening exercises alone were not sufficient in the treatment of AS or in stopping the progression of symptoms. Patients with AS had significant improvement in disease activity, functional level, mobility, lateral lumbar flexion, maximal intermalleolar distance, quality of life, and disability level with soft-tissue mobilization in addition to spinal mobility exercises. Hence, soft-tissue mobilization have been shown to be an effective and useful additional treatment method. Achieving these positive results in a short period like 4 weeks can be advantageous in choosing specific soft-tissue mobilization as an effective treatment method compared with long-term treatments in AS. Indeed, there is a general idea in the literature that at least 8 weeks of training are required to see changes in muscle structure, such as strength and flexibility,[48,49] and the most common reason for drop out in treatment programs is the lack of time,[50-52] something that can be overcome by the comprehensive treatments we are proposing.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS

EGK and BBC designed the study. EGK searched databases and performed the selection of studies; EGK, MO, and VC collected data; EGK and MO wrote the manuscript; BBC analyzed the data; BBC and VC contributed to writing and critically appraising the manuscript and approved the last version.

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Ek-12

Annals of Clinical and Analytical Medicine
Original Research

Investigation of the relationship between menopausal symptoms and physical activity level in the postmenopausal period of women

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Abstract
Aim: The aim of this study was to investigate the relationship between menopausal symptoms and physical activity levels in postmenopausal women.
Material and Methods: One hundred seventeen women in the postmenopausal period with a mean age of 55.26 ± 6.24 years were included in the study. Physical activity level was evaluated with the International Physical Activity Questionnaire Short Form (IPAQ-SF), while menopausal symptoms were evaluated using the Menopausal Symptom Assessment Scale (MRS). MRS consists of three subtests: somato-vegetative, psychological and urogenital symptoms. Pearson's correlation was used to analyze the data. The significance level was accepted as $p \leq 0.05$.
Results: The relationship between IPAQ-SF scores and MRS somato-vegetative, psychological and urogenital symptoms subtests and total score of women was as follows: $r = 0.561$, $p = 0.054$, $r = 0.668$, $p = 0.040$; $r = 0.936$, $p = 0.008$; $r = 0.937$, $p = 0.007$, respectively.
Discussion: As a result of our study, it was determined that there was a moderate and high negative correlation between physical activity level and menopausal symptoms in postmenopausal women. This result showed us that physical activity had an effective role on the menopausal symptoms of postmenopausal women.

Keywords
Menopause; Physical activity; Climacterium

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Introduction

The World Health Organization defines menopause as the absence of menstruation for one year in a woman as a result of a decrease in estrogen hormone levels due to the cessation of ovarian functions (available at: http://whqlibdoc.who.int/trs/WHO_TRS_866.pdf). Menopause age varies from society to society. While menopause age is accepted as 51 in the world, in Turkey, it is accepted as 47 (available at : https://www.jcog.com.tr/article/en-editorials-66894.html). Therefore, women spend one-third of their life span with the effects and problems of menopause [1].

The menopausal period consists of premenopause, menopause and postmenopause. During the premenopausal period, the first symptoms appear; the menopause period is when the last menstrual bleeding occurs, and the postmenopausal period is the period starting one year after menopause and lasting until the beginning of old age [2].

Menopausal symptoms are influenced by age, occupation, education level, economic independence, income level, marital adjustment, marital status, orientation to other fields, the size of the family, the status of obtaining information specific to this period, role change and the value that society attaches to women [3].

Menopause is a period of hormonal changes in a woman, as well as changes in the family, in business life and in self-perception. Physiological and psychosocial changes, depending on estrogen deficiency, occurring in this period, manifest themselves with different intensity and duration and negatively affect physical and mental health. In addition to early health problems such as hot flashes, sweating, fatigue, insomnia and tension, late-term health problems such as osteoporosis, osteoporotic fractures, urogenital symptoms and cardiovascular diseases can also be seen. In this process, women are worried about aging, loss of fertility, changes in physical image, health problems combined with social and symbolic meanings negatively affect their lives [4].

Physical activity is defined as any movement that is performed using skeletal muscles in daily life and requires energy expenditure. Regular physical activity and exercise are low-cost and low-risk, as well as preserving and controlling health-related parameters such as cardiovascular endurance, body composition, muscle strength and endurance, flexibility is an effective healthy lifestyle behavior in the treatment of many diseases and symptoms [5].

While studies in the literature examine the effects of exercise on menopausal symptoms, quality of life and activities of daily living in women in the menopausal period, it has been observed that studies on physical activity often belong to the perimenopausal period [1,11,12,23].

The protective effect of physical activity in reducing menopausal symptoms has been emphasized, but certain conclusions have not been reached. Therefore, our study aims to examine the relationship between the physical activity level and menopausal symptoms of postmenopausal women. The study is expected to guide physiotherapists in the planning of the physical activity level for postmenopausal women to reduce menopausal symptoms.

Material and Methods

Participants:

Ethical approval was obtained for this study, which was planned as a cross-sectional analytical study, with the committee meeting of Pamukkale University Non-Invasive Clinical Research Ethics Committee dated 31.01.2017 and numbered 60116787-020 / 8896, and then an application was made to Denizli Province Public Health Directorate. After the application, evaluations were made in Kinikli and Camlik Primary care clinic in Denizli. For the evaluation, people enrolled in the family health center were provided with oral information over the phone, which indicated the inclusion criteria. Beginning with 133 women, 6 women were deemed ineligible for this study, and 10 women declined to participate. As a result, 117 women were analyzed for this study (Figure 1). Informed consent forms were signed by women who agreed to participate in this study, and they were assessed using face-to-face interviews.

Inclusion criteria:

The study included women aged 35 to 65 years who had at least one year after their last menstrual bleeding, whose menopausal status was defined as postmenopausal according to the STRAW classification, and who volunteered to participate in the study. The STRAW evaluation was carried out by physicians in the primary care clinic.

Exclusion criteria:

The exclusion criteria were the presence of a physical illness or mental disability that prevented understanding and responding to the scales applied, hysterectomy and any gynecological surgery, chronic menstrual irregularity, having received hormone therapy for any reason in the last 3 months and not speaking Turkish. Verbal information about the study was given to the participants again before the registration process. Then, anthropometric measurements (height and weight) of the participants were made by the same researcher, and sociodemographic (age, education, employment and marital status) and health information forms were filled with face-to-face interview technique. Later, the Menopausal Symptom Assessment Scale (MRS) and the International Physical Activity Questionnaire-short form (IPAQ-SF) were used for evaluation.

Data Collection Tools:

1. Menopause Rating Scale (MRS)

Menopausal symptoms were evaluated according to internationally accepted Menopausal Symptoms Assessment Scale (MRS) and developed by Schneider et al. (2000). MRS consists of 11 items and 3 subtests including menopausal complaints. Subtests are somato-vegetative complaints, psychological complaints, and urogenital complaints. The validity and reliability of the scale was made by Gurkan in 2005 [6].

Likert-type scale has 5 options for each item. They are 0: none, 1: mild, 2: moderate, 3: severe and 4: very severe options. While the minimum score obtained from the total of MRS is "0", the maximum score is "44". An increase of the total score on the scale indicates the increase in the severity of the complaints. Also, it shows that the quality of life is negatively affected.

2. International Physical Activity Questionnaire Short Form (IPAQ-SF)

The physical activity status of the women participating in the

study was obtained by evaluating the activity frequency and duration, which they declared in the International Physical Activity Questionnaire Short Form. The IPAQ was developed by the International Group for Consensus of Physical Activity Measurements and has been used in 25 countries with the approval from the World Health Organization. The validity and reliability study of the IPAQ was first conducted at 14 centers in 12 countries. The validity and reliability study of the Turkish version of the questionnaire was made by Karaca (2007). The test-retest reliability of the IPAQ short form was found to be r = 0.69 [7].

Statistical analysis:

Data were analyzed with the SPSS package program (software). Frequency and percentage distributions for descriptive categorical variables, means and standard deviations for continuous variables were calculated. The level of significance in statistical test results was accepted as p≤0.05 and interpreted. Chi-square and Fisher's exact tests for categorical variables, t-test for continuous variables, ANOVA analysis of variance and Pearson correlation test were used in comparative analyzes.

Results

One hundred seventeen women in the postmenopausal period with a mean age of 55.26 ± 6.24 years participated in the study. Figure 1 shows a flow chart of the study design. The demographic and health-related data of the participants are shown in Table 1.

Among the participants, 84.6% had no current or past smoking history. When the physical activity level of the women participating in the study was examined, it was seen that 60 (51.3%) women were inactive, and 57 (48.7%) women were minimally active (Table 1).

Considering the relationship between the total score of the women participating in the study on the MRS scale and their IPAQ-SF scores, it was observed that 58.3% of women with no menopausal symptoms were physically active (minimal or very active), and 53.3% of women with severe menopausal symptoms were inactive. The total IPAQ and MRS scores and subscores of the women are shown in Table 2. The relationship between the women's IPAQ-SF scores and the MRS somato-vegetative, psychological and urogenital symptoms subtests and total scores was as follows: r = -0.561, p = 0.054, r = -0.668, p = 0.040; r = -0.936, p = 0.008; r = -0.937, p = 0.007, respectively (Table 3).

Table 1. Demographic and clinical characteristics of the participants

Variables	M±SD (n=117)
Age (year)	55,26±6,24
Height (cm)	157,96±6,01
Weight (kg)	72,85±11,66
BMI	29,23±4,62
	n (%)
Education	
Lettered	4 (3,4)
Primary school	62 (53)
Secondary school	8 (6,8)
High school	27 (23,1)
College/university	16 (13,7)
Employment status	
Working	13 (11,1)
Non working/retired	104 (88,9)
Marital status	
Married	100 (85,5)
Never married	1 (0,9)
Separated/divorced/widowed	16 (13,7)
Physical activity level (%)	
Low	60 (51,3)
Moderate	57 (48,7)
High	0 (0)
Number of children (%)	
0	3 (2,56)
1	19 (16,23)
2	58 (49,57)
3	32 (27,35)
>4	5 (4,27)
Age at first menstrual period (%)	
10-13 years	77 (65,81)
14-18 years	40 (34,18)
History of menopause (%)	
0-5 years	46 (39,31)
6-10 years	38 (32,47)
>10 years	33 (28,20)

BMI= body mass index, M=mean, SD=standard deviation

Table 2. Descriptive statistics of physical activity levels (IPAQ) and Menopausal Symptom Assessment Scale (MRS) Total score/subscores

Variables	Min.-Max.	M±SD (n=117)
IPAQ	0-5119,50	741,57±794,17
Menopausal Symptom Assessment Scale Total	0-34	11,98±7,10
Somato-vegetative	0-10	2,53±1,94
Psychological	0-22	7,05±4.61
Urogenital	0-10	2,39±2,41

M=mean, SD=standard deviation

Table 3. Correlation between physical activity levels (IPAQ) and Menopausal Symptom Assessment Scale (MRS) Total score/ subscores

Variables	IPAQ (n=117)	
	r	p
Menopausal Symptom Assessment Scale Total	0,937	0,007
Somato-vegetative	0,561	0,054
Psychological	0,668	0,040
Urogenital	0,936	0,008

Pearson correlation analysis; p= significance level, r= correlation coefficient.

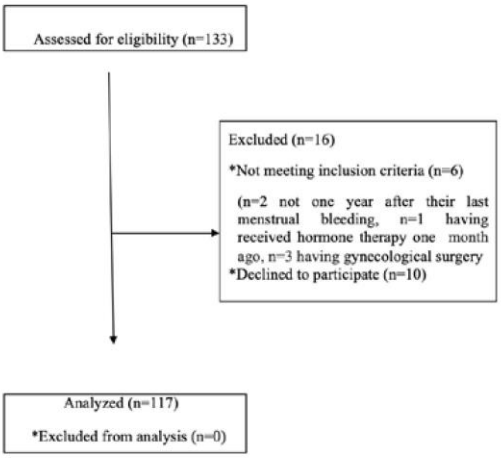

Figure 1. Flow chart of the study design

Discussion

In our study, we aimed to evaluate the relationship between physical activity level and menopausal symptoms in postmenopausal women, and we found that physical activity level was inversely associated with menopausal symptoms in postmenopausal women.

The menopausal period causes hormonal, physical and emotional changes. These changes are not at the same level for all woman, because they are affected by cultural differences, education level and some personal factors [8]. The low scores of women in our study on the assessment of menopausal symptom made us think that they were severely affected by the symptoms in this period. Similar effects were reported in other studies conducted in our country [8,9].

Hormone Replacement Therapy, which is considered the basic and most effective treatment option for symptoms experienced by women during menopause, directs women to alternative methods (lifestyle changes, weight control, physical activity) due to concerns of some risks and side effects. While the effect of such lifestyle changes on general quality of life is evident, their relationship with menopausal symptoms is contradictory [10].

We encounter different results in studies that examine the relationship between menopausal symptoms and physical activity levels, which is among alternative treatment approaches. In the literature, in addition to all the positive contributions mentioned above, it has been reported that the symptoms of menopause do not decrease with physical activity, but the quality of life increases in the postmenopausal period [11]. Among the contradictory data, studies showing that there is insufficient evidence to determine whether physical activity has a positive or negative effect on these symptoms have also been reported [12].

The relationship between physical activity status and menopausal symptoms may vary depending on the intensity of the activity [13]. A study showed that women who were physically active or min active had fewer somato-vegetative, psychological, and urogenital complaints. A statistically significant negative correlation was found between the physical activity status of women and somatic complaints in the form of joint-muscle disorders, sleep problems, dryness of the vagina, sexual problems and urinary problems. There was no significant relationship between anxiety, malaise, irritability, mental and physical fatigue, hot flashes and heart problems and physical activity. Weight control and regular physical activity have been recommended as lifestyle changes for women with menopausal symptoms. [8]. In another study examining the relationship between physical activity level and menopausal symptoms, high-intensity exercise had little effect on menopausal symptoms; it has been observed that mild physical activity in leisure time and gardening, at work or while carrying something is more effective in menopausal symptoms. It has been reported that with regular physical activity, individuals feel more comfortable, less severe and less frequent menopause symptoms [14].

The most typical finding of the climacteric period is vasomotor symptoms. Discigil et al., in their study investigating the perception of menopause, reported that the most common symptom experienced by women in the menopausal period in the last 3 months was vasomotor complaints, and women most frequently associate hot flashes, night sweats and nervousness with menopause [15].

Mood disorders and mood changes are observed under the influence of hormonal changes in the central nervous system during premenopause and postmenopause. The decrease in serotonin hormone due to estrogen deficiency makes it difficult for women to fall asleep and causes insomnia. The study reported that 91% of menopausal women had irritability, 86% of them had depression, 82% had a loss of concentration, 81% had personality changes, 77% had sleep problems, 77% had lack of motivation, 75% had memory loss, 37% had hot flashes, 19% had a headache and 18% had excessive sweating [16]. There were studies showing that physical activity had a significant effect on menopausal symptoms, especially in terms of vasomotor symptoms [17, 18], and also it was reported that it was not related [19]. In our study, we found a moderately positive significant relationship between physical activity level and vasomotor symptoms. Regular physical activity reduces the body's response to stress. The severity and frequency of symptoms such as hot flashes and sweating can be reduced by the combined use of relaxation techniques such as deep breathing that reduce sympathetic activation.

Elavsky and Mcauley reported in their study that menopausal women with more physical activities had less perception of menopausal symptom violence and increased psychological well-being [18]. Daniel et al. stated that after intense physical activity, women in the menopausal period tend to be significantly more calm, relaxed and pleasant, free from depression, anger and confusion, and this is due to the increase in endogenous endorphin levels in response to activity [13]. In a study conducted with menopausal women between the ages of 42-52, depressive symptoms decreased as the intensity of physical activity increased [20]. A study from Italy reported that the complaints of depression, forgetfulness and nervousness were more common in menopausal women with low physical activity levels [21]. When the relationship between physical activity

level and the Menopausal Quality of Life Scale (MOYKO) was examined in 2606 women in menopausal period, it was reported that physically inactive women had increased levels of anxiety, depression, decreased well-being, memory and concentration problems compared to active women. It has also been reported that physically active women have a better quality of life [22]. In our study, it was found that most of the women with psychological complaints were physically inactive. This period may also lead to an increase in feelings of loneliness, aging, uselessness and pessimism, as the general health condition that is moderate or poor, retirement, parental deaths, children leave home due to reasons such as school, work, marriage, etc. The inadequacy in the mechanism of coping with physical health and emotional problems may have caused women to feel more severe menopausal symptoms by reducing their activity levels. This result is actually a reflection of our country, we believe that individuals in our country gaining physical activities and hobby activities that they can enjoy in daily life from childhood will transform individuals into more active and happier individuals in life in the future.

A decrease in muscle tone around the reproductive organs is observed with menopause. Li et al. reported that physically active women had fewer complaints of vaginal dryness and lack of sexual desire. It was reported that sexual symptoms of physical activity during the transition to menopause helped to recover [23]. Similar to the literature, we found that women who were inactive during the postmenopausal period had more urogenital complaints. We thought that these complaints could be reduced by increasing the physical activity of postmenopausal women, therefore they should be informed about this issue.

Although we thought that the limitation of our study was that the study was conducted on a small population, we believed that it was a useful study in terms of creating a role model representing our society in determining the relationship between physical activity level and menopausal symptoms.

Conclusion and Recommendations

In our study, it was observed that somato-vegetative, psychological and urogenital symptoms related to the postmenopausal period decreased with the increase in the level of physical activity. Most women who experienced symptoms such as sleep problems, hot flashes, heart problems, muscle-joint disorders, malaise, irritability, anxiety, physical and mental fatigue, urinary problems, sexual problems and vaginal dryness were found to be inactive. Especially when the negative effects of the postmenopausal period are combined with a sedentary life, the health problems that occur during this period increase even more and may cause a person to experience this period of poor quality. The changes that occur due to menopause, which is a period of life, affect each woman differently and direct women to seek alternative treatment. Regular physical activity and weight control are recommended lifestyle changes. In this direction, studies and publications on women's health may recommend to investigate the effect of physical activity on menopause symptoms, conduct more interventional studies in physical therapy units and menopause clinics related to the subject, sharing the results and influencing hospital policies to raise women's awareness of menopause and increase exercise training in this field.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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Ek-13

Evrak Tarih ve Sayısı: 03/11/2020-E.66540

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PAMUKKALE ÜNİVERSİTESİ
Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu

Sayı :60116787-020/66540 03/11/2020
Konu :Başvurunuz Hk.

Sayın Doç. Dr. Bilge BAŞAKCI ÇALIK

İlgi :19/10/2020 tarihli dilekçeniz 10.185.1.86 151 4.11.2020

İlgi dilekçe ile başvurmuş olduğunuz **"Fibromiyalji'li Bireylerde Terapatik Nörobilim Eğitiminin Etkinliğinin İncelenmesi:Randomize Kontrollü Çalışma"** konulu çalışmanız **27.10.2020 tarih ve 20 sayılı** kurul toplantımızda görüşülmüş olup,

Yapılan görüşmelerden sonra, söz konusu çalışmanızda istenilen değişikliklerin yapılmasında **ETİK AÇIDAN SAKINCA OLMADIĞINA**, altı ayda bir çalışma hakkında Kurulumuza bilgi verilmesine oy birliği ile karar verilmiştir.

Bilgilerinizi rica ederim.

Prof. Dr. Tahir TURAN
Başkan

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Ek-14

Sosyodemografik Veri Formu

Adı-Soyadı: Telefon:
Yaş: Tarih:
Cinsiyet:
Boy:
Kilo:
BMI:
Dominant taraf:
Meslek:
Eğitim Yılı:
Tanı yılı:
Özgeçmiş:
Soygeçmiş:
Kullanılan İlaçlar:
Şikayet:
Egzersiz Alışkanlığı☐ Yok ☐ Var (……dakika……gün/hafta)

Ek-15

FİBROMİYALJİ ETKİ ANKETİ

1 Aşağıdaki aktiviteleri yapabiliyor musunuz?

		Daima	Çoğunlukla	Ara sıra	Hiçbir zaman
a	Alışveriş yapmak	❑0	❑1	❑2	❑3
b	Çamaşır yıkamak	❑0	❑1	❑2	❑3
c	Yemek hazırlamak	❑0	❑1	❑2	❑3
d	Bulaşıkları (tabak, kazan vs.) elde yıkamak	❑0	❑1	❑2	❑3
e	Elektrik süpürgesi ile halı süpürmek	❑0	❑1	❑2	❑3
f	Yatakları düzenlemek	❑0	❑1	❑2	❑3
g	Birkaç yüz metre yürümek	❑0	❑1	❑2	❑3
h	Arkadaş/akraba ziyareti yapmak	❑0	❑1	❑2	❑3
I	Bahçe işleri yapmak	❑0	❑1	❑2	❑3
J	Araba kullanmak	❑0	❑1	❑2	❑3
k	Merdiven çıkmak	❑0	❑1	❑2	❑3
		Toplam Skor:		[(a+b+….+k) / 10 x 3.33]	

2 Son bir hafta içinde kendinizi kaç gün iyi hissettiniz?

0 1 2 3 4 5 6 7 ☐

3 Geçen hafta boyunca kaç gün fibromiyaljiden dolayı iş yapamaz duruma geldiniz?

0 1 2 3 4 5 6 7 ☐

4 İşe gittiğiniz zaman, ev işlerinizi yaparken ağrı ve diğer yakınmalar iş yapmanızı ne kadar engelledi?

Engellemedi 0 1 2 3 4 5 6 7 8 9 10 Çok Engelledi ☐

5 Ağrınızın düzeyi ne kadardı?

Yoktu 0 1 2 3 4 5 6 7 8 9 10 Çok Fazlaydı ☐

6 Ne kadar yorgunsunuz?

Yorgun değilim 0 1 2 3 4 5 6 7 8 9 10 Çok Yorgunum ☐

7 Sabahları kalktığınızda kendinizi nasıl hissediyorsunuz?

Dinlenmiş 0 1 2 3 4 5 6 7 8 9 10 Çok Yorgun ☐

8 Sabah tutukluğunuz ne kadar?

Hiç yok 0 1 2 3 4 5 6 7 8 9 10 Çok Tutuk ☐

9 Kendinizi ne kadar sinirli ve gergin hissediyorsunuz?

Sakin 0 1 2 3 4 5 6 7 8 9 10 Çok Sinirli ☐

10 Kendinizi ne kadar hüzünlü, çökkün, morali bozuk veya depresif hissediyorsunuz?

Hiç 0 1 2 3 4 5 6 7 8 9 10 Çok ☐

Ek-16

Ek-17

Yaygın Ağrı İndeksi (0-19 arası puan)

	Var	Yok		Var	Yok
sol çene			Sol kalça		
sol omuz			Sol uyluk		
sol kol			Sol bacak		
Sol önkol			Sağ kalça		
Sağ çene			Sağ uykluk		
Sağ omuz			Sağ bacak		
Sağ kol			Boyun		
Sağ önkol			Üst sırt		
Karın			Alt sırt		
			Göğüs		

Semptom Şiddet Ölçeği (0-12 arası puan)

	0=normal	1=hafif	2=orta	3=şiddetli
Halsizlik				
Yorgun uyanma				
Bilişsel semptomlar				

Geçen altı ay boyunca aşağıdaki semptomların varlığı	Var	Yok
Baş ağrısı (0-1)		
Alt karında ağrı ve kramplar (0-1)		
Depresyon (0-1)		

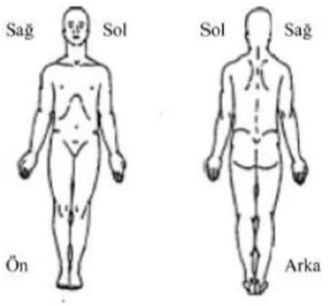
Ek-18

KISA AĞRI ENVANTERİ

1. Yaşamımız boyunca zaman zaman birçok ağrı deneyimleriz (minör baş ağrısı, burkulma, diş ağrısı gibi). Bugünkü ağrınız her zaman yaşadığınız bu ağrı çeşitlerinden farklı mı?

   1. ☐ Evet 2. ☐ Hayır

2. Şekil üzerinde ağrı hissettiğiniz bölgeleri işaretleyiniz. En çok ağrıyan bölgeye X işareti koyunuz.



3. Son 24 saatteki "**en kötü**" ağrınızı en iyi tanımlayan sayıyı işaretleyiniz.

0	1	2	3	4	5	6	7	8	9	10
Ağrı Yok										**Dayanılmaz Ağrı**

4. Son 24 saatteki "**en hafif**" ağrınızı en iyi tanımlayan sayıyı işaretleyiniz.

0	1	2	3	4	5	6	7	8	9	10
Ağrı Yok										**Dayanılmaz Ağrı**

5. Son 24 saatteki "**ortalama**" ağrınızı en iyi tanımlayan sayıyı işaretleyiniz.

0	1	2	3	4	5	6	7	8	9	10
Ağrı Yok										**Dayanılmaz Ağrı**

6. "**Şu anki**" ağrınızı en iyi tanımlayan sayıyı işaretleyiniz.

0	1	2	3	4	5	6	7	8	9	10
Ağrı Yok										**Dayanılmaz Ağrı**

7. Ağrınız için aldığınız tedaviler ya da ilaçlar nelerdir?

8. Son 24 saatte, ağrı tedavisi ile ağrıdan kurtulmanız nasıldı? Ağrınızdan en fazla ne kadar kurtulduğunuzu yüzde olarak gösteriniz.

%0	%10	%20	%30	%40	%50	%60	%70	%80	%90	%100
Hiç Kurtulmadım.										**Tamamen Kurtuldum.**

9. Son 24 saatte, ağrınız nedeniyle aktivitelerinizdeki etkilenme durumunu en iyi tanımlayan sayıyı işaretleyiniz.

A. GENEL AKTİVİTE

0	1	2	3	4	5	6	7	8	9	10
Hiç Etkilenmedim.										**Tamamen Etkilendim**

B. EMOSYONEL DURUM

0	1	2	3	4	5	6	7	8	9	10
Hiç Etkilenmedim.										**Tamamen Etkilendim**

C. YÜRÜYEBİLME

0	1	2	3	4	5	6	7	8	9	10
Hiç Etkilenmedim.										**Tamamen Etkilendim**

D. DERİN SOLUNUM VE ÖKSÜRME EGZERSİZİ

0	1	2	3	4	5	6	7	8	9	10
Hiç Etkilenmedim.										**Tamamen Etkilendim**

E. DİĞER İNSANLARLA İLİŞKİLER

0	1	2	3	4	5	6	7	8	9	10
Hiç Etkilenmedim.										**Tamamen Etkilendim**

F. UYUMA

0	1	2	3	4	5	6	7	8	9	10
Hiç Etkilenmedim.										**Tamamen Etkilendim**

G. YAŞAMDAN ZEVK ALMA

0	1	2	3	4	5	6	7	8	9	10
Hiç Etkilenmedim.										**Tamamen Etkilendim**

Ek-19

AĞRIYI FELAKETLEŞTİRME ÖLÇEĞİ

	Hiç yok	Hafif derece	Orta derece	Büyük ölçüde	Her zaman
Ağrının sona erip ermeyeceği konusunda sürekli endişelenirim	0	1	2	3	4
(Ağrı nedeniyle) Devam edemeyeceğimi hissederim	0	1	2	3	4
Ağrının korkunç olduğunu ve asla düzelmeyeceğini düşünürüm	0	1	2	3	4
Ağrı berbat bir şeydir ve beni bunalttığını hissederim	0	1	2	3	4
Ağrıya daha fazla dayanamayacağımı hissederim	0	1	2	3	4
Ağrının kötüleşeceğinden korkarım	0	1	2	3	4
Sürekli olarak başka ağrılı durumları düşünürüm	0	1	2	3	4
Endişeli biçimde ağrının geçmesini dilerim	0	1	2	3	4
Ağrıyı kafamdan atamıyorum	0	1	2	3	4
Sürekli olarak ağrının canımı ne kadar yaktığını düşünürüm	0	1	2	3	4
Ağrının geçmesini beklemenin ne kadar zor olduğunu düşünüp dururum	0	1	2	3	4
Ağrının şiddetini azaltmak için yapabileceğim hiçbir şey yok	0	1	2	3	4
Ağrının ciddi bir sorunla ilgili olup olmadığını merak ederim	0	1	2	3	4

Ek-20

TAMPA KİNEZYOFOBİ ÖLÇEĞİ

Lütfen, her soruda kendinize en uygun olan kutucuğu işaretleyiniz (*her soruda yalnızca bir kutucuğu işaretleyiniz*). *Teşekkür ederiz.*

	Kesinlikle katılmıyorum	Katılmıyorum	Katılıyorum	Tamamen katılıyorum
1. Egzersiz yaparsam kendi kendimi sakatlarım diye kaygılanıyorum.	☐	☐	☐	☐
2. Ağrımla baş etmeye çalışacak olsam, ağrım artar.	☐	☐	☐	☐
3. Ağrımdan dolayı vücudum bana tehlikeli derecede yanlış giden bir şeyler olduğunu söylüyor.	☐	☐	☐	☐
4. Egzersiz yaparsam sanki ağrım hafifleyecekmiş gibi geliyor.	☐	☐	☐	☐
5. İnsanlar benim tıbbi sorunlarımı yeterince ciddiye almıyorlar.	☐	☐	☐	☐
6. Başıma gelen bu olay nedeni ile vücudum hayat boyu risk altında olacak.	☐	☐	☐	☐
7. Ağrımın olması her zaman, vücudumu sakatladığım/bir problemim olduğu anlamına gelir.	☐	☐	☐	☐
8. Sırf bazı şeylerin ağrımı artırıyor olması, onların tehlikeli oldukları anlamına gelmez.	☐	☐	☐	☐
9. Kendimi kazara sakatlamaktan korkuyorum.	☐	☐	☐	☐
10. Ağrının artmasını engellemenin en basit ve güvenli yolu gereksiz hareketler yapmaktan kaçınmaktır.	☐	☐	☐	☐
11. Vücudumda tehlike arz eden bir şey olmasaydı, bu kadar çok ağrı hissetmezdim.	☐	☐	☐	☐
12. Ağrıma rağmen, fiziksel olarak aktif olsaydım, durumum daha iyi olurdu.	☐	☐	☐	☐
13. Ağrı, kendimi sakatlamamam için egzersizi ne zaman bırakmam gerektiği konusunda bana sinyal verir.	☐	☐	☐	☐
14. Benim durumumda olan birinin, fiziksel olarak aktif olması pek güvenli değildir.	☐	☐	☐	☐
15. Normal insanların yaptığı her şeyi yapamam, çünkü çok kolay sakatlanırım.	☐	☐	☐	☐
16. Bazı şeyler çok fazla ağrıya neden olsa bile, bunların gerçekte tehlikeli olduklarını düşünmem.	☐	☐	☐	☐
17. Hiç kimse ağrı hissederken egzersiz yapmak zorunda olmamalı.	☐	☐	☐	☐

Ek-21

BİLİŞSEL EGZERSİZ TERAPİ YAKLAŞIMI ÖLÇEĞİ

Lütfen aşağıdaki her bir soruyu okuyun ve bugündahil SON BİR HAFTA İÇİNDE her bir maddenin sizin için uygun olan seçeneği işaretleyin.					
1. Ağrımı artıracağını bile bile kendimi işleri yapmaktan alıkoyamıyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
2. Ağrım olduğunda hareket etmekten çekiniyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
3. Ağrımın daha da kötüye gideceğinden korkuyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
4. Ağrı kesici almazsam rahat edemiyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
5. Ağrımla nasıl baş edebileceğimi bilmiyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
6. Yatağa yatıp kalkarken zorlanıyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
7. Basamak/merdiven inip çıkarken zorlanıyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
8. Yürüyüşümün bozuk olduğunu düşünüyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
9. Tuvalete oturup kalkarken zorlanıyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
10. Barsak fonksiyonlarımın düzensiz olduğunu düşünüyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
11. Kendimi yorgun hissediyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
12. Ağrılarım nedeniyle kaslarımı – eklemlerimi doğru kullanmayı bilmiyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
13. Hastalığımın vücudumda yarattığı değişiklikler nedeniyle insanların sürekli bana baktıklarını düşünüyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
14. Hasta olduğu için bedenimi kabullenemiyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
15. Hastalığımın bende yarattığı olumsuz duygulardan kurtulamıyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
16. Hastalığımın bir insanın başına gelebilecek en kötü şey olduğunu düşünüyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
17. Geçmişte yaşadığım olumsuz duyguları hatırlamanın ağrılarımı arttığını düşünüyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
18. Gelecekle ilgili kaygılardan kendimi bir türlü kurtaramıyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
19. Kendime değer vermiyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
20. İstemediğim olaylar karşısında 'hayır' diyemediğim için ağrılarımın arttığını düşünüyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
21. İşlerimi yetiştirmek için aceleci davranmanın ağrımı artırdığını düşünüyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
22. Aklımdaki işleri bitirene kadar rahat edemiyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
23. Kendime vakit ayıramıyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
24. Hastalığım hayattan geri çekilmeme neden oldu.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
25. Sosyalleşmekte ve arkadaş edinmekte kendimi yetersiz hissediyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
26. Arabaya binip inmekte zorlanıyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
27. Hastalığımın beni cinsellikten uzaklaştırdığını düşünüyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
28. Ellerimle yapabileceğim işleri yapmakta zorlanıyorum (ayakkabı bağını bağlama, düğme iliklemek, yemek yemek, banyo yapmak, kavanoz açmak vs...).	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
29. Hasta olduktan sonra cinselliğe eskisi kadar istekli değilim.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman
30. Uyku sorunları (uykuya dalmada zorluk, sık sık uyanma, kalitesiz uyku...) yaşıyorum.	EVET Her zaman	EVET SIKLIKLA	EVET BAZEN	EVET NADİREN	HAYIR Hiçbir zaman

Ek-22

Basınç Ağrı Eşikleri

	Sağ		Sol	
	Maks.	Ort.	Maks.	Ort.
M. Trapezius (Trapezius kasının üst sınırının orta noktası)				
Lateral Epikondil (2 cm distali)				
M. Quadriceps Femoris				
Dizler (Eklem Hattına Yakın Medial Yağ Yastığında)				