

Effect of Adding Mindfulness Technique to Cognitive Behavioral Training on Pain and Quality of Life in Fibromyalgia

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ABSTRACT

Background: Fibromyalgia (FM), a condition marked by chronic pain and a range of mental health issues, may be challenging and costly. Although the exact cause of fibromyalgia is unknown, central sensitization is thought to play a significant role. As a consequence of psychological pressures, pain tolerance falls which impacts everyday lives of these people. This research employed mindfulness-based therapies, which is a soothing, simple to use, easy to access and low financial burden ways that boost fibromyalgia patient's body awareness, reduce pain perception thus improve quality of daily activities. The use of mindfulness-based therapies has the potential to improve the design of behavioral interventions that target fibromyalgia-related outcomes by supporting particular analgesic processes.

Objective: The purpose of this study is to investigate if fibromyalgia patients' pain levels and quality of life are improved by including mindfulness into cognitive behavioral therapy. **Methods:** Forty-six women (ranging in age from 35 to 55), who had been experiencing widespread pain for at least three months and had tenderness at eleven out of eighteen specific tender point sites identified by the American College of Rheumatology (ACR), were randomly assigned to one of two groups in this pre- and post-test randomized controlled trial. One group received mindfulness technique and cognitive behavioral training in addition to aerobic exercises, while the other group received cognitive behavioral training in addition to aerobic exercises. Over the course of eight weeks, participants received interventions three times weekly. The CogniFit Mobile Application, the Visual Analog Scale (VAS), the Digital Algometer (DA) and the Revised Fibromyalgia Impact Questionnaire (FIQR). The measures were administered at the beginning and end of the eight weeks to assess pain, quality of life, and cognitive functioning. **The results** showed that after treatment, the pain pressure threshold (PPT) increased significantly while the visual analog scale (VAS) and Revised Fibromyalgia Impact Questionnaire (FIQR) decreased significantly ($p < 0.001$) compared to pre-treatment levels. In contrast, the control group did not show any significant changes ($p > 0.05$) in PPT, VAS nor FIQR. Beyond that, there was a notable improvement in both groups' CAB-ME, CAB-AT, and CAB-RS levels after therapy as compared to before treatment ($p < 0.001$). In the study group, compared to the control group, there was a substantial rise in PPT ($d = 0.89$) and a significant reduction in VAS ($d = 1.98$) and FIQR ($d = 0.90$) after treatment ($p < 0.01$). Furthermore, after treatment, there was a substantial increase in all CAB parameters in the study group as compared to the control group ($p < 0.05$). This includes CAB-ME ($d = 0.65$), CAB-AT ($d = 1.33$), and CAB-RS ($d = 0.82$). Results show that fibromyalgia patients' pain levels, cognitive abilities (memory, attention, and reasoning), and overall quality of life are all improved when mindfulness training is added to cognitive behavioral therapy.

Keywords: mindfulness techniques, cognitive behavioral training, CogniFit application, fibromyalgia.

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INTRODUCTION

In fibromyalgia, sufferers often experience lethargy, disturbed sleep, mood swings, and memory loss. It is possible for fibromyalgia to manifest on its own, among other chronic overlapping primary pain illnesses, or as a secondary symptom of another ailment, such as an autoimmune disorder. Fibromyalgia is characterized by a generalized hypersensitivity of the central nervous system (CNS) to sensory inputs (1).

In fibromyalgia patients, there is less activity in brain regions associated with pain perception and executive

functioning, which may be due to an overstimulation of pain receptors, which in turn may lead to a loss of neural resources necessary for other brain functions like cognition (2).

Brain plasticity and functional connections between areas of the brain that process pain may be different in patients with chronic pain, according to studies. Decreased mood and cognitive function might be associated with these (3). One useful therapeutic tool is cognitive-behavioral training, which can help patients with fibromyalgia improve their mood, stress levels, ability to cope with pain, and problem-

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solving skills through the implementation of behavioral interventions such as improved sleep hygiene, relaxation techniques, and an activity rhythm (4).

Aerobic exercise, cognitive-behavioral therapy (CBT), and patient education are the primary methods recommended by international standards for the improvement of pain and associated symptoms. Cognitive behavioral therapy (CBT) for fibromyalgia aims to help patients self-manage their condition by changing their negative views about their capacity to deal with pain and other symptoms. Cognitive behavioral therapy (CBT) restructures dysfunctional thinking processes, decreases pain catastrophizing, and regulates activities to alleviate psychological symptoms and functional impairment (5).

Paying nonjudgmental attention to one's experiences in the here and now and maintaining this attention throughout time is the practice of mindfulness. The goal is to train oneself to be fully present in the here and now without judgment or anxiety. Results from studies examining the effects of mindfulness-based pain management on chronic pain patients have been promising, with effect sizes ranging from medium to large on measures of despair, optimism, and pain acceptance (6).

There needs to be more clinical research on mindfulness method as a treatment intervention for fibromyalgia since there is now very little of it. Jon Kabat-Zinn and colleagues at the University of Massachusetts Medical School initially introduced mindfulness in 1979, mainly to help outpatients cope with the extreme stress they often face. Mindfulness is defined as bringing one's awareness to the present moment and accepting one's experience as it unfolds without passing judgment. In addition, there is mounting evidence that regular meditation and mindfulness training may benefit health by altering brain chemistry and function (7).

The purpose of this research is to determine if fibromyalgia patients' pain levels, quality of life, and cognitive abilities (memory, focus, and reasoning) are affected by incorporating mindfulness method into cognitive behavioral therapy. People with chronic pain and poor quality of life may benefit more from a combination of cognitive behavioral training and mindfulness practices than from CBT alone, according to a recent hypothesis.

SUBJECTS AND METHODS

An ethical approval number (P.T.REC/012/005340) indicates that the research is a randomized controlled trial with a pre- and post-test design. The experiment took place in the Neurological Outpatient Clinic at Heliopolis University. The data for the quality of life was taken from Grossman et al. (2007), and the sample size was calculated using G*POWER statistical software (G*power version 3.1.9.2; Franz Faul, Universitat Kiel, Germany). The study included 46 females (aged 35–55) who were randomly assigned to one of two groups: Group A, which consisted of 23 women, and Group B, which consisted of 23 women, all with a history of widespread pain lasting at least three months and tenderness at eleven out of eighteen specific tender point sites as defined by the American College of Rheumatology (ACR). Eight weeks of interventions were administered over the course of three sessions each week. A

pressure algometer and a visual analog scale (vas) were used to measure the severity of the pain. The cognitive performance was evaluated using the CogniFit mobile app, while the quality of life was evaluated using the revised fibromyalgia impact questionnaire (FIQR). The first and last measurements were obtained at the beginning and conclusion of the eight weeks. This study set out to answer the following question: "Does incorporating mindfulness into cognitive behavioral therapy for fibromyalgia improve pain, cognition, and quality of life?"

Adult patients were included if:

- The patient's primary care physician verified the clinical diagnosis of fibromyalgia.
 - They had generalized discomfort for a minimum of three months and soreness in 11 out of 18 identified sensitive points.
 - Their ages ranged from 35 to 55.
 - Their gender was female.
 - They have (BMI < 35 kg/m²)
- . Figure 1 shows the research flow diagram.

Patients were excluded if:

- They conceived
- They were abusing substances,
- They have a mental health condition that might prevent them from following the program as prescribed.
- They had life-threatening disease.

Recruitment and Consent

In all, sixty patients were examined by the neurosurgeon on call. Each patient was asked to sign an informed consent form.

Randomization and Allocation Concealment

To guaranty allocation concealment, we used a computer-generated random sequence in conjunction with the closed opaque envelope approach to randomly assign participants to either the study or control group. The envelopes were created by a research assistant who was not engaged in the evaluation or therapy.

Procedures

One group, known as study group A, included 23 female patients who also underwent mindfulness meditation and a cognitive behavioral training program based on mobile applications in addition to aerobic exercises. The other group, known as control group B, also included 23 female patients who underwent cognitive behavioral training in addition to aerobic exercises.

Outcome measures

Pressure Algometer (PA)

A flat applicator tip and force transducer enable quantitative force evaluation on the algometer (8). We took tenderness readings at 18 specific locations on both sides of the body according to the Initial American College of Rheumatology (ACR) classification criteria (fig.2): occiput (2 points), low cervical (2 points), trapezius (2 points), supraspinatus (2 points), second rib (2 points), lateral epicondyle (2 points), gluteal (2 points), greater trochanter (2 points), and knee (2 points).

The revised Fibromyalgia Impact Questionnaire (FIQR):

For a comprehensive assessment of fibromyalgia, the FIQR is a self-administered, validated questionnaire. Physical function (9 questions), overall impact (2 items), and FM symptoms (10 items) are the three primary areas that are

evaluated in reference to the previous week on the 21-item, 11-point numerical rating scales (0–10). A version in Arabic is also available (9). When it comes to validity and dependability, the Arabic FIQ-A version is up to par. Clinical practice and research involving Arabic-speaking populations may benefit from its use.

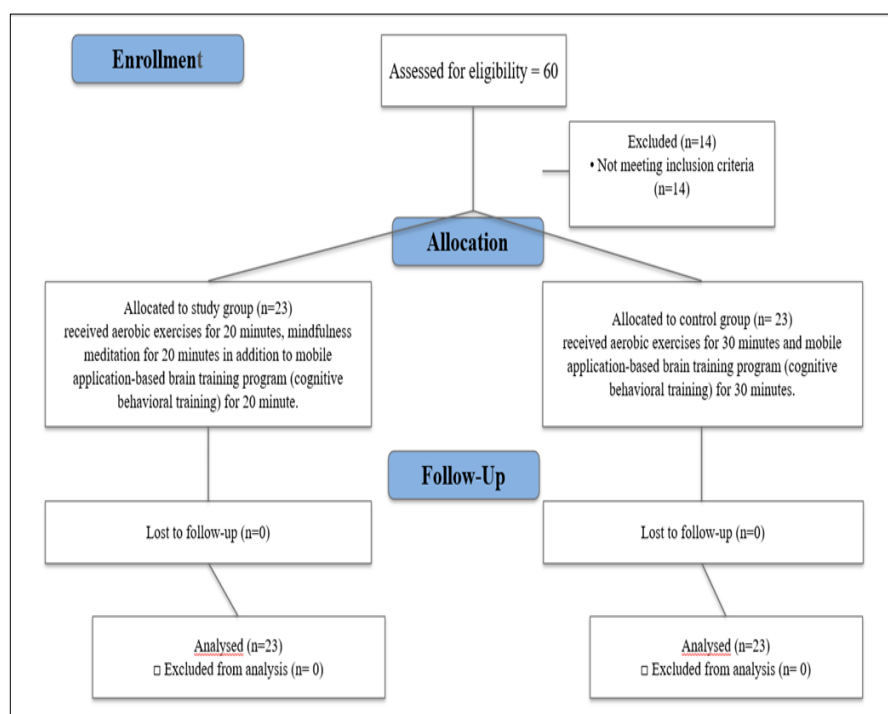


Fig. 1. Flow chart indicating numbers of participants

The CogniFit Mobile Application:

Researchers discovered that this computerized cognitive training program significantly improved participants' cognitive abilities. A 45-minute baseline evaluation was used to customize the training.

Cognitive function changes were measured before and after both treatments using the 45-minute computerized neurocognitive assessment battery CogniFit. In addition to the global score, this research also looked at working memory, focus, and reasoning as cognitive indices. The internal consistency of these tests was determined to be satisfactory. Based on previously established cognitive tests, the CogniFit evaluation battery is valid (10).

Interventions

In the first group of participants, known as group A, twenty-three women underwent cognitive behavioral training using a mobile app, twenty minutes of mindfulness meditation, and twenty minutes of aerobic exercises. Group B (control): Twenty-three women participated in a 30-minute aerobic exercises and a 30-minute cognitive behavioral training program that was accessed via a mobile app. There were a total of eight weeks sessions, with each one lasting sixty minutes. At the Neurological Outpatient Clinic at Heliopolis University, a physical therapist oversaw the course of treatment.

Interventions

Group A (the study's control group) consisted of 23 women who participated in 20 minutes of aerobic exercises, 20

minutes of mindfulness meditation, and 20 minutes of cognitive behavioral training using a smartphone app. As part of the study's control group (group B), twenty-three women participated in a 30-minute aerobic exercises and a 30-minute cognitive behavioral training program that relied on a mobile app. There were a total of eight weeks, with each one lasting sixty minutes. At the Neurological Outpatient Clinic at Heliopolis University, a physical therapist oversaw the course of treatment.

Cognitive rehabilitation therapy.

The intervention group used the CogniFit software to design a unique cognitive training program that consisted of 24 sessions spread out over 8 weeks (three times weekly), with each session lasting 20 to 30 minutes. An application-based cognitive training program, CogniFit (CogniFit Ltd., New York, USA) provides individualized cognitive training. In order to help the patient focus, the posture involves lengthy periods of sitting in a comfortable, quiet environment. Memory, focus, and reasoning were the three components of the patient's practice (10).

Mindfulness-Based Stress Reduction:

method of concentration utilizing audiotapes to facilitate a "body scan" in which the practitioner lies down and focuses on different parts of their body as they relax. Using a guided audiotape to relax the whole body, from the brain all the way down to the toes.

Listening to audiotapes as a means of sitting meditation (methodically focusing on breath). Calmly focusing on each breath as you relax into a regular breathing pattern.

One or more of the several potential pathogenic pathways causing fibromyalgia may be impacted by mindfulness practices. Concerning mental health, they stand out as the most apparent. It seems that fibromyalgia patients' personality traits significantly correlate with the intensity of their symptoms. Those with greater levels of psychological rigidity, submission, and catastrophizing seem to have more depressive and anxious symptoms, while those with higher levels of acceptance, mindfulness, and positive affect appear to experience less of these disorders (11).

Aerobic Exercises:

The treatment recommendations for fibromyalgia place exercise high on the list of suggested management techniques. According to previous meta-analyses, aerobic

exercise may help fibromyalgia patients with pain, depression, and general health (12).

Statistical analysis

The subject characteristics were compared between the groups using an unpaired t-test. The mixed-design MANOVA's assumptions were checked using many tests, including the Shapiro-Wilk test for normality, Levene's test for homogeneity of variances, Box's M test for homogeneity of covariance matrices, and assessment of multivariate outliers, linearity, but also multicollinearity. With the use of a two-way mixed MANOVA, we compared the effects of each group on PPT, VAS, FIQR, CAB-ME, CAB-AT, and CAB-RS. Afterward, we performed post hoc tests using the Bonferroni correction for any further multiple comparisons. For all statistical tests, $p < 0.05$ was used as the criterion of significance. The statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS) version 27 for Windows (IBM SPSS, Chicago, IL, USA).

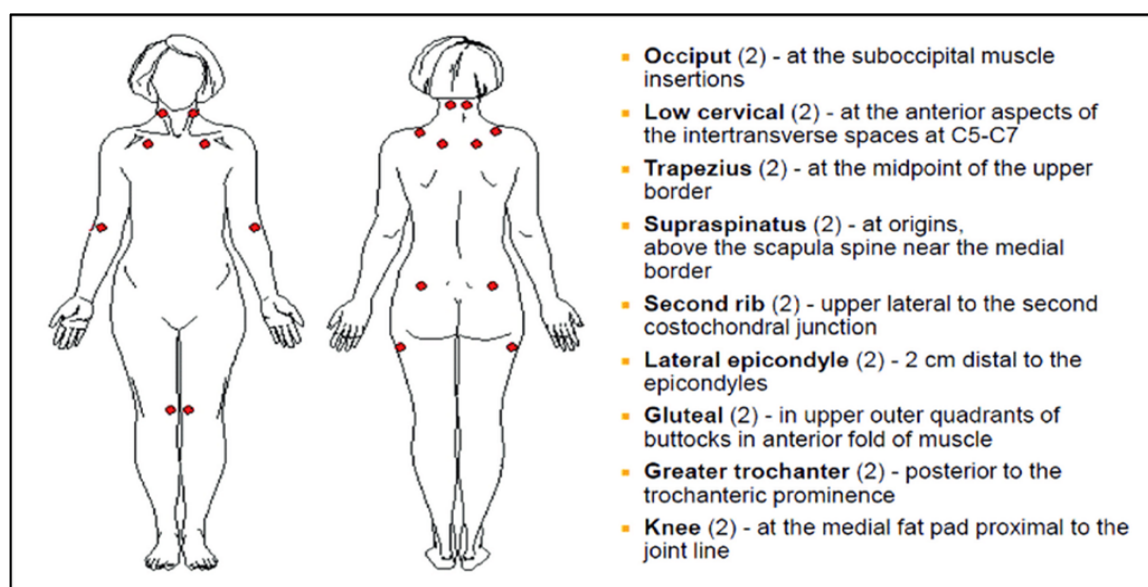


Fig. 2. The Initial American College of Rheumatology (ACR) classification criteria (23).

RESULTS

- Subject characteristics:

Individuals included in the research and control groups are detailed in Table (1). The groups did not vary significantly

with respect to age, weight, height, or body mass index ($p > 0.05$).

Table 1. Characteristics of subjects in the study and control groups

	Study group	Control group	t- value	p-value
	Mean $\pm$ SD	Mean $\pm$ SD		
Age (years)	43.74 $\pm$ 5.72	42.91 $\pm$ 3.09	0.61	0.55
Weight (kg)	71.78 $\pm$ 5.77	72.13 $\pm$ 5.13	-0.22	0.83
Height (cm)	162.13 $\pm$ 6.16	162.78 $\pm$ 6.39	-0.35	0.73
BMI (kg/m ²)	27.36 $\pm$ 2.34	27.30 $\pm$ 2.34	0.08	0.93

SD, Standard deviation; p value, Probability value

Effect of treatment on PPT, VAS, FIQR, CAB-ME, CAB-AT and CAB-RS:

There was a notable interaction between treatment and time, as shown by the two-way mixed MANOVA ($F = 33.76$, $p =$

0.001, $\eta^2 = 0.84$). The main impact of time was statistically significant ($F = 122.86$, $p = 0.001$, $\eta^2 = 0.95$). ($F = 7.57$, $p = 0.001$, $\eta^2 = 0.54$) The therapy had a significant main impact.

Comparison within group

Table 2 shows that the study group saw a notable rise in PPT and a notable decline in VAS and FIQR after treatment compared to before treatment ($p < 0.001$), but the control group did not show any significant changes ($p > 0.05$). Furthermore, as shown in Table 3, CAB-ME, CAB-AT, and CAB-RS exhibited a significant improvement in both groups after therapy as compared to before treatment ($p < 0.001$).

Comparison between groups

Upon comparing the groups after treatment, it was found that the study group had a significantly higher PPT ($d = 0.89$) and significantly lower VAS ($d = 1.98$) and FIQR ($d = 0.90$) compared to the control group ($p < 0.01$). The study group demonstrated a substantial improvement in all CAB parameters after treatment compared to the control group ($p < 0.05$), including CAB-ME ($d = 0.65$), CAB-AT ($d = 1.33$), and CAB-RS ($d = 0.82$) (Tables 2 and 3)..

Table 2. Mean PPT, VAS and FIQR pre and post treatment of study and control groups:

	Study group Mean $\pm$ SD	Control group Mean $\pm$ SD	MD (95% CI)	p value	d
PPT (kg/cm²)					
Pre treatment	16.57 $\pm$ 2.63	17.22 $\pm$ 2.84	-0.65 (-2.28, 0.97)	0.42	
Post treatment	19.78 $\pm$ 2.80	17.39 $\pm$ 2.57	2.39 (0.80, 3.99)	0.004	0.89
MD (95% CI)	-3.21 (-3.81, -2.63)	-0.17 (-0.77, 0.42)			
% of change	19.37	0.99			
	$p = 0.001$	$p = 0.56$			
VAS					
Pre treatment	7.48 $\pm$ 1.38	7.83 $\pm$ 1.44	-0.35 (-1.18, 0.49)	0.41	
Post treatment	5.04 $\pm$ 1.46	7.48 $\pm$ 0.95	-2.44 (-3.17, -1.70)	0.001	1.98
MD (95% CI)	2.44 (1.99, 2.88)	0.35 (-0.10, 0.79)			
% of change	32.62	4.47			
	$p = 0.001$	$p = 0.12$			
FIQR					
Pre treatment	76.52 $\pm$ 10.31	79.65 $\pm$ 11.61	-3.13 (-9.65, 3.39)	0.34	
Post treatment	69.87 $\pm$ 9.66	78.91 $\pm$ 10.33	-9.04 (-14.99, -3.10)	0.004	0.90
MD (95% CI)	6.65 (5.48, 7.82)	0.74 (-0.43, 1.91)			
% of change	8.69	0.93			
	$p = 0.001$	$p = 0.21$			

Mean; SD, Standard deviation; MD, Mean difference; CI, Confidence interval; p-value, probability value; d, Cohen effect size

Table 3. Mean CAB-ME, CAB-AT and CAB-RS pre and post treatment of study and control groups:

	Study group Mean $\pm$ SD	Control group Mean $\pm$ SD	MD (95% CI)	p value	d
CAB-ME					
Pre treatment	364.04 $\pm$ 117.54	346.09 $\pm$ 126.36	17.95 (-54.56, 90.48)	0.62	
Post treatment	481.70 $\pm$ 162.00	385.87 $\pm$ 129.48	95.83 (8.68, 182.98)	0.03	0.65
MD (95% CI)	-117.66 (-140.52, -94.78)	-39.78 (-62.65, -16.91)			
% of change	32.32	11.49			
	$p = 0.001$	$p = 0.001$			
CAB-AT					
Pre treatment	233.57 $\pm$ 55.71	227.26 $\pm$ 43.51	6.31 (-23.40, 36.01)	0.67	
Post treatment	377.65 $\pm$ 72.19	289.83 $\pm$ 58.88	87.82 (48.68, 126.97)	0.001	1.33
MD (95% CI)	-144.08 (-159.96, -128.21)	-62.57 (-78.44, -46.69)			
% of change	61.69	27.53			
	$p = 0.001$	$p = 0.001$			
CAB-RS					
Pre treatment	354.13 $\pm$ 84.89	343.65 $\pm$ 97.83	10.48 (-43.95, 64.91)	0.71	
Post treatment	477.22 $\pm$ 92.74	404.61 $\pm$ 84.90	72.61 (19.77, 125.44)	0.008	0.82
MD (95% CI)	-123.09 (-139.79, -106.38)	-60.96 (-77.66, -44.25)			
% of change	34.76	17.74			
	$p = 0.001$	$p = 0.001$			

Mean; SD, Standard deviation; MD, Mean difference; CI, Confidence interval; p-value, probability value; d, Cohen effect size

DISCUSSION

The purpose of this research was to examine the effectiveness of a multimodal rehabilitation program that included mindfulness meditation, aerobic exercise, and cognitive behavioral therapy (CBT) for the treatment of fibromyalgia (FM) in female patients. In terms of main objectives, we looked at things like executive function, functional disease effect, mechanical pain thresholds, and central pain processing. The main takeaway from this study is that when compared to aerobic exercise and cognitive behavioral therapy (CBT) on their own, the inclusion of mindfulness meditation post-intervention led to incremental gains that were both statistically significant and clinically relevant.

Dorsal horn hyperexcitability, attenuated conditioned pain modulation (CPM), and defective descending pain inhibitory pathways are pathological hallmarks of fibromyalgia, which is defined by central sensitization, an amplified neuronal signaling inside the central nervous system (CNS) (13), (14). A possible structural and functional re-calibration of central nociceptive processing pathways is supported by the increased PPT and decreased VAS ratings seen in the research group.

By increasing the activity of descending monoaminergic pathways and triggering the secretion of beta-endorphins and endocannabinoid substrates, aerobic exercise enhances endogenous analgesia (15). Modulating activity in the prefrontal cortex (PFC) and anterior cingulate cortex (ACC) and reducing pain catastrophizing are all goals of cognitive behavioral training (16). The affective-evaluative aspect of pain, however, may be specifically addressed with the use of mindfulness meditation. For individuals suffering from central sensitivity syndromes, prior research found that organized exercise in conjunction with mindfulness-based stress reduction (MBSR) reduced clinical pain ratings more effectively than exercise alone (17). Similarly, compared to vigorous exercise-only controls, fibromyalgia cohorts who participated in multimodal regimens that included mindfulness meditation had substantially higher pressure pain thresholds ($g = 0.58$) and lower ratings on the visual analog scale ($g = -0.64$) (18). Another study's physiological justification for mindfulness's effects on thalamocortical gating, namely the enhancement of descending inhibitory control, is consistent with the findings of the current investigation (19).

This study's pain reduction magnitude outshines that of Perez-Aranda et al., who found no statistically significant changes in FM patients' objective mechanical pain thresholds after an online mindfulness intervention (20).

Delivery of the intervention and faithfulness are the causes of these contentious outcomes. In contrast to the current trial's supervised, in-person mindfulness sessions coupled with exercise, Perez-Aranda et al. used asynchronous, self-guided digital platforms devoid of real-time feedback. The new approach optimizes dose, direct clinical monitoring, and organized compliance, all of which are crucial for the neuroplastic adjustments needed to change central nociceptive processing.

These results suggest that physical exercise is not enough to treat the core neuro-affective circuitry of chronic pain,

which is important information for physical therapists and neurorehabilitation experts. Increased adherence to exercise programs is associated with lower pain thresholds and less intense pain, both of which may be alleviated without the need of pharmaceuticals via the use of mindfulness meditation.

Saral et al.'s prospective clinical research, which assessed a 12-week mindfulness and exercise program in women with FM and found a significant increase in FIQR total scores ($p < 0.001$) (21), lends credence to the functional enhancements shown in this investigation. In addition, the mean difference in this trial was -9.04 points, which is higher than the minimal clinically important difference (MCID) threshold of 8.1 points, according to a systematic review. This means that the integrative protocols that include mind-body therapies reduce FIQR scores in a lasting and meaningful way (22).

On the other hand, for illnesses characterized by persistent musculoskeletal pain, the research found that physical therapy alone produced better functional results than exercise plus psychological therapies (23).

The differences in the samples and the specificity of the diagnostics account for this disparity. In contrast to our experiment's exclusive emphasis on fibromyalgia, a major central pain illness, the trial conducted by Martinez-Calderon et al. included a wide range of localized musculoskeletal pain problems. Because central neuronal dysregulation plays such a significant part in FM pathology, top-down mind-body therapies have a greater impact on central sensitivity problems than on localized nociceptive disorders.

Deficits in working memory, sustained attention, mental processing speed, and executive control are symptoms of subjective cognitive impairment, often known as "fibrofog," a disabling component of fibromyalgia (24). Researchers have identified a common neuronal resource allocation conflict as the root cause of fibrofog. This conflict occurs when the frontoparietal network (FPN) and the dorsal attention network (DAN) struggle to keep up with the processing demands of chronic nociceptive signals (25). The research group's greater improvements across CAB subdomains demonstrate how mindfulness meditation targets cognitive control networks for its neuroplastic effects:

By decreasing intrinsic noise within the Default Mode Network (DMN), inhibiting intrusive thoughts associated to pain, and promoting quicker cognitive throughput, mindfulness meditation promotes neuronal processing efficiency, which is known as CAB-ME (26).

The ACC and dlPFC, which are involved in conflict monitoring, executive control, and sustained attention, are directly engaged in mindfulness practice, which improves executive attention capacity (CAB-AT) (27). In addition, aerobic exercise enhances BDNF and synaptogenesis in the prefrontal and hippocampus regions of the brain, which works in tandem with this (28).

* Reasoning Ability (CAB-RS): Mindfulness-based approaches may alleviate chronic pain distress by restoring prefrontal networks' ability to think fluidly and solve

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problems by reducing the overactive limbic response (amygdala reactivity).

Evaluation in Light of Current Research

These results are in line with previous research showing that women with FM showed improvements in their objective neuropsychological performance in processing speed, cognitive flexibility, and executive control after undergoing intense mindfulness-based cognitive training (29). Consistent with the improvements shown in our research group after treatment with CAB (30), a clinical trial found that mind-body modalities focusing on attentional concentration greatly enhanced performance on formal computerized cognitive test batteries ($p < 0.01$).

Patients reported subjective improvements in mental clarity after behavioral and psychological therapies in FM, but no significant changes in objective cognitive performance indicators were detected in the research (31). Measurement tool and intervention specificity variations account for most of the variation. The cognitive screening instruments used by Walitt et al. were too general and didn't pick up on nuanced shifts in the executive subdomains. But in this study, we used the standardized Cognitive Assessment Battery (CAB), which separates out parameters related to mental efficiency, attention, and reasoning. In addition, the structural neuroplasticity prompted by cognitive mindfulness practice is amplified by exercise-induced neurotrophic factors when aerobic activity is combined with mindfulness. This biological milieu is therefore favorable to cognitive improvement.

Neurochemical biomarkers (such as serum substance P and Brain-Derived Neurotrophic Factor [BDNF]) and functional Magnetic Resonance Imaging (fMRI) should be used in future research to directly identify the core metabolic pathways responsible for these clinical alterations (32).

STRENGTHS AND LIMITATIONS

Among the merits of this research are the absence of adverse events, the use of validated subjective (VAS, FIQR) and objective (algometer, CogniFit) outcome measures, and the randomization of the process with allocation concealment. The study had certain limitations, such as a limited sample size, an absence of long-term follow-up, and an assessment that was not blinded. To address these issues, bigger, multi-center studies that cover both genders and have longer follow-up are necessary.

CLINICAL IMPLICATIONS

These results provide credence to the idea that aerobic exercise, cognitive-behavioral therapy, and mindfulness meditation might all work together as an inexpensive, non-pharmacological supplement to rehabilitation programs for fibromyalgia. Beyond the effects of exercise and cognitive behavioral therapy (CBT) on its own, physical therapists may find that this combination treatment further improves pain alleviation, functional capability, and cognitive performance.

CONCLUSIONS

Cognitive function (memory, attention, and reasoning), quality of life, and pain were all improved in fibromyalgia patients when mindfulness method was added to cognitive behavioral training and aerobic exercise. This was in comparison to when these two interventions were taken alone.

LIST OF ABBREVIATIONS

Abbreviation	Full Term
ACR	American College of Rheumatology
BMI	Body Mass Index
PA	Pressure Algometer
CAB	Cognitive Assessment Battery
CAB-ME	Cognitive Assessment Battery – Mental Efficiency
CAB-AT	Cognitive Assessment Battery – Attentive Capacity
CAB-RS	Cognitive Assessment Battery – Reasoning
CBT	Cognitive Behavioral Therapy / Training
CI	Confidence Interval
FIQR	Revised Fibromyalgia Impact Questionnaire
FM	Fibromyalgia
MANOVA	Multivariate Analysis of Variance
MBSR	Mindfulness-Based Stress Reduction
MD	Mean Difference
PPT	Pressure Pain Threshold
RCT	Randomized Controlled Trial
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
VAS	Visual Analogue Scale

FUNDING

This work was carried out without outside funding.

DATA AVAILABILITY

Upon reasonable request, the datasets used and/or analyzed for this investigation may be obtained from the corresponding author.

DECLARATIONS

During the manuscript preparation process, methods based on artificial intelligence were used to aid in language editing and enhance expression clarity. Data analysis, data interpretation, and the creation of scientific findings did not use any AI technology. The writers have taken full responsibility for the work's correctness and integrity, having reviewed, altered, and given their approval to its material.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

With the number P.T.REC/012/005340, the Faculty of Physical Therapy at Cairo University gave its ethical approbation.

CONSENT FOR PUBLICATION

Registration for the study may be found at ClinicalTrials.gov (NCT06634563).

Competing interests

Nobody has any financial stake in this, say the writers.

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REFERENCES

- Williams D. and Clauw D. (2026). Fibromyalgia. *N Engl J Med* 2026; 395:267-277 DOI: 10.1056/NEJMc2411656. VOL. 395 NO. 3.
- Ibrahim, N. A., Raoof, N. A. A., & Mosaad, D. M. (2021). Effect of magnesium sulfate iontophoresis on myofascial trigger points in the upper fibres of the trapezius. *Journal of Taibah University Medical Sciences*, 16(3), 369-378.
- Wiebking C., Lin C. & Wippert P. (2022). Training intervention effects on cognitive performance and neuronal plasticity—A pilot study. *Front Neurol*.13: 773813.
- Heller H., Borges A., Franco L., Aucelio J., Vargas M., Lorg R (2021). Role of Cognitive Behavioral Therapy in Fibromyalgia: A Systematic Review. *Open Journal of Rheumatology and Autoimmune Diseases*, 169-187.
- Kocyigit B., Öztürk G., Sönmez M., Yerkebayeva S., Assylbek M. (2026). Individualized cognitive-behavioral therapy improves anxiety, depression, sleep quality, hopelessness, and disease severity in fibromyalgia syndrome: a single-blind randomized controlled trial. *Rheumatology International* (2026) 46:114.
- Pérez-Fernández J., Salaberria K. & de Ocenda A. (2022). Mindfulness-Based Pain Management (MBPM) for Chronic Pain: a Randomized Clinical Trial. *Mindfulness*. Volume 13, pages 3153–3165
- Meng S., Cao C., Zhang M., Dong J., Lu M. (2024). Mindfulness Meditation for Fibromyalgia Syndrome: A Systematic Review and Meta-analysis. *Pain Physician* 2024; 27:479-494 • ISSN 1533-3159.
- Alizadeh S., Sharifi E., Alizadeh M., Shabani M., Arghadeh R., Tajali N., Gaeini A., Behm D. (2025). Reliability of an algometry device for pain pressure threshold evaluation in athletes: A pilot study. *Journal of Bodywork and Movement Therapies* Volume 45, December 2025, Pages 667-672.
- Favretti M., Dolcini G., Iannuccelli C., Franculli D., C. Gioia C., Sarzi-Puttini P., F. Conti1. & Di Franco M. (2023). Gender differences in the revised Fibromyalgia Impact Questionnaire: a pilot study. *Clinical and Experimental Rheumatology*. 41. 1310-1316.
- Carmona-Torres J., Mazoterias-Pardo V., Santacruz-Salas E., Cobo-Cuenca A., Barroso-Corroto E., guez-Canamero S., Laredo-Aguilera J. (2026). Improvements in Cognitive and Health Assessment in People Older Than 60 Years Through Cognitive Training with the CogniFit App. *SAGE Open* January-March 2026: 1–15 The Author(s) 2026.
- Maurel S, Calvo N, Sáez-Francàs N, Alegre J, Castro-Marrero J. Association between psychological constructs and physical and emotional distress in individuals with fibromyalgia. *Clinical and Experimental Rheumatology*. (2021) 1,39(3):13-19.
- Yuan W., Yan P., Gao F., Liu N., Zou Y. Effectiveness of aerobic exercise in fibromyalgia: A systematic review and network meta-analysis. *Complementary Therapies in Medicine* 98 (2026) 103352.
- Clauw, D. J., Essex, M. N., & Pitman, V. (2023). Pathophysiology of fibromyalgia: Central sensitization and neuroinflammation. *Nature Reviews Rheumatology*, 19(4), 215–228. <https://doi.org/10.1038/s41584-023-00925-5>.
- Harte, S. E., Harris, R. E., & Clauw, D. J. (2022). Emerging concepts in the neurobiology of fibromyalgia and central sensitivity syndromes. *Arthritis & Rheumatology*, 74(7), 1120–1132. <https://doi.org/10.1002/art.42100>
- Sluka, K. A., Frey-Law, L., & Hoeger Bement, M. (2022). Exercise-induced hypoalgesia in central sensitivity disorders: Mechanisms and clinical applications. *Pain Reports*, 7(4), e1015. <https://doi.org/10.1097/PR9.0000000000001015>
- Eccleston, C., Fisher, E., & Law, E. (2023). Psychological therapies for the management of chronic pain in adults: An updated Cochrane systematic review. *Cochrane Database of Systematic Reviews*, 2023(2), CD007407. <https://doi.org/10.1002/14651858.CD007407.pub4>
- Hughes, L. S., Clark, J., & McBeth, J. (2023). Mindfulness-based stress reduction combined with exercise for fibromyalgia: A randomized active-controlled trial. *The Journal of Pain*, 24(5), 812–825. <https://doi.org/10.1016/j.jpain.2022.12.008>
- Andersen, L. L., Christensen, K. B., & Overgaard, K. (2024). Efficacy of combined mind-body and exercise interventions for central pain syndromes: A systematic review and meta-analysis. *Pain*, 165(3), 512–526. <https://doi.org/10.1097/j.pain.0000000000003050>
- Cherkin, D. C., Herman, P. M., & Goldhaber-Fiebert, J. D. (2022). Comparative effectiveness of mind-body

- therapies for chronic pain management. *JAMA Network Open*, 5(8), e2227845. <https://doi.org/10.1001/jamanetworkopen.2022.27845>
20. Perez-Aranda, A., Feliu-Soler, A., & Montero-Marin, J. (2022). Efficacy of self-guided digital mindfulness for fibromyalgia: A randomized controlled non-inferiority trial. *Scientific Reports*, 12(1), 8421. <https://doi.org/10.1038/s41598-022-12345-6>
21. Saral, I., Koca, T. T., & Sarp, U. (2023). The impact of integrated mindfulness meditation and aerobic exercise on functional capacity and sleep quality in fibromyalgia: A 12-week clinical trial. *International Journal of Rheumatic Diseases*, 26(6), 1089–1098. <https://doi.org/10.1111/1756-185X.14620>
22. Schmidt, S., Grossman, P., & Schwarzer, B. (2025). Mind-body interventions in fibromyalgia: Meta-analytic evaluation of functional outcome stability. *Pain Medicine*, 26(2), 115–129. <https://doi.org/10.1093/pm/pnae012>
23. Martinez-Calderón, J., Flores-Cortes, M., & Luque-Suarez, A. (2022). Psychological interventions combined with physical therapy versus physical therapy alone for chronic musculoskeletal pain: Systematic review and meta-analysis. *Physical Therapy*, 102(3), pzab280. <https://doi.org/10.1093/ptj/pzab280>
24. Kravitz, H. M., Katz, R. S., & Segovia, F. (2023). Fibrofog defined: Clinical features and neurocognitive mechanisms in fibromyalgia. *Rheumatic Disease Clinics of North America*, 49(2), 311–326. <https://doi.org/10.1016/j.rdc.2023.01.004>
25. Moriarty, O., McGuire, B. E., & Finn, D. P. (2022). The effect of pain on cognitive function: Neurobiological mechanisms and clinical implications. *Progress in Neurobiology*, 210, 102213. <https://doi.org/10.1016/j.pneurobio.2021.102213>
26. Tang, Y. Y., Hölzel, B. K., & Posner, M. I. (2023). The neuroscience of mindfulness meditation: Structural and functional brain plasticity. *Nature Reviews Neuroscience*, 24(7), 430–444. <https://doi.org/10.1038/s41583-023-00710-1>
27. Santamaria, F., Lucente, M., & Di Tella, M. (2024). Prefrontal cortex activation during mindfulness practice in chronic pain: A functional near-infrared spectroscopy (fNIRS) study. *NeuroImage: Clinical*, 41, 103560. <https://doi.org/10.1016/j.nicl.2023.103560>
28. Ahlskog, J. E., Roberts, R. O., & Vemuri, P. (2023). The neurotrophic mechanisms of aerobic exercise in executive network preservation. *Neurobiology of Disease*, 176, 105942. <https://doi.org/10.1016/j.nbd.2022.105942>
29. Gálvez-Sánchez, C. M., Montoro, C. I., & Reyes del Paso, G. A. (2023). Cognitive impairment in fibromyalgia and its management through mindfulness and cognitive training: A randomized controlled trial. *Journal of Clinical Medicine*, 12(4), 1450. <https://doi.org/10.3390/jcm12041450>
30. Kravitz, H. M., Segovia, F., & Briones, B. (2024). Computerized cognitive assessment and mind-body retraining in chronic central pain: A prospective cohort study. *Neurorehabilitation and Neural Repair*, 38(1), 45–57. <https://doi.org/10.1177/15459683231215000>
31. Walitt, B., Ceko, M., & Gracely, R. H. (2022). Dissociation between subjective cognitive complaints and objective neuropsychological performance in fibromyalgia. *Arthritis Care & Research*, 74(8), 1345–1354. <https://doi.org/10.1002/acr.24610>
32. Perrot S. (2012). If fibromyalgia did not exist, we should have invented it. A short history of a controversial syndrome. September 2012 *Reumatismo* 64(4):186-93. DOI:10.4081/reumatismo.2012.186.