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Feldenkrais awareness though movement intervention for fibromyalgia syndrome: A proof-of-concept study

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ABSTRACT

Introduction: The Feldenkrais Method® is a form of awareness through movement (ATM) aimed at improving spatial and kinesthetic awareness through verbally guided movements, in order to learn more effective actions.
Method: The present study, a proof-of-concept, observational, non-controlled prospective study, aims at exploring the effectiveness of ATM for fibromyalgia syndrome (FM), measuring the effect by means of multi-dimensional questionnaires, administered at baseline and after 4 months of ATM activity.
Results: One hundred twenty-eight FM patients (mean age 54 years old, 2% males) participated in the study. A statistically significant improvement was found in FM-specific measures (Polysymptomatic Distress Scale, PDS) ($p = 0.003$) and the Pain Catastrophization Scale (PCS) ($p = 0.020$); coherently, the Revised Fibromyalgia Impact Questionnaire (FIQR) showed a trend in improvement after the intervention, although this improvement was not statistically significant. The logistic regression analysis found a correlation between PDS, fatigue and anxiety measures; PCS, years from diagnosis and anxiety.
Conclusion: ATM could improve FM-specific measures and pain-related catastrophizing. Further studies are needed to identify FM subgroups in order to find personalized targets that can be used to guide treatments.

1. Introduction

The Feldenkrais Method® is a form of awareness through movement (ATM) (Feldenkrais 1972) aimed at improving awareness in order to learn more effective actions. This is done through verbally guided exploration of slow and gentle movements, increasing awareness about spatial and kinesthetic relationships among body segments and the environment, that in turn allow the person to collect information and make perceptual discriminations (Zahid and Khan 2020). Fibromyalgia syndrome (FM) is a form of chronic widespread pain associated to a variety of ancillary symptoms, among which fatigue and sleep disturbances are preponderant (Clauw 2014), and lacks a gold-standard treatment. The latest European guidelines (Macfarlane et al., 2017) for FM treatment recommend a multidisciplinary management, in which moderate, progressive physical exercise should be first-line. Furthermore, increasingly more attention has lately been drawn on the effectiveness of mind-body interventions, such as mindfulness (Haugmark et al., 2019) and Tai Chi (Langhorst et al., 2013; Cheng et al., 2019), on FM. ATM application for chronic pain has been given promising results (Bearman and Shafarman 1999), although by means of low quality studies (Malmgren-Olsson et al., 2001; Öhman et al., 2011). A recent meta-analysis (Berland et al., 2022) found that the Feldenkrais Method could be compared to other physiotherapy techniques in patients with chronic spine pain, ameliorating pain, functional balance, disability, quality of life and interoceptive awareness.

However, studies regarding the treatment of FM through ATM are extremely scarce. A 2001 study (Kendall et al., 2001) compared twenty FM patients who started ATM intervention trice weekly for 15 weeks, with nineteen patients who started a group-based pain education program followed by hydrotherapy sessions. The ATM group had trends in improvements in balance and better lower extremity muscle function, which were not maintained after 6 months. Additionally, no change in pain and fatigue were shown.

The aim of this study was to explore the effectiveness of ATM for FM patients. The proof-of-concept design specifically amied to identify the domains in which an ATM-based intervention could be effective for FM patients. The effect was measured using multi-dimensional questionnaires. In addition, our study is also the first one to explore the feasibility

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of Internet-based ATM therapy for FM.

2. Methods

2.1. Study design and participants

This is a proof-of-concept, observational, non-controlled prospective study. Its aim is to determine the domains for which an ATM-based intervention may be effective for FM patients, and to assess the magnitude of such effect. This will help test the feasibility of future randomized controlled trials. In the actual COVID-19 pandemic context, ATM sessions were conducted on a virtual platform to avoid additional risk of contagion. Additionally, in this way, a higher number of patients were included and benefit from the intervention. The efficacy and feasibility of Internet-based interventions for FM and chronic pain has already been confirmed (Palermo et al., 2009; Williams et al., 2010; Bernardy et al., 2019), but mainly for psychological therapies or behavioural self-management programmes. The virtual platform-based FM intervention of our study may lack the benefits of a direct, face-to-face interaction; notwithstanding, the virtual platform and the small groups allowed a continuous interaction with the teacher.

The present study lasted a total of 6 months. Participants were recruited by the Italian Fibromyalgia Syndrome Association (AISFOdv), a non-profit patient organization, through social media advertising. Each participant was then personally contacted by the research team and eligibility for the study was determined. Inclusion criteria were: (i) adults aged 18 years and over, (ii) widespread pain index (WPI) ≥ 7 and symptom severity scale (SSS) score ≥ 5 OR WPI of 4–6 and SSS score ≥ 9 at baseline, respecting the 2010/2011 F M diagnostic criteria and its 2016 Revisions (Wolfe et al., 2016), (iii), able to understand and sign the informed consent and to attend the ATM sessions. Exclusion criteria were: (i) attended a complete ATM or other body awareness therapy courses in the last 3 months, (ii) unable to understand and sign the informed consent and to attend the ATM sessions.

Participants were asked to fill in WPI and SSS self-administered questionnaires at baseline, i.e., before the intervention. Participants who did not meet the required WPI and SSS inclusion criteria were able to follow the ATM programme, but their data were excluded by means of *ex post* data analysis. One hundred twenty-eight participants were selected. After signing the informed consent, they were divided into eleven groups of eleven/twelve patients each. Two Feldenkrais teachers were assigned to each group: one who guided the lessons, the other one who gave support as an observer. The Feldenkrais Teachers (n = 26) were part of the Italian Association of Feldenkrais Method Teachers and each one had at least 10 years' experience in the field.

Clinimetric tests and patient-reported outcome tests were administered at baseline and at the end of the intervention. Participants were entitled to withdraw from the intervention at any point, without affecting their future care or participation in the patients' association.

2.2. Description of the intervention

All patients attended an ATM course lasting 15 lessons, with a lesson every week, 1.5 h long (from January to May 2021). The sessions were entirely virtual platform-based and live. The lessons were created and proposed as a homogeneous path, being the same, as far as possible, for each group, but also respecting each group's differences. The lessons were organized into four thematic groups, each aimed at providing an experience of trust and pleasure in movement while gradually increasing in complexity. The sessions followed different functional themes or reference actions typical of ATM, starting from simple opening/closing movements and progressing towards rotary movements and the transmission of weight and pressure.

The progression of the lessons grouped by themes was as follows.

1. Introduction to mindful movement and the relationship with self-image. Three lessons focused on: Modulating tone through self-perception in space with simple contraction and release movements; Experimenting with body opening and closing movements and regulating the motor patterns of flexion and extension.
2. Spatial orientation: understanding and becoming comfortable with space. Four lessons focused on: Cardinal movements (forward-backward; up-down; right-left) from the hips and shoulders aiming to clarify the relationship of one's body with the external space; Developing cognitive ability for orientation.
3. Organizing movement. Four lessons focused on: Transmitting movement from the extremities (hands, feet) towards the trunk or from the centre towards the periphery in flexion and extension, rotation, and lateral inclination; Coordinating head-pelvis movements to guide rotations and twists along and around the spine.
4. Moving in relation to gravity: being heavy, being light. Four lessons focused on: Becoming aware of ground supports and their role in support, allowing effective anti-gravitational responses to emerge; Pushing from the feet and hands and transmitting force along the skeleton; Exploring lightness in sitting and standing, and moving in space.

2.3. Outcome measures

Since the study was a proof-of-concept, we tried to include all the domains that could be possibly affected by the ATM intervention as outcome measures. In addition, no direct measurement was performed due to the virtual nature of the treatment. A detailed description and references for each self-report measure is found in Appendix 1.

- Demographic data: Age, sex, weight, height, marital status, level of education, years from diagnosis;
- FM-specific measures: The Italian version of the Revised Fibromyalgia Impact Questionnaire (FIQR); the Fibromyalgia Assessment Status modified (FAS, 2019 mod); the Polysymptomatic Distress Scale (PDS);
- Scores evaluating FM typical clinical characteristics: visual analogue scale (VAS) for sleep; the Functional Assessment of Chronic Illness Therapy (FACIT)-Fatigue Scale; the Zung Self-Rating Depression Scale (ZSR-D); The Zung Self-Rating Anxiety Scale (ZSR-A); the Patient Health Questionnaire (PHQ);
- Measures evaluating quality of life: the 5-item World Health Organization Well-Being Index (WHO-5);
- Measures evaluating cognitive aspects of pain and illness: Rosenberg Self-Esteem Scale; General Self-Efficacy Scale (GSES); Postural awareness scale (PAS); Mindfulness Attention Awareness Scale (MAAS); Perceived Autoefficacy in Complex Problem Management Scale (SAP) - Italian version; the pain catastrophizing scale (PCS).

Participants were asked to fill in all questionnaires at baseline (before the course) and after 4 months (at the end of the course). All the questionnaires were sent by e-mail to the research team; therefore, all Feldenkrais teachers were blinded to participants' data and outcomes.

2.4. Data management and analysis

The principal investigator of the study and the research team ensured confidentiality of all participants. Sensitive data of the subjects recruited were processed by the Study Coordinators and their collaborators according to the EU Regulation 2016/679 (GDPR - General data Protection Regulation) and Legislative Decree June 30, 2003, n. 196 (Code regarding the protection of personal data). Subject data were managed by AISF according to the Privacy Policy terms signed upon becoming associates.

Continuous variables were presented as the mean and standard deviation or medians with 95% confidence interval (95% CI), depending

on the distribution of the data (tested with the Kolmogorov-Smirnov test). Due to the skewed nature of the outcome data, nonparametric tests, Wilcoxon test was performed in all of the pre- and post-test variables. The Wilcoxon test (for paired samples) ranks the absolute values of the differences between the paired observations in sample 1 and in sample 2 and calculates statistic on the number of negative and positive differences. Further, a multivariate regression analysis was performed to identify the factors most strongly associated with the FIQR, PDS, FAS 2019 mod, VAS sleep and PCS. All the data were entered into a Microsoft Excel data management database, and were analyzed using 64-bit MedCalc®, version 19.0.1.0 (MedCalc Software, Mariakerke, Belgium).

3. Results

One hundred twenty-eight FM patients were included in the study and final data analysis; their clinical and descriptive statistics at baseline are summarized in Table 1. Mean age was 54 years old (SD 9.39) mean body mass index (BMI) was 24.45 (SD 5.52) and 11.4 were the average years passed from diagnosis (SD 9.47); only three of all the participants (2%) were males. Medications/nutraceuticals/nutritional supplements used by participants are listed in Table 2.

Wilcoxon test was performed in all the pre- and post-test variables. Results and p-values are shown in Table 3. The variables which significantly ameliorated after the intervention were FM-specific measures (WPI, SSS and PDS) and the PCS. The FIQR showed a trend in improvement after the intervention, although this improvement was not statistically significant.

A logistic regression analysis was performed for all the variables which had a change (FIQR, PDS and PCS) (Tables 4–6).

4. Discussion

Our study found a positive effect of ATM, in the form of Feldenkrais Method, in patients affected by FM. Our goal was to primarily find the domains in which the ATM intervention would manifest its effect. Therefore, we administered a big battery of tests to the study population (see the Appendix), trying to cover disease severity (*via* disease-specific measures) and main domains of FM symptomatology (both for patients and physicians (Mease et al., 2009)); in addition, we wanted to test the hypothesis that ATM would have a beneficial effect also in some cognitive domains that were recently found to affect pain intensity and disease activity, such as mindfulness and catastrophizing (Dorado et al., 2018).

In our study, patients reported an amelioration of FM symptoms, as reported through the PDS. In addition, also the FIQR improved after the intervention, even if the probability did not reach statistical significance ($p = 0.08$). In recent studies, it has been highlighted that ATM could be beneficial for spine pain as a form of physiotherapy (Berland et al., 2022). A study investigating chronic neck and low back pain in employees working from home found a superiority of ATM with respect to conventional exercise programs, not only in reducing pain but also in improving the personal and social domains of participants (Sheikh et al., 2023). However, a literature review investigating possible postural approaches for chronic neck pain failed to find any study about Feldenkrais Method which respected their inclusion criteria (Kumar Alagingi 2022).

What remains to be established is the mechanism through which ATM benefits FM symptomatology. Recent real-life pharmacological studies have highlighted the beneficial effect of cyclobenzaprine and medical cannabis on FM symptoms (Tofferi et al., 2004; Moldofsky et al., 2011; Fitzcharles et al., 2019), both of which also have a prominent myorelaxant and anti-spastic effect (Lakhan and Rowland 2009). Accordingly, various studies found a positive effect of ATM on muscle relaxation and flexibility, mostly in samples made of healthy volunteers or people complaining of regional pain syndromes and muscle stiffness. Ruth & Kegerreis found an improvement in cervical flexion in thirty healthy subjects (Ruth and Kegerreis 1992); Lundblad et al. found an

Table 1
Means, medians and standard deviations (SD) of baseline data in the study population.

	Mean	Median	SD	25–75 P	Normal Distr.
Age	54.281	56.000	9.3950	50.000 to 60.000	<0,0001
Sex:		N/A	N/A	N/A	N/A
Female	125 (97.6)				
Male	3 (2.3)				
Marital status:		N/A	N/A	N/A	N/A
Married	75 (58.5)				
Single	18 (14.0)				
Widow	2 (1.5)				
Divorced	19 (14.8)				
Education Level:		N/A	N/A	N/A	N/A
Secondary school	17 (13.2)				
High school	70 (54.6)				
Degree	24 (18.7)				
Master's Degree	15 (11.7)				
BMI	24.459	23.629	5.5264	20.478 to 27.210	<0.0001
Years from diagnosis	11.410	10.000	9.4735	5.000 to 15.000	<0.0001
WPI	10.906	11.000	4.6133	7.000 to 15.000	0.0005
SSS	8.453	9.000	2.4905	7.000 to 10.000	<0.0001
PDS (WPI + SSS)	19.359	19.000	6.3217	15.000 to 25.000	0.0227
FACIT	28,680	31,000	11,5806	21,500 to 37,000	0,0017
FAS mod	25,906	27,000	7,9014	21,000 to 33,000	0,0003
FIQR	59,035	62,917	21,1919	42,583 to 74,833	0,0025
PAS	52,719	54,000	13,8086	44,000 to 62,000	0,3058
PCS	28,156	29,000	9,9205	21,000 to 35,000	0,3422
VAS Sleep	7.43	8	2,58	6.000 to 9.000	<0.0001
RSES	18,297	18,000	5,8260	15,500 to 22,000	<0,0001
SAP – DIM 1	17,266	17,000	4,1516	15,000 to 19,500	0,0460
SAP – DIM 2	19,414	18,000	4,5412	17,000 to 23,000	0,0030
SAP – DIM 3	19,992	19,000	4,4163	17,000 to 23,000	0,0279
SAP – DIM 4	21,508	21,000	3,9104	18,000 to 24,500	0,0031
PHQ	17,312	17,000	5,3223	14,500 to 21,500	0,0027
ZSR-A	46,555	46,000	9,8571	39,000 to 53,000	0,5952
ZSR-D	47,352	47,000	9,9886	41,000 to 53,000	0,0003
GSES	27,664	29,000	5,6125	25,000 to 30,000	<0,0001
MAAS	3982	4071	0,8595	3286 to 4679	0,0266
WHO5	34,688	34,000	19,0688	20,000 to 48,000	0,0106

WPI:Widespread PAin Index; SSS: Symptom Severity Scale; PDS: Polisymptomatic distress scale; Zung_A: Zung Self-Raiting Anxiety Scale; Zung_D: Zung Self-Raiting Depression Scale; VAS: Visual Analogue Scale; FACIT: Fatigue Scale; FIQR: revised Fibromyalgia Impact Questionnaire; FAS_Mod: Fibromyalgia

Assessment Status Modified; MAAS: Mindful Attention Awareness Scale; SAP: Perceived Autoefficacy in Complex Problem Management Scale; WHO 5: the 5-item World Health Organization Well-Being Index; GSES: General Self-Efficacy Scale; PAS: Postural Awareness Scale; RSES: Rosenberg Self Esteem Scale; PCS: Pain Catastrophizing Scale; PHQ: Patient Health Questionnaire.

Table 2
Medications and Nutraceuticals used by participants in the study at the enrolment. NSAIDs: non-steroidal anti-inflammatory drugs.

Medication/Nutraceutical	Number of patients
NSAIDs	43
Benzodiazepines	26
Duloxetine	15
Gabapentin	17
Myorelaxants	4
Medical Cannabis	18
Any drugs for hypertension	11
Biphosphonates	5
Palmitoyl-ethanolamine (PEA)	4
L-Acetyl-Carnitine	5
Nutritional Supplement	54
-of which: Vitamine D	20

Table 3
Probability tests obtained by Wilcoxon test, performed on all the variables, pre- and post-treatment. Variables which reached statistical significance are highlighted. WPI:Widespread PAin Index; SSS: Symptom Severity Scale; PDS: Polisymptomatic distress scale; Zung_A: Zung Self-Rating Anxiety Scale; Zung_D: Zung Self-Raiting Depression Scale; VAS: Visual Analogue Scale; FACIT: Fatigue Scale; FIQR: revised Fibromyalgia Impact Questionnaire; FAS_Mod: Fibromyalgia Assessment Status Modified; MAAS: Mindful Attention Awareness Scale; SAP: Perceived Autoefficacy in Complex Problem Management Scale; WHO 5: the 5-item World Health Organization Well-Being Index; GSES: General Self-Efficacy Scale; PAS: Postural Awareness Scale; RSES: Rosenberg Self Esteem Scale; PCS: Pain Catastrophizing Scale; PHQ: Patient Health Questionnaire.

Questionnaire	Median Pre-Post Test	Probability test	z-test
WPI	11.000–10.000	p = 0,006	**2,65**
SSS	9.000–9.000	p = 0,037	**2085**
PDS	19.000–19.000	p = 0,003	**2895**
ZSR-A	46.000–46.000	p = 0,140	1475
ZSR-D	47.000–47.000	p = 0,538	0614
VAS sleep	8.000–8.500	P = 0,6290	−0,483
FACIT	31.000–31.000	p = 0,205	−1266
FIQR	62.917–63.830	p = 0,081	−1,74
FASmod	27.000–27.000	p = 0,840	0201
MAAS	4.0714–4.429	p = 0,344	−0,946
SAP			
Dim 1 Emotional maturity:	17.000–17.000	p = 0,585	0546
Dim 2 Finalization of the action:	18.000–18.000	p = 0,423	0,8
Dim 3 Relational fluidity:	19.000–19.000	p = 0,297	1042
Dim 4 Context analysis:	21.000–21.000	p = 0,250	−1149
WHO 5	34.000–32.000	p = 0,083	1,73
GSES	29.000–28.000	p = 0,484	0699
PAS	54.000–54.500	p = 0,509	−0,66
RSES	18.000–18.000	p = 0,249	−1152
PCS	29.000–27.000	p = 0,020	**2313**
PHQ	17.000–17.000	p = 0,539	−0,614

*Dependent variable: FIQR (*revised Fibromyalgia Impact Questionnaire*).*

improvement in the range of motion of neck and shoulders (Lundblad et al., 1999) in a randomized controlled trial comparing traditional physiotherapy, ATM and no intervention. In a study by Stephens et al., (2006), hamstring muscle length was measured before and after a ATM intervention in thirty-three healthy subjects, and researchers found that the ATM group gained significantly more hamstring muscle length compared with the control group. However, studies are not always concordant. No effect on modified active knee extension was highlighted

Table 4
Logistic regression analysis.

Variable	Coefficient	Std. Error	Wald	P
AGE	0,066,171	0,044,590	2,2022	0,1378
BMI	−0,11,422	0,092,053	1,5396	0,2147
YEARS SINCE DIAGNOSIS	−0,14,406	0,067,362	4,5736	0,0325
FACIT	−0,11,583	0,042,264	7,5117	0,0061
PCS	0,010,202	0,058,388	0,03053	0,8613
WPI	−0,38,829	0,14,605	7,0683	0,0078
ZUNG DEPRESSION	−0,092,256	0,069,452	1,7645	0,1841
ZUNG ANXIETY	0,039,245	0,079,269	0,2451	0,6205
Constant	8,64,774	4,44,814	3,7796	0,0519

Dependent variable: PDS (Polisymptomatic Distress Scale).

Table 5
Logistic regression analysis.

Variable	Coefficient	Std. Error	Wald	P
AGE	0,037,220	0,030,082	1,5309	0,2160
YEARS SINCE DIAGNOSIS	0,0035,291	0,028,169	0,01570	0,9003
BMI	0,034,765	0,048,092	0,5226	0,4697
FACIT	−0,098,331	0,030,411	10,4551	0,0012
PCS	−0,012,200	0,035,143	0,1205	0,7285
ZUNG ANXIETY	−0,10,395	0,046,409	5,0173	0,0251
ZUNG DEPRESSION	0,083,804	0,054,079	2,4014	0,1212
Constant	1,02938	2,46,359	0,1746	0,6761

Dependent variable: PCS (Pain Catastrophization Scale).

Table 6
Logistic regression analysis.

Variable	Coefficient	Std. Error	Wald	P
AGE	0,0061,526	0,027,741	0,04919	0,8245
YEARS SINCE DIAGNOSIS	−0,058,833	0,024,315	5,8548	0,0155
BMI	−0,041,777	0,037,794	1,2218	0,2690
FACIT	−0,010,143	0,038,587	0,06910	0,7927
FIQR	−0,027,254	0,026,093	1,0909	0,2963
WPI	0,075,844	0,068,982	1,2088	0,2716
ZUNG DEPRESSION	0,040,668	0,041,892	0,9424	0,3316
ZUNG ANXIETY	−0,083,682	0,038,047	4,8375	0,0278
Constant	6,08634	2,40,485	6,4052	0,0114

after an ATM session in an Australian study (James et al., 1998), and a 1999 study (Hopper et al., 1999) concluded that ATM had an effect on sit and reach measurements but not on measures of hamstring length. These are mostly older findings. A more recent (2018) randomized-controlled trial investigated body relaxation and muscle tone in a more complete way by measuring the amount of pressure and contact surface of the body on the mat in a supine position in thirty volunteers after ATM session (Brummer et al., 2018). This measure significantly changed at the end of the study and was confirmed by subjective reports. Indeed, muscle tension and spasticity are FM important features. Altered neuromuscular control mechanisms have been highlighted by electromyographical studies in FM patients (Casale et al., 2009; Gerdle et al., 2010), and these are thought to prevent normal muscle activity causing local circulation disturbances, low neuromuscular efficiency and disturbed microcirculation, increasing fatigue and pain (Casale et al., 2019a). This may be mirrored by a highly abnormal intra-muscular pressure (Katz et al., 2021). Indeed, restless leg syndrome is a common parasomnia in the FM population, and it could be seen as a complex form of leg cramping (Viola-Saltzman et al., 2010). Therefore, ATM could be seen as a form of "neuromuscular rehabilitation" and "re-education" which may decrease muscular tone and reduce FM symptom burden.

In addition, we found a significant amelioration of the PCS. Recent insights in the investigation of pain from a bio-psycho-social model suggest that cognitive and emotional processes play a crucial role in all chronic pain and rheumatological conditions (Edwards et al., 2011).

Catastrophizing, defined as "an excessive negative mental attitude brought to bear during a real or expected painful experience", has been proposed as a behavior pattern of repetitive negative thought, acting as a stabilizing mechanism that helps to manage painful interior experiences. Pain catastrophizing has been identified as one of the most powerful psychological drivers of poor pain outcomes (Ellingson et al., 2018; Casale et al., 2019b; Ellingsen et al., 2021). Indeed, amelioration in catastrophizing mediates a positive outcome in multidisciplinary interventions for chronic pain (Scascighini et al., 2008), and this is line with our findings, even though we did not find any correlation between the PCS and PDS in our logistic regression analysis, but we did find it between the PCS and the FASMod. Improving awareness about one's one body and movements through ATM sessions may have helped FM patients to improve their cognitive attitude towards their pain condition, embracing a more positive, hence less catastrophizing attitude. This positive cognitive effect of ATM may also explain its ubiquitous efficacy, in a very diverse range of diseases and illnesses (Hillier and Worley 2015). This should be taken into account also for the construction of adequate health policies: our results emphasize the necessity of monitoring pain catastrophizing to identify high-risk individuals with FM in order to perform a treat-to-target intervention.

This study carries several significant strengths. Firstly, the study is one of the few that investigates the efficacy of the Feldenkrais Method in treating fibromyalgia, and the first to explore the feasibility of internet-based ATM therapy for FM. This is a novel approach that considers the limitations imposed by the COVID-19 pandemic and associated safety measures. By extension, this type of intervention could facilitate therapy continuation for patients who are unable to leave their homes due to various reasons. Secondly, the study employs a comprehensive battery of tests that cover not only disease severity but also main domains of FM symptomatology, as well as cognitive domains that have been found to affect pain intensity and disease activity. This is a notable strength as it allows for a more nuanced understanding of the effects of the intervention on the participants. It is also worth noting that our study had a good sample size with 128 FM patients included, and a good retention rate, with participants complying with filling out a battery of lengthy questionnaires at both baseline and post-intervention evaluations. Finally, the study found a positive effect of ATM on FM-specific measures and pain-related catastrophizing, which are major domains of FM symptomatology. This is a valuable finding that has important implications for the management of fibromyalgia. Exploring non-pharmacological treatments for this condition is important due to the unsatisfactory effects of drugs on this population. Moreover, non-pharmacological treatments such as body therapies can provide benefits to the cardiovascular, respiratory, and endocrine systems, all of which are important for the described age group. Therefore, finding effective non-pharmacological treatments for fibromyalgia could improve patients' quality of life and reduce the burden of the condition on healthcare systems.

Limitations include the short period between baseline and final evaluation, with no follow-up period to see the duration of the effect. The lack of a control group is also a limitation in this study, as we were unable to compare the effects of the ATM intervention with those of a different type of intervention or no intervention at all. This is important also in the light of the inclusion criterion that required participants to not have attended a complete ATM or other body awareness therapy courses in the last 3 months, since this period may not be enough to eliminate the residual effects of other previous practices. Additionally, we did not perform any objective evaluations on the population studied (such as muscular strength or balance) due to the online nature of the ATM session. In fact, the only other study investigating ATM intervention for FM patients (Kendall et al., 2001) found improvements in balance and muscular strength/coordination measured as stepping, but did not show any change in the cardinal FM symptoms of pain and fatigue. Another limitation is represented by the definition of ATM or body awareness. There is no consensus about which interventions may be considered ATM or body awareness therapies, and even what is the difference between the two. "Body awareness therapies" (BATs) is used interchangeably with ATM and "mind-body therapies" including both traditional oriental mind-body practices (such as Tai-Chi, Yoga) and more modern methodologies (Body-Oriented Psychotherapy, mindfulness-based therapies, Feldenkrais and Alexander Methods) (Mehling et al., 2011; Wu et al., 2023), complicating the possibility of a fair comparison among studies (Bravo et al., 2019). Indeed, a recent meta-analysis of randomized controlled trials which investigated the efficacy of basic body awareness therapy on functional outcomes (Vancampfort et al., 2023) in various diseases failed to find a beneficial effect, probably because the variety of diseases and types of BATs was too wide. Hence, for our study we decided to conform to the expression *awareness through movement* (ATM), which has been traditionally associated mostly with the Feldenkrais Method.

In conclusion, ATM could improve FM-specific measures and pain-related catastrophizing. Since the inability to cope with pain-related catastrophizing is the factor most significantly linked to improvement in FM-specific measures, effective non-pharmacological approaches on catastrophizing would also be desirable to be more integrated in the therapy of patients with FM. Further studies on pain phenotyping are needed to identify personalized targets that can be used to guide treatments.

5. Clinical Relevance

- The Feldenkrais Method® is a form of awareness through movement (ATM) that may be a promising non-pharmacological intervention for fibromyalgia (FM) patients.
- The Feldenkrais Method ATM could potentially improve FM-specific measures and pain-related catastrophizing.
- ATM may be a form of "neuromuscular rehabilitation" and "re-education" which may decrease muscular tone and reduce FM symptom burden.
- Improving awareness about one's one body and movements through ATM sessions may help FM patients improve their cognitive attitude towards their pain condition, embracing a more positive, hence less catastrophizing attitude.

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CRediT authorship contribution statement

Valeria Giorgi: Data curation, Methodology, Writing – original draft, Writing – review & editing, Investigation, Project administration. **Sonia Farah:** Data curation, Formal analysis, Software, Writing – original draft. **Fausto Salaffi:** Formal analysis, Supervision, Writing – review & editing. **Gabriella Butera:** Data curation, Funding acquisition, Methodology, Writing – original draft, Investigation, Project administration. **Piercarlo Sarzi-Puttini:** Conceptualization, Funding acquisition, Supervision, Validation, Writing – review & editing.

Declaration of competing interest

All the Authors declare that there are no financial or other relationships that could lead to a conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbmt.2023.08.001.

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