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RESEARCH PAPER

The discordance between subjectively and objectively measured physical function in women with fibromyalgia: association with catastrophizing and self-efficacy cognitions. The al-Ándalus project

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ABSTRACT

Purpose: People with fibromyalgia experience a disagreement between patient-reported (i.e., subjective) and performance-based (i.e., objective) status. This study aimed to (i) corroborate the discordance between subjectively and objectively measured physical function and (ii) examine whether catastrophizing (worrying, pain magnifying, and helpless cognitions) and self-efficacy (believing capable to manage pain) are independently associated with this discordance.

Methods: This population-based cross-sectional study included 405 women with fibromyalgia and 193 age-matched female controls. Participants completed the Pain Catastrophizing Scale, Chronic Pain Self-efficacy Scale, and physical functioning subscales of the Revised Fibromyalgia Impact Questionnaire and Short Form-36 (SF-36) health survey. Objective physical function was measured with the Senior Fitness Test battery. Subjective and objective physical functions were expressed as deviation from the general population in standard deviation (*SD*) units using means and *SD* of the control group.

Results: In fibromyalgia, subjective physical function was worse than objective physical function ($p < 0.001$). Higher catastrophizing was consistently associated with greater discordance between subjective and objective physical function, while self-efficacy was only significantly associated with this discordance when subjective physical function was assessed by means of the SF-36.

Conclusions: Subjective physical function is more impaired than objective physical function in fibromyalgia, yet both are markedly impaired. Catastrophizing cognitions are associated with this discordance. In particular, high catastrophizing may promote a feeling of reduced ability to do meaningful activities of daily living (i.e., restrictions) that people with fibromyalgia are actually able to. Therefore, catastrophizing should be assessed and potentially targeted when focusing on improving physical function in fibromyalgia.

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Chronic pain; disability; functional capacity; functional fitness; observed physical function; self-reported physical function

➤ IMPLICATIONS FOR REHABILITATION

- Rehabilitation should focus on physical exercise programs to help women with fibromyalgia to improve their reduced physical function.
- In rehabilitation settings, physical function of people with fibromyalgia should be evaluated by both subjective and objective assessments to fully understand physical functioning and to test the existence of discordance between both assessments.
- In case of a large discordance between subjective and objective physical function, a physical exercise program might be better complemented with cognitive management techniques to reduce catastrophizing and subjective physical dysfunction.
- When people with fibromyalgia experience high levels of catastrophizing, subjective assessments seem to be poor indicators of physical function.

Introduction

Fibromyalgia is a rheumatic and musculoskeletal disease characterized by chronic pain [1] and a vast number of non-pain symptoms [2] that are associated with substantial physical disability [3]. Fibromyalgia entails a huge burden to the patients and is a first-order public health problem leading to high health care utilization and socio-economic costs [4]. Therefore, it seems essential to identify modifiable factors that may

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improve the assessment and prognosis of people with fibromyalgia.

In rheumatic and musculoskeletal diseases, a disagreement between (subjective) patient-reported outcomes and (objective) clinical observations has been indicated [5–7]. This discordance suggests worse functioning according to subjective than objective assessments and is particularly high among women [6] and in fibromyalgia [7]. For instance, an early study indicated that fibromyalgia has more impact on the self-perceived ability to perform physical activity (e.g., how well patients report to be able to climb stairs) than on performance of the activity itself (e.g., how well patients were able to climb stairs according to clinicians' observations) [7]. This discordance suggests that, more than peripheral muscle aberrations, the experience of physical capacity (i.e., the subjective appraisal) is markedly deteriorated, which may be a consequence of central aberrations [8–11]. Later studies confirmed this finding of discordance between subjective and objective physical function [12,13]. These findings must be interpreted cautiously as the sample size of these studies was rather low; i.e., 13 [7], 25 [13], and 38 [12] participants.

Many studies have shown that an active lifestyle and increased physical fitness are markers of health in fibromyalgia [14–16]. Moreover, current recommendations suggest physical exercise as an effective early step for the management of fibromyalgia [17–19]. However, one of the main concerns about physical exercise therapy is patients' adherence [20], which is a key for long-term health improvements in fibromyalgia [21]. Those people with fibromyalgia who feel that they are unable to perform activities that they are actually able to, might experience a relevant discordance between subjective physical function and objective physical function and, therefore, they may prevent themselves from participating in a rehabilitation program based on physical exercise, continuing the training, or benefiting enough from the program.

Cognitions play an important role in the adaptation to chronic pain [22,23]. In particular, catastrophizing (i.e., the tendency to focus on and magnify pain experiences, and to feel helpless during pain episodes) and self-efficacy (i.e., the belief of being able to effectively manage chronic pain) are potential determinants of physical function in chronic pain conditions [24–26]. However, the association of these modifiable cognitions with the discordance between subjective and objective physical function has not been examined.

Therefore, the present study aimed (i) to corroborate the presence of discordance between subjective and objective physical function in a large sample of women with fibromyalgia and (ii) to examine whether catastrophizing and self-efficacy are independently associated with this discordance.

Participants and methods

Participants

Detailed description of the methods and sampling procedures followed in the al-Ándalus project are provided elsewhere [2]. Briefly, through the Andalusian Federation of Fibromyalgia, we contacted those local associations with the largest number of people with fibromyalgia in the eight provinces of Andalusia (Southern Spain). We asked participants with fibromyalgia to invite apparently non-fibromyalgia acquaintances with similar demographic characteristics to take part in the study as non-fibromyalgia participants (i.e., controls). Additional participants were recruited via e-mail, letter or telephone, and by mass-media advertisements (e.g., local newspaper and universities webpage). A total of 960 participants (646 people with fibromyalgia and 314 controls) were interested in participating in the present population-based cross-sectional study.

Only women were included in the present study. The inclusion criteria for people with fibromyalgia were (i) a certified diagnosis of fibromyalgia by a rheumatologist and (ii) current verification of fibromyalgia according to the 1990 American College of Rheumatology (ACR) criteria [1]. The inclusion criterion for controls was neither to have a medical diagnosis of fibromyalgia nor to fulfill the 1990 ACR criteria. Data from participants with acute or terminal illness, severe cognitive impairment, unfilled questionnaires, or an incomplete physical performance evaluation were excluded. Most of the participants with fibromyalgia were between 37 and 65 years old ($n = 608$, 94%). Thus, to achieve an age-matched control group, people younger than 37 and older than 65 years old were excluded. All participants provided written informed consent before taking part in the study. Assessments were performed by researchers that were fully trained. Although fibromyalgia status was not revealed to the assessors, we cannot defend that they were blinded, because most patients revealed their status immediately by words or behavior. The al-Ándalus project protocol was approved by the Ethics Committee of the *Hospital Virgen de las Nieves* (Granada, Spain); Registration number: 15/11/2013-N72. The ethical guidelines of the Declaration of Helsinki (modified in 2000) were followed.

Instruments

The mini-mental state examination (MMSE)

MMSE was used to assess cognitive performance [27,28]. The MMSE contains 30 items. Scores range from 0 to 30 with a lower score indicating more severely affected cognitive performance. Participants with severe cognitive impairment (i.e., a score of less than 10) were excluded. Psychometric properties of the MMSE are adequate [29].

A standard socio-demographic questionnaire

The questionnaire was filled out by participants. This questionnaire included the question "Have you ever been diagnosed with an acute or terminal illness?", which was an exclusion criterion.

Body fat (%)

Body fat (%) was measured with a bioelectrical impedance analyzer (InBody R20; Biospace, Seoul, South Korea). The measurements were made at least 2 h after the last lunch, with participants released from clothing and metal objects and having remained standing at least 5 min before the assessment. Following the manufacturer's recommendations, we asked them not to have a shower, not to practice intense physical exercise, and not to ingest large amounts of fluid in an hour before the measurement. The validity and reliability of this instrument are adequate [30,31].

The 1990 ACR criteria for fibromyalgia

The criteria were verified by means of a physical examination with a standard pressure algometer (FPK 20; Wagner Instruments, Greenwich, CT) at the 18 tender points [1,32]. Total tender points count (i.e., reported pain at a pressure of $\leq 4\,kg/cm^2$) was recorded for each participant. The validity and reliability of this examination are adequate [33,34].

Pain catastrophizing

Pain catastrophizing was assessed using the Pain Catastrophizing Scale (PCS) [35,36]. The PCS includes 13 items to assess how

frequently participants experienced cognitions of rumination (e.g., "I can't seem to keep it out of my mind"), magnification (e.g., "I keep thinking of other painful events"), and helplessness (e.g., "It's terrible and I think it's never going to get any better") on a 5-point Likert scale, from 0 (not at all) to 4 (all the time). The PCS total score ranges from 0 (no catastrophizing) to 52 (maximum catastrophizing). Psychometric properties of the PCS are adequate [37].

Pain self-efficacy

Pain self-efficacy was assessed using the pain management subscale (PSE) of the Chronic Pain Self-efficacy Scale (CPSS) [38,39]. The Spanish version of the PSE subscale includes five items to assess the participants' perceived ability to achieve specific outcomes during pain episodes (e.g., "How certain are you that you can decrease your pain quite a bit?") on an 11-point Likert scale, from 0 (very uncertain) to 10 (very certain). The PSE raw total score was transformed into a scale from 0 (no self-efficacy) to 100 (maximum self-efficacy) following the original authors' suggestion [38]. Psychometric properties of the CPSS are adequate [38,39].

Subjective physical function

This was assessed using a fibromyalgia-specific questionnaire, the Revised Fibromyalgia Impact Questionnaire (FIQR) [40,41], and a generic questionnaire, the Short Form 36 health survey (SF-36) [42,43]. Both instruments include a subscale to assess the difficulties or limitations that participants experience when they perform daily life activities, which involve large muscles of the upper and lower limbs. The function subscale of the FIQR (FIQR-PF) includes nine items. Participants rate their difficulty to perform specific activities over the last 7 days on a 11-point numeric rating scale (NRS), from 0 (no difficult) to 10 (very difficult). Raw total scores of the FIQR-PF were transformed into a scale from 0 (no impairment) to 30 (maximum impairment) [40]. Controls filled out the general population version (i.e., the SIQR-PF), which is identical to the FIQR-PF with reference to fibromyalgia being omitted [40]. Psychometric properties of the FIQR and SIQR are adequate [40,44].

The physical functioning subscale of the SF-36 (SF-36-PF) includes 10 items. Participants rate their current physical limitations on a 3-point NRS, from 1 (yes, limited a lot) to 3 (no, not limited at all). Raw total scores of the SF-36-PF were transformed into a scale from 0 (maximum impairment) to 100 (no impairment) [42]. Psychometric properties of the SF-36 are adequate [45,46].

Observed physical function

This was assessed using the Senior Fitness Test battery [47]. This performance-based test battery assesses the major underlying physical parameters associated with functional mobility: flexibility (the *chair sit-and-reach* and *back scratch* tests), muscular strength (the *30-s chair stand* and *30-s arm curl* tests), motor agility (*8-foot up-and-go test*), and cardio-respiratory fitness (*6-min walk test*). Psychometric properties of these tests are adequate [47–49].

The chair sit-and-reach test. From a sitting position at front of a chair and with one leg extended, the participant slowly bending forward and sliding the hands down the extended leg in an attempt to reach the tip of the toe (negative scores) or reach beyond it (positive scores). The distance (in centimeters) between the tip of the extended middle fingers and the tip of the toe was measured with a ruler. The test is performed twice for each leg (alternating between legs). The score of this test is the average of the best score (i.e., the highest value) for each leg. Higher scores indicate better performance.

The back scratch test. In a standing position with one hand reaching over the shoulder and one up the middle of the back, the participant attempts to reach the tips of the middle fingers (negative scores) or to overlap them (positive scores). The distance (in centimeters) between the tips of the extended middle fingers was measured with a ruler. The test is performed twice for each arm (alternating between arms). The score of this test is the average of the best distance (i.e., the highest value) for each arm. Higher scores indicate better performance.

The 30-s chair stand test. From a sitting position and with arms folded across chest, the participant stands up to a fully standing position. The test is performed once for 30 s. The score is the count of full stands. Higher scores indicate better performance.

The 30-s arm curl test. In a sitting position, the participant curls up a hand weight (2.3 kg). The test is performed once for 30 s with each arm. The score of this test is the average count of hand weight curls through the full range of motion. Higher scores indicate better performance.

The 8-foot up-and-go test. From a sitting position, the participant gets up, walks 8 ft (i.e., 2.44 m), turns, and returns to the seated position. This test is performed twice and the score is the shortest trial (in seconds) to return to a seated position. Lower scores indicate better performance.

The 6-min walk test. The participant walks for 6min along a 45.7 m rectangular course. The test is performed once. The score of this test is the walked distance (in meters). Higher scores indicate better performance.

Procedure

Assessments took place over three consecutive days. On day 1, the MMSE, socio-demographic data, body composition, and tender point examination were assessed. On day 2, the PCS, PSE, SF-36-PF, and FIQR-PF/SIQR-PF questionnaires took place. On day 3, the physical test battery was assessed.

Statistical analysis

Differences between participants with fibromyalgia and controls in continuous and categorical variable were tested by *t*-test and χ^2 test, respectively. The mean and *SD* of the SIQR-PF, SF-36-PF, and performance-based tests in the sex- and age-matched control group were calculated and used to compute standardized *z*-scores ([value-mean]/standard deviation [*SD*]) of these questionnaires and tests in each participant with fibromyalgia. Once these *z*-scores were computed for each performance-based test, four normalized *z*-scores were computed: (i) "a flexibility *z*-score" using the mean of the *chair sit-and-reach* and *back scratch* tests, (ii) a "muscular strength *z*-score" using the mean of *30-s chair stand* and *30-s arm curl* tests, (iii) a "motor agility *z*-score" using inversed score of *8-foot up-and-go test*, and (iv) "a cardio-respiratory fitness *z*-score" using *6-min walk test*. Finally, a composite overall *z*-score (i.e., objective physical function) was computed as the mean of the four physical fitness *z*-scores. This standardized *z*-score reflects the deviation from the control group in standard deviation units, similar to Cohen's *d* effect-size.

To identify potential confounders, Pearson's correlations within participants with fibromyalgia were computed between subjective physical function measures and age, marital status (married vs. unmarried), education level (unfinished/primary education vs. secondary/tertiary education), years since clinical diagnosis (≤ 5 years vs. > 5 years), years since first symptoms (≤ 5 years vs. > 5 years),

and body fat (%). As no statistically significant correlations were observed (all p's > 0.08.), these variables were not entered as covariates in the main analyses.

One-way within-subjects analyses of variance (ANOVA) were conducted to test differences between the three physical function z-scores; i.e., the FIQR-PF, SF-36-PF, and objective physical function. Bonferroni's corrections were used for multiple comparisons. The η^2 effect sizes are interpreted as follows: small, $0.01 \leq \eta^2 < 0.06$; medium, $0.06 \leq \eta^2 < 0.14$; and large $\eta^2 \geq 0.14$ [50].

To test independent associations of catastrophizing and self-efficacy with the discordance between subjective and objective physical function, first, partial correlations of catastrophizing and self-efficacy with subjective physical function (i.e., FIQR-PF and SF-36-PF) controlling for objective physical function were computed. Second, sequential regression models were performed by each subjective physical function measurement (i.e., FIQR-PF and SF-36-PF) as dependent variable and with independent variables entered in three steps. Step 1: objective physical function (z-score) to take away the variance of subjective physical function explained by objective physical function (i.e., overlap between both measurements). Step 2: catastrophizing. Step 3: self-efficacy. Catastrophizing was entered before self-efficacy because there is more evidence available on the association of catastrophizing with physical function than of self-efficacy with physical function.

Level of significance was set at $p < 0.05$. Analyses were performed with Statistical Package for Social Sciences (IBM SPSS Statistics for Mac, version 20.0; Armonk, NY).

Results

From 646 potential participants with fibromyalgia, 241 were excluded because of the following reasons: 21 were men, 39 were not previously diagnosed by a rheumatologist, 99 did not fulfill the 1990 ACR criteria, 2 reported to have an acute or terminal illness, 1 showed severe cognitive impairment, 38 were either younger than 37 or older than 65 years old, 19 did not fill out all main questionnaires of the present study (i.e., the PCS, PSE, FIQR-PF, and SF-36-PF), and 22 did not complete all functional fitness tests. From 314 potential controls participants, 121 were excluded because of the following reasons: 57 were men, 6 fulfilled the 1990 ACR criteria, 40 were either younger than 37 or older than 65 years old, 14 did not fill out all main questionnaires (i.e., the SIQR-PF and SF-36-PF), and 4 did not complete all functional fitness tests. Therefore, after applying inclusion and exclusion criteria, a total of 405 women with fibromyalgia and 193 age-matched female controls were included in the analyses of the present study. Sample of fibromyalgia participants was representative of the Andalusian (Southern Spain) population of women with fibromyalgia [2]. Table 1 represents the characteristics of the participants. Significant differences between groups emerged for

Table 1. Characteristics of participants in the study.

Characteristics	Fibromyalgia ($n = 405$)	Controls ($n = 193$)	p
Age (years old), mean (*SD*)	51.7 (6.8)	51.0 (6.8)	0.254
Marital status, *n (%)*			0.443
Married	312 (77.0)	138 (71.5)	
Single	28 (6.9)	20 (10.4)	
Separated/divorced	47 (11.6)	25 (13.0)	
Widow	18 (4.5)	9 (4.7)	
Missing data	0 (0.0)	1 (0.5)	
Education level, *n (%)*			0.002
Unfinished education	38 (9.4)	11 (5.7)	
Primary education	200 (49.4)	74 (38.3)	
Secondary (including vocational) education	113 (27.9)	63 (32.6)	
Tertiary education	54 (13.3)	45 (23.3)	
Years since clinical diagnosis, *n (%)*			
Less than 1 year	24 (5.9)		
Between 1 and 5 years	135 (33.3)		
More than 5 years	234 (57.8)		
Missing data	12 (2.9)		
Years since first symptoms to clinical diagnosis, *n (%)*			
Less than 1 year	36 (8.9)		
Between 1 and 5 years	172 (42.5)		
More than 5 years	185 (45.7)		
Missing data	12 (3.0)		
Body fat (%), mean (*SD*)	40.0 (7.6)	37.0 (7.2)	<0.001
Pain-related cognitions			
Pain catastrophizing (PCS) [0–52], mean (*SD*)	24.5 (12.7)		
Pain self-efficacy (CPSS-PSE) [0–100], mean (*SD*)	34.9 (22.6)		
Subjective physical function			
FIQR-PF [0–30], mean (*SD*)	17.0 (6.4)	2.3 (3.9)	<0.001
SF-36-PF [0–100], mean (*SD*)	40.0 (18.5)	79.9 (20.6)	<0.001
Objective physical function			
Chair sit-and-reach test (cm), mean (*SD*)	−10.9 (11.8)	2.7 (10.7)	<0.001
Back scratch test (cm), mean (*SD*)	−13.8 (12.2)	−5.0 (8.7)	<0.001
30-s chair stand test (rep), mean (*SD*)	10.5 (3.1)	14.9 (3.1)	<0.001
30-s arm curl test (rep), mean (*SD*)	14.4 (4.9)	22.2 (4.4)	<0.001
8-foot up-and-go test[a] (s), mean (*SD*)	6.8 (1.7)	5.5 (0.9)	<0.001
6-min walk test (m), mean (*SD*)	489.2 (77.1)	569.5 (66.2)	<0.001

p Values based on t-test (continuous data) or χ^2 test (categorical data). *SD*: standard deviation; PCS: Pain Catastrophizing Scale; CPSS-PSE: Pain management subscale of the Chronic Pain Self-efficacy Scale; FIQR-PF: Function subscale of the Revised Fibromyalgia Impact Questionnaire (for fibromyalgia participants) or the SIQR-PF (for controls participants); SF-36-PF: Physical Function subscale of the Short Form 36 health survey.
[a]Lower scores indicate better performance.

education level, body fat (%), subjective physical function, and objective physical function (all p's ≤ 0.002)

Figure 1 shows the standardized deviation scores from the general population for the three physical function scores. Greenhouse-Geisser's corrected tests were considered ($\varepsilon = 0.85$), because the assumption of sphericity had been violated; Mauchly's test: $\chi^2(2) = 75.62$, $p < 0.001$). One-way ANOVA showed differences between the physical function scores: $F(1.71, 689.96) = 654.57$, $p < 0.001$, partial $\eta^2 = 0.62$. The effect size is large. The mean (*SD*) deviation of people with fibromyalgia from the control group in *SD* units were −3.74 (1.62), −1.93 (0.90), and −1.34 (1.03) at the FIQR-PF, SF-36-PF, and the objective physical function, respectively. All the pairwise comparisons between physical function measurements were significantly different (all p's < 0.001).

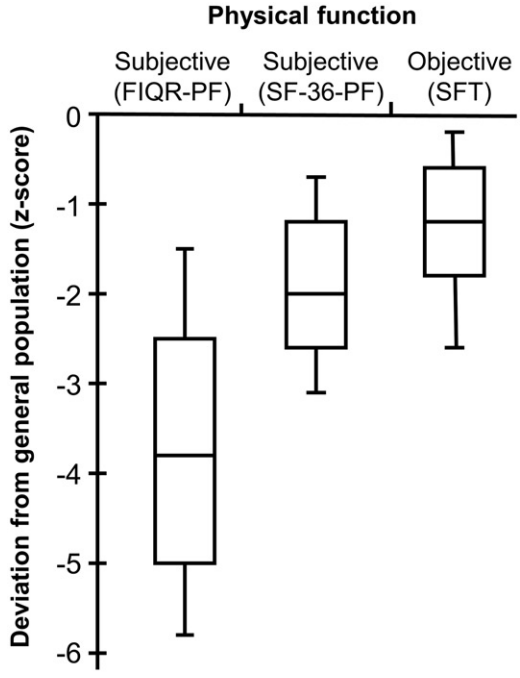

Figure 1. Physical function of women with fibromyalgia, $n = 405$. Values are expressed in standard deviation units as deviation from age-matched females (control group). Each box represents the 25th to 75th percentile with the median in the middle. Bars outside the boxes represent the 10th to 90th percentile. FIQR-PF: Function subscale of the Revised Fibromyalgia Impact Questionnaire; SF-36-PF: Physical Function subscale of the 36-item Short Form health survey; SFT: Senior Fitness Test battery. All the pairwise comparisons between physical function measurements were significantly different (all p's < 0.001).

Partial correlations of catastrophizing and self-efficacy with subjective physical function (i.e., FIQR-PF and SF-36-PF) adjusted for objective physical functions were all significant (all p's < 0.02). Table 2 shows the results of regression analyses. In step 1, subjective and objective physical function measurements were strongly associated. In steps 2 and 3, lower catastrophizing and higher self-efficacy were independently associated with less discordance between objective physical function and subjective physical function assessed by means of the SF-36-PF ($t = -3.16$, $p = 0.002$; $t = 2.03$, $p = 0.043$, respectively). Lower catastrophizing ($t = 4.18$, $p < 0.001$), but not self-efficacy ($t = -1.26$, $p = 0.209$), was independently associated with less discordance between objective and subjective physical function assessed by means of the FIQR-PF.

Discussion

The present study shows that subjective physical function was more impaired than objective physical function in women with fibromyalgia, yet both were markedly impaired. Interestingly, higher catastrophizing was consistently and independently, while lower self-efficacy was inconsistently and independently, associated with higher discordance between subjective and objective physical function among women with fibromyalgia.

Our findings clearly suggest that subjective physical function of people with fibromyalgia is more impaired than objective physical function, which is in line with previous findings in small samples [7,12,13]. The experience of impaired performance might be part of the core pathology of fibromyalgia. The dominant view about the pathology of fibromyalgia posits that central aberrations, a process of hypersensitivity of neural nociceptive pathways, are crucial to understand the onset and persistence of chronic pain and other fibromyalgia symptoms [8–11]. Structures and processes in the brain involving among others the anterior cingulate cortex and amygdala may play a key role in having an unpleasant experience [51], while the insular cortex could play a key role in interoception i.e., sensitivity to stimuli originating from inside the body [52]. Functional magnetic resonance imaging indicated that these

Table 2. Regression weights and significance of the independent association of objective physical function, pain catastrophizing, and pain self-efficacy with subjective physical function as measured with the FIQR-PF and the SF-36-PF ($n = 405$).

	Discordance between subjective (FIQR-PF) and objective physical function				Discordance between subjective (SF-36-PF) and objective physical function			
Dependent variable	*B*	*(SE)*	*β*	Adj. R^2	*B*	*(SE)*	*β*	Adj. R^2
Step 1				0.106***				0.126***
Objective physical function	−2.03	0.29	−0.33***		6.45	0.84	0.36***	
Step 2				0.141***				0.145**
Objective physical function	−1.64	0.30	−0.27***		5.60	0.87	0.31***	
Pain catastrophizing (PCS)	0.10	0.02	0.20***		−0.22	0.07	−0.15**	
Step 3				0.142				0.152*
Objective physical function	−1.55	0.31	−0.25***		5.15	0.89	0.29***	
Pain catastrophizing (PCS)	0.09	0.03	0.18***		−0.18	0.07	−0.12*	
Pain self-efficacy (CPSS-PSE)	−0.02	0.01	−0.06		0.08	0.04	0.10*	

B: Unstandardized Regression Coefficient; *β*: Standardized Regression Coefficient with significance levels of *t*; *SE*: standard error; Adj. R^2: adjusted R^2 with significance levels of *F*-change; PCS: Pain Catastrophizing Scale; CPSS-PSE: Pain management subscale of the Chronic Pain Self-efficacy Scale; FIQR-PF: Function subscale of the Revised Fibromyalgia Impact Questionnaire; SF-36-PF: Physical Function subscale of the Short Form 36 health survey.
*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

neural structures are involved in augmented pain processing in fibromyalgia [53].

The model could be as follows. In fibromyalgia, the chronically sensitized brain gives alarm signals including a constellation of nonspecific symptoms such as pain, fatigue, and a motivational state to reduce physical activity [54–56]. This neural perturbation may be experienced as deteriorated physical function [57] and a sense of feeling physically week to face activities of daily living [2]. Our findings indicate that the subjective physical function is more impaired than the objective physical function, which is consistent with the notion that a neural process is disturbed in fibromyalgia [8,10,11]. However, a key role for a sensitized brain does not discard the possibility that peripheral impairments trigger these neural processes [58]. Moreover, it is important to keep in mind that both subjective and objective measurements of physical function are markedly impaired, which has been widely recognized [49,57,59].

Research focusing on factors associated with the discordance between how people with fibromyalgia feel about their abilities and how they actually perform is of major interest [60]. Previous studies showed that psychological factors are able to influence the sensitized brain [61] and that an individual can learn to reduce and enhance activation of sensitized brain areas [62]. This suggests that cognitive-emotional factors are able to control neural processes underlying the feeling of being physically impaired.

In the present study, the association of catastrophizing with the discordance between physical function measures was higher when subjective physical function was assessed with the FIQR-PF (i.e., a disease-specific instrument) than with the SF-36-PF (i.e., a generic instrument). Our findings, therefore, support that FIQR-PF captures better inherent impairments of fibromyalgia than the SF-36-PF. The combination of disease-specific and generic instruments is recommended in clinical settings [63]. In addition, the association of catastrophizing with the discordance was consistent across subjective assessments (i.e., the FIQR-PF and SF-36-PF), while the association of self-efficacy was inconsistent (i.e., only significant when subjective physical function was assessed by the SF-36-PF). If it is assumed that cognitions influence the discordance, our data might reflect that unhelpful cognitions (i.e., catastrophizing) have more impact on the discordance than helpful cognitions (i.e., self-efficacy); particularly, when subjective physical function is assessed with disease-specific questionnaires. However, it must to be noted that our cross-sectional design does not allow causal inferences and therefore longitudinal research is warranted.

Regarding potential clinical applications of the present study, we believe that according to the hypothesis of a sensitized brain, the challenge is to find a treatment able to sooth its hyperreactivity. Research supports the notion that aerobic exercise or increased cardiorespiratory fitness diminishes activations of the areas involved in pain sensitization [64–66]. The current recommendations for the management of fibromyalgia consist of a stepped approach beginning with graded physical exercise therapy that can be combined with cognitive-behavior therapy depending on patients' characteristics [17]. Adherence to the program is considered as a challenge in fibromyalgia [21,67]. Our results suggest that people with fibromyalgia with high levels of catastrophizing feel that they are unable to perform exercises that they are actually able to perform. This may prevent them from initiating and continuing physical rehabilitation programs.

Our data tentatively suggests that a physical program *per se* may be effective to those people with fibromyalgia that experience neither a relevant discordance between subjective and objective physical function nor high levels of catastrophizing. However, when such discordance is relevant or catastrophizing is high, it may be better to complement the physical exercise program with cognitive management techniques that help to identify and modify cognitive distortions that fuel the negative spiral between increased symptoms and behavioral avoidance [68–71]. A topic for further investigation is whether outcomes of physical exercise interventions is poorer in people with a larger discordance between subjective and objective physical function than among those with a smaller discordance.

Some limitations of the present study must be considered. First, the study had a cross-sectional design, which prevents causal interpretations of the associations of catastrophizing and self-efficacy with objective and subjective physical function. Second, it might be expected that physical function in our sample consisting of volunteer participants was relatively high compared to the general fibromyalgia population; people who participated were confident that they could do the required tasks assessing physical function. Third, men were not included. In addition, this study did neither include other rheumatic and musculoskeletal diseases comparable to fibromyalgia (e.g., rheumatoid arthritis) nor other sensitivity syndromes (e.g., chronic fatigue syndrome or irritable bowel syndrome). While the discordance between subjective and objective physical function measurements is particularly high among women [6] and in fibromyalgia [7], our design precludes generalizing conclusions beyond women with fibromyalgia. The main strength of the present study was its large sample size and the broad assessment of physical function using questionnaires as well as a complete performance-based test battery.

In conclusion, the present study corroborated that subjective physical function is more impaired than objective physical function in fibromyalgia. Catastrophizing is consistently and independently associated with this discordance between subjective and objective physical function. Our main claims are related to the clinical applications of our results when designing physical therapies. These results indicate that in rehabilitation settings, the physical function of people with fibromyalgia should be evaluated by both subjective and objective assessments, which is in line with previous literature [72]. When there is discordance between these measurements, then unhelpful cognitions are a potential additional target of physical exercise interventions.

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Disclosure statement

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