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Independent and combined association of overall physical fitness and subjective well-being with fibromyalgia severity: the al-Ándalus project

Fernando Estévez-López · Cindy M. Gray · Víctor Segura-Jiménez · Alberto Soriano-Maldonado · Inmaculada C. Álvarez-Gallardo · Manuel J. Arrayás-Grajera · Ana Carbonell-Baeza · Virginia A. Aparicio · Manuel Delgado-Fernández · Manuel Pulido-Martos

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Abstract
Purpose The present study aimed: (1) to test the associations of overall physical fitness and subjective well-being with fibromyalgia severity and (2) to determine whether the combination of overall physical fitness and subjective well-being is associated with fibromyalgia severity among adult women patients.
Methods This cross-sectional study included 424 participants from Andalusia, southern Spain. Overall physical fitness and the components of subjective well-being (positive affect, negative affect and cognitive well-being), and fibromyalgia severity were assessed using the Functional Senior Physical Fitness Test Battery, the Positive and Negative Affect Schedule, the Satisfaction With Life Scale, and the Fibromyalgia Impact Questionnaire, respectively.
Results Overall physical fitness ($\beta = -.23$), positive affect ($\beta = -.18$), negative affect ($\beta = .26$), and cognitive well-being ($\beta = -.18$) were all associated with fibromyalgia severity. The patients with the highest overall physical fitness and increased subjective well-being reported $\sim$15 % lower fibromyalgia severity than those with the lowest fitness and poorest subjective well-being (Cohen's $d > 1.0$).
Conclusion Our results suggest that higher levels of overall physical fitness and subjective well-being are independently associated with lower fibromyalgia severity. Moreover, patients with higher overall physical fitness and increased subjective well-being (high positive affect, low negative affect, or high cognitive well-being) reported lower fibromyalgia severity than those with low levels of overall physical fitness and subjective well-being.

Keywords Chronic pain · Functional capacity · Physical fitness · Psychology · Quality of life · Resilience (psychological)

F. Estévez-López (✉) · V. Segura-Jiménez · A. Soriano-Maldonado · I. C. Álvarez-Gallardo · M. Delgado-Fernández
Department of Physical Education and Sport, Faculty of Sport Sciences, University of Granada, Carretera de Alfacar, s/n, 18011 Granada, Spain
e-mail: festevez@ugr.es

F. Estévez-López · C. M. Gray
Institute of Health and Wellbeing, University of Glasgow, Glasgow, UK

M. J. Arrayás-Grajera
Department of Physical Education, Music, and Fine Arts, Faculty of Education, University of Huelva, Huelva, Spain

A. Carbonell-Baeza
Department of Physical Education, Faculty of Education Sciences, University of Cádiz, Cádiz, Spain

V. A. Aparicio
Department of Physiology, Faculty of Pharmacy, Faculty of Sport Sciences, Sport and Health Institute, and Institute of Nutrition and Food Technology, University of Granada, Granada, Spain

M. Pulido-Martos
Department of Psychology, School of Humanities and Sciences of Education, University of Jaén, Jaén, Spain

Introduction

Fibromyalgia is a common health condition of unknown etiology characterized by a history of chronic widespread musculoskeletal pain and tenderness which persists for at least 3 months [1]. In fibromyalgia, pain may be produced by both central and peripheral mechanisms. For example,

central abnormalities of the central endocrine system and brain have been observed in fibromyalgia [2], as have metabolic abnormalities in peripheral muscular tissues [3]. Recent research also suggests that disturbed thermoregulation may lead to central sensitization among fibromyalgia patients [4]. In addition to pain and tenderness, people with fibromyalgia often report cognitive difficulties, fatigue, musculoskeletal stiffness, and poor sleep quality [5]. A number of studies have shown that poor physical fitness [6–10] and decreased subjective well-being [11] are associated with fibromyalgia severity.

When people experience chronic pain, they often avoid physical effort so as not to exacerbate their symptoms [12], leading to decreased physical fitness [13]. Physical activity is recommended to help patients cope with fibromyalgia [14] and active pain management is associated with better adjustment to the condition [15]. Although there is some debate [16], a number of previous studies have demonstrated associations between the individual components of physical fitness and fibromyalgia severity [6–10]. However, as physical activity recommendations for people with fibromyalgia focus on increasing physical fitness holistically [17], it is important to improve understanding of the associations of overall physical fitness and fibromyalgia severity.

Although treatments for fibromyalgia that include physical activity have been shown to have beneficial short [18] and long-term effects [19], patient outcomes remain highly variable [20]. De Ridder et al. [21] have demonstrated that a number of psychological variables (including subjective well-being) are involved in adaptation to chronic pain. Thus, psychological techniques are also commonly used in interventions for people with fibromyalgia. Sturgeon and Zautra [22] suggest that psychological vulnerability and resilience are also involved in adaptation to chronic pain. While traditional research has mainly focused on psychological vulnerability (e.g., anxiety, depression, or pain catastrophizing), a growing body of evidence suggests that resilience to chronic pain may have important health benefits for people with fibromyalgia [22]. Resilience is a construct that describes the psychological factors, including subjective well-being, that allow people to maintain positive functioning in the face of significant physical or psychological challenges [23]. Subjective well-being plays an adaptive role in helping people cope with adverse situations. It is widely recognized that people with high levels of subjective well-being (both patient and non-patient groups) have better perceptions of their global health [24, 25].

Improved understanding of the physical and psychological factors that moderate fibromyalgia severity is important to help clinicians to develop more effective and individualized treatments for people with fibromyalgia. The main aims of the present study were therefore: (1) to test the associations of overall physical fitness and subjective well-being with fibromyalgia severity and (2) to determine whether a combination of overall physical fitness and subjective well-being is associated with fibromyalgia severity among adult women patients.

Materials and methods

Participants

The sampling procedure to recruit a representative sample of women with fibromyalgia from southern Spain is described elsewhere [26]. All interested participants ($n = 616$) gave written informed consent before taking part in the study. In the current cross-sectional study, assessments were carried out between November 2011 and January 2013. Inclusion criteria for the current study were: (1) to be an adult woman (aged 18 to 65 years old), i.e., men and older adult women were excluded; (2) a medical diagnosis of fibromyalgia from a rheumatologist (participants were requested to provide their medical records to confirm their diagnosis); (3) meeting the 1990 American College of Rheumatology (ACR) fibromyalgia criteria [1]; (4) the absence of acute or terminal illness (such as cancer, stroke, recent cardiopathy, severe coronary disease, schizophrenia, or any other disabling injury). People with severe cognitive impairment, as defined by a score of less than ten on the mini-mental state examination (MMSE) [27, 28], and participants who did not complete all physical assessments and questionnaires were excluded. Assessments were performed by researchers fully trained to standard measurement and assessment protocols to reduce inter-examiner error. The project was reviewed and approved by the Ethics Committee of the *Hospital Virgen de las Nieves* (Granada, Spain). The ethical guidelines of the Declaration of Helsinki (modified in 2000) were followed.

Measures

Cognitive impairment was assessed using the MMSE [27, 28] which is a structured scale that consists of 30 items grouped into seven categories: orientation to place, orientation to time, registration, attention and concentration, recall, language, and visual construction. MMSE scores range from 0 to 30, with lower scores reflecting greater cognitive impairment.

Anthropometric measurements were assessed using a portable eight-polar tactile-electrode impedanciometer (InBody R20; Biospace, Seoul, Korea) to measure weight (kg). Height (cm) was measured using a stadiometer (Seca 22, Hamburg, Germany). Body mass index (BMI) was

calculated as weight (in kg) divided by height (in m) squared.

Physical fitness was assessed using the Functional Senior Physical Fitness Test Battery [29] which has been shown to be feasible and reliable for use in women with fibromyalgia [30]. We also measured handgrip strength, which is commonly used in fibromyalgia patients [6, 7]. Detailed descriptions of the procedures are available elsewhere [30]. Briefly, lower body muscular strength was assessed using the '30-s chair stand test'. Upper body muscular strength was assessed using the 'arm curl test' and the 'handgrip strength test.' Lower and upper body flexibility was measured using the 'chair sit- and- reach test' and the 'back scratch test,' respectively. Motor agility/dynamic balance was measured using the '8-foot up- and- go test' (where higher scores represent poorer performance). Cardio-respiratory fitness was assessed with the '6-min walk test'.

Subjective well-being was assessed using the Spanish versions of the Positive and Negative Affect Schedule (PANAS) [31] and the Satisfaction With Life Scale (SWLS) [32]. The PANAS assesses affective well-being using two subscales (positive and negative affect) with scores ranging from 10 to 50, where higher scores reflect greater positive or negative affect. SWLS scores range from 5 to 25, with higher scores reflect greater cognitive well-being. Participants were asked to use an 'in general' time frame for both instruments. Both questionnaires are commonly used in patients with fibromyalgia [33–36].

Fibromyalgia severity was assessed using the Spanish version of the Fibromyalgia Impact Questionnaire (FIQ) [37]. FIQ scores range from 0 to 100, with higher scores indicating greater severity. The FIQ uses a 'last 7 days' time frame.

Procedure

Assessments took place over three consecutive days. On Day 1, a tender point examination was conducted, body composition measurements were taken, and socio-demographic data were collected. On Day 2, the PANAS, SWLS, and FIQ questionnaires were completed by participants at home without supervision. On Day 3, physical fitness was assessed.

Statistical analyses

To examine the association between overall physical fitness and fibromyalgia severity, four normalized z-scores [(value-mean)/standard deviation (SD)] were computed: (1) a 'cardio-respiratory fitness z-score' using data from the '6-min walk test'; (2) a 'flexibility z-score' using the mean of the z-scores of the 'chair sit- and- reach test' and the 'back scratch test'; (3) a 'motor agility/dynamic balance z-score' using inverted '8-foot up- and- go test' scores, so that higher scores represented better performance; and (4) a 'muscular strength z-score' using the mean of the z-scores of the '30-s chair stand test,' 'arm curl test,' and 'handgrip strength test.' Finally, an overall physical fitness score was calculated as the mean of the four physical fitness z-scores. Prior to the main analyses, Pearson's correlations were used to check whether age, marital status, educational level, work status, years from first symptoms to clinical diagnosis, years since clinical diagnosis, BMI status, frequency of alcohol consumption, and smoking status were associated with fibromyalgia severity in order to test their role as potential confounders (all $p > .25$; except for work status, alcohol consumption, and smoking status—all $p < .05$).

Pearson's correlations were also used to examine associations between overall physical fitness, positive affect, negative affect, and cognitive well-being, and fibromyalgia severity. A sequential multiple regression was performed with independent variables entered in three steps: step 1, overall physical fitness; step 2, positive affect and negative affect; step 3, cognitive well-being. The order was determined by the research team. Overall physical fitness was entered first because previous studies provide evidence that components of physical fitness are associated with fibromyalgia severity. The association between affective well-being and fibromyalgia severity has been less explored, and given the lack of evidence of any association between cognitive well-being and fibromyalgia severity, cognitive well-being was incorporated to the model in the last step.

The overall physical fitness, positive affect, negative affect, and cognitive well-being scores were dichotomized using the means as the cutoff value—i.e., low levels were those below the mean, and high levels were those equal or above the mean. Thereafter, we determined whether the combination of overall physical fitness and the individual subjective well-being components was associated with fibromyalgia severity among women patients. Three new variables with four categories (groups) were computed: for example, for positive affect, the groups were: 'high overall physical fitness' + 'high positive affect' = 1; 'low overall physical fitness' + 'high positive affect' = 2; 'high overall physical fitness' + 'low positive affect' = 3; and 'low overall physical fitness' + 'low positive affect' = 4. Similar categorizations were computed for negative affect and cognitive well-being. A one-way analysis of variance (ANOVA) was used to examine differences in fibromyalgia severity (FIQ z-scores) between the groups; Bonferroni corrections were used for multiple comparisons. We calculated the effect sizes using the Cohen's d (standardized mean differences) statistic. Values of Cohen's $d \sim 0.2$, ~ 0.5, and ~ 0.8 were considered to represent small, medium, and large effects, respectively.

All analyses were performed using Statistical Package for Social Sciences (IBM SPSS Statistics for Mac, version 20.0; Armonk, NY, USA), and the level of significance was set at $p < .05$ (two-tailed).

Results

Of patients who expressed an interest in the study, 21 were excluded because they were men and 25 because they were older than 65 years old. Thirty-nine women who did not provide evidence of a medical diagnosis of fibromyalgia and 101 who did not meet the 1990 ACR criteria were also ineligible to take part. Two women had other acute or severe health conditions, and 35 were excluded because they did not complete all the assessments (17 did not fill out all the questionnaires and 18 did not perform the physical fitness tests due to physical injury). The final study sample comprised 424 adult women with fibromyalgia from Andalusia, southern Spain. Almost 60 % ($n = 249$) of them reported severe levels of fibromyalgia severity —i.e., a FIQ total score >70. Table 1 shows the characteristics of study participants.

Independent associations between overall physical fitness and subjective well-being and fibromyalgia severity

The correlations between overall physical fitness, positive affect, negative affect, and cognitive well-being, and fibromyalgia severity were moderate [$r(422) = -0.39, p < .001$, $r(422) = -0.43$, $p < .001$, $r(422) = 0.45$, $p < .001$, and $r(422) = -0.43$, $p < .001$; respectively]. Sequential regression revealed that high overall physical fitness ($t = 5.44$; $p < .001$), high positive affect ($t = 3.90$; $p < .001$), low negative affect ($t = 5.80$; $p < .001$), and high cognitive well-being ($t = 3.82$; $p < .001$) were independently and inversely associated with fibromyalgia severity (Table 2). The final model explained 35 % of the variability in fibromyalgia severity (adjusted $R^2 = 0.35$; $F(4, 419) = 57.91$; $p < .001$). In order to test the role of the potential confounders, the regression analysis was repeated including work status, alcohol consumption frequency, and smoke status in the first step, and the results did not change.

Associations between the combination of overall physical fitness and the components of subjective well-being components and fibromyalgia severity

The ANOVA revealed that the combination of overall physical fitness and the individual components of subjective well-being was associated with fibromyalgia severity [positive affect: $F(3, 420) = 25.22$, $p < .001$;

Table 1 Characteristics of participants in the study ($n = 424$)

Characteristics	Value
Age (years)	51.24 (7.40)
Marital status, *n* (%)	
Married	323 (76.20)
Single	34 (8.00)
Separated/divorced/widow(er)	67 (15.80)
Educational level, *n* (%)	
Unfinished studies	38 (9.00)
Primary school	207 (48.80)
Professional training	66 (15.60)
Secondary school	55 (13.00)
University degree	58 (13.70)
Working status, n (%)	
Unemployed	309 (72.90)
Part-time employed	46 (10.80)
Full-time employed	69 (16.30)
Fibromyalgia diagnosis, *n* (%)	
Years from first symptoms to diagnosis	
Less than 1 year	39 (9.20)
Between 1 and 5 years	176 (41.50)
More than 5 years	196 (46.20)
Missing data	13 (3.10)
Years since clinical diagnosis	
Less than 1 year	26 (6.10)
Between 1 and less than 5 years	143 (33.70)
More than 5 years	242 (57.10)
Missing data	13 (3.10)
Body mass index (BMI) status, *n* (%)	
Normal weight (BMI 18.5–24.9 kg/m^2)	123 (29.00)
Overweight (BMI 25.0–29.9 kg/m^2)	155 (36.60)
Obese (BMI $\geq$ 30.0 kg/m^2)	146 (34.40)
Frequency of alcohol consumption, *n* (%)	
Never	233 (54.95)
Only weekdays or weekends	120 (28.30)
Both weekdays and weekends	68 (16.04)
Missing data	3 (0.71)
Smoking status, *n* (%)	
Non-smoker	299 (70.52)
Smoker, but not everyday	14 (3.30)
Daily smoker	110 (25.94)
Missing data	1 (0.24)
Overall physical fitness[a]	
30-s chair stand test (repetitions)	10.47 (3.19)
Arm curl test (repetitions)	14.35 (4.94)
Handgrip strength test (kg)	19.39 (6.38)
Chair sit- and- reach test (cm)	−11.00 (11.88)
Back scratch test (cm)	−13.62 (12.09)
8-foot up- and- go test (s)	6.85 (2.07)
6-min walk test (m)	487.84 (80.95)

Table 1 continued

Characteristics	Value
Subjective well-being	
Positive affect (PANAS)	23.01 (6.78)
Negative affect (PANAS)	24.01 (8.46)
Cognitive well-being (SWLS)	14.04 (4.62)
Fibromyalgia severity (FIQ)	65.37 (14.78)

Means (standard deviations) are presented unless otherwise indicated

FIQ Fibromyalgia Impact Questionnaire, *PANAS* Positive and Negative Affect Schedule, *SWLS* Satisfaction With Life Scale

[a] Overall physical fitness was calculated as the weighted average of age-specific z-scores of the four physical fitness components: cardiorespiratory fitness, flexibility, motor agility/dynamic balance, and muscular strength

Table 2 Sequential linear regression examining the associations of overall physical fitness, positive affect, negative affect, and cognitive well-being with fibromyalgia severity ($n = 424$)

	B (SE)	β	Adj. R^2
Step 1			.15***
Overall physical fitness[a]	−7.65 (0.89)	−.39***	
Step 2			.33***
Overall physical fitness[a]	−4.81 (0.84)	−.24***	
Positive affect (PANAS)	−0.52 (0.10)	−.24***	
Negative affect (PANAS)	0.54 (0.08)	.31***	
Step 3			.35***
Overall physical fitness[a]	−4.5 (0.83)	−.23***	
Positive affect (PANAS)	−0.39 (0.10)	−.18***	
Negative affect (PANAS)	0.45 (0.08)	.26***	
Cognitive well-being (SWLS)	−0.57 (0.15)	−.18***	

B and β = unstandardized and standardized regression coefficients, respectively; *SE* standard error; *PANAS* Positive and Negative Affect Schedule, *SWLS* Satisfaction With Life Scale

Fibromyalgia severity was assessed by the Fibromyalgia Impact Questionnaire. Adjusted R^2 (Adj. R^2) with significance levels of *F*-change

[a] Overall physical fitness was calculated as the weighted average of the age-specific z-scores of the four physical fitness components: cardio-respiratory fitness, flexibility, motor agility/dynamic balance, and muscular strength

* $p < .05$; ** $p < .01$; *** $p < .001$

negative affect: $F(3, 420) = 28.25$, $p < .001$; cognitive well-being $F(3, 420) = 28.94$, $p < .001$; respectively]. Differences in fibromyalgia severity between: the high overall physical fitness/high positive affect and low overall physical fitness/low positive affect groups; the high overall physical fitness/low negative affect and low overall physical fitness/high negative affect groups; and the high overall physical fitness/high cognitive well-being and low overall physical fitness/low cognitive well-being groups were ~15 %, and all effect sizes were large (Cohen's $d > 1.0$). Further information is available in Table 3. Figure 1 shows the fibromyalgia severity profiles of the patient groups; each graph shows one group with high reported severity (left bar, z-score ~−0.5), two groups with high to severe reported severity (central bars, z-score close to the mean), and one group with severe reported severity (right bar, z-score ~0.5).

Discussion

The findings of the present study extend current knowledge about the association of physical fitness and subjective well-being with the overall impact of the disease in adult women with fibromyalgia. Overall physical fitness, positive affect, and cognitive well-being were inversely associated with fibromyalgia severity, while higher negative affect was associated with increased fibromyalgia severity. In addition, the combination of overall physical fitness and individual components of subjective well-being showed significant associations with fibromyalgia severity: women with high overall physical fitness and either high positive affect, low negative affect, or high cognitive well-being experienced lower fibromyalgia severity compared to those with low physical fitness and either low positive affect, high negative affect, or low cognitive well-being.

Overall physical fitness is associated with fibromyalgia severity

Our results provide new evidence that higher overall physical fitness is associated with lower fibromyalgia severity. Past research focused on single physical fitness components (e.g., muscular strength) or performance tests (e.g., handgrip strength test or 30-s chair stand test) [6–10]. Our findings provide support for current recommendations for the management of fibromyalgia that advocate the development of interventions to improve physical fitness holistically [17], rather than those that focus separately on individual components of physical fitness. Future intervention studies are needed to determine whether a causal relationship exists where supporting patients' to become physically fitter overall can help to reduce their fibromyalgia severity.

Subjective well-being is associated with fibromyalgia severity

Our study also provides new evidence on the association between subjective well-being and fibromyalgia severity.

Table 3 Mean (standard error) fibromyalgia severity for participants grouped according to their combined overall physical fitness and subjective well-being (positive affect, negative affect, cognitive well-being; $n = 424$)

Positive affect (PA)	High OPF, high PA ($n = 134$)	Low OPF, high PA ($n = 80$)	High OPF, low PA ($n = 78$)	Low OPF, low PA ($n = 132$)	Difference[a] (%)	Effect size[a]
Fibromyalgia severity (FIQ)	57.54 (1.36)	65.88 (1.60)	67.25 (1.23)	71.88 (1.07)	14.34	1.01 (0.76, 1.27)
Negative affect (NA)	High OPF, low NA ($n = 124$)	Low OPF, low NA ($n = 89$)	High OPF, high NA ($n = 88$)	Low OPF, high NA ($n = 123$)	Difference[a] (%)	Effect size[a]
Fibromyalgia severity (FIQ)	57.26 (1.40)	64.89 (1.41)	66.54 (1.27)	73.04 (1.13)	15.78	1.12 (0.85, 1.38)
Cognitive well-being (CWB)	High OPF, high CWB ($n = 138$)	Low OPF, high CWB ($n = 91$)	High OPF, low CWB ($n = 74$)	Low OPF, low CWB ($n = 121$)	Difference[a] (%)	Effect size[a]
Fibromyalgia severity (FIQ)	57.53 (1.29)	65.22 (1.42)	67.81 (1.38)	72.93 (1.13)	15.40	1.10 (0.84, 1.37)

OPF overall physical fitness, *FIQ* Fibromyalgia Impact Questionnaire

[a] Difference (%) and effect size statistics—Cohen's *d* (95 % exact confidence interval)—were calculated between the groups with the lowest and the highest fibromyalgia severity scores

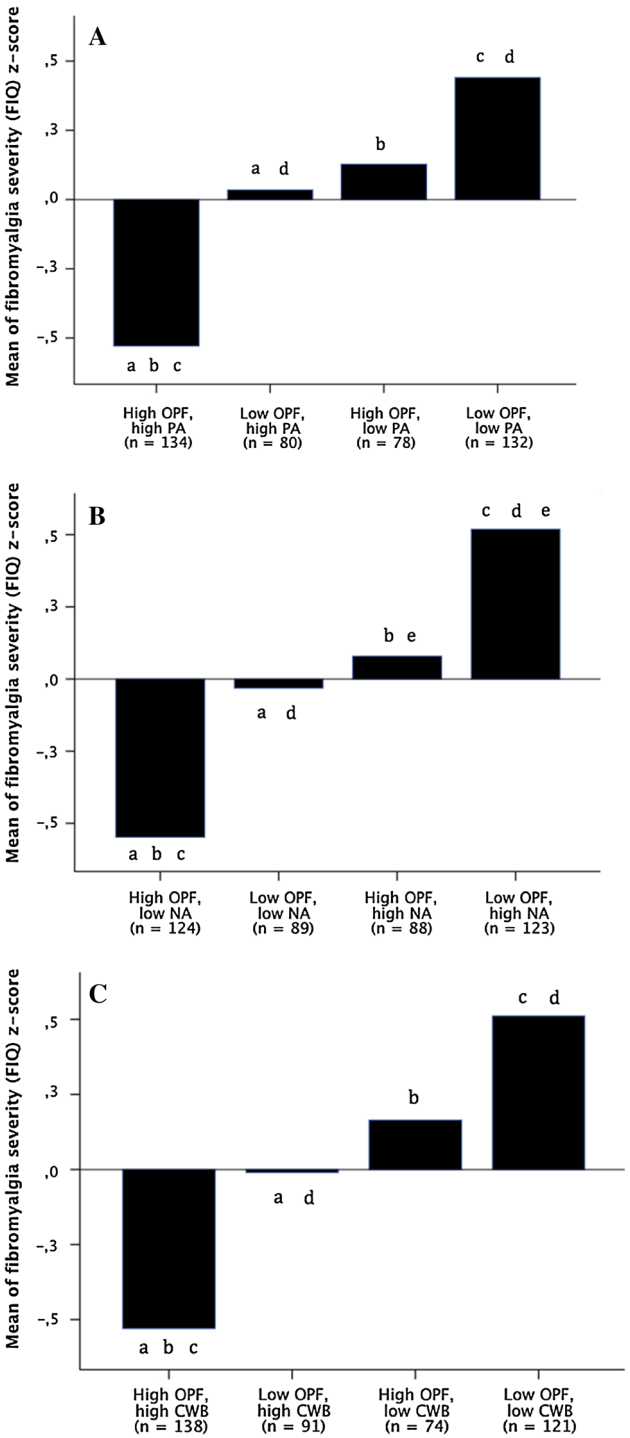
There is evidence that positive affect is a source of resilience against pain among people with fibromyalgia [38], however no previous studies have reported any associations between positive affect and fibromyalgia severity [11]. Our findings demonstrate that positive affect is not associated only with lower pain intensity, but that it is also associated with lower fibromyalgia severity. Our results also suggest that having increased cognitive well-being may potentially help patients manage their fibromyalgia severity better. Future prospective research should be conducted to test this hypothesis.

The finding that increased negative affect was associated with greater self-reported fibromyalgia severity is consistent with previous research. For example, one study [11] used affect balance style (a combination of negative affect and positive affect scores) to distinguish four groups of patients with fibromyalgia and other medical conditions: healthy (low negative affect and high positive affect), low (low values in both scores), reactive (high values in both scores), and depressive (high negative affect and low positive affect). The results showed that the affect balance styles characterized by higher negative affect (i.e., reactive and depressive) were associated with increased fibromyalgia severity in the whole study sample (i.e., people with fibromyalgia and people with other medical conditions).

Combined impact of overall physical fitness and components of subjective well-being on fibromyalgia severity

Recently, Sturgeon and Zautra [22] have suggested that more sophisticated psychological models are required to explain the complex process of adaption to pain in chronic medical conditions. However, it is highly likely that adaptation to pain is influenced by a complex interplay between psychological and physical factors. Our findings support this hypothesis by showing that a combination of: high overall physical fitness and increased subjective well-being (e.g., high positive affect, low negative affect, or high cognitive well-being) is associated with lower fibromyalgia severity. These findings support the development of interventions that adopt a multidisciplinary approach to the management of fibromyalgia [39], aiming to both increase patients' overall physical fitness levels and improve their subjective well-being.

The combinations of overall physical fitness and the components of subjective well-being revealed three groups of patients with different levels of fibromyalgia severity (i.e., high, high to severe, and severe fibromyalgia severity). Since fibromyalgia is a complex health condition, it is important to identify subgroups of patients in order to design tailored interventions to help them better manage their symptoms. For example, levels of morning tiredness, anxiety, and depression have been used to classify patients as fibromyalgia-type I (i.e., high levels of these symptoms) and fibromyalgia-type II (i.e., low levels of these symptoms). These findings have been replicated by other authors [40, 41]. Wilson et al. [42] used levels of musculoskeletal, non-musculoskeletal, and psychological symptoms to distinguish four groups of fibromyalgia patients. Hassett et al. [11] used affect balance styles (i.e., the combination of positive affect and negative affect) to describe fibromyalgia patient profiles. Our study suggests a new approach to classification that is based on both



◀**Fig. 1** Combined impact of overall physical fitness (OPF) and **A** positive affect (PA); **B** negative affect (NA); and **C** cognitive well-being (CWB) on fibromyalgia severity in women patients ($n = 424$) assessed using one-way analysis of variance (ANOVA). *Note.* Overall physical fitness was calculated as the weighted average of age-specific z-scores of the four physical fitness components: cardio-respiratory fitness, flexibility, motor agility/dynamic balance, and muscular strength. PA and NA were assessed using the PANAS. CWB was assessed using the SWLS. Common superscripts indicate significant differences between fibromyalgia severities (assessed using the Fibromyalgia Impact Questionnaire) across groups ($p < .05$, Bonferroni-corrected for multiple comparisons). Mean (standard deviation) of OPF, PA, NA, and CWB was 0.57 (0.33), 28.48 (4.78), 30.86 (6.21), and 17.51 (2.86), respectively, for 'high' levels group; and −0.57 (0.60), 17.63 (3.16), 17.23 (3.43), and 9.96 (2.42), respectively, for 'low' levels group

physical functioning (overall physical fitness) and psychological functioning (subjective well-being). We suggest that these classifications could be used to develop tailored interventions for different patients subgroups that focus more on overall physical fitness, more on subjective well-being, or equally on overall physical fitness and subjective well-being.

Clinical applications

Since fibromyalgia is currently incurable, symptom management is the main treatment. Overall physical fitness can be targeted by exercise interventions, while subjective well-being can be improved through cognitive–behavioral therapies. However, the clinical picture of fibromyalgia and the effectiveness of treatment are highly variable among patients. The development of more tailored interventions is a priority for both clinicians and psychologists [43, 44]. Our findings suggest that multidisciplinary interventions that include a combination of physical exercise and psychological components, such as cognitive–behavioral therapy, have high potential to be effective in all patient subgroups, and particularly for those with low physical fitness and low subjective well-being.

Limitations and strengths of the study

A number of limitations should be considered. First, the cross-sectional nature of this study does not allow inferences about causality. Second, since participation in the study relied on volunteers, better psychological and physical health might be expected among the study sample than among the general population of people with fibromyalgia. Third, several variables were assessed using self-report instruments. However, although inadvertent (e.g., inaccurate recall) or intentional (e.g., influenced by social desirability) misreported answers are feasible, all of the questionnaires used in the present study have been shown to be reliable and valid in this population. Fourth, affective well-being was assessed at a single time point (providing a measure of its intensity), whereas repeated measurement over an extended period (i.e., affective well-being frequency) is recommended.

The main strength of the present study is the sample size, which was large compared with previous studies

[6–10] and highly representative of the Andalusian (southern Spain) population of women with fibromyalgia [26]. Additionally, physical fitness was assessed by a performance-based test battery which has been shown to be feasible and reliable for use in women with fibromyalgia [30].

Conclusion

The findings of the present study suggest that higher levels of overall physical fitness and subjective well-being are independently associated with lower fibromyalgia severity. Moreover, overall physical fitness and subjective well-being combine so that the patients with higher overall physical fitness and increased subjective well-being (high positive affect, low negative affect, or high cognitive well-being) report ~15 % lower fibromyalgia severity than patients with lower overall physical fitness and decreased subjective well-being.

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Conflict of interest The authors have no competing interests to report.

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