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REVIEW ARTICLE

Physical activity correlates in people with fibromyalgia: a systematic review

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ABSTRACT

Purpose: Understanding the enablers of and barriers to physical activity (PA) participation in people with fibromyalgia (PwF) is an essential first step to developing effective PA interventions. This systematic review examined correlates of PA across the socio-ecological model (i.e., intra-personal, inter-personal, environmental, and policy level) in PwF.

Materials and methods: PubMed, Embase, and CINAHL were searched from inception until 12 July 2022. Keywords included "physical activity" or "exercise" and "fibromyalgia" or "fibrositis." Summary coding was used to quantify the PA correlates.

Results: Out of 74 PA correlates retrieved from 39 articles ($n = 9426$), co-morbid depression and higher pain intensity were found to be consistent (i.e., reported in four or more articles) barriers to PA in PwF, while higher self-efficacy and better endurance were found to be consistent enablers to PA. Despite the abundance of evidence for the PA benefits for PwF, we only found consistent evidence for PA correlates at the intrapersonal level.

Conclusions: Health professionals should consider mental and physical health barriers when promoting PA in PwF. There remains a need to better understand social, environmental, and policy-related factors associated with PA participation in PwF

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KEYWORDS
Exercise; depression; fibromyalgia; pain; self-efficacy

➤ IMPLICATIONS FOR REHABILITATION

- Co-morbid depression is a notable barrier to physical activity participation in people with fibromyalgia.
- Experienced pain intensity should be considered as a barrier when promoting physical activity for people with fibromyalgia.
- Rehabilitation professionals should facilitate self-efficacy in physical activity interventions for people with fibromyalgia.
- Rehabilitation professionals should promote endurance when motivating people with fibromyalgia towards an active lifestyle.

Introduction

International multidisciplinary treatment recommendations for fibromyalgia highlight the importance of adapted physical activity (PA) combined with patient education in improving health outcomes [1]. Despite the demonstrated benefits of PA on sleep quality, feelings of fatigue [2], anxiety [3], depression [4,5], pain, and self-reported daily life functioning [6], a large proportion of people with fibromyalgia (PwF) do not engage in PA regularly [7]. Besides this, behavior change interventions targeting PA in PwF have had limited success [8]. Understanding barriers and enablers of participation in PA in PwF is therefore urgently needed in order to develop effective PA programs.

The socio-ecological framework proposes that factors at the intrapersonal (e.g., demographic, biological, psychological, emotional, and cognitive factors), interpersonal/cultural (e.g., social support), environmental (e.g., financial costs, walkability), and policy levels (e.g., laws, rules, regulations) influence a person's health behavior [9]. A key principle is that knowledge about all types of influence can inform the development of multilevel interventions to offer the best chance of success [10]. Previous research in people with mental health problems [11–16] demonstrated that the socio-ecological framework is useful in trying to understand enablers and barriers influencing PA behavior. Qualitative research [17–20] indicates that positive previous experiences, social support from friends, family and health professionals and local, accessible exercise facilities are notable enablers for being physically active among PwF, while fear of deterioration and the experience of pain are notable barriers. However, a quantitative overview identifying potential correlates of PA participation in PwF at all levels of the socio-ecological model is needed. Such correlates can be targeted in future PA studies and interventions and guide priorities for future research in PwF.

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The present review systematically evaluates published quantitative studies on correlates of PA in PwF over the age of 18. We focused on potential correlates at the four levels of the socio-ecological model [9]. In addition to summarizing the methods and results of the included studies, gaps in the existing literature are identified, and directions for future research are proposed.

Material and methods

This systematic review was conducted in accordance with the "Meta-Analyses and Systematic Reviews of Observational Studies" guidelines [21] and reported in agreement with previous reviews on PA correlates in clinical populations [11–13,15,22,23].

Data sources and searches

Two reviewers (initials removed) conducted an electronic search of Medline, Embase, and CINAHL from inception until 12 July 2022. Also, manual searches were performed using the reference lists from identified articles. Search terms included "exercise" OR "physical activity" AND "fibromyalgia" OR "fibrositis" in the title, abstract, or index term fields. Full electronic search strategies are presented in Supplement 1.

Eligibility criteria

Inclusion criteria were as follows: (a) adults (aged 18 or older) with a diagnosis of fibromyalgia (diagnosed using any recognized diagnostic criteria), and (b) the dependent variable was a PA level measure, i.e., amount of PA performed. Language limiters were not used as the research team was multilingual, and Google translate or a translator would be used to review articles where the research team did not have language proficiency. For cohort or intervention studies, only associations of PA with baseline data were included. We excluded articles if the dependent variable was aerobic fitness, an intention to become physically active, PA self-efficacy levels, or adherence to PA programs, as these variables are less direct indicators of actual PA levels [24]. We also excluded articles limited to PwF with specific co-morbidities to avoid confounding. Finally, conference abstracts were also excluded.

Study selection

After removing duplicate papers, two reviewers (initials removed) independently screened the titles and abstracts of all potentially eligible articles. Both reviewers applied the eligibility criteria, and a list of full-text articles was developed through consensus. Full texts were then screened by the two reviewers and a final list of articles for inclusion was reached through consensus. Where necessary, a third reviewer would be involved. Since there was no disagreement between the two reviewers during the study selection, no third reviewer was needed.

Data extraction

Two reviewers (initials removed) extracted the following data: (a) gender (% female), (b) age (mean and standard deviation in years or age range), (c) the PA measure, (d) statistical analyses used to explore the correlates, and (e) the correlates. In accordance with previous reviews exploring PA correlates in clinical populations [11–13,16,22,23] the following categories from the socio-ecological model were included: (a) demographic, (b) biological, (c) psychological/cognitive/emotional, and behavioral attributes/skills, (d) social/cultural factors, (e) environmental, and (f) policy factors. Variables were classified as "related" or "not related" to PA based on statistical significance defined by the authors.

Coding associations with PA

Various statistical techniques were used to evaluate correlates, including uni-/multivariate analyses, correlations, *t*-tests, and analyses of (co-)variance. If both univariate and multivariate analyses were conducted, univariate analyses were reported for consistency across studies. The column "related to PA" in Table 2 indicates which studies reported significant associations between the variable and the PA measure. The direction of association is indicated with a "+" or "–". The column "unrelated to PA" in Table 2 indicates which studies reported non-significant associations between the variable and PA.

Summary codes

A summary code for each variable was given using previous recommendations [25,26]. More in detail, the association of each variable with PA was coded as: "0" (0%–33% of studies supporting association); "?" (34%–59% of studies supporting an association); or "+" or "–" (60%–100% of studies supporting an association). When correlates were reported in four or more studies the summary code for these correlates were considered as "consistently reported" and coded with "++", "- -" or "??". In the results section, only consistently reported correlates are summarized. The percentages refer to the number of significant associations with the variable divided by the total number of times the variable was studied in the literature.

Assessment of the quality of the PA measures

In accordance with previous correlates reviews [11–13,15,22,23], the following categories were used to code the quality of the PA measure: (a) self-report with poor, unknown, or not reported reliability/validity in PwF; (b) self-report with reported and acceptable reliability/validity in persons with fibromyalgia; and (c) acceptable objective measurements for PwF. Objective measurements included accelerometers and pedometers. The acceptability of the psychometric properties of measurement tools was assessed according to previous recommendations [27]. The associations with the objective measure were reported if both subjective and objective assessments were conducted.

Differences in the number of significant correlates

In accordance with previous correlates reviews [11–13,15,22,23], we also used Fisher's exact tests in order to explore differences in the number of significant correlates versus unrelated variables obtained *via* valid PA assessments versus assessments with unknown validity versus objective tools. Similarly, Fisher's exact tests were applied to explore differences in the number of significant correlates versus unrelated variables investigated in articles with a sample size lower than versus equal to or larger than the median sample size.

Results

Study selection

Of the 1650 search hits, 39 articles from 34 studies were included in this review [28–66]. Five articles [34,39,40,44,48] explored

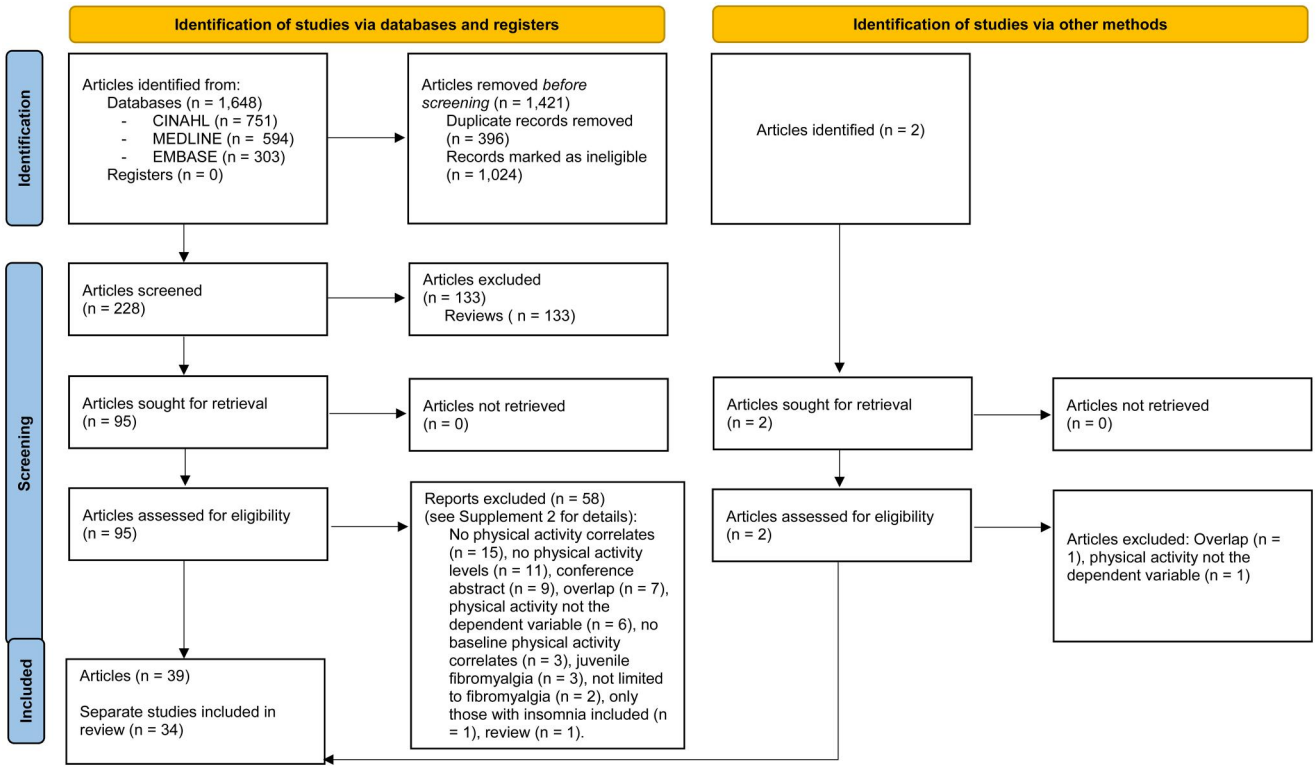

Figure 1. Flow chart of the included and excluded studies.

different correlates from the al-Ándalus study [67]. The search strategy and reasons for exclusion are shown in Figure 1. A list of excluded studies with reasons for exclusion is presented as supplementary material (Supplement 2).

Participant and study characteristics

In total, 74 correlates were found. All but three [29,43,63] included articles had a cross-sectional design. The median sample size was 105, ranging from 12 [60] to 2714 [42] participants. Concerning the quality of the PA measure, 24 articles were based on unvalidated or unreliable self-report measures of PA [28,31–33,37,42,43,45–51,53,54,57–59,62–66], 7 were based on a self-report measure with an acceptable reliability/validity in persons with fibromyalgia [30,34,41,52,55,56,61], and 8 used an objective measure of PA, i.e., accelerometers [29,35,36,38–40,44,60]. Table 1 presents the characteristics of the 39 articles, the characteristics of the 9426 included participants, the quality of the PA assessments, and the statistical analyses undertaken.

Correlates of PA in adults with fibromyalgia

Table 2 summarizes associations between 74 correlates and PA levels in PwF. Below we only summarize the correlates considered to be consistently reported in the literature (i.e., referred to in at least four different articles).

Demographic correlates

Both age and work status (having a job) were reported in four or more articles. While age was consistently unrelated to PA levels in PwF, the current literature remains inconclusive with regard to work status. Correlates explored in less than four articles are presented in Table 2.

Biological correlates

Endurance, pain intensity, physical fatigue, and physical health status are the four biological correlates reported in four or more articles. While better endurance is consistently associated with higher PA levels, higher experienced pain intensity is consistently associated with lower PA levels. Associations with physical fatigue and physical health status are inconclusive. Correlates explored in less than four articles are presented in Table 2.

Psychological, behavioral, cognitive, and emotional correlates

The level of depression, the global fatigue experience, and level of self-efficacy are the four consistent psychological, behavioral, cognitive, or emotional correlates. While higher levels of depression were related to lower PA levels, more self-efficacy was related to higher PA levels. Associations of PA levels with pain catastrophizing, subjective sleep quality, and global fatigue experience remain inconclusive. Correlates explored in less than four articles are presented in Table 2.

Social/cultural and environmental correlates

There were no consistently reported social or cultural PA correlates found. Correlates explored in less than four articles are presented in Table 2.

Policy-related correlates

There were no policy-related PA correlates investigated in PwF.

Differences in the number of significant correlates

When pooling all the studies, a Fisher's exact test showed there were no differences in the number of significant correlates between studies with a sample size lower versus equal to or larger than the median sample size (41/57 vs. 48/74, $p = .57$) and between studies using subjective, unvalidated versus objective PA

Table 1. Characteristics of articles exploring physical activity correlates in adults with fibromyalgia.

Nr	First author / year	Design	Country	Participants	Physical activity measurement	Quality of the physical activity measurement	Statistical analysis
1	Alvarez 2022 [28]	Cross-sectional	Brazil Portugal	237 Portuguese women (49.1 ± 8.9 years) and 117 Brazilian women (46.7 ± 8.4 years)	IPAQ [68]	A [69]	Mediation analyses
2	Kaleth 2022 [29]	Longitudinal	USA	170 (162♀=95.5%) (46.0 ± 11.0 years)	ActiGraph Model GT1M	C	Path analyses
3	Sanromán 2022 [30]	Cross-sectional	Spain	234 women (57.0 ± 9.0 years)	Walking behavior [70]	B [71]	Student's *t* tests
4	Aloush 2021 [31]	Cross-sectional	Israel	55 (45♀=81.8%) (23–70 years)	Self-report min. 20 min/1 week	A	ANOVA
5	López-Roig 2021 [32]	Cross-sectional	Spain	211 women (52.6 ± 7.9 years)	IPAQ [68]	A [69]	Pearson correlations
5	Pastor-Mira 2021 [33]	Cross-sectional	Spain	211 women (52.6 ± 7.9 years); similar to [32]	IPAQ [68]	A [69]	Pearson correlations
7	Girela-Rejón 2020 [34]	Cross-sectional	Spain	258 women (51.4 ± 7.9 years), data from al-Ándalus study [67]	LTPAI and PAHWI [62]	B [62]	MANCOVA
8	Kingsbury 2020 [35]	Cross-sectional	Canada	100 (94♀=94%) (53.5 ± 1.2 years)	Actical accelerometer	C	Poison models
9	Lazaridou [36]	Cross-sectional	USA	107 women (39.5 ± 12.4 years)	FitBit Flex	C	Moderation analyses
10	Olive 2020 [37]	Cross-sectional	Australia	102 (96♀=94%) women (45.1 ± 13.5 years)	IPAQ [68]	A [69]	Correlation analyses
11	Munguía-Izquierdo 2021 [38]	Cross-sectional	Spain	375 women (50.8 ± 7.3 years)	ActiGraph Model GT3X+	C	Hierarchical multivariate regressions
12	Borges-Cosic 2019 [39]	Cross-sectional	Spain	409 women (51.4 ± 7.6 years)	ActiGraph Model GT3X+	C	ANCOVA
13	Segura-Jimenez 2019 [40]	Cross-sectional	Spain	439 women (51.3 ± 7.6 years)	ActiGraph Model GT3X+	C	Linear regressions
14	Ceron Lorente 2018 [41]	Cross-sectional	Spain	34 women (52.9 ± 7.9 years)	LTPAI [62]	B [62]	Pearson correlations
15	Joustra 2018 [42]	Cross-sectional	The Netherlands	2714 (48.4 ± 10.7 years)	SQUASH [72]	A	Linear regressions
16	Merriwether 2018 [43]	RCT-baseline	USA	171 women (49.3 ± 11.5 years)	IPAQ [68]	A [69]	Pearson correlations
17	Acosta-Manzano 2017 [44]	Cross-sectional	Spain	436 women (51.4 ± 7.5 years)	ActiGraph Model GT3X+	C	ANCOVA
18	Del Pozo-Cruz [45]	Cross-sectional	Spain	105 women (55.3 ± 9.3 years)	IPAQ [68]	A [69]	Spearman rho
19	Fitzcharles 2016 [46]	Cohort study	Canada	248 (226♀=91%) (47.9 ± 10.3 years)	Medical file records	A	ANOVA
20	Lopez-Roig 2016 [47]	Cross-sectional	Spain	920 women (52.6 ± 8.8 years)	IPAQ [68]	A [69]	Logistic regressions
21	Herrador-Colmenero 2015 [48]	Cross-sectional	Spain	109 women (51.1 ± 9.3 years)	IPAQ [68]	A [69]	Pearson correlations
22	Umeda 2015 [49]	Cross-sectional	USA	14 women (45.5 ± 12.2 years)	BPAQ [73]	A	Multiple regressions
23	Umeda 2014 [50]	Cross-sectional	USA	20 women (56.0 ± 11.4 years)	BPAQ [73]	A	Spearman rho
24	Breda 2013 [51]	Cross-sectional	Brazil	30 women (42.6 ± 5.8 years)	IPAQ [68]	A [69]	Spearman rho
25	Ruiz 2013 [52]	Cross-sectional	Spain	94 women (18–75 years)	ActiGraph Model GT1M	C	Linear regressions
26	Sanchez 2013 [53]	Cross-sectional	Spain	21♀ (49.0 ± 7.3 years); 17 ♂ (48.9 ± 9.4 years)	BPAQ [73]	A	Pearson correlations
27	Homann 2011 [54]	Cross-sectional	Brazil	19 women (41.8 ± 6.2 years)	IPAQ [68]	A [69]	Spearman rho
28	Munguía-Izquierdo 2012 [55]	Cross-sectional	Spain	75 women (48.6 ± 8.4 years)	LTPAI and PAHWI [62]	B [62]	Spearman rho
29	Cancela 2011 [56]	Cross-sectional	Spain	44 women (68.1 ± 5.4 years)	LTPAI and PAHWI [62]	B [62]	Spearman rho
30	McLoughlin 2011 [57]	Cross-sectional	USA	39 women (42.7 ± 12.1 years)	IPAQ [68]	A [69]	Spearman rho
31	Jones 2010 [58]	Cross-sectional	USA	100 (93♀=93%) (59.4 ± 7.5 years)	RAPA [74]	A	Linear regressions
32	Kaleth 2010 [59]	Cross-sectional	USA	30 (27♀=90%) (49.1 ± 9.6 years)	IPAQ [68]	A [69]	Pearson correlations
33	Raftery 2009 [60]	Cross-sectional	UK	12 women	Numact monitor	C	Spearman rho
34	Mannerkorpi 2005 [61]	Cross-sectional	Sweden	37 women (46.0 ± 8.4 years)	LTPAI and PAHWI [62]	B [62]	Spearman rho/
35	Oliver 2005 [62]	Cross-sectional	USA	187 women (60.2 ± 10.2 years)	NHIS [75]	A	Bivariate and MANOVA
36	Da Costa 2001 [63]	Longitudinal	Canada	70 women (49.1 ± 8.8 years)	Self-report	A	Pearson correlations
37	Culos-Reed 2000 [64]	Cross-sectional	Canada	86 (83♀=96.5%) (49.4 ± 11.2 years)	Self-report	A	MANOVA
38	Kurtze 1999 [65]	Cross-sectional	Norway	322 women (60.2 ± 10.2 years)	Self-report	A	MANCOVA
39	Natvig 1998 [66]	Cross-sectional	Norway	357 women	Self-report	A	Spearman rho

A: self-report of poor or unknown reliability/validity in fibromyalgia; B: self-report with acceptable reliability/validity in fibromyalgia; c: objective physical activity assessment; ANOVA: analysis of variance; IPAQ: International Physical Activity Questionnaire; LTPAI: Leisure Time Physical Activity Instrument; MANCOVA: multivariate analysis of covariance; NHIS: National Health Interview Survey; PAHWI: Physical Activity at Home and Work Instrument; RAPA: Rapid Assessment of Physical Activity; SQUASH: Short Questionnaire to Assess Health-enhancing physical activity.

Table 2. Summary of the physical activity correlates in adults with fibromyalgia.

	Significantly related to physical activity		Unrelated to physical activity	Summary code○	
Variable	Articles[a]	Association	Articles[a]	Association	% Articles reporting association
Demographic factors					
Age (years)	[41]F	+	[52]F; [62]F; [63]F	00	1/4 (25%)
Educational level (low)			[52]F; [62]F; [63]F	0	0/3 (0%)
Ethnicity (White)			[62]F	0	0/1 (0%)
Income (low)			[62]F	0	0/1 (0%)
Marital status (married)			[52]F; [62]F	0	0/2 (0%)
Socioeconomic status (higher)			[63]F	0	0/1 (0%)
Work status (having productive work)	[34]F; [46]	+	[52]F; [62]F	??	2/4 (50%)
Biological factors					
Balance (more static)	[58]	+	[41]F	?	½ (50%)
Balance (more dynamic)	[58]	+	[41]F	?	½ (50%)
Body fat percentage (higher)			[52]F	0	0/1 (0%)
Body mass index (more)			[41]F; [52]F	0	0/2 (0%)
Cardiovascular disease risk profile (presence)	[44]F	–		–	1/1 (100%)
Disability (presence / more severe)	[46]; [60]F; [63]F	–		–	3/3 (100%)
Disease duration (more)			[52]F; [63]F	0	0/2 (0%)
Disease severity (more)	[40]F	–	[42]; [43]F; [52]F; [53]; [62]F; [63]F	00	1/7 (14.3%)
Endurance (better)	[43]F; [51]F; [58]; [53]F; [61]F; [66]F	+	[54]F; [56]F; [59]	++	6/9 (66.7%)
Functional mobility (better)	[41]F; [58]	+		+	2/2 (100%)
Hamstring flexibility (better)			[41]F	0	0/1 (0%)
Inflammatory markers (higher levels)	[35]	–		–	1/1 (100%)
Muscle strength (more)	[58]	+	[41]F; [43]F	0	0/1 (0%)
Pain intensity (higher)	[30]F; [36]F; [40]F; [47]F; [49]F; [62]F	–	[37]; [43]F; [53]; [63]F	–	6/10 (60%)
Pain sensitivity (higher)			[43]F	0	0/1 (0%)
Physical fatigue (more)	[40]F; [62]F	–	[28]F; [43]F	??	2/4 (50%)
Physical health status (better)	[58]; [64]	+	[28]F; [41]F	??	2/4 (50%)
Spinal inclination (more)	[41]F	+		+	1/1 (100%)
Biological factors (continued)					
Tender points count (more)			[63]F	0	0/1 (0%)
Waist circumference (more)			[52]F	0	0/1 (0%)
Psychological, behavioral, cognitive and emotional factors					
Affect (negative)			[38]F	0	0/1 (0%)
Affect (positive)	[38]F	+		+	1/1 (100%)
Anxiety (more)	[31]	–	[65]F	?	½ (50%)
Bored feelings (more)	[62]F	–		–	1/1 (100%)
Cognitive fatigue (more)			[28]F	0	0/1 (0%)
Commitment to change (yes)	[62]F	+		+	1/1 (100%)
Coping strategy for worries (yes)	[62]F	+		+	1/1 (100%)
Counterconditioning (yes)	[62]F	+		+	1/1 (100%)
Depression (more)	[31]; [45]F; [57]F	–	[63]F; [65]F	–	3/5 (60%)
Global fatigue experience (more)	[47]; [62]F	–	[28]F; [63]F	??	2/4 (50%)
Experienced barriers (more)	[62]F	–		–	1/1 (100%)
Experienced benefits (more)	[62]F	+		+	1/1 (100%)
Experienced disability (more)	[30]F; [33]F; [62]F	–		–	3/3 (100%)
Experienced enjoyment (more)	[50]F; [62]F	+		+	2/2 (100%)
Fear of movement (more)			[43]F	0	0/1 (0%)
Healthy foods (more)			[62]F	0	0/1 (0%)
Helplessness (more)	[30]F	–		–	1/1 (100%)
Interest in exercise (lack)	[62]F	–		–	1/1 (100%)
Magnification (more)			[30]F	0	0/1 (0%)
Mental health (better)	[64]	+	[28]F	?	½ (50%)
Motivation (higher)			[28]F	0	0/1 (0%)
Pain avoidance (more)	[33]F	–		–	1/1 (100%)

(*continued*)

Table 2. Continued.

	Significantly related to physical activity		Unrelated to physical activity	Summary code○	
Variable	Articles[a]	Association	Articles[a]	Association	% Articles reporting association
Pain catastrophism (more)	[30]F; [36]F	–	[37]; [43]F	??	1/3 (33%)
Perceived barriers (more)	[29]	–		–	1/1 (100%)
Perceived physical functioning (better)	[43]F	+	[63]F	?	½ (50%)
Reinforcement management (yes)	[62]F	+		+	1/1 (100%)
Psychological, behavioral, cognitive and emotional factors (continued)					
Rumination (more)	[30]F	–		–	1/1 (100%)
Satisfaction with life (more)	[38]F	+		+	1/1 (100%)
Self-efficacy (higher)	[32]F; [29]; [62]F; [64]	+		++	4/4 (100%)
Self-discipline (lack)	[62]F	–		–	1/1 (100%)
Sleep subjective quality (better)	[39]F; [53]F; [55]F	+	[37]; [53]M; [63]F	??	3/6 (50%)
Unhealthy foods (more)			[62]F	0	0/1 (0%)
Weekend day (versus weekday)	[52]F	–		–	1/1 (100%)
Social/cultural factors					
Having exercise partners (yes)	[62]F	+		+	1/1 (100%)
Family support (yes)			[62]F	0	0/1 (0%)
Friend support (yes)			[62]F	0	0/1 (0%)
Environmental factors					
Aesthetics of the built environment (better)			[48]F	0	0/1 (0%)
Availability of active transport network (more)	[48]F	+		+	1/1 (100%)
Connectivity of active transport network (better)	[48]F	+		+	1/1 (100%)
Density of the built environment (more)	[48]F	+		+	1/1 (100%)
Distance to local facilities (shorter)	[48]F	+		+	1/1 (100%)
Home environment active facilities (more)			[48]F	0	0/1 (0%)
Maintenance of the built environment (better)	[48]F	+		+	1/1 (100%)
Physical environment in general (better)			[62]F	0	0/1 (0%)
Pleasantness of the built environment (better)			[48]F	0	0/1 (0%)
Safety (crime, traffic) (more)	[48]F	+		+	1/1 (100%)
Work/study environment active facilities (more)			[48]F	0	0/1 (0%)

[a]The percentages in parentheses refer to the number of associations supporting the expected association divided by the total number of associations for the variable. Associations are coded with: "0" (0%–33% of studies supporting association); "?" (34%–59% of studies supporting an association); or "+" or "–" (60%–100% of studies supporting an association); when correlates were reported in four or more studies the summary code for these correlates were considered as "consistently reported" and coded with "++", "- -" or "??".

BPAQ: Baecke Physical Activity Questionnaire; F: female participants only; IPAQ: International Physical Activity Questionnaire.

measures (48/89 vs. 10/19, $p = .79$) and subjective, validated versus objective PA measures (10/16 vs. 8/17, $p = 0.49$).

Discussion

General findings

The current systematic review provides insight into the wide range of factors, mainly at the intrapersonal level of the socio-ecological framework [9], that are associated with PA participation in PwF. Despite the abundance of evidence of the PA benefits for PwF, we only found consistent evidence for co-morbid depression and higher pain intensity as barriers and higher self-efficacy and better endurance as consistent enablers in PwF. Below we discuss the consistent findings in more detail.

At the intrapersonal level of the socio-ecological model, exploring demographic variables associated with PA participation helps to prioritize target groups. The current data show that in PwF, no consistent demographic barriers or enablers were found. Age was consistently unrelated to PA levels. The current literature indicates that all adults with fibromyalgia, irrespective of age, need the same care in PA programs.

Related to biological correlates at the intrapersonal level of the socio-ecological model, our data demonstrate that in facilitating PwF to be physically active, attention should be paid to the experienced pain intensity and the endurance level. Both were found to be consistent correlates. It has been previously demonstrated that associations between lower levels of PA and higher levels of pain intensity are moderated by the level of catastrophizing [36]. These findings align with the fear-avoidance model of chronic pain [76], postulating that PwF who experience higher pain intensity might become ensnared in a downward spiral of increasing avoidance behavior, lower endurance, and physical disability. The fear-avoidance model posits that pain-related fear increases when bodily sensations, including sensations when being physically active, are catastrophized (e.g., sensations are perceived as a significant threat to bodily integrity) [76]. An increase in pain-related fear then provokes the initiation of several safety behaviors, including avoidance of PA [76]. Avoidance of PA may then lead to physical and mental deconditioning [77]. More research on the association between higher experienced pain intensity, pain catastrophizing, and habitual PA in PwF is needed as data on the association between pain catastrophizing and habitual PA in the current review were, to date, inconclusive.

Our hypothesis is, however, in line with the observation that co-morbid depression was a consistently reported psychological barrier to PA participation in PwF. It is known that PwF who experience depressive symptoms report higher pain intensity levels and are more prone to pain catastrophizing [78,79]. The finding that co-morbid depression is a barrier to being physically active in PwF is, in itself, important since fibromyalgia is a known risk factor for depression [80]. For example, the overall pooled point prevalence for clinical depression and self-reported depression is 25% and 45% in PwF, respectively, while the lifetime prevalence for clinical depression is 65% [81].

Co-morbid depression is also related to lower self-efficacy in PwF [82]. The current review demonstrates that having higher levels of self-efficacy is consistently related to higher levels of PA, while previous research indicated that individuals with fibromyalgia and co-morbid depression might benefit most from interventions that aim to increase self-efficacy [83]. A reason might be that PwF, and mainly those experiencing depressive symptoms experience a lack of control over their illness. A recent study [33] however shows that in fact almost all PwF, also those without depression, do not feel confident in carrying out physical activities at any level of intensity or duration, supporting the assertion that this vulnerable population needs skills to overcome the barriers of becoming physically active [84]. It has also been demonstrated in PwF that when PA self-efficacy levels increase, avoidance behavior is likely to reduce [33]. Psychologically informed physiotherapy, including a combination of interactive education sessions, graded activity, and problem-solving strategies might be effective in improving self-efficacy for PA in patients with widespread chronic pain [85].

Limitations and recommendations for future research

Although the current systematic review provides insight into the wide range of factors that are associated with PA participation in PwF, there are several limitations, which should be acknowledged.

First, all correlates investigated were only documented in a small number of studies. Examination of the same, standardized variables in a range of studies is therefore necessary in order to build a consistent body of evidence that can support or refute the potential role of individual variables.

Second, the diversity of PA measures prevented us from performing a formal meta-analysis. Since subjective PA assessment tools are often less reliable and valid in PwF [69], we hypothesized that fewer significant associations would be expected in studies that relied on unvalidated self-report measures versus objective assessments. However, the number of significant associations found in studies relying on self-report measures did not differ from studies relying on objective assessments. Considering the wide diversity in PA assessments, our findings echo previous calls to adopt a clear consensus on which PA assessment tools should be recommended in PwF [86].

A third limitation is that the current review required the establishment of definitions for consistency of association that are debatable [25]. However, the categories of evidence and summary codes provide a relative assessment of the consistency of associations with PA levels in PwF.

Fourth, the majority of the articles investigated PA correlates at only one or two levels of the socio-ecological model [9], with very limited data about the potential role of interpersonal and environmental factors and no studies on policy-related variables. As indicated recently, rehabilitation studies in PwF should attempt to analyze the role of multiple correlates of functioning, and consequently PA participation from a broad socio-ecological perspective [86]. Given that research suggests that maintaining changes in PA requires a multilevel approach [9], exploring these interactions in PwF is essential in order to enhance our understanding of the daily life functioning of this vulnerable clinical population. At the social level of the socio-ecological model, future research could focus in more detail on the role of social support. At the environmental level of the socio-ecological model, future research could explore in more detail the role of the built environment such as a better availability and connectivity of active transport networks, in facilitating PA participation in PwF. Exploring these attributes in more detail is important, especially since walking in the neighborhood is a preferred, easy, low-cost solution to improving outcomes in PwF [30,87]. Since alterations to the physical environment may not always be feasible, future studies could also investigate whether enhancing the social environment (e.g., neighborhood social cohesion) [88] may present another opportunity to improve PA levels in PwF (e.g., neighborhood social cohesion) [88]. Neighborhood social cohesion can be considered as the network of relationships, shared values, and norms of

residents in a neighborhood [89] and may affect the health of individuals residing close to one another through several mechanisms, such as collective advocacy for appropriate resources and facilities, increased dissemination of health-related information, psychosocial support, and self-efficacy to engage in healthy behaviors [89]. At the policy level of the socio-ecological model [9], correlates could initially also be explored using a qualitative approach [30]. Researchers should, for example, examine policies that are currently in place to motivate PwF to engage in PA and maintain PA levels. Focus groups with patients, health professionals, and policymakers may provide further insight into which kind of policies are needed to stimulate PA. If the purpose is to inform policy changes, merely documenting the relationship between policy changes and PA behavior in this vulnerable population is likely to be insufficient. At some point, policy change research will need to include assessments of broader outcomes in PwF, such as changes in disease impact, quality of life, and the economic costs and benefits of proposed policy changes.

In conclusion, despite the abundance of evidence of the PA benefits for PwF, we only found consistent evidence for co-morbid depression and higher pain intensity as barriers and higher self-efficacy and better endurance as consistent enablers in PwF. More research about enablers and barriers to PA participation in PwF at the inter-personal, environmental, and policy levels are urgently needed before any rigorous clinical rehabilitation recommendations can be formulated.

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