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REVIEW ARTICLE



Do women with fibromyalgia adhere to walking for exercise programs to improve their health? Systematic review and meta-analysis

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ABSTRACT

Background: Walking is recommended for fibromyalgia, but the rate of adherence to this exercise is not known. Poor adherence to physical exercise can limit the effectiveness in health benefits.

Objectives: To examine adherence to interventions that include walking for fibromyalgia and to explore its moderators among the characteristics of patients, of the walking prescription and of the interventions.

Data sources: References from 2000 to 2016 have been collected through PubMed, PsycINFO, CINAHL, SPORTDiscus, Cochrane, and Teseo.

Study selection: We included quasi-experimental and randomized controlled trials in adults with fibromyalgia that involved walking for exercise. Two authors screened records independently and disagreements were resolved by discussion.

Data extraction: Independently extracted by two assessors. Methodological quality of the studies was assessed using an *ad hoc* scale.

Data synthesis: Nineteen trials, 32 experimental groups, recruited a total of 983 participants (96.78% women) with mean ages between 45 and 60.60. Adherence to the intervention program was reported in 19 of 32 experimental groups and ranged, on average, from 73 to 87.20% depending on the type of assessment. Most relevant moderators of adherence were the recruitment of participants through physicians and the nurses as supervisors of exercise.

Conclusion: Adherence rates (attendance at sessions) to programs with walking were high. However, a lack of information precludes knowledge of whether participants sustained walking between sessions or after the treatment. Further work is required to examine in greater depth such contextual variables of interventions as the professional-participant relationship or to explore other possible moderators such as patient expectations of the treatment.

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► IMPLICATIONS FOR REHABILITATION

- Adherence to walking programs is more likely if doctors recommend the attendance at them.
- The combination with other activities may result in better adherence to walking than those that are only-walking exercise.
- The adherence to walking programs was larger in those in which nurses supervised the exercise.
- It is necessary to have adherence as objective, improving the record of adherence during treatment, assessing it between sessions and with a follow-up after the end of treatment.

Introduction

Fibromyalgia is a chronic condition characterized by widespread pain, cognitive symptoms, non-restorative sleep, fatigue, and other somatic symptoms [1] that lead to a reduced quality of life [2] and limitations in daily-life activities [3,4]. The worldwide prevalence in the general population is 2.7% and it is more frequent in women (4.1%) than in men (1.4%) [5].

Together with pharmacological and psychological treatment, physical exercise is an important mainstay of the recommended and effective treatment in fibromyalgia [6–8]. Regular exercise decreases the intensity of pain and fatigue, enhances physical function, psychological welfare, and improves quality of

life [6,8–11]. Regarding the most appropriate type of exercise, the latest reviews have shown that aerobic exercise of slight to moderate intensity, with or without accompanying strengthening or flexibility exercises, improves health status in people with fibromyalgia [12,13]. Among the variety of aerobic exercises, walking is a moderate intensity activity, easy and adaptable to the self-management of fibromyalgia [14]. Its relatively low impact and positive health outcomes has made it widely recommended for chronic pain problems in general and particularly in fibromyalgia [13,15–17].

Although it is well-known that poor adherence to physical exercise can limit the effectiveness in long-term health benefits

[18–20], adherence data have not always been accessible [13,21]. Nevertheless, in some exercise interventions in fibromyalgia, reported adherence ranged between low and moderate [12,13,21,22]. Accordingly, management of adherence conditions is an issue that requires increased attention [13,18,21,22] and therefore, data on the adherence to walking protocols in fibromyalgia could be vital.

The objectives of this review were (1) to identify the adherence to the interventions that include walking for treatment in fibromyalgia and (2) to explore their moderators among (a) the characteristics of patients, (b) the characteristics of the walking prescription, and (c) the characteristics of the interventions.

Materials and methods

This systematic review and meta-analysis is reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols 2015 (PRISMA-P 2015) statement [23] and its former version of 2009 [24]. A protocol (unpublished) was made prior to the writing of this article.

Eligibility criteria

We considered all (1) interventions containing walking as the only exercise, or combined with other exercises, or as a component of a multidisciplinary program in any setting: hospital, clinic, university or community association, (2) randomized controlled trials (RCT) and quasi-experimental trials, (3) studies with patients with a fibromyalgia diagnosis according to the criteria of the American College of Rheumatology [1,25] aged ≥ 18 .

As we focused on outcomes related to descriptive characteristics of the interventions, we were not interested in the comparisons (of results) between the different interventions. Moreover, we were interested in adherence to the intervention. We considered three types of adherence outcomes: (1) program attendance, (2) carrying out the prescribed exercise between sessions, and (3) carrying out the exercise during follow-up.

We included studies that had at least 75% of women in the sample, but we excluded studies of “only men” because of the major frequency of diagnosis in women. We also excluded single-case and crossover clinical trials.

Search methods for identification of studies

The information was collected between the months of March 2015 and December 2016, through searches of the PubMed (including Medline), PsycINFO, CINAHL (Nursing Resources from EBSCO Health), SPORTDiscus (EBSCO) y Cochrane databases, as well as of gray material (theses) in Teseo. In order to include as many publications as possible on the subject, the combination of managed keywords we used was: Fibromyalgia, Walking AND Exercise (OR = Physical Exercise, Physical Activity, Physical fitness). The search strategy in PubMed (see Supplementary Material 1) was performed under the terms approved by the Mesh in English with the help of a database technician of the University of Miguel Hernandez, adapting the syntax and subject headings to the different databases. The literature search was limited to the last 16 years, English and Spanish and adult samples with fibromyalgia. To ensure a saturation of literature, we analyzed the reference lists of included studies and relevant reviews identified through the search. We also searched personal files of authors to ensure that all relevant material had been found.

Selection of studies

Initially, the first author transferred all records of searches to *Refworks*, a repository of publications that allows us to create an organized list of records. Then, the first author used the tool to identify and remove the duplicates. Finally, first and second authors independently screened all titles and abstracts against the inclusion criteria through the list drawn from *Refworks*. Then, the two authors reviewed the full text shortlisted independently and recorded the reasons for rejection. Disagreements were resolved by discussion, in some cases with a third author. In cases where the record provided insufficient information (only title or abstract), we contacted the study authors to clarify study eligibility. Where there was no answer, the study was discarded ($n=2$) (see Supplementary Material 2).

Data extraction and management

Prior to the independent coding, a pilot was performed with a coding protocol to refine the procedures and codes. Two authors of this paper extracted the data independently from each study using a pre-designed form with lists of data validation to ensure greater objectivity. Disagreements were resolved through discussion and consultation with a third researcher with extensive knowledge in fibromyalgia. The following details were recorded: (1) study design, methodological and contextual variables (year and country of publication), (2) characteristics of study participants (age, sex, duration of disorder, diagnosis criteria), clinical setting and recruitment, (3) characteristics of prescription: duration, frequency and intensity of walking and other physical exercises that were conducted along with walking, (4) characteristics of interventions: supervision of walking and other exercises, combination or not with psychological treatment (cognitive-behavioral, educational, self-management or goal-setting) conducted besides walking or other exercise, (5) adherence to the program: either from the number of participants in attendance at the beginning and at the end of study or from data provided by authors in several forms such as (i) the percentage of participants who met a previously established criterion; for instance, attending a minimum number of sessions or performing a minimum amount of exercise (adherence percentage) (ii) the average of the percentage of attendance of each participant (mean adherence), or (iii) the number of participants attending each session; (6) adherence to the prescribed exercise: through log data at or between exercise sessions (self-reporting or pedometers) and (7) adherence to the exercise during follow-up (self-reporting or pedometers).

Assessment of methodological quality

We assessed the quality of included studies through an *ad hoc* tool developed by us based on another review related to prevalence data [26]. Fourteen items for quality of adherence data were evaluated (see Supplementary Material 3) and the sum of their scores yielded an overall score of methodological quality (from 0 to 14). Furthermore, with this scale, we obtained a classification as high (≥ 10), medium (from 5 to 9.99) and poor quality (< 5) (see Supplementary Table S1).

Statistical analysis

Studies were analyzed and described according to the recommendations of Sánchez-Meca and Botella [27]. Descriptive characteristics of the individual studies were extracted in order to examine their potential influence as moderator variables on walking

adherence. Thus, qualitative data were collected using tables to compile information on intervention variables and methodological and adherence measures (see Supplementary Tables S1 and S2). The proportion of patients that attended treatment was obtained from each individual study. To obtain this proportion, we considered the three types of outcomes commented above, adherence: (1) to the program, (2) to the prescribed exercise, and (3) to the exercise during follow-up. Data of adherence to the program were obtained from information provided by authors in several forms (adherence percentage, mean adherence, or number of participants attending each session). When authors did not provide this data, we calculated it from the number of participants at the beginning and at the end of study. These proportions were the dependent variables in the meta-analysis. To normalize the distribution of these proportions, they were translated by means of the logit function: $L_p = \text{Log}_e[p/(1-p)]$, p being the proportion of adherence to walk, Log_e the natural logarithm, and L_p the logit adherence proportion. The sampling variance of the logit adherence proportion is given by: $V(L_p) = 1/np + 1/n(1-p)$, where n is the sample size of the study. This variance is important because in meta-analysis each proportion is weighted by its inverse variance when the statistical analyses are conducted. In order to make the interpretation of the results easier, the mean logits and their 95% confidence limits were back-transformed to the proportion metric by means of: $p = e^{L_p}/(e^{L_p} + 1)$, where e is the base of the natural logarithm.

The statistical analyzes were performed with a random-effects model. It is reasonable to apply this statistical model when the existence of heterogeneity is suspected among the adherence proportions due to the influence of differential characteristics of the studies [28]. A forest plot was constructed to illustrate graphically each individual adherence proportion as well as the pooled adherence rate obtained from the studies. The heterogeneity exhibited by the adherence proportions was assessed by means of the Q statistic and the I^2 index. To analyze the moderating variables related to the methodological, participant and intervention characteristics of the studies, we performed subgroup analyzes (weighted ANOVAs) for qualitative variables, and simple meta-regressions on continuous variables. Q_b for weighted ANOVAs and Z statistics for meta-regressions were applied in order to test the statistical significance of each moderator variable on the adherence proportions. The proportion of variance explained by the moderator variable was estimated by means of R^2 . In addition, the model misspecification was assessed with Q_w and Q_E statistics for ANOVAs and meta-regressions, respectively. Moderator analyzes were accomplished by assuming a mixed-effects model [27]. To undergo analysis, a moderator variable required to be reported in at least 10 studies, as moderator analyzes with less than 10 studies are not appropriate [29]. Finally, publication bias was assessed by constructing a funnel plot and applying on it the trim-and-fill technique for imputed potentially missing adherence rates [28]. All statistical analyzes were carried out with the statistical program *Comprehensive Meta-analysis 3.3* [30].

Results

Selection process

The searches identified 1136 publications. Thirty of these were examined in full text, of which 22 studies (23 papers) met the inclusion criteria [31–53] (Figure 1). One of the 23 papers was a follow-up [45] of another study [44]. Excluded studies with the specific reasons are listed in Supplementary Material 2. The main

reasons for excluding articles from the 625 potentially eligible articles were:

1. the sample was mostly men ($n = 5$)
2. they were based on heterogeneous samples with other diagnoses besides fibromyalgia ($n = 19$)
3. the sample age was under 19 or exclusively elderly ($n = 10$)
4. they were studies on the physical effects of exercise in fibromyalgia but not programs or trials (reviews, laboratory situations or questionnaires) ($n = 284$)
5. they included programs of aerobic exercise but without walking ($n = 259$), the type of exercise was not specified in the full text ($n = 14$) or it was not possible to obtain the full text in order to find out the exercise performed ($n = 4$)

Methodological quality

The analysis of reliability of the coding by two reviewers of study characteristics and adherence rates was satisfactory. Cohen's kappa coefficients calculated for qualitative variables varied between 0.64 and 1, while intra-class correlations calculated for continuous variables ranged between 0.86 and 1. Of the 22 studies selected, 18 were randomized controlled trials, two quasi-experimental controlled studies [32,50] and two were pilots, one with a quasi-experimental design [42] and the other with randomized clinical trials of two groups [52]. Most used simple randomization ($n = 10$) [33,37–40,48,49,51–53] but many did not report the randomization process ($n = 9$) [31,32,35,36,41–43,47,50] and one reported problems of randomization [50]. Ten studies did not report masking [31,32,35,36,38,42,43,46,47,50] and the other studies used blinded evaluation to assess results. The studies were published in 10 different countries of which Spain ($n = 6$) was the most frequent. Most studies did not report about the analysis of differences between participants who completed the treatment and those who did not ($n = 13$). Of the remaining studies fewer than a half found differences ($n = 4$): Non-completers showed more pain intensity and pain disability [35,38,42] and lower values in vitality and social functioning [38], were older than completers [33] and most were single [33].

Description of included studies

The 22 trials, with 32 experimental groups, recruited a total of 983 participants (96.78% women) with mean ages between 45 and 60.60 and an average duration of disorder of 8.12 years (see Table 4). There was a wide variability among the 32 experimental groups in exercise prescription: duration of walking exercise (from 5 to 45 min), intensity of activity (from 55 to 80% of different ways to measure Heart Rate), duration of sessions (from 25 to 180 min), frequency (from 1 to 4 times per week) and total time of treatment (from 4 to 24 weeks). There were programs in which the treatment lasted 1 week, with sessions of 60 min [52] and 180 min [41] or 2 weeks, with daily sessions [42]. Concerning the characteristics of interventions, given that each experimental group was taken as an independent unit of analysis ($N = 32$), it was pertinent to observe these data in each experimental group (see Table 1).

There were three types of intervention depending on the elements that made up the treatment delivered:

1. one-component experimental groups ($n = 12$) which included only walking as exercise, with three exceptions in which patients were allowed to choose among several physical activities [32,34] or which prescribed the exercise according to the season: walking outdoors in summer and pool-based exercise in winter [33]

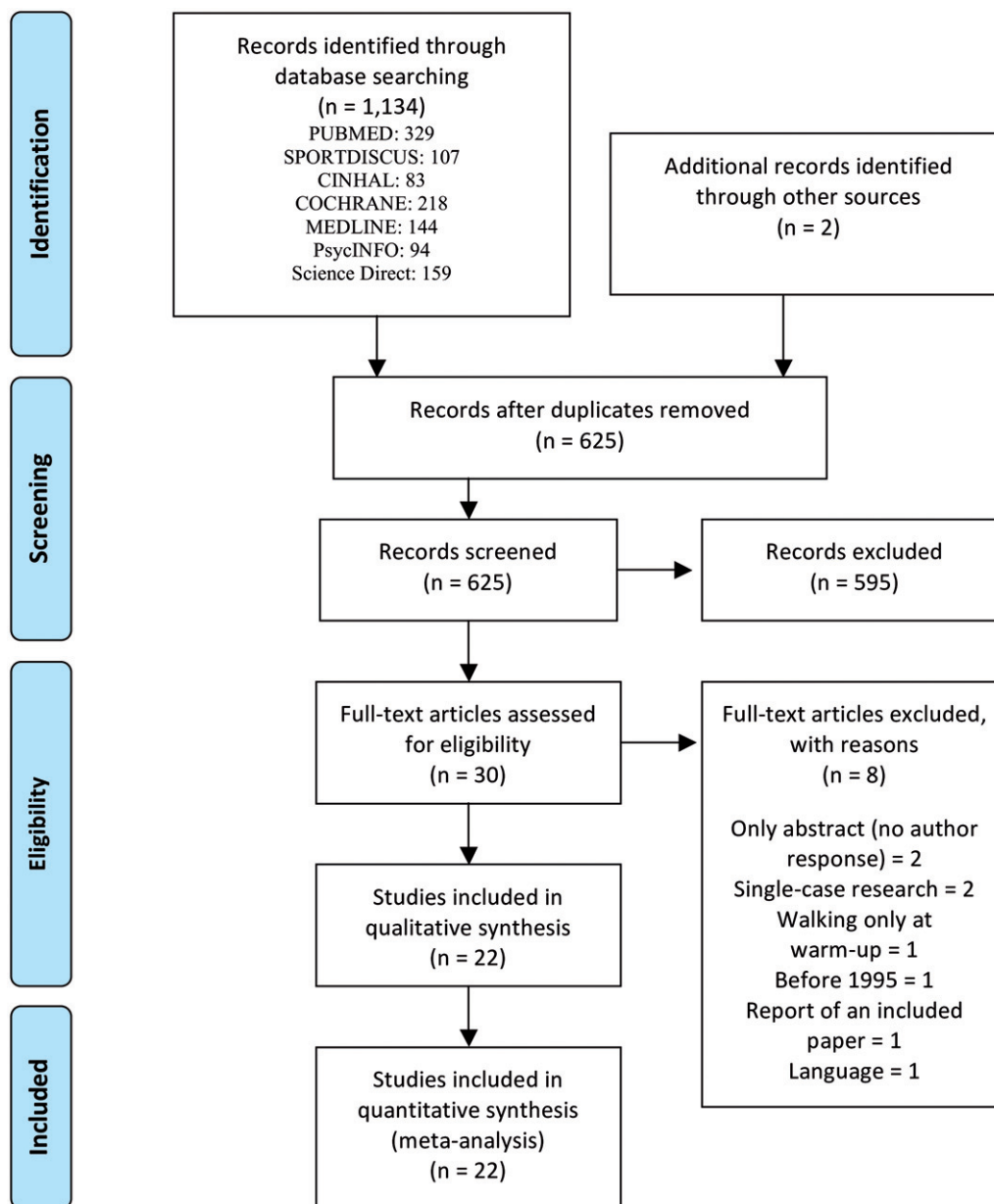


Figure 1. Flow diagram [26].

- multi-component experimental groups ($n = 10$) which included walking together with other types of exercise (see Table 1) and of which two also incorporated elements related to self-management of symptoms [46] and educational sessions of motor habits (10% of sessions) with instructions to continue exercise at home for 12 weeks [50], and
- multidisciplinary experimental groups ($n = 10$), which included diverse elements besides the exercise: psychosocial support through problem-solving, instructions or goal-setting for exercise [40,42], cognitive-behavioral treatment, educational sessions and self-management [33,39], transcranial stimulation [53] and even sessions of rheumatology, physiotherapy, psychology, dietary advice, thermal therapy or massage therapy [39,40,43] and the attendance of partners or close relatives of participants [41]. In the multidisciplinary experimental groups, walking was combined with other exercises (see Table 1) and in two experimental groups, patients had to choose from among different types of aerobic exercise [39,42].

Among all the experimental groups, 17 included the progression of exercise in either time or intensity; in 20 experimental groups the development of the exercise was supervised; in 22 groups warming and cooling, or one of the two, were included within the sessions (see Table 1) and in one experimental group, exercise in different bouts was prescribed with a rest between them [35].

There were only two experimental groups that clearly had adherence to the program as a target. In one, a physiotherapist was responsible for monitoring and improving the attendance of participants by "creating a social, non-intimidating environment for the patients" and achieved an adherence of 90.56% [39]. In the other study, during the first six weeks, the prescription was exercise in a warm therapy pool in sessions of 30 min and walking, in two of the three weekly sessions, was not performed until the seventh week [44]. This progressive prescription was performed with the explicit aim of improving adherence and achieved a rate of 67%.

Table 1. Characteristics of interventions.

Study	Experimental groups	Control groups	Weekly frequency	Total weeks	Main PE	Walking form (% Total session)	M Min Session	M Effort intensity	PE supervised (% Sessions)	Warm up	Cool down
1. One-component: walking Meyer et al. [31]	1. High-intensity exercise program		3	24	Walking	(100%)	23.63	78.75% Heart Rate rest age	N/NR	No	No
Meyer et al. [31]	2. Low-intensity exercise program		3	24	Walking	(100%)	23.63	54.63% Heart Rate rest age	N/NR	No	No
Meiworm et al. [32]	1. Self-management training program	2. Waiting list	3	12	Aerobic (cycling, swimming, jogging, or walking)	(100%)	42.06	NR	N/NR	No	No
King et al. [33]	1. Supervised aerobic exercise program (SAEP)	4. Waiting list	3	12	Aerobic (walking, pool-based, or low-impact activities)	Outdoors (NR)	30	67.50% Heart rate max age	PE instructor and Physiotherapist (100%)	Yes	Yes
Richards and Scott [34]	3. Education	2. Active	2	12	Aerobic (walking or cycling)	Treadmill (100%)	60	NR	PE instructor (100%)	No	No
Valim et al. [35]	1. Individualized exercise program + info leaflet	3. Active	3	20	Walking	(66.67%)	45	Heart rate prior anaerobic load (100%)	Physiotherapist (100%)	Yes	Yes
Bircan et al. [36]	2. Stretching	3. Active	3	8	Walking	Treadmill (71.43%)	35	65% Heart rate max age	N/NR	Yes	Yes
Mannerkorpi et al. [37]	1. Aerobic exercise program	2. Strength	2	15	Walking	Nordic walking (100%)	42.50	13 Borg/RPE	Physiotherapist and trained leaders (100%)	No	Yes
Mannerkorpi et al. [37]	1. Nordic Walking	2. Low Impact Walking	1	15	Walking	Outdoors (100%)	42.50	9.50 Borg/RPE	Physiotherapist and trained leaders (100%)	No	Yes
Kayo et al. [38]	1. Walking program	3. Active	3	16	Walking	(75%)	60	51.88% Heart Rate rest	Physiotherapist (100%)	Yes	Yes
Lopez-Pousa et al. [52]	2. Strength	1. Walking in young forest	6	1	Walking	Outdoors (100%)	60	NR	Nurses (100%)	No	No
Lopez-Pousa et al. [52]	1. Walking in young forest	2. Walking in mature forest	6	1	Walking	Outdoors (100%)	60	NR	Nurses (100%)	No	No
2. Multicomponent: walking and other exercises											
Gowans et al. [44]	1. Exercise Program	2. Waiting list	3	23	Aerobic (walking and pool-based)	Indoor (32.75%)	30	77% heart rate max age	PE instructor (NR)	Yes	Yes
Rooks et al. [46]	1. Aerobic and flexibility exercise AE	3. Usual care	3	16	Aerobic and flexibility	Treadmill (45.10%)	60	NR	YES NR (66.67%)	Yes	Yes
Rooks et al. [46]	2. Strength, aerobic and flexibility (ST)	2. Usual care	3	16	Strength, aerobic and flexibility	Treadmill (33.33%)	60	NR	YES NR (66.67%)	Yes	Yes
Rooks et al. [46]	3. Fibromyalgia self-help (FSHC) and ST	2. Usual care	3	16	Strength, aerobic, and flexibility	Treadmill (33.33%)	60	NR	YES NR (66.67%)	Yes	Yes
Etnier et al. [47]	4. Education	2. Waiting list	3	18	Walking and strength	(25%)	60	60% Heart Rate max	Research (NR)	No	No
Sanudo et al. [48]	1. Physical activity program	3. Usual care	2	24	Aerobic	Walking with arm movements (33.33%)	52.50	70% Heart Rate max age	N/NR	Yes	Yes
Sanudo et al. [48]	2. Combined exercise	2. Usual care	2	24	Aerobic, strength, and flexibility	Walking with arm movements (33.33%)	52.60	67.50% Heart Rate max age	N/NR	Yes	Yes
Sanudo et al. [49]	1. Exercise program	2. Usual care	2	24	Aerobic, strength, and flexibility	Walking with arm movements (25%)	50	65% Heart Rate max age	N/NR	Yes	Yes
Latorre et al. [50]	1. Physical training	2. Usual care	3	24	Aerobic (walking and pool-based) and strength	Indoor (12.5%)	60	Borg/RPE	Physiotherapist (100%)	Yes	Yes
Paolucci et al. [51]	1. Rehabilitation program	2. Usual care	2	5	Low-impact aerobic (walking and steps), strength and flexibility	Indoor (NR)	60	60% Heart Rate maximum age	Physiotherapist (50%)	No	No
3. Multidisciplinary: one or multicomponent plus other intervention											
King et al. [33]	1. SAEP	4. Waiting list	3	12	Aerobic (walking, pool-based, low-impact activities)	Outdoor (NR)	30	67.50 Heart Rate max age	PE instructor and Physiotherapist (100%)	Yes	Yes
	2. SAEP and education										
	3. Education										

(continued)

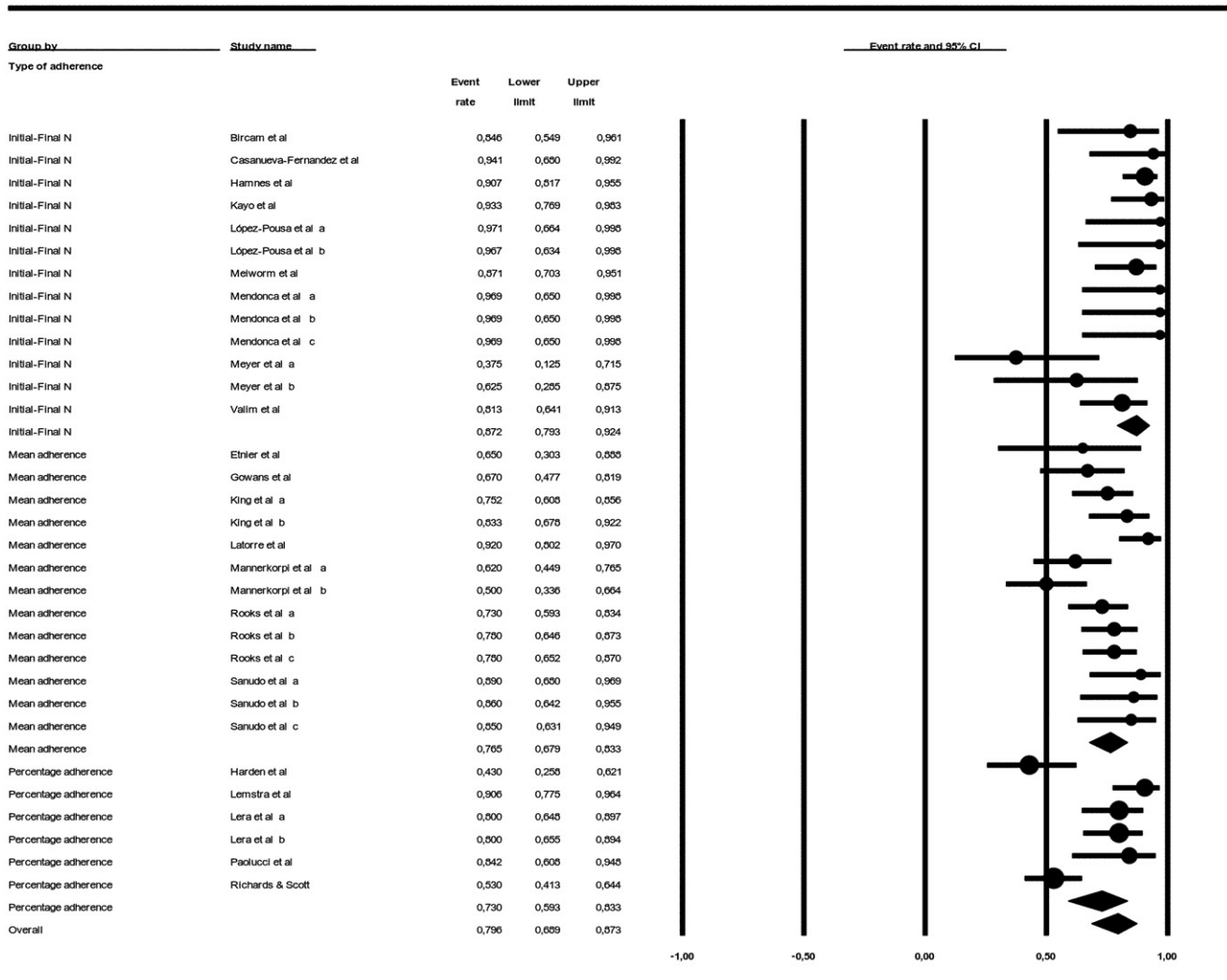


Figure 2. Forest plot of the adherence rates classified as a function of the type of adherence reporting.

adherence was reported or not in the study, with lower mean adherence for studies that did report it ($Q_B(1)=5.497$, $p=.019$; $R^2=0.21$) and whether the reported adherence was specific of walking or of all the treatment, with lower mean adherence for studies that reported specific adherence for walking ($Q_B(1)=9.659$, $p=.002$; $R^2=0.22$) (see Supplementary Table S4). With regard to other methodological variables (see Table 2), the random assignment of the participants to the groups reached statistical significance, and the mean adherence for simple random assignment was larger than for the other two types of random assignment ($Q_B(2)=6.121$, $p=.047$; $R^2=0.25$). In addition, two contextual moderator variables presented a statistically significant relationship with the adherence rates (see Table 2): the continent where the study was carried out ($Q_B(2)=7.454$, $p=.024$; $R^2=0.05$), with the studies conducted in South America presenting better mean adherence than those of Europe and North America, and the publication year of the studies, with the more recent ones exhibiting better adherence rates than the earlier ones ($Z=2.49$, $p=.013$; $R^2=0.08$).

In relation to the characteristics of the participants (see Table 3), the recruitment of participants was a moderator variable of adherence to the program ($Q_B(3)=13.222$, $p=.004$; $R^2=0.40$), with the highest average rate of adherence when recruitment was through physicians ($P_+=85.9\%$; 95% CI: 77.5 and 91.5%) and the lowest rate was from the use of advertising ($P_+=57.2\%$; 95% CI:

41.7 and 71.4%). Another moderator variable that exhibited a positive, statistically significant relationship with the adherence rates was the standard deviation of age in the samples ($Z=2.33$, $p=.020$; $R^2=0.23$; see Table 3).

Analyses conducted on moderating variables related to the characteristics of interventions (see Table 4) showed a statistically significant relationship for the supervisor training ($Q_B(4)=12.687$, $p=.013$; $R^2=0.35$), with the largest mean adherence rate being exhibited by nurses ($P_+=96.9\%$; 95% CI: 88.7 and 99.2%), and the poorest adherence being for experienced researchers ($P_+=65\%$; 95% CI: 21.5 and 92.6%). Two additional moderator variables were statistically related with the adherence rates (see Table 4): the duration of the intervention ($Z=-2.09$, $p=.037$; $R^2=0.02$) and the total number of intervention sessions ($Z=-2.13$, $p=.033$; $R^2=0.0$). However, these two last variables presented practically no explained variance.

It is important to note that all the Q_W and Q_E tests reported in the moderator analyzes (see Tables 2–4 and Supplementary Table S4) reached statistical significance. This meant that, although some moderator variables were statistically related to the adherence rates, a large heterogeneity still remained to be explained.

Analysis of publication bias

To examine whether publication bias might be a threat to the validity of the meta-analytic results, a funnel plot of the

Table 2. Results of the subgroup analyzes for methodological and contextual moderator variables.

Moderator variables (qualitative)	<i>k</i>	P_+	95% CI		ANOVA results	
			P_L	P_U		
Continent					$Q_B(2) = 7.454, p = .024$ $R^2 = 0.05$	
Europe	19	.807	.737	.861		
North America	8	.691	.550	.804	$Q_W(29) = 90.363, p < .001$	
South America	5	.919	.801	.969		
Design type					$Q_B(2) = 2.353, p = .308$ $R^2 = 0.11$	
RCT	27	.788	.727	.838		
Quasi-experimental	2	.898	.729	.967	$Q_W(29) = 86.705, p < .001$	
Pilot study	3	.716	.419	.899		
Random assignment					$Q_B(2) = 6.121, p = .047$ $R^2 = 0.25$	
Simple	17	.825	.761	.875		
Restrictive	1	.530	.262	.782	$Q_W(19) = 42.264, p < .001$	
Stratified	4	.744	.609	.845		
Masking					$Q_B(2) = 2.966, p = .227$ $R^2 = 0.0$	
Not reported	12	.762	.658	.842		
Assessors and patients	6	.888	.763	.951	$Q_W(29) = 94.567, p < .001$	
Assessors only	14	.791	.702	.859		
Control group					$Q_B(1) = 0.164, p = .686$ $R^2 = 0.0$	
Waiting list	6	.802	.650	.898		
Standard treatment	13	.832	.733	.899	$Q_W(17) = 67.782, p < .001$	
Methodological quality					$Q_B(2) = 2.791, p = .248$ $R^2 = 0.0$	
Poor (0–4.99)	8	.764	.624	.864		
Medium (5–9.99)	18	.835	.763	.889	$Q_W(29) = 96.933, p < .001$	
High (10–14)	6	.728	.577	.840		
Moderator variables (continuous)	<i>k</i>	b_j	<i>Z</i>	<i>p</i>	Q_E	R^2
Methodological variable						
Total quality score (0–14)	32	0.005	0.08	.937	100.69***	0.0
Contextual variable						
Publication year	32	0.084	2.49	.013	91.39***	0.08

RCT, randomized controlled trial; *k*, number of studies in each category; P_+ , mean adherence rate for each category; P_L and P_U , lower and upper limits of the 95% confidence interval around the mean adherence rate for each category; Q_B , between-categories statistic to test the mean adherence rates; Q_W , total within-category statistic to test the model misspecification; R^2 , proportion of variance explained by the quality item; b_j , regression coefficient of the moderator variable; *Z*, statistical test of b_j ; Q_E , residual heterogeneity statistic to test the model misspecification.
*** $p < .001$. R^2 = proportion of variance explained by the moderator variable.

Table 3. Results of the subgroup analyzes for participants' moderator variables.

Moderator variable (continuous)	<i>k</i>	b_j	<i>Z</i>	<i>p</i>	Q_E	R^2
Participant characteristics						
Gender (% women)	31	0.036	1.35	.177	89.02***	.09
Mean age (in years)	32	0.068	1.48	.139	94.95***	.04
SD of the age (in years)	28	0.141	2.33	.020	62.52***	.23
Mean duration of disorder	22	−0.045	−0.99	.323	73.27***	.0
SD of the duration of disorder	21	−0.065	−1.31	.191	54.79***	.0
Moderator variables (qualitative)	<i>k</i>	P_+	95% CI		ANOVA results	
Participant origin			P_L	P_U	$Q_B(3) = 3.636, p = .304$ $R^2 = .08$	
Associations	7	.839	.700	.921		
Community	5	.885	.724	.958	$Q_W(27) = 84.94, p < .001$	
Primary care	9	.734	.620	.701		
Specialized care	10	.796	.824	.866		
Participant recruitment					$Q_B(3) = 13.222, p = .004$ $R^2 = .40$	
Physician	6	.859	.775	.915		
Advertisement	5	.572	.417	.714	$Q_W(21) = 45.94, p = .001$	
Physician + advertisement	7	.800	.686	.880		
Researchers	7	.801	.696	.877		

k, number of studies; b_j , regression coefficient of the moderator variable; *Z*, statistical test of b_j ; Q_E , residual heterogeneity statistic to test the model misspecification; R^2 , proportion of variance explained by the moderator variable; P_+ , mean adherence rate for each category; P_L and P_U , lower and upper limits of the 95% confidence interval around the mean adherence rate for each category; Q_B , between-categories statistic to test the mean adherence rates; Q_W , total within-category statistic to test the model misspecification; R^2 , proportion of variance explained by the quality item.
*** $p < .001$.

adherence rates was constructed, and the trim-and-fill technique was applied to achieve symmetry in the funnel plot. As Figure 3 shows, the trim-and-fill technique imputed 7 additional values to achieve symmetry. The mean adherence rate with the 32 original

estimates was $P_+ = 79.5\%$ (95% CI: 73.8 and 82%), whereas the average adherence adding the 7 imputed estimates was slightly lower: $P_+ = 76.4\%$ (95% CI: 70.2 and 81.6%). As the average adherence rate with the imputed values implied a negligible

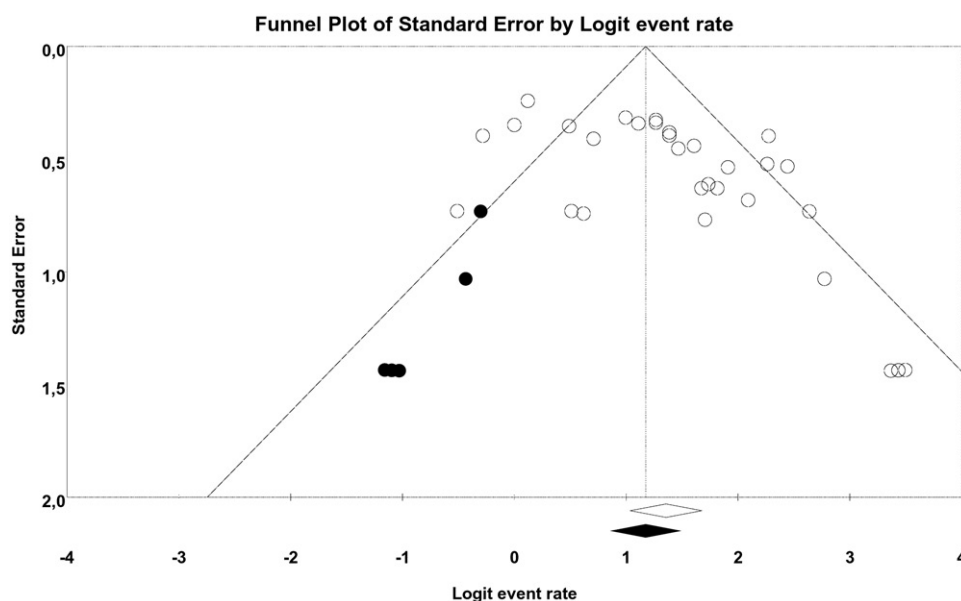


Figure 3. Funnel plot with the trim-and-fill technique of the adherence rates. Black dots represent the imputed adherence estimates to achieve symmetry.

Table 4. Results of the subgroup analyzes for intervention moderator variables.

Moderator variables (qualitative)	k	P ₊	95% CI		ANOVA results	
			P _L	P _U		
Type of intervention					Q _B (2) = 3.375, p = .185 R ² = .13	
One component	12	.731	.621	.818		
Multicomponent	10	.846	.755	.907	Q _W (29) = 83.06, p < .001	
Multidisciplinary	10	.805	.711	.874		
Progressive time					Q _B (1) = 1.248, p = .264 R ² = 0.0	
No or not reported	18	.824	.748	.881		
Yes	14	.764	.673	.836	Q _W (30) = 97.96, p < .001	
Progressive effort					Q _B (1) = 0.164, p = .685 R ² = .01	
No or not reported	21	.802	.734	.856		
Yes	11	.778	.664	.862	Q _W (30) = 94.90, p < .001	
Physical training supervised					Q _B (1) = 0.304, p = .582 R ² = 0.0	
No or not reported	9	.769	.637	.864		
Yes	23	.804	.738	.857	Q _W (30) = 100.5, p < .001	
Supervisor training					Q _B (4) = 12.687, p = .013 R ² = .35	
Physical exercise instructor	4	.699	.531	.826		
Physical therapist	9	.804	.709	.873	Q _W (15) = 42.12, p < .001	
Occupational therapist	1	.907	.691	.977		
Experienced researcher	1	.650	.215	.926		
Nurse	5	.969	.887	.992		
Psychological treatment					Q _B (1) = 0.409, p = .522 R ² = 0.0	
No	23	.784	.708	.844		
Yes	9	.820	.720	.889	Q _W (30) = 99.81, p < .001	
Psychological treatment to improve adherence					Q _B (1) = 1.119, p = .290 R ² = .03	
No	31	.789	.731	.838		
Yes	1	.906	.634	.982	Q _W (30) = 95.65, p < .001	
Moderator variables (continuous)	k	b _j	Z	P	Q _E	R ²
Treatment characteristics						
Duration (n° of weeks)	32	-0.052	-2.09	.037	96.28***	.02
Intensity (n° sessions in a week)	31	0.022	.17	.863	95.43***	.0
Sessions (total n° of sessions)	31	-0.016	-2.13	.033	92.34***	.0
Sessions duration (in minutes)	30	0.008	1.60	.108	74.37***	.10
Treatment magnitude (total hours)	30	-0.001	-.11	.914	81.64***	.0
Walking magnitude (total hours)	30	-0.029	-1.66	.097	78.59***	.03
Mean effort	21	-0.006	-.63	.528	59.96***	.0
% of supervised sessions	15	-0.013	-1.54	.123	38.98***	.28

k, number of studies in each category; P₊, mean adherence rate for each category; P_L and P_U, lower and upper limits of the 95% confidence interval around the mean adherence rate for each category; Q_B, between-categories statistic to test the mean adherence rates; Q_W, total within-category statistic to test the model misspecification; R², proportion of variance explained by the quality item; b_j, regression coefficient of the moderator variable; Z, statistical test of b_j; Q_E, residual heterogeneity statistic to test the model misspecification; R², proportion of variance explained by the moderator variable.

*** p < .001.

reduction of 3.4% only, publication bias can be discarded as a serious threat to the results.

Discussion

To the best of our knowledge, this systematic review and meta-analysis is the first that aims to explore the adherence to interventions that include walking as exercise in patients with fibromyalgia. Overall findings showed high rates of adherence to these programs. Recruitment of participants by physicians and intervention variables such as supervisor training were relevant among the different moderator variables of adherence collected in this review. We found other significant moderators, e.g. the duration of sessions, but with very little relevance.

With regard to the high rates of adherence in terms of attendance to the program, our findings are coincident with a review of aerobic exercises in fibromyalgia that established a mean of attendance of 78.1% in experimental groups and 83.1% in control groups [6]. These high rates are appropriate to maintain the benefits of physical exercise in a population with chronic musculoskeletal pain [18] and fibromyalgia [17], as long as people continue to exercise once the program is finished. Given the similarity of adherence rates with other studies of aerobic exercise in fibromyalgia with proven effectiveness, this could mean that walking—an easy, comfortable, and recommended exercise in this population—is indeed expedient in sustaining physical activity in these persons. However, adherence to walking in and between exercise sessions is not known because it is not reported in any of the studies included in this review. Regarding adherence after treatment, in only two studies was the adherence to exercise reported throughout follow-up [39,44].

The fact that the adherence data was reported or not has resulted in 18% of explained variance, indicating that those who have not reported the adherence, obtained better means. This may show an overestimation of the rates since we have obtained them through the initial and final sample data and they are not contributed by the authors. With regard to rates of adherence to only-walking, they have only been measured in two studies [31,37] and this does not allow us to draw any conclusions. The reporting of the adherence data may influence the remaining significant moderating variables. In the case of contextual variables, none of the studies conducted on the continent of South America report adherence [35,38,53]. Likewise, the omission of this data by the authors occurs in studies published more recently [52,53]. In the case of sample age variability, it is related to the best adherence rates with 23% of explained variance, but if we analyze these results in detail, we can see that, most studies that have the most standard deviations, did not report adherence rates and we had to calculate them [32,35,41,53].

The absence of data regarding adherence to physical exercise in fibromyalgia is observed in prior systematic reviews [13,21]. Specifically, in the context of supervised interventions of walking in samples with chronic diseases including fibromyalgia, information about participants' adherence was also scarce [15]. As in a recent umbrella study (review of reviews) on exercise interventions in fibromyalgia [54], none of the studies included in our review took advantage of appliances to monitor heart rates in order to report whether the participants reached the target intensity or the intensity progression. Although 23 of the 32 experimental groups were supervised in-session, we do not know whether participants completed their exercises as instructed. Some authors have suggested the use of scales to supervise performance [55,56]. Nevertheless, the supervision of exercise performance in-session does not reflect what happens between

sessions or after the treatment in an unsupervised environment. Under supervision, the individual does not have the autonomy to choose whether or not to adhere [55]. Therefore, it would be necessary to measure the performance between sessions and after the treatment to know the real adherence by individual choice.

In relation to who supervised exercise, we found that when nurses performed this task, the adherence rates were higher. Nurses are health professionals with a relevant role in rehabilitation of people with fibromyalgia [57], which is highlighted by patients as a useful complement of the rheumatology consultations [58]. However, our results could be questioned by two facts. First, as pointed out earlier, studies reporting adherence have achieved worse rates and this should be considered, as none of the studies monitored by nurses reported adherence data. Second, other professionals could be under-represented in these analyzes, because in some cases, the number of studies in each category was only one (occupational therapist [41] and experienced researcher [47]).

When the participants were recruited by physicians, either from specialized or primary care, adherence rates to the program were higher. The remaining options of recruitment were generally through the contact of researchers with patients' associations and the voluntary attendance of participants through advertisements. In the context of adherence to drug therapies in fibromyalgia, the therapeutic relationship is influential [59] in the sense that with lower physician-patient discrepancy and longer treatment with the professional, it is more likely that patients adhere to the treatments [60]. Moreover, in a population with chronic fatigue it has been shown that the provider expertise also influences the adherence of participants [61]. Our results are consistent with the above findings and show the relevance of the professionals' behavior in adherence. Compliance with the intervention in programs with walking may also be related to the effect of what could be interpreted as the advice given by a doctor, who is seen as a reference authority and with whom a relationship of trust has been established. In fact, in a previous study, medical advice was the most important predictor of walking [62]. This should be considered in order to reinforce the persuasiveness of doctors in the communication with their patients when encouraging physical exercise. Another significant moderator of participants' variables was the greater variability in the age of the sample, but careful observation reveals that most of the studies that have the greater typical deviations, did not report the adherence rates.

Otherwise, our findings are not consistent with other systematic reviews that reported the improvement of adherence to exercise through the implementation of strategies for enhancing self-efficacy and self-management on samples of chronic pain [18] and fibromyalgia [13,17,21,22]. There is evidence of positive effects on adherence by including educational or behavioral techniques to encourage accomplishment [19] or incorporating cognitive behavioral therapy, education, or relaxation [13]. In our study, we have classified this type of intervention as multidisciplinary studies. However, we have not obtained significant results among different types of treatment (one-component, multi-component or multidisciplinary) on adherence, whereas the results of another recent review showed that combining different exercises had higher rates of therapeutic adherence [63]. Nevertheless, to analyze the moderators of adherence better, more studies that include this aim might be necessary [29].

There are some limitations that should be considered in this review. We might overestimate the adherence to walking exercise through the rates obtained. Apart from the specific lack of information on whether the participants performed walking in and between exercise sessions, we have calculated the estimates of

adherence from 32 experimental groups in which 10 included walking as the only exercise. In fact, although high, the mean of estimates of the 10 experimental only-walking-exercise groups is slightly lower than the other two types of intervention (multi-component and experimental groups). This could suggest that including other activities in itself produces better adherence, but as the type of intervention was not a moderator, more investigation is needed to determine whether this fact is related to the lack of data reported by studies, the mode of codification of data in this review or even, to the still low number of studies of walking in this sample.

Another limitation could be that, we might have overlooked other potential moderators. Further research is needed to explain in more detail the variability among adherence rates. Some contextual variables have shown an influence on adherence to treatments in musculoskeletal pain [64]: patients' expectations of the treatment [65], the therapeutic relationship between professional-participant [66], and the physical environment of the intervention [67]. Alternatively, variables related to the characteristics of patients such as severity of disorder, comorbid conditions and age that could hinder exercise [51] might be relevant as moderators of adherence, since there is growing interest in tailoring the programs not only to improve the exercise adherence in fibromyalgia but also to optimize the benefits of physical activity [17]. Finally, another limitation that prevents the generalizability of the review findings is the exclusion of male samples.

Regarding the limitations of the included studies themselves, we discovered a lack of clarity in the criteria used to distinguish the participants who completed the treatment and those that did not. Moreover, it was difficult to find coherence amongst the heterogeneity of terms found in studies referring to the participants who follow or do not follow treatment and this factor might generate bias in the review [68]. Regarding data limitations, in some moderator variables there was only one study recorded in each category (e.g., there was only one study with "random assignment: restrictive" to the experimental group of graded aerobic exercise [34]) and this may be unrepresentative, therefore it must be taken with caution.

This review has several strengths. On the one hand, we have conducted an extensive search into all interventions of recent years containing walking exercise as treatment in fibromyalgia in any setting, including quasi-experimental trials, rather than limiting inclusion to studies on the basis of experimental design, or because they are only walking-based, or have only one context of intervention. On the other hand, the methodological quality of the assessment of adherence of most of the studies included reached moderate to high quality.

Conclusions

The studies reviewed showed overall moderate to high adherence rates in programs with walking exercise. Nonetheless, these adherence rates were mostly based only on the attendance at sessions of supervised exercise. Thus, we do not know if participants of these interventions sustained the walking exercise during and after the treatment. Nor do we know the intensity, the duration, or the frequency of the exercise performed between sessions and once the program was finished. Therefore, this review shows the attendance at sessions as a first step in the study of the efficacy of interventions regarding walking adherence. More studies are needed to investigate the assessment of exercise parameters in order to find the proper prescription for better adherence to walking in fibromyalgia.

The meta-analysis of different types of walking interventions showed that the physicians' encouragement and the supervision of exercise by nurses may promote better adherence of people with fibromyalgia. Moreover, the combinations with other activities may result in better adherence to walking than those that are only-walking exercise. Further research is needed to improve knowledge of the moderator variables in adherence rates to walking.

Meanwhile, we encourage further and better reports on adherence issues and the strategies carried out in trials both to assess and to manage them in order to provide data for future research. To this end, the assessment of both adherence to the frequency and intensity of exercise, and increased fibromyalgia symptoms and adverse events associated with walking need to be systematically documented and reported.

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