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# **Motivation toward physical activity in patients with chronic musculoskeletal disorders: a meta-analysis of the efficacy of behavioural interventions**

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## Abstract

Musculoskeletal disorders (MDs) represent a global health issue, which can lead to disability. Physical activity (PA) reduces pain and increases physical function among patients with MDs. To promote behavioural changes, it seems important to focus on modifiable factors, such as motivation. Thus, this review aims to assess effects of interventions targeting PA on motivation towards PA. Searches used terms referring to "physical activity", "motivation" and "chronic musculoskeletal disorders" on the databases PubMed, PsychINFO, MEDLINE, EMBASE, PEDro and Web of Science. All types of intervention-including but not limited to RCTs-were eligible for inclusion. Risk of bias was assessed with the Quality Assessment Tool for Studies with Diverse Designs (QATSDD). Among 6 489 abstracts identified, there were 387 eligible studies and 19 were included, reporting in total 34 effect sizes. The meta-analysis concerned 1 869 patients and indicated a small effect of interventions on change in motivation towards PA ( $d = 0.34$ ; 95% CI [0.15; 0.54];  $p < .01$ ;  $k = 33$ ). Behavioural interventions positively impact PA motivation in patients with MDs. In the literature, most studies focused on intervention's effect on fear of movement. Future research should assess other explicit motivational constructs, as well as implicit processes.

Nowadays, people live longer<sup>1</sup> but become more prone to non-communicable diseases, including musculoskeletal conditions<sup>2</sup>. Musculoskeletal disorders (MDs)—osteoarthritis, low back or neck pain—represent a widespread health issue, which can lead to temporary or permanent disability at work, causing high costs for global economy<sup>3</sup>. In 2021, MDs were the leading cause for years lived with disability worldwide, with a prevalence of 1,690 million<sup>3,4</sup>, women being more affected than men.

Physical activity (PA) is unequivocally recommended in the management of MDs<sup>5– 8</sup>, due to its effects in reducing pain, improving physical function and quality of life<sup>9– 11</sup>. However, a large majority of patients affected by MDs are not sufficiently active in regard to WHO's recommendations (i.e., 64%-73%)<sup>12,13</sup>. Therefore, it seems crucial to implement efficient interventions to promote PA behaviour in this population. Several systematic reviews and meta-analyses examined the effect of interventions aiming at increasing PA level in MDs patients<sup>14–18</sup>, revealing mixed results. Some articles do not report significant increase<sup>17,18</sup>, while others do <sup>14,16</sup>. Mansi et al.'s systematic review<sup>16</sup> showed that interventions using pedometers appear to be effective. Davergne et al.<sup>13</sup> found similar results: the use of wearable activity trackers (including pedometers) led to an increase in daily steps ( $d = 0.83$ ), and in the time spent in moderate-to-vigorous PA ( $d = 0.41$ ) at the end of the intervention. However, these results are based on a small number of studies—7 and 3, respectively—and there was no evidence of a maintained change in PA at follow-up 2 to 4 months after the end of the interventions. This last result is in line with two previous meta-analyses in which no significant increase in objectively

To take up this challenge, it is essential to focus on behaviour determinants<sup>19</sup>. Among factors that may account for this absence of long term effect, patient's motivation is considered as a key construct to understand the process of behaviour change<sup>20</sup>. Motivation is defined as “a driving force or forces responsible for the initiation, persistence, direction, and vigour of goal-directed behaviour”<sup>21</sup>. In health psychology, socio-cognitive models, which consider the rationality of individuals as the root of behaviours adoption, were predominantly used as theoretical basis in previous studies. With this regard, some authors pointed out the presence of a small set of core concepts that enable understanding the adoption of a behaviour or its absence<sup>19</sup>. Those concepts include (i) beliefs associated with positive / negative behaviour's effects, (ii) beliefs in one's ability to achieve it; and (iii) individual's intention to achieve it. In patients with MDs, there was a major focus on negative outcomes mentally associated to PA behaviour; this particular type of belief was frequently studied through fear of movement or kinesiophobia<sup>22</sup>. Kinesiophobia is defined as an excessive, irrational and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to a painful injury or reinjury<sup>23</sup>. Fear of movement is a specific fear of movement and physical activity that is (wrongfully) assumed to cause reinjury<sup>24</sup>. Although the definitions are distinct, those two concepts are very similar<sup>25</sup> and are sometimes used interchangeably. Finally, PA is perceived as a dangerous behaviour by individuals.

To complement the dominant, socio-cognitive approach, dual models have been proposed in health psychology<sup>26</sup>. The authors of such models state that two main types of processes govern our behaviours: explicit and implicit. This dichotomy is based on the idea that humans act according not only or always to their reason (explicit), but also to their drives (implicit)<sup>27</sup>. Over the past decade, there has been a significant increase in the number of studies questioning health-related behaviour adoption through this lens. Regarding PA, most previous studies derived from dual models focused on implicit attitudes (i.e., automatic evaluations of a behaviour, as favourable or unfavourable). Recently, Chevance et al.<sup>28</sup> conducted a meta-

analysis of 26 studies on this concept, and concluded to the existence of a significant relationship between individual's implicit attitudes towards PA and their level of PA. Such results were in particular observed among people with chronic conditions (i.e., obese patients<sup>29</sup>; chronic respiratory disease patients<sup>30</sup>), but at the time no study was reported among patients with

chronic MDs. In sum, past literature suggests that to improve MDs patients' level of PA, interventions should target PA motivation both at the explicit and implicit level.

Additionally, there were previous attempts to examine the extent to which behavioural interventions actually impact PA motivation is subject to potential moderator effects. Firstly, Knittle and colleagues<sup>20</sup> observed that all theoretical constructs may not equally evolve following such an intervention. Larger effects of the intervention were observed in the studies of autonomous motivation (i.e., when people engage in a behaviour for pleasure or fun, when it is congruent with an individual's sense of self or when it is personally important to the individual) compared to intention. Past literature also examined which characteristics of intervention were associated to PA intervention efficacy. In particular, several features of intervention are associated with more important effects on PA motivation. Interventions targeting groups were more successful than those targeting individuals<sup>31</sup>. Knittle et al.<sup>20</sup> found similar results and also observed that interventions incorporating face-to-face<sup>20</sup> components resulted in larger effects compared to those without face-to-face components. However, those meta-analyses did not specifically focus on population concerned by chronic disease, and none concerned MDs patients.

The aims of this systematic review and meta-analysis are thus to (i) assess the effects of intervention targeting PA on motivation towards PA among patients with chronic MDs and (ii) identify potential theoretical and methodological moderators of intervention efficacy.

## Methods

### Guidelines and registration

The protocol of the current systematic review and meta-analysis was registered at the PROSPERO international database (Number: CRD42021234601). Procedures followed the principles of Preferred Reporting Items for Systematic Reviews and Meta-analysis<sup>32</sup>. All relevant study material (e.g., pre-registration protocol, pre-print, data and R code) and Supplementary Materials are available on the Open Science Framework (see [https:// osf.io/tybwz/](https://osf.io/tybwz/)).

### Search strategy

The following electronic databases were used: PubMed, PsycINFO, MEDLINE, EMBASE, PEDro, Web of Science from inception to March 2021. Search terms were referring to “physical activity”, “motivation”, and “chronic musculoskeletal disorders”, using the AND modifier. The keywords used in different databases are listed in Supplementary Material 1. There was no restriction on publication date. Studies published in English, Spanish, French or Italian were considered for inclusion.

## **Inclusion and exclusion criteria**

Studies meeting the following PICOS criteria were considered eligible for inclusion: (1) Population: adults ( $\geq 18$  years) with chronic MDs ( $\geq 3$  months); (2) Intervention: targeting explicitly a change in PA motivation and/or in PA behaviour; (3) Comparison intervention: all conditions, except identical interventions concerning PA and the absence of a control group; (4) Outcomes: a motivational construct assessed pre—and post—intervention; (S) Study design: all experimental design.

For each step of the studies selection, four reviewers established inter-rater reliability, using percentage agreement, working in dyads based on 5% of the articles. If a researcher was not sure about an article inclusion, reviewers discussed until a consensus decision on inclusion/exclusion was reached. They independently screened the titles and abstracts of studies retrieved and then the full-text retained. For studies fulfilling all inclusion criteria but presenting data unsuitable for meta-analysis, corresponding authors were contacted up two times by email to obtain appropriate data.

Coding and data extraction: The same reviewers extracted data. Once the final studies' inclusion was made, inter-rater reliability in data coding was assessed with a phase in dyads based on 10% of the articles. Then, the articles were divided among reviewers. Data were extracted regarding study population and design (number of participants, sex ratio, mean age, mean BMI, type of musculoskeletal disorder, level of pain), outcomes (motivation variables), and intervention characteristics: duration in weeks, modalities (face-to-face, digital, mix). Data are provided in Supplementary Material 2.

Quality was assessed with the Quality Assessment Tool for Studies with Diverse Designs (QATSDD)<sup>33</sup>. Scores on the QATSDD can range from 0 to 42. This tool was not proposed to determine which studies should or should not be excluded from a review, but only to get a sense of the variability of methodological quality within the set of studies included. According to Sirriyeh et al.<sup>33</sup>, any cut-off points to indicate high or low quality would be arbitrary. From its publication to December 2019, it has been used in more than 80 reviews<sup>34</sup>.

For this step, inter-rater reliability in quality assessment was calculated for a phase in which dyads evaluated 10% of the articles. In the event of ambiguous cases raised by a researcher, consensus was sought through discussion in the team.

## **Statistical analyses**

Based on the mean, standard deviation, and sample size at both points of measurement in each group, Hedges'  $g$  was used as the primary measure of cumulative effect size and 95% CIs and two-sided  $p$ -values were calculated. The magnitude of effect sizes was interpreted as small  $> 0.2$ , medium  $> 0.5$  or large  $> 0.8$ <sup>35</sup>.

A method of Robust Variance Estimation (RVE) was used to account for dependencies of having multiple effect sizes come from each study. A correction for meta-analysis with fewer than 40 studies included were applied<sup>36</sup>. RVE with small sample correction was used as the main meta-analysis.

## **Sensitivity analyses**

A set of sensitivity analyses were carried out. For outliers' detection, we performed Baujat and funnel plots. There are two other options recommended to deal with dependencies in effect sizes: aggregating effect sizes within study and performing a multi-level meta-analysis<sup>37</sup>. These options (i.e., aggregation and multi-level analyses) were performed as sensitivity analyses. Then, we compared these models to verify the robustness of our estimated effect sizes.

Heterogeneity was quantified using the I<sup>2</sup> indicator.

## **Moderator analyses**

We conducted moderator analyses according to Assink and Wibbelink<sup>38</sup>. Significant moderator effects were discussed when at least 4 effect sizes were available for all modalities.

All analyses were carried out in R 4.0.3<sup>39</sup>, the code used for this study is available in Supplementary Material 3.

We used the robumeta package<sup>40</sup> for the robust variance estimation meta-analysis, the metafor package<sup>41</sup> for study aggregation and multi-level meta-analyses.

# **Results**

## **Eligible studies and assessment tools**

The PRISMA flowchart summarizing the process of study selection and the reasons for study exclusion is shown in Fig. 1. The other items on the PRISMA checklist are presented in Supplementary Material 4. Of the 432 fulltext articles assessed for eligibility, 19 were included with 34 effect sizes. In the various stages of selection, we achieved very good interrater reliability, with kappa values ranging from 0.67 to 1.

## **Descriptive sample characteristics**

The characteristics of studies are shown in Supplementary Material 2. Overall, this study involved 1,869 patients with a mean age of 56.1 (• +/- 9.3) years. They had been experiencing pain for an average of 97.6 (• +/- 58.8) months. Their mean pain was 53.3 (• +/- 14.8) on a visual analog scale of 100. They had a mean BMI of 29.1 (• +/- 3.6). All interventions included both women and men. Eight studies (42%; k = 9) focused on patients with chronic low back pain, seven studies (37%; k = 15) were conducted on patients with arthritis, and only one study (5%) included patients with neck pain (k = 2), ankylosing spondylitis (k = 2), rheumatoid arthritis (k = 2) and axial spondylarthritis (k = 4), respectively.

## **Descriptive intervention characteristics**

On average, the interventions lasted 12.7 weeks. Only three interventions out of 19 (16%) were explicitly based on theoretical models of motivation. Ten interventions (53%) were individual, six (32%) collective and three (16%) mixed. Of the 19 interventions, 14 (78%) were with a face-to-face interventionist only, one (6%) was only phone sessions, and three (17%) were mixed, through smartphone (two, 11%) or phone sessions (one, 6%). Fourteen interventions (74%) out of 19 provided PA, among which 13 (68%) included supervised practice.

Seven studies (37%) combined PA with educational sessions, two (11%) with a booklet, two with both educational sessions and a booklet (11%), and two provided PA practise only (11%). Of the five interventions (26%) without PA practice, four (21%) provided educational sessions and booklet, and one (5%) booklet only.

Regarding control groups, six studies (32%) had no intervention, seven (37%) included PA, four studies (21%) offered booklet but no PA practise, one study (5%) proposed both PA with educational sessions and a booklet, and one study proposed only educational sessions (5%).

## **Motivational outcomes**

The 19 studies yielded effect sizes on 34 motivation scores. Out of those 34 outcomes, fear of movement or kinesiophobia were assessed 13 times (38%); exercise self-efficacy and barriers five times each (15%); PA benefits, four times (12%); and six variables were assessed only once: attitudes, autonomous motivation, barriers, controlled motivation, facilitators, and perceived impact on disease. The scales used to assess each motivational outcomes are presented in Supplementary Material 5.

## **Risk of bias**

The set of included studies had a QATSDD mean score of 31 (•) 3.0) on 42. This appears similar to previous investigations using the same tool—in their systematic review of PA intervention among disabled people, Jaarsma and Smith (2018)<sup>42</sup> reported an average score of 27. In our meta-analysis, studies' quality was globally respected for the following items: the presentation of explicit framework, stating their aims clearly in the report, and fitting the research question, and analysis method used. However, studies usually scored poorly on items related to sample size consideration, information on data collection, and involving users or stakeholders in the study design.

Full information on the risk of bias of each study is available in Supplementary Material 6.

## **Meta-analysis and sensitivity analyses**

An outlier was identified and removed<sup>43</sup>. The RVE corrected for small sample size indicated a small effect of interventions on post-interventions motivation ( $d = 0.34$ ; 95% CI [0.15; 0.54];  $p < 0.01$ ;  $N = 19$ ;  $k = 33$ ; see Fig. 2). Between-study heterogeneity was moderate ( $I^2 = 47\%$ ).



The estimate was very comparable to the one observed with other strategies (study aggregation:  $d = 0.31$ ; 95% CI [0.15; 0.48];  $p < 0.01$ ;  $N = 19$ ;  $k = 33$ ; multi-level meta-analysis:  $d = 0.35$ ; 95% CI [0.17; 0.54];  $p < 0.01$ ;  $N = 19$ ;  $k = 33$ ; see Supplementary Material 7).

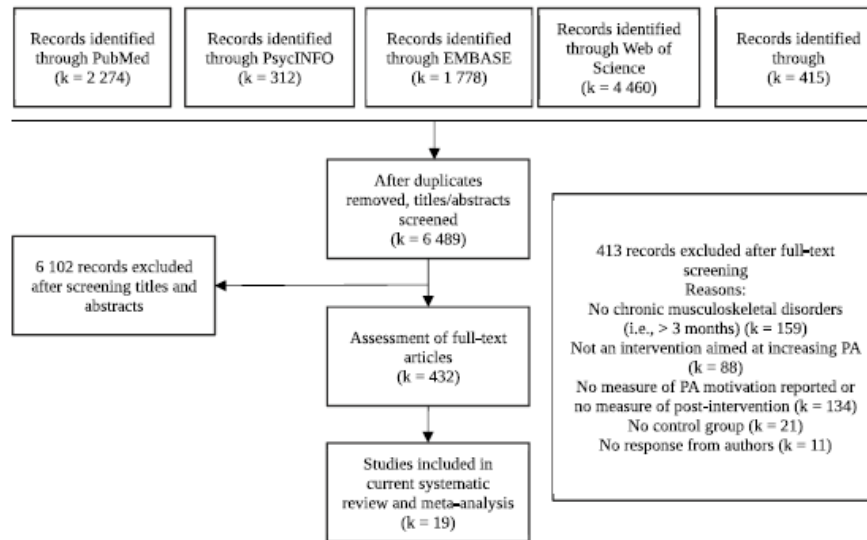


Figure 1. Flow diagram of inclusion process.

## Moderator analyses

Various moderator analyses were computed, so as to examine whether motivational constructs (fear vs self-efficacy vs other), modality of intervention (individual vs collective vs mixed), mode of delivery (face to face only vs with smartphone support vs with phone sessions), type of pathology (arthritis vs chronic low back pain vs other), type of intervention (PA only vs PA and additional features), duration of intervention, and study quality, significantly impacted intervention efficacy. There was not significant result. All analyses carried out are available in Supplementary Material 3.

## Discussion

This meta-analysis assessed the effects of intervention targeting PA on motivation towards PA among patients with chronic MDs. This work included 19 studies, representing 34 effect sizes and involving 1 869 patients. The studies had a mean QATSDD score of 31 out of 42. In general, studies adequately presented an explicit framework, clearly stated their aims in the report, and aligned the analysis method used and the research question. Our work is the first to examine this research question focusing on this specific population. In view of MDs' impact on individuals and societies, it is essential to address the issue of regular PA in these populations. The analyses showed a small effect of interventions on motivation.

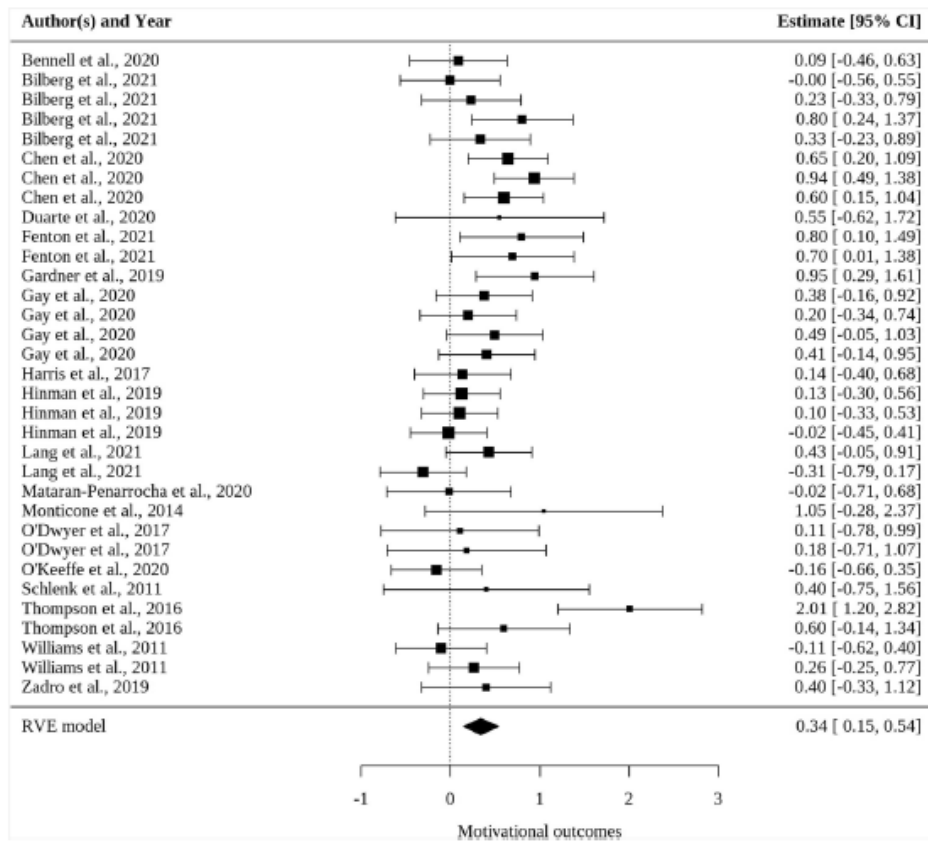


Figure 2. Forest plot of RVE corrected for small sample size.

### Overall effect size

The main meta-analysis (i.e., Robust Variance Estimation corrected for small sample sizes) indicated that compared to those in control groups, participants in intervention groups presented a significantly larger change in PA motivation ( $d = 0.34$ ). There was a low to moderate level of heterogeneity ( $I^2 = 47%$ ) [44](#).

We consider this result as consistent because the two other ways of addressing dependent effect sizes in a meta-analysis (i.e., study aggregation and multi-level meta-analysis) lead to comparable results (respectively,  $d = 0.31$  and  $d = 0.35$ ).

Our work is in line with previous meta-analyses investigating the impact of interventions aiming at increasing PA levels on motivation towards this behaviour, in which effect sizes ranging from small [20](#), [45](#) to moderate [46,47](#) were reported. However, those results were observed in individuals from the general population [20](#), [46](#), obese individuals [47](#), or elderly individuals [45](#).

Our secondary aim was to discern potential theoretical and methodological moderators that might impact intervention efficacy.

### Motivational constructs as moderators

Motivation is a theoretical concept encompassing multiple constructs. We did not find a moderating effect of these constructs. In this work, over a third (13/34) of the effect sizes concerned fear of movement or kinesiophobia. Those variables incorporate beliefs regarding

the behaviour's effects and are specific to patients with chronic MDs. Self-efficacy and barriers to PA practice were also frequently studied ( $k = 5$  for each); those variables refer to individuals' perceived ability to engage in PA behaviour. Regarding the effect of interventions aimed at increasing PA on self-efficacy, our results are consistent with previous meta-analyses reporting small effect sizes ( $d = 0.23$  to  $0.37$ )[45,47](#).

### **Features of interventions as moderators**

This study explored several moderators of interventions effects but there were no significant results. Interventions therefore appear to be just as effective in modifying the various motivational constructs, whether they are delivered face-to-face or remotely, in groups or individually, and regardless of the duration of the intervention. These results do not align with the literature. Indeed, previous meta-analyses [20, 31](#) observed a favourable effect of group intervention on individuals motivation.

However, these previous works involved a much larger number of interventions (89 and 41, respectively) and predominantly included individuals without chronic pathology. We can hypothesize that the lack of motivation toward PA [48](#) in these patients may make them more responsive to an intervention, regardless of how it is delivered.

### **Strengths and limitations of the current study**

The present study adhered to the protocol previously deposited in the PROSPERO international database (Number: CRD42021234601). Additionally, employed robust and reproducible search, selection and coding procedures, all of which have been made accessible (see [https:// osf. io/ tybwz/](https://osf.io/tybwz/)). We posit that enhancing motivation for PA among these patients is important; indeed, qualitative studies report that lack of motivation is one of the most commonly reported barriers to physical activity [48, 49](#). This work thus provides a synthesis of existing interventions found to be effective in addressing this lack of motivation. Our systematic review showed that most studies in the literature focused on fear of movement and exercise self-efficacy. Specifically, examining fear of movement, assessed using the original Tampa Scale for Kinesiophobia Questionnaire or the PA subscale of the Fear Avoidance Beliefs Questionnaire, we observed that 5 out of 10 studies (50%) reported a difference greater than the minimal clinically important differences for this population (i.e., respectively 4.5 and 4 points) [50, 51](#). This is encouraging for clinicians, but it should not discount the inter-individual differences that may exist.

Our study has also some limitations. Compared to similar works examining the effect of interventions aimed at increasing PA levels on motivation, we found a relatively limited number of available studies. This smaller sample size may have restricted our ability to detect significant moderators. Furthermore, patients involved in our meta-analyses have different pathologies, with pain experienced for highly heterogeneous periods of time (i.e., ranging from a minimum of 3 months to over ten years).

Moreover, we opted to use a risk of bias assessment tool that does not provide thresholds[33](#). Nonetheless, we tested the moderating effect of study quality scores and found no significant results.

## Perspectives

Regarding motivational constructs, only few explicit processes have been studied in MDs patients to date. Fear of movement and self-efficacy are linked to the initiation of intention formation. Intention, while essential, often falls short as a sole determinant when it comes to actualizing behaviour for many individuals [52](#). It is therefore necessary to adopt (i) regulation processes, pertain to the factors that support achieving goals. These processes involve the execution of behaviour in alignment with one's intentions while adjusting them to suit the specific context; and (ii) reflexive or implicit processes, which represent less deliberative elements that impact behavioural actions, primarily via learned associations activated by specific circumstances and stimuli.

To the best of our knowledge, no study has investigated implicit processes in this population. In patients with chronic low back pain, Caneiro et al. [53](#) showed that self-report measures do not always reflect implicit associations between particular movements and threat. Among chronic respiratory patients, implicit attitudes were more favourable to PA at the end of a pulmonary rehabilitation programme. Moreover, they were associated 6 months later with PA [30](#). This stresses the importance of considering such PA predictors in patients with MDs. With regard to interventions, according to Rebar et al. [54](#), PA interventions could potentially enhance their effectiveness by integrating strategies that specifically target non-conscious regulatory, or implicit, processes. Previous research showed that interventions such as evaluative conditioning [55](#) or mental imagery [56](#) may modify implicit processes.

However, patient-reported barriers extend beyond mere motivation. Some of these factors include pain, time restrictions, false recommendations from healthcare professionals, or lack of social support [48](#), [49](#). The authors of these works highlight the diversity of responses from one individual to another. It is therefore important to propose interventions aimed specifically at targeting the needs and expectations of each patient.

Therefore, this systematic review with meta-analysis enabled us to identify some perspectives for interventions aimed at increasing PA in patients with chronic MDs.

For about twenty years, studies aimed at increasing PA in individuals have sought to describe their interventions more precisely. With this goal in mind, Michie et al. [57](#) have proposed a taxonomy of Behaviour Change Techniques (BCTs). BCTs are defined "as an observable, replicable, and irreducible component of an intervention designed to alter or redirect causal processes that regulate behaviour" [57](#). A meta-analysis has identified several BCTs more effective on motivation towards PA (e.g., behavioural goal setting, self-monitoring of behaviour, behavioural practice, or rehearsal) [20](#). Considering the literature specific to this population, we did not find adequate data to test these different BCTs as moderating variables. In patients with chronic MDs population, these BCTs should therefore be included in interventions and well described.

To this end, the Intervention Mapping framework [58](#) appears to be relevant [59](#). This approach, based on theory and evidence, allows interventionists to systematically plan, develop, implement, and evaluate health promotion programs (e.g., increasing levels of PA). It provides a structured 6-step approach to integrating evidence-based techniques and behaviour change theories.

Beyond the components of the interventions, the methodological design employed would benefit from evolving. Indeed, RCTs were well recognized as the “gold standard” for evaluating treatment or intervention outcomes [60](#). However, it seems necessary to adopt another experimental paradigm to understand changes in complex behaviours, including PA [61](#). Firstly, these designs, as in the studies included in this work, present two measurement times. Research that includes multiple evaluations has emphasized how health behaviours are subject to change over time and influenced by various factors, as demonstrated across different temporal contexts [62–64](#). As health behaviours are complex, adaptive and continuous tuning interventions should be more effective than “static” interventions and should therefore be adopted. In addition to these two proposals, Chevance et al. [61](#) have also called for a shift from group-only to group- and individual-level statistical inference.

## Conclusion

PA is the cornerstone of disease management among patients with chronic MDs. Nevertheless, they often present an insufficient PA level. Therefore, it is essential to set up dedicated interventions. To be efficient, these interventions should act on modifiable factors of PA. In this review, we investigated the efficacy of behavioural interventions targeting PA on PA motivation change in patients with MDs. PA interventions have a small effect on motivation at the end of the interventions. Until now, researchers mainly focused on negative beliefs associated with PA behaviour, especially fear of movement or kinesiophobia. Future studies should (i) have high-resolution behavioural assessments, (ii) precisely describe the content of related to BCT used within the interventions, and (iii) investigate implicit processes.

### Data availability

The datasets used and/or analysed during the current study are available on the Open Science Framework (see [https:// osf. io/ tybwz/](https://osf.io/tybwz/)).

### Author contributions

All the authors contributed to the drafting of the current systematic review and meta-analysis’ protocol. M.H., J.B., C.L. and M.B. selected articles and extracted data. M.H. and G.C. conducted the statistical analysis. M.H., J.B. and A.D. contributed to the interpretation of the results. M.H. performed the quality assessment appraisal manuscript. J.B., A.D. and A.L.C. required study’s funds.

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### Competing interests

The authors declare no competing interests.

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