# How to optimize exercise behavior in axial spondyloarthritis? results of an intervention mapping study

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# How to optimize exercise behavior in axial spondyloarthritis? Results of an intervention mapping study

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ABSTRACT

*Objective:* Many individuals with axial spondyloarthritis (axSpA) do not engage in adequate exercise, despite its proven health benefits. This study aimed to identify the intervention components needed to optimize exercise behavior in people with axSpA.
*Methods:* The first three steps of the Intervention Mapping protocol were used: 1) needs assessment; 2) identification of axSpA-specific exercise barriers and facilitators (determinants'); 3) selection of effective intervention components addressing potentially modifiable determinants. All three steps included scoping reviews and semi-structured interviews with patients (n = 2) and physical therapists (n = 2).
*Results:* The scoping reviews included 28, 23 and 15 papers, respectively. Step 1 showed that only one third of axSpA patients exercise regularly, demonstrating especially a lack of strengthening and cardiorespiratory exercises. Based on eight determinants identified in Step 2, 10 intervention components were selected in Step 3: education, motivational interviewing, goal setting, action planning, monitoring, feedback, tailoring, guided practice, therapists' training and group exercise encouragement.
*Conclusion:* Using the Intervention Mapping method, 10 intervention components for optimizing exercise behavior in people with axSpA were identified and an intervention with behavior change guidance and a training for health professionals is proposed.
*Practice Implications:* This study provides a foundation for the development of an axSpA-specific exercise intervention.



## 1. Introduction

Axial spondyloarthritis (axSpA) is an inflammatory rheumatic disease primarily affecting the spine and sacroiliac joints, causing chronic back pain and stiffness [1]. Exercise was found to have positive effects on functioning, disease activity, pain, stiffness, mobility, cardiorespiratory function and depressive symptoms in people with axSpA [2–8]. Regular exercise is therefore included in international recommendations for the management of axSpA [1,9].

Despite the potential beneficial effects, a considerable proportion of people with axSpA does not engage in exercise at all, engagement in exercise is not sustained, or their exercise regimens are not – or not consistently – carried out with the appropriate frequency, intensity and/or type of exercises [10–13]. A potential explanation for the lack of usage of appropriately dosed exercise programs could be that the content of interventions to promote exercise in people with axSpA does not meet the requirements to achieve lasting behavioral changes. Interventions consist of 'intervention components', which are methods or techniques (e.g. 'goal setting') that aim to change certain behavior by influencing its 'determinants', which are the factors that significantly affect that behavior (e.g. 'intentions'). Ideally, interventions aiming to optimize exercise behavior of axSpA patients should use intervention components that explicitly target axSpA-specific determinants of exercise behavior [14]. This is also proposed in the 2018 EULAR recommendations for physical activity in people with inflammatory arthritis and osteoarthritis [9]. In that study, the importance of taking into account disease-specific barriers and facilitators when promoting physical activity in people with

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rheumatic and musculoskeletal diseases is underlined. In addition, it advocates the conduct of more research on how to facilitate exercise behavior change and how to address disease-specific barriers and facilitators (determinants). Identification of relevant determinants and intervention components should be based on scientific evidence from literature as well as patient values and clinical expertise of important stakeholders (i.e. health care providers) [15].

A number of studies have been published that specifically aim to optimize exercise behavior of people with axSpA [16–20]. However, either the development process of the intervention was not described [16–18], relevant determinants and corresponding intervention components were not identified during the development [19] or when selecting determinants, only the patients' perspective was examined qualitatively, without reviewing the literature [20]. Furthermore, various other studies examined axSpA-specific determinants of exercise, but without identifying intervention components that target these determinants [21–25]. Thus, it appears that no study combined the identification of axSpA-specific exercise determinants with a selection of corresponding intervention components, while accounting for literature as well as patient values and clinical expertise.

Therefore, this study aimed to first identify axSpA-specific exercise determinants and then connect these with effective intervention components to optimize exercise behavior in people with axSpA, while combining theory, literature and the involvement of stakeholders from different ecological levels. Since other important studies have already focused extensively on the perspective of stakeholders [19–21], the current study will put more emphasis on literature reviews, while using the findings of these previous studies. The selected intervention components should be used in exercise interventions for people with axSpA, in order to increase the likelihood and magnitude of sustainable change in exercise behavior.

## 2. Methods

### 2.1. Study design

In order to identify intervention components targeting axSpA-specific determinants of exercise, the Intervention Mapping (IM) protocol was used [26]. IM is a six-step framework for the development of theory- and evidence-based interventions, guiding the path from problem identification to solution development and using literature, stakeholders' perspectives and an ecological approach. The current study included the first three IM steps: a needs assessment (Step 1), an identification of determinants (Step 2) and a selection of intervention components (Step 3). In this study, two ecological levels were distinguished: individual axSpA patients and (physical or exercise) therapists, as most exercise interventions for patients with inflammatory arthritis are provided by physical therapists [9]. Therefore, in each of the three IM steps, a scoping review of literature and semi-structured interviews with two persons with axSpA and two specialized therapists were conducted. IM Steps 4 (intervention development), 5 (implementation) and 6 (evaluation) were not performed in this study.

### 2.2. Scoping reviews

For all three steps, a scoping review was performed using the electronic database PubMed, searching for all types of studies, in English, Dutch or German, published between January 1990 up to May 2017. These searches combined terms related to 'axSpA', 'exercise' and the associated IM steps (Appendix A). The same author (BH) performed all scoping reviews and assessed papers for eligibility. The search strategy was extended to other databases if the PubMed search did not yield certain key references. After removing duplicates, titles and abstracts were screened for relevance: studies that did not cover axSpA, exercise and the corresponding IM Step were excluded. Reference lists of important articles were manually searched for additional studies. Full-texts were obtained and relevant data of the included studies were extracted, including first author, year of publication, title, study type, population and the main findings relating to the research question(s) of each IM step.

### 2.3. Semi-structured interviews

In each step, semi-structured interviews were used to better understand the literature findings, to verify them with the Dutch situation and to rank the identified determinants and intervention components. The interviews were conducted by BH with two patients and two physical therapists, selected from an outpatient rehabilitation center in Groningen, the Netherlands (the Allied Healthcare Center for Rheumatology and Rehabilitation, PCRR). Both patients were diagnosed with ankylosing spondylitis (49 year old male with 30 years disease duration and 52 year old female with 20 years disease duration). Both therapists were experienced in treating people with axSpA (34 year old female with 11 years of experience in axSpA treatment and 51 year old male with 18 years of experience in axSpA treatment). The interviews lasted approximately one hour each and interviews were stopped if data saturation was achieved and no new information emerged. Only four interviewees were initially selected, because the stakeholders' perspective on this matter is well covered in earlier studies [19–21]. This study focused more on literature reviews, which also explicitly covered the literature on the patients' perspective. However, if the interviews would yield conflicting or insufficient results, additional subjects would be included for interviews. More detailed and IM Step-specific information is provided in the following paragraphs.

### 2.4. IM step 1: needs assessment

With this step, three topics were addressed: (a) the potential health benefits of exercise for people with axSpA, (b) the discrepancy between current and desired exercise behavior and (c) the patients' perspective on this matter. Since this step particularly focused on current needs, the scoping review included only recent studies, published after May 2012. In addition, recommendations on the management of axSpA written in English or Dutch were used for topics a and b. In question b, exercise types recommended in at least two systematic reviews or axSpA management recommendations were linked to the proportion of people with axSpA engaging in this exercise type according to the included studies. This was done to map the discrepancy between recommended and current exercise behavior.

Semi-structured interviews with patients and therapists were used to explore the scoping review findings qualitatively. The interviewees were given summaries of the scoping review results in writing. They were asked to provide their perspective on these three questions, which were used to identify similarities and potential additions to the scoping review findings.

### 2.5. IM step 2: determinants identification

This step specified what should change to optimize exercise behavior in people with axSpA ('change objectives'), by identifying relevant and changeable (behavioral and environmental) exercise barriers and facilitators ('determinants') and connecting these to 'performance objectives', which are specific aspects of the desired behavior. For the scoping review in IM Step 2, the search was

extended to Web of Science (in addition to PubMed), to cumulate more evidence on axSpA-specific exercise determinants. Determinants found in the included studies were only selected if they were judged as both changeable and relevant: changeability was estimated by the author (BH) and relevance was based on the strength of association with behavior in the 'Reasoned Action Approach' model [27]. The Reasoned Action Approach states that behavior is predicted by one's intentions and 'self-efficacy' (perceived behavioral control), while intentions are determined by an individual's attitudes, perceived norms and self-efficacy and it will only translate to behavior given the right environmental factors, skills and abilities. This theory was used because it is often used to explain exercise behavior [27].

In the semi-structured interviews, the specified change objectives were explained by the interviewer and then scored verbally by the patients and therapists for their expected relevance in influencing exercise behavior of people with axSpA with a grade between 1 ("not relevant at all") and 10 ("absolutely essential"). Interviewees were stimulated to share their reasoning, which provided additional insight in their thought process, and they were able to either combine or split up certain change objectives. The interviewer made field notes of the interviewees' comments and their relevance grades. The grades were averaged for each change objective: if it was below a 7, it was determined whether it was justified to exclude the change objective, by re-evaluating its evidence from the scoping review and by accounting for potential reasoning of the interviewees.

### 2.6. IM step 3: intervention components selection

In this step, the scoping review searched for studies on interventions that included theory-based intervention components, which target the selected determinants from IM Step 2. The IM taxonomy [28] was used to determine which determinants the intervention components target and to which theories they are related. Only effective components found in at least two different studies from the scoping review were included. The selected components were translated into practical applications by linking them to the change objectives and to the I-Change Model [29,30], a model on behavior change integrating ideas of various social cognitive theories. The I-Change Model was used because the Reasoned Action Approach model – which is used in the selection of determinants – is integrated in it as well and it organizes determinants in different successive behavior change phases [29]: awareness, motivation and action. During translation of the intervention components into practical applications, the parameters for effectiveness were also accounted for, which are the conditions under which an intervention component is more or most effective [28].

The semi-structured interviews were similar to those in IM Step 2, but in Step 3 the intervention components (instead of the change objectives) were graded.

## 3. Results

### 3.1. IM step 1: needs assessment

The scoping review of IM Step 1, which addressed (a) exercise benefits, (b) current and desired exercise and (c) the patients' perspective, identified 64 abstracts, from which 28 full-text articles were selected (Fig. 1). Table B.1 (Appendix B) presents the designs of the included studies.

For question a of this scoping review (exercise benefits), 22 studies were included: ten studies about effectiveness of exercise-interventions [3,7,8,17,31–36], five studies with a qualitative approach [13,21,22,37,38] and seven studies examining associations with exercise [11,12,23,39–42]. Reported benefits of exercise among people with axSpA are improved (physical) functioning, cardiorespiratory function, quality of life, (spinal) mobility, chest expansion and global assessment and decreased disease activity, pain, stiffness, depression, fatigue and body mass index (BMI) [3,7,8,17,31,32,34,35]. Due to the heterogeneity in the type of exercise used in the various interventions, it is not possible to establish which type of exercise results in which specific benefits.

Furthermore, 15 included studies covered question b (current and desired exercise). Ten of these reported on current exercise behavior [11–13,23,37,39,40,43–45] and five studies reported on desired exercise behavior [3,8,19,31,32]. In addition, six recommendation articles on the management of axSpA were obtained [1,9,46–49]. Table 1 presents which exercise types are desired and to what extent they are currently executed by people with axSpA according to the studies found in the scoping review. These results show that about a third of the patients engage in mobility exercise, a tenth in strength exercise and a third in cardiorespiratory exercise, while these exercise types were explicitly recommended. Furthermore, it shows that few studies reported on the types of exercise people with axSpA engage in and that no study reported on current engagement in supervised group exercise, which is recommended by two systematic reviews [3,19] and one recommendation article [47].

Question c of IM Step 1 (patients' perspective on exercise) was covered by eight studies [13,20–22,37,38,42,50]. These studies indicated the importance of a personally tailored exercise prescription, better monitoring, more exercise education and sufficient coherence in exercise advice.

The interviews with the patients and therapists mostly confirmed the literature findings. The therapists also expressed a need for more emphasis on exercises with higher intensity and

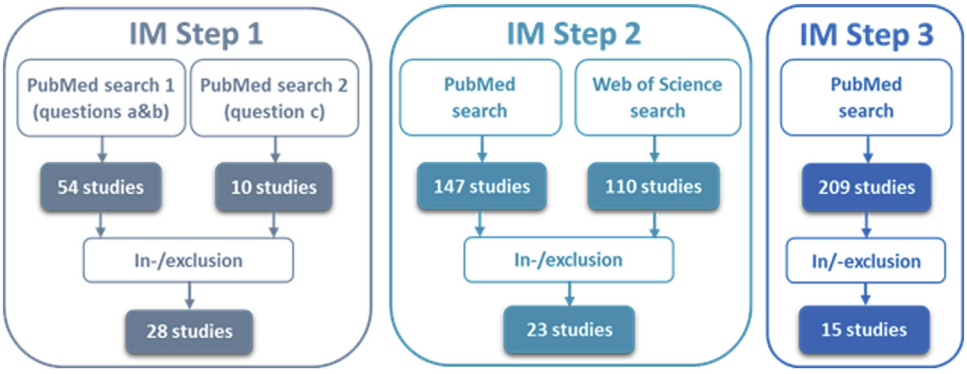


**Fig. 1.** Flowchart of the scoping reviews of IM Steps 1, 2 and 3.].

**Table 1**
Proportion of people with axSpA engaging in exercise types recommended in axSpA management (IM Step 1, question b).

| Recommended Exercise Types[a] | Current Exercise Behavior[b] |
|---|---|
| Mobility exercise | In one study, 43% of patients performed home stretching weekly, of which 33% performed it at least 3 times per week [13]. In another study, 26% of axSpA patients executed 'back exercises' [12]. |
| Strengthening exercise | In one study, around 10% of axSpA patients engaged in strength exercise, compared to 27% among population controls [12]. |
| Cardiorespiratory exercise | In 3 studies, axSpA patients engaged less in physical activities with higher intensities than the general population [39,40,44]. In one study, 32% of the patients were exercising at vigorous intensity for at least 30 minutes 2-3 times per week [23]. In another study, 58% of patients executed any form of aerobic exercise, but 30% executed it at least once a week for 30 minutes or more [37]. |
| Supervised group exercise | No studies found |
| Regular physical activity | In seven studies, the amount of weekly moderate-intensity physical activity of patients was comparable to that of the general population: around half of the participants did not adhere to the recommended amount [11,12,23,37,39,40,44]. |
| Interrupting sedentary time | In three studies, the total amount of weekly inactivity of axSpA patients was comparable to that of the general population [39,40,44]. |

[a] Exercise types that are recommended by at least two axSpA management recommendations or systematic reviews [3,9,19,46–49].
[b] Based on the results from the scoping review of IM Step 1.

core-stability and postural exercises. The patients indicated the importance of incorporating enjoyable activities and sufficient variation in exercise programs.

### 3.2. IM step 2: determinants identification

The scoping review for IM Step 2 selected 23 studies [13,17,18,20–24,37,51–64]. In total, 45 different factors influencing exercise behavior of people with axSpA were found (see Table B.2 in Appendix B), which could be clustered in 11 overarching determinants. Table 2 shows the overarching determinants and their underlying factors, supporting studies, relevance according to the Reasoned Action Approach Model [27] and expected changeability. Eight of the determinants were deemed changeable and relevant by the authors and were selected for intervention development; these are shown in Fig. 2.

The desired behavioral outcome of the intervention (optimized exercise behavior) was split into three performance objectives: (1) initiating exercise, (2) exercising sufficiently and adequately and (3) maintaining exercise activities. These three performance objectives were linked to the eight selected determinants in a matrix of change objectives, as shown in Table B.3 (Appendix B). The resulting 40 formulated change objectives specify what should change in which of the two ecological levels (individual patients and therapists) for an intervention to be successful.

During the semi-structured interviews, change objectives were clustered and eventually 23 were scored by the patients and therapists for their relevance: Table B.4 (Appendix B) shows the relevance grades. Four change objectives were rated lower than a 7 on average and were rejected after re-evaluating the supporting literature and the reasoning of the interviewees, namely: experiencing support from family and friends, experiencing social responsibility, planning coping with barriers and participating in a support group.

### 3.3. IM step 3: intervention components selection

The scoping review of IM Step 3 included 15 studies [16–21,52,53,65–71]. As shown in Table B.5 (Appendix B), 32 intervention components can be effective in improving exercise behavior in people with axSpA. Only intervention components reported in at least two different studies were selected: therefore,

**Table 2**
Underlying factors, supporting studies, relevance and changeability for overarching exercise determinants found in the literature search (IM step 2).

| Determinant | Factors | Number of supporting studies | Relevance | Changeability |
|---|---|---|---|---|
| Self-efficacy | Exercise self-efficacy +, trust + | 6: Mattukat 2017, Mattukat 2013, Da Costa 2010, Lim 2005, Stenström 1997, Curbelo Rodríguez 2017 | ++ | ++ |
| Attitude | Perceived exercise benefits +, perceived barriers -, attitude towards exercise +/-, experiencing exercise as tiring and hard work - | 7: Mattukat 2017, Niedermann 2014, Santos 1998, O'Dwyer 2016, Da Costa 2010, Passalent 2010, Fabre 2016 | + | ++ |
| Perceived Norm | Social support +, experiencing social responsibility + | 3: Ward 2002, Curbelo Rodríguez 2017, O'Dwyer 2016 | + | ++ |
| Intention | Motivation +, Intrinsic motivational factors (interest, enjoyment, competition) + | 5: O'Dwyer 2016, Mattukat 2013, Mattukat 2014, Fongen 2015, Niedermann 2014 | ++ | ++ |
| Knowledge | Knowledge +, information and education about disease, exercise (incl. frequency and benefits) and coping +, coherent education + | 6: Zangi 2015, Curbelo Rodríguez 2017, Rodríguez-Lozano 2013, Dubinina 2013, Mattukat 2013, Hammond 2008 | + | ++ |
| Skills | Coping +, Self-management +, intensive training and (home) exercising +, goal setting + | 6: Hammond 2008, Sweeney 2002, Mattukat 2014, Rodríguez-Lozano 2013, Dagfinrud 2008, O'Dwyer 2016 | ++ | + |
| Planning | Timing in daily routine +, Time +, Regularity + | 5: Niedermann 2014, Mattukat 2013, Fongen 2015, Passalent 2010, Curbelo Rodríguez 2017 | ++ | ++ |
| Environment | Individual counselling +, tailoring exercise +, presence of exercise groups and well-educated exercise guidance +, monitoring of patients' coping and exercise behavior +, rheumatologist follow-up +, membership self-help group + | 8: Zangi 2015, Fongen 2015, Mattukat 2013, Dagfinrud 2008, Curbelo Rodríguez 2017, O'Dwyer 2016, Santos 1998, Barlow 1992 | ++ | ++ |
| Disease related variables | Symptoms -, pain -, stiffness -, fatigue -, fear -, disability -, quality of life +, disease activity -, disease stability +, perceived stress - | 6: Niedermann 2014, Curbelo Rodríguez 2017, Fongen 2015, O'Dwyer 2016, Haglund 2012, Da Costa 2010 | – | + |
| Personal factors | Sex +/-, Age +/-, education level +, being married -, employment -, past exercise behavior +, smoking - | 4: Haglund 2012, Santos 1998, Stenström 1997, Fabre 2016 | + | – |
| Fear avoidance | Fear -, Kinesiophobia - | 2: Er 2017, Curbelo Rodríguez 2017 | – | + |

Relevance: - = no mentioning in the Reasoned Action Approach (RAA) model; + = indirectly related to exercise behavior in RAA model; ++ = directly related exercise behavior in RAA model. Changeability: - = no expected changeability; + = possible changeability on longer term; ++ = (fairly) changeable on relatively short term.

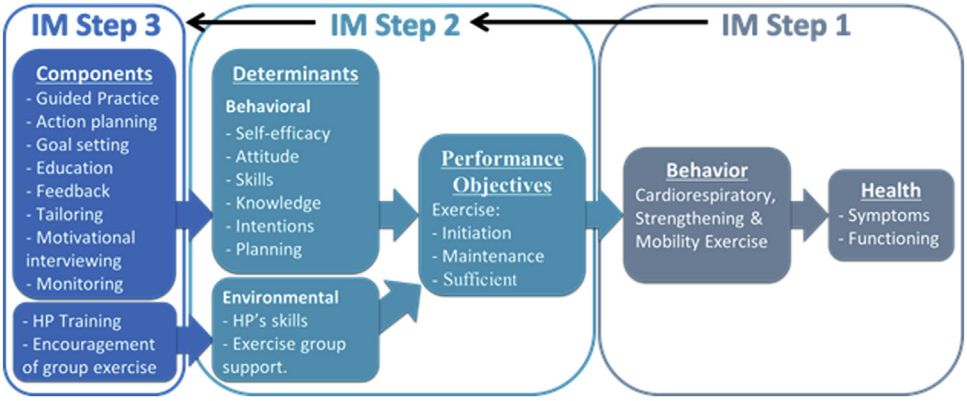


**Fig. 2.** A model with the results of this study, demonstrating how the intervention components from IM Step 3 eventually improve health, by influencing behavioral and environmental determinants identified in IM Step 2 in order to change the desired behavior determined in IM Step 1.].

11 intervention components were excluded. The 21 remaining intervention components were graded for their expected relevance by the patients and therapists (see Table B.6 in Appendix B). Three intervention components were scored lower than a 7 on average: coping planning, mobilizing social support and providing social comparison. These three were all excluded after re-evaluating evidence and interviewee rational. When linking the 18 remaining intervention components to the selected determinants and change objectives, 11 of them were combined into three components. This finally resulted in 10 intervention components relevant for optimizing exercise behavior in axSpA by targeting identified behavioral and environmental determinants, which are shown in Fig. 2.

The selected intervention components were translated into practical applications, as shown in Table 3, by accounting for the two ecological levels, the intervention's context and the components' parameters for effectiveness [28] and by sorting them to the different factors and behavior change stages of the I-Change Model [30]. Consequently, the intervention should consist of (1) behavior change guidance (through counseling or an instruction manual), including individualized education, motivational interviewing, goal setting, action planning, monitoring and feedback, (2) a training for therapists on how to tailor, practice and guide exercise and (3) encouragement to exercise in a group.

## 4. Discussion and conclusion

### 4.1. Discussion

This study combined literature reviews with theories on exercise behavior and the perspective of important stakeholders of two ecological levels (individual patients and therapists) to identify the effective intervention components required to optimize (determinants of) exercise behavior of people with

**Table 3**
Change objectives with corresponding determinants, intervention components and practical applications, sorted by I-Change factors (IM step 3).

| Change objectives and determinants (italic) sorted by I-Change factors (bold) | Intervention components | Practical application |
|---|---|---|
| **Awareness** | | |
| *Knowledge*: Patients describe the consequences of axSpA, the importance of initiation and maintenance of exercise and the optimal frequency, intensity, duration and type of exercise. | Education (incl. Elaboration, Consciousness raising and Persuasive communication) | Education by instruction manual and/or health professional on disease and exercise (importance and guidelines) |
| *Attitude*: Patients explain the benefits and their positive outcome expectations of initiation and of sufficient and adequate execution of exercise. | Education (incl. Individualization) | Help patients translate education to personal situation |
| **Motivation** | | |
| *Intentions*: Patients indicate that they want to initiate their exercise program and keep executing it sufficiently and adequately. | Motivational interviewing; Goal setting | Individual counselling with motivational interviewing and goal setting |
| *Self-efficacy*: Patients express confidence in ability to initiate and maintain execution of their personal exercise program, the right way and often, intense and long enough. | Guided practice; Tailoring | Tailor exercise program to patients' level and needs and practice with guidance |
| *Attitude*: Patients acknowledge that they enjoy (certain) exercise. | Tailoring | Tailor exercise to patients' preferences |
| *Attitude*: After 3 months, patients describe their perceived benefits of exercise and the realization of their positive outcome expectations. | Goal setting; Feedback (during follow-up) | Help patients set goals and provide feedback over time on goal attainment |
| *Social norm*: Patients indicate that they experience support from exercise group members and health care providers to keep executing their exercise program. | Group setting; Monitoring | Monitor and encourage patients over time to continue their exercise program |
| **Ability** | | |
| *Skills*: Patients demonstrate that they are able to execute their exercise program and they demonstrate self-management and self-regulation skills to fully adhere to their exercise program (despite barriers or relapses). | Guided practice; Education (on pain- and stress-management, joint protection and self-regulation) | Practice exercise program with specialized therapist and education on self-management and self-regulation |
| *Planning*: Patients make specific plans for when, where and how to carry out their exercise program, with the right frequency and duration and linked to routine daily activities and they adjust their plans as soon as they are unable to comply with them. | Action planning | Help patients make weekly, specific, personal action plans, prompt them to create routine and re-plan when needed |
| **Environment** | | |
| *Environment*: Specialized therapists tailor personal exercise programs, provide individual counselling and provide (follow-up) monitoring of exercise, outcomes and coping responses. | Educate environmental agents; Monitoring; Feedback. | Train therapists on how to tailor and practice exercise and how to provide counselling, monitoring and feedback |
| *Environment*: Patients are able to partake in exercise groups. | Education on available resources | Encourage and inform patients on (axSpA-specific) exercise groups |

axSpA. Incorporating these components in an intervention should increase the likelihood and magnitude of sustainable change in exercise behavior of people with axSpA. It was found that in order to optimize exercise behavior in people with axSpA, an intervention should include (1) behavior change guidance, including individualized education, motivational interviewing, goal setting, action planning, monitoring and feedback, (2) a training for therapists on how to tailor and practice an exercise program and provide behavior change guidance and (3) encouragement to exercise in a group.

As far as we know, this is the first study on the development of an exercise intervention for people with axSpA in which prior to selecting effective intervention components, relevant determinants were identified using both literature and stakeholders' perspective. The use of the Intervention Mapping protocol ensured that the steps preceding behavior change were examined using theories, literature and interviews with important stakeholders from two ecological levels. Two prior studies on the effects of an intervention on axSpA patients' exercise behavior, that did not first examine which determinants to target, only found small effects [17,18]. The contents of these existing interventions deviate from the current intervention proposal; one of these interventions [17] only used one (extensive) education-session, which might be insufficient for a sustainable behavior change [72], whereas the other intervention [18] put quite some emphasis on anticipating barriers (coping planning). Coping planning was excluded in the present study as it might decrease self-efficacy when applied during exercise initiation by focusing too much on barriers instead of opportunities [73,74]. The intervention contents of the current intervention are fairly similar to the other existing interventions aimed at exercise behavior of people with axSpA [16,19,20]. They appear most similar to the intervention studied by O'Dwyer et al. [16], which consists of various counseling sessions with a physiotherapist and also puts a large emphasis on tailoring, goal setting, feedback, monitoring and motivational interviewing principles. Their study showed promising intervention effects, but the intervention group only consisted of 20 participants. Therefore, in a future study examining the effectiveness of the current intervention (after further development), a larger population should be used.

In order to further develop, implement and evaluate the proposed intervention, IM Steps 4, 5 and 6 should be executed in a future study. The comparable intervention by O'Dwyer et al. [16] then might serve as a suitable example, together with the different stages from the I-Change Model [29]. The intervention might exist of a training for health professionals to provide behavior change guidance, which consists of the following phases: an awareness phase with education and tailoring, a motivational phase with mainly motivational interviewing, an action phase with goal setting, action planning and practice and a maintenance phase with monitoring, feedback and potentially group exercise. The behavior change guidance could also be provided or supported by an instruction manual with various assignments.

#### 4.1.1. Study limitations

This study was limited by including only two patients and two therapists to provide the perspective of important stakeholders. Their representativeness was limited as they were all selected from one rehabilitation center and both patients had a relatively long disease duration (20 and 30 years). However, eight studies on the patients' perspective were included in the search of Step 1 (question c) and in all three literature searches, multiple qualitative studies among stakeholders were included. The interviewees' responses were consistent with each other and with the findings from the included studies. Hence, no additional interviewees were included. Another limitation is that the stakeholders' interviews were mostly used for confirmatory analysis instead of exploratory analysis throughout the project, deviating slightly from the IM protocol. A final limitation is that the scoping reviews and data extraction were done by only one author and not by multiple reviewers.

#### 4.1.2. Future research

It is recommended to include IM steps 4, 5 and 6 in a follow-up study. When testing the intervention's effects, preferably a large sample should be used. Furthermore, IM Step 1 showed that little research is done in exercise type engagement among people with axSpA, with no studies reporting on current participation rates regarding supervised group exercise: this should be further examined. Also, many studies argued that there is insufficient evidence to describe the most optimal exercise parameters (type, frequency, duration and intensity) for people with axSpA [3,8,9,19,47]: future studies should compare exercise types and dosages regarding their (long-term) health benefits and (cost-) effectiveness to determine the best exercise regimen.

### 4.2. Conclusion

This study showed that in order to optimize exercise behavior of people with axSpA, patients should be offered behavior change guidance including education, motivational interviewing, goal setting, action planning, monitoring and feedback and they should be encouraged to exercise in a group. In addition, therapists should be trained in how to tailor and practice an exercise program and how to provide behavior change guidance. This intervention proposal should be further developed using IM Steps 4, 5 and 6.

### 4.3. Practice implications

This study provides a foundation for an axSpA-specific exercise intervention. It demonstrates that such an intervention should consist of various intervention components aimed at behavior change guidance as well as a training for health professionals.

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## CRediT authorship contribution statement

**Bas Hilberdink:** Writing - original draft, Investigation, Conceptualization, Methodology. **Florus van der Giesen:** Writing - review & editing, Conceptualization, Methodology. **Thea Vliet Vlieland:** Writing - original draft, Supervision. **Marjan Nijkamp:** Writing - review & editing, Methodology. **Salima van Weely:** Writing - original draft, Validation, Supervision.

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## Appendices A and B. Supplementary data

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