Development and initial validation of a questionnaire to assess facilitators and barriers to physical activity for patients with rheumatoid arthritis, axial spondyloarthritis and/or psoriatic arthritis

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Abstract (N=250)

Objectives: To develop and validate a self-administered questionnaire to identify in people with Inflammatory arthritis (IA) Facilitators And Barriers to Physical activity (PA): the IFAB questionnaire.

Methods: The development of the questionnaire included a systematic review of barriers and facilitators to PA to identify key themes, face validity assessment by 11 experts and cognitive debriefing with 14 patients. The psychometric properties of the questionnaire were assessed by convergent validity (Spearman correlation) against the modified Health Assessment Questionnaire (mHAQ), the Fear-Avoidance Beliefs Questionnaire subscale for PA and the Tampa Scale for Kinesiophobia, internal consistency (Cronbach α) in 63 IA patients with rheumatoid arthritis (RA), axial spondyloarthritis (axSpA) or psoriatic arthritis (PsA). Reliability and feasibility were assessed in 32 IA patients.

Results: The questionnaire comprises 10 items: 4 assessing either barriers or facilitators, 3 assessing barriers and 3 assessing facilitators. The items are related to: psychological status (N=6), social support (N=2), disease (N=1), environmental factors (N=1). The validation study included 63 patients: 26 RA, 24 axSpA, 13 PsA; with mean age 52.8 (standard deviation 16.5) years, mean disease duration 12.5 (12.3) years and 53% of women. The questionnaire was correlated (rho=0.24) with mHAQ. Internal consistency (Cronbach α 0.69) and reliability (interclass coefficient 0.79 [95% confidence interval 0.59; 0.88]) were satisfactory, as was feasibility (missing data 12%, mean completion time <5 minutes).

Conclusion: The questionnaire allows the assessment of barriers and facilitators to PA in patients with IA. This questionnaire may guide targeted interventions to increase levels of PA in these patients.

Highlights

- Patients with inflammatory arthritis (axial spondyloarthritis, rheumatoid arthritis and psoriatic arthritis) often do not engage in enough physical activity, due to individual barriers
- A questionnaire to assess barriers and facilitators towards physical activity, the IFAB, was developed and validated in terms of psychometric properties.
- The IFAB includes 10 questions which assess psychological status (N=6), social support (N=2), disease status (N=1), or environmental factors (N=1).
- This questionnaire can be used in clinical practice or in research and may help guide interventions to increase physical activity.

1. Introduction

Axial spondyloarthritis (axSpA), rheumatoid arthritis (RA) and psoriatic arthritis (PsA) are the most prevalent inflammatory rheumatic diseases, representing 2% of the general population [1, 2]. They share common characteristics such as inflammation, pain and fatigue, systemic manifestations and can potentially lead to structural changes in joint or spine with loss of function [1, 3].

According to the World Health Organization (WHO), physical inactivity (lack of physical activity) has been identified as the fourth leading risk factor for global mortality [4]. Patients with these 3 inflammatory arthritis (IA) i.e., RA, SpA or PsA, are more prone to physical inactivity than the general population [5]. For example, only a quarter of axSpA patients met the recommended level of physical activity (PA) [5] and PA objectively measured by a tracker revealed that RA patients performed 200 minutes of PA per week less than healthy subjects [6].

Patients with IA derive specific benefits from regular PA. These include, in particular, reduction of pain intensity and risk of cardiovascular diseases [7, 8]. For example in AxSpA, increased PA leads to improved physical function and reduced fatigue and disease-related activity [9]. Thus, PA is a key component of clinical practice guidelines for the management of these rheumatic conditions [8, 10, 11].

Increasing PA is a challenge [12]. Lifestyle changes (such as PA levels) should be addressed by a global approach and by taking into account behavioural barriers to increase chances of success [13]. Regarding PA, barriers and facilitators have been identified [14]. Barriers appear to be mostly related to psychological status, and facilitators are linked in part to social support [14, 15]. Questionnaires can be used to assess barriers and facilitators, which could be useful in developing interventions tailored to the patient's needs, and thus more likely to be successful. Such a questionnaire could be also valuable in the process of implementing physical activity recommendations [16].

For the general population and for people with osteoarthritis, questionnaires have been developed to assess barriers and facilitators to PA [14, 15]. However, barriers in IA may be different due to the specific burden of the disease, including pain and fatigue, but also structural damage possibly leading to joint or spine functional impairment [3].Furthermore, patients with IA may have erroneous beliefs regarding PA [12]. To our knowledge, no questionnaire assessing perceived barriers and facilitators to PA has been validated for patients with IA.

The aim of this work was to elaborate a self-administered questionnaire to identify the perceived barriers and facilitators to PA in people with IA, and to validate the questionnaire in terms of psychometric properties.

2. Methods

The study was developed according to COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) and Outcome Measures in Rheumatology (OMERACT) [17, 18].

Several phases were performed, to generate, select and score items for the questionnaire, then to assess the psychometric properties of this questionnaire and to finalise the questionnaire and assess its reliability. These steps are shown in **Figure 1**.

2.1. Phase 1: Systematic review of barriers and facilitators to physical activity

The first step aimed to inform the choice of barriers and facilitators. Given the more abundant literature in RA, we chose to concentrate the systematic review on barriers and facilitators to PA for RA patients. The search was performed in Medline, Web of Science and the grey literature, as well as bibliography of included studies and related studies, from inception to January 2019. Key search terms were exercise [MeSH], barriers [Title/Abstract], facilitators [Title/Abstract] and Arthritis, Rheumatoid [MeSH]. All qualitative reports of barriers and facilitators in RA, published in English were collected. A thematic synthesis was applied to extract main barriers and facilitators to PA, which were selected when reported at least in 2 publications, then grouped by theme by the experts.

2.2. Phase 2: Identification of the questionnaire items

First, each main barrier and facilitator from the systematic review was formulated using the patients' verbatim where possible. Items were presented at either barriers, facilitators or either one of those categories. This preliminary wording was then assessed for face validity, and reworded where needed, by 11 experts in rheumatology or physiotherapy. Finally, the preliminary questionnaire was tested by 14 patients with IA through cognitive debriefing, and the items were reworded if needed [19]. For this, consecutive outpatients were contacted from one tertiary care hospital in France. They were aged above 18, with definite RA based on the ACR/EULAR classification criteria of rheumatoid arthritis [20], or axSpA based on the Assessment of SpondyloArthritis international Society classification criteria [21] with no restriction for co-morbidities and were able to read and write in French language. At that step, items were developed simultaneously in English and French and the quality of the cross-cultural validity was tested using the usual translation and back-translation procedure (29). The following steps were carried out using the French version.

2.3. Phase 3: Scoring

Based on the cognitive debriefing, we chose to first ask for impact of each item on PA (yes/no), then to rate the impact on PA on a numeric scale ranging from 0 (no impact) to 10 (maximal impact). Rating the impact is important since other authors have demonstrated that the presence or absence of an item is not enough to discriminate between active and inactive participants, and that the extent to which the items impact PA should be noted [22]. Items which can be considered as either barriers or facilitators are rated from -10 to 10, items which are barriers only are rated from -10 to 0, and items which are facilitators only are rated from 0 to 10. This scoring has been used previously [22]. When an item was indicated as not affecting physical activity, it was scored at 0.

2.4. Phase 4: Evaluation of the psychometric properties and finalisation of the IFAB

To assess the items and different versions of the Inflammatory arthritis Facilitators And Barriers questionnaire (IFAB), several analyses were performed.

Study design

A prospective observational study was conducted in a single tertiary care centre in Paris, France. A longitudinal observation was used in a subset of patients for reliability. The validation study was accepted by the ethics committee (CPP Sud-Est III, France, EudraCT 2019-A01413-54, methodology MR03 for non-interventional study). Participant informed consent was collected before inclusion.

Population

All patients who satisfied the inclusion criteria, seen in outpatient visits from November 2019 to January 2020 were asked to participate. The inclusion criteria were: age above 18; definite IA confirmed by the rheumatologist: axSpA (referring to the Assessment of SpondyloArthritis international Society classification criteria [21]), RA (referring to the international classification criteria of RA [20]) or PsA (referring to the ClASsification of Psoriatic ARthritis (CASPAR) criteria [23]); agreement to participate and informed consent; ability to read and write in the language of participating country. There were no restrictions for comorbidities; however, bed-ridden patients were excluded.

Instruments administered

The participants completed self-administered questionnaires: the newly-developed IFAB questionnaire, the Modified Health Assessment Questionnaire (mHAQ) to assess functional status [24], the Fear-Avoidance Beliefs Questionnaire subscale for PA (FABQ-PA) to assess patients' fear avoidance and beliefs about PA [25], the Tampa Scale for Kinesiophobia (TSK) to assess the subjective rating of kinesiophobia or fear of movement [26] and the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) to assess disease activity for patients with AxSpA [27] (**online supplementary Table 1**). In RA, disease activity was assessed by the physician through the Disease Activity Score 28 (DAS28) [28]. Disease duration, level of pain and patient global assessment were also collated. Finally, the steering committee developed two numeric rating scale global questions related to PA as follows: “when I think about the PA I want to do, I feel held back and limited” and “when I think about the PA I want to do, I feel supported and encouraged”

Reliability was explored by test-retest one week after the first completion, which is long enough to prevent recall of the 14 items questionnaire, and short enough to ensure that patients remain stage, including without onset of flare. The second completion concerned only the IFAB in the same format, and was filled in from home. Only patient with stable condition between the two assessment were included. Patients who expressed a change in conditions were excluded of the analysis of reliability. Number of expected patients for reliability was 30 to achieve an adequate sample size.

All questionnaires were administered in French, using the French versions.

Analysis of psychometric properties and choice of the final IFAB items

Based on the validation study, the steering committee finalized the questionnaire: the objective was to aim for brevity (to enhance feasibility) without losing content validity, leading to possible deletion of some questions. The selection of the most relevant items for the final IFAB was based on correlation

against legacy measures, correlation between each item and the total score (Spearman's rho coefficient greater than 0.5, with $P < 0.05$), clinical relevance (modifiable items were preferred), and reliability of each item (intraclass correlation coefficient, ICC > 0.5). Construct validity of each item and of several versions of the IFAB questionnaire were assessed against each of the legacy questionnaires. The hypotheses included: for convergent validity, correlation between the IFAB and the individual items and the legacy questionnaires assessing related concepts (mHAQ, FABQ-PA, TSK); and for divergent validity, absence of correlation with BASDAI, DAS28, level of pain, patient global assessment and disease duration. A correlation between the IFAB and the two simple questions related to PA was also expected. Reliability was assessed on the sub-set of patients with stable symptoms since the first completion.

The distribution of the scores was evaluated for the questionnaire score and items by the mean, standard deviation, range and median. Floor and ceiling effects were investigated for the questionnaire score and items (accepted maximum for both: 15%). Internal consistency and feasibility were also analysed. Respondent acceptability was considered satisfactory for a frequency of missing data < 15% on the retest. Feasibility was also tested by measuring the duration of completion on 10 participants.

2.5. Statistical analyses

For assessment of psychometric properties, a sample size of 60 patients was aimed for validity, and 30 patients for reliability, as proposed by COSMIN, without a formal calculation of power [18]. Statistical analyses were performed using R version 3.5.1. Continuous data were presented as mean (standard deviation (SD)) and discrete data were presented as median [interquartile range]. Normality was assessed visually before using means (SD) and parametric tests. There was no imputation of missing data. Convergent and divergent validity were assessed by Spearman's correlations, considered very small if < 0.30, small if 0.30 to 0.50, moderate if 0.50 to 0.70 and strong if > 0.70 [29]. ICC was based on the two-way random effect model, and coefficients > 0.70 were considered satisfactory. Internal consistency of the questionnaire was determined by Cronbach's α, and ≥ 0.70 was considered as satisfactory [30].

3. Results

3.1. Systematic review of barriers and facilitators to physical activity

Of 89 references, 10 (11.2%) studies were qualitative reports in RA and were analysed: 3 (49 patients) were focus groups and 7 (99 patients) were individual interviews [31–40] (**Online supplementary Figure 1**). In all, 148 patients participated: weighted mean age 57.9 years (standard deviation, SD 3.6, range of means 50.0-63.5 years), weighted mean disease duration 13.5 years (SD 5.7, range 6.9-21.0). Barriers and facilitators to PA were reported for general PA in 6 studies and for supervised exercises (e.g. exercise program led by physiotherapist) in 4 studies. Overall, 7 categories of barriers (mean 3.4 (SD 1.9) per study) and 8 categories of facilitators (mean 3.7 (SD 2.1) per study) were reported (**Table 1**). These could be grouped in 4 major themes psychological status, social support,

disease, or environmental factors. The 3 most reported categories of barriers were symptoms of RA (8/10 studies), beliefs, fears and loss of motivation (7/10) and lack of support, exercise knowledge, confidence and conflict in advice from healthcare (4/10). The 3 most reported categories of facilitators were group socialization and social support (8/10), positive beliefs, knowledge about benefits of PA (5/10) and positive emotions and experiences of PA (5/10).

3.2. Identification of the questionnaire items

The main themes were reworded into short items and face validity was confirmed by the expert committee. Cognitive debriefing with 14 IA patients led to slight rewordings. The preliminary IFAB questionnaire contained 14 items: 6 considered as either barriers or facilitators, 4 items as barriers only and 4 items as facilitators only (**online Supplementary Table 2**).

3.3. Psychometric properties of the questionnaire

Characteristics of participants included in the validation study

The study included 63 patients (26 (41%) RA, 24 (38%) axSpA, 13 (21%) PsA), with mean age 52.8 (SD 16.5) years, mean disease duration 12.5 (SD 12.3) years and 53% of women (**Table 2 and online Supplementary Figure 2**). Disease activity was moderate (mean DAS28 3.8 (SD 1.1), median 3.7 [interquartile range 3.1;4.3], mean BASDAI 3.1 (SD 1.4), median 3.1 [1.9;3.9]) and 73% received a biological treatment (**Table 2**).

Final version of the questionnaire

Based on the results and the pre-defined criteria, the decision was taken to reduce the questionnaire from 14 items to 10 items (**Table 3 and** (**online Supplementary Table 2**). In the final questionnaire, 4 items can be considered either as barriers or facilitators, 3 items as barriers only and 3 items as facilitators only (**Table 3 and 4**). The score of the final list of items can vary between -70 and 70 (**Figure 1**). The items are related to: psychological status (N=6), social support (N=2), disease (N=1), or environmental factors (N=1) (**Table 3**).

Concurrent validity and internal consistency

Main psychometric properties are shown in **Table 4 and online Supplementary Table 3**. Convergent validity was partly satisfied, with correlation between the IFAB total score and the mHAQ (rho=-0.24, $p<0.05$), but no correlation with TSK and FABQ-PA. Divergent validity was satisfied (**online Supplementary Table 3**). The questionnaire score had a significant positive correlation with the single questions related to the feeling of support and encouragement (rho=0.32, $p<0.05$) and a significant negative correlation with the feeling of limitation (rho=-0.29, $p<0.05$) as expected. The internal consistency of the final version of the questionnaire was good (Cronbach α values= 0.69).

Data completeness and score distribution

The proportion of missing values ranged from 0 to 6% for items and was 12% for the final score at retest (**Table 3**).

For use in practice, the questionnaire is available **online Supplementary Table 4** in English, and from the authors in French. We propose that in case of one missing item, that item is replaced by the value 0; in case of 2 or more missing items, the questionnaire cannot be scored.

The distribution of items considered as barrier or facilitator only was not normal (**Table 4**). Floor and ceiling effect were noted when patients were not affected by a barrier (range, 42-73%) or facilitator

(range 24-53%). This reflects the fact that not all barriers/facilitators affect all patients, which was expected. In the validation study, there were no floor/ceiling effects for the global score. The completion time was < 5 minutes.

Reliability

Of the 48 participants who were asked to complete the questionnaires for the test-retest analysis, 32 were analysed (**Online Supplementary Figure 2**). The ICC of the IFAB questionnaire was satisfactory (0.78 [95% confidence interval, 0.59; 0.88]) (**Table 4**).

4. Discussion

In this study, we have developed an easy to use questionnaire to assess barriers and facilitators to PA for patients with IA. The proposed IFAB questionnaire has 10 items, with a score from -70 to 70, higher scores indicating higher levels of facilitation and lower levels of barriers. This questionnaire appears to be feasible, reliable and to have satisfactory internal consistency. This questionnaire may guide targeted interventions to increase PA level of patients with IA.

Other questionnaires have been developed to assess barriers to PA in the general population [14] or other disabled populations such as osteoarthritis [15], mobility impairments [41], stroke population [42] or coronary artery disease [43]. In these questionnaires, the number of items used to assess barriers varied from 11 to 63. Only one recently-published questionnaire (the EPPA questionnaire) assessed facilitators of PA [44]. Seven out of ten barriers and facilitators of the EPPA questionnaire were also assessed in the IFAB questionnaire, indicating an expected overlap. However, the EPPA questionnaire is applicable to osteoarthritis, not IA. When comparing with a theoretical framework of behaviour change developed by Canes in 2012, we observed that the IFAB questionnaire covers 7 out of the 14 possible domains (knowledge, beliefs about the capabilities, beliefs about consequences, reinforcement, intentions, environmental factors and resources and social influence) [45]. This shows the potential interest of the IFAB questionnaire to examine different aspects of the areas of behaviour change.

PA is highly recommended for the IA population, but not performed sufficiently [6]. There's been a growing interest patient reported outcomes; the Food and Drug Administration underlines their importance and encourages their use [46]. This study applied recommended methodology for the IFAB questionnaire development and validation. The current questionnaire can be both used for research and clinical practice as it takes less than 5 minutes to complete and has little missing data. This questionnaire has the potential to identify perceptions towards PA in order to address barriers such as mistaken beliefs, and encourage facilitators. It may be useful to implement such a questionnaire during patient education to increase awareness of barriers and facilitators or in clinical trials evaluating PA level to observe the relationship between perceived facilitators and barriers and PA levels. The question remains on how to interpret IFAB scores. In the present study, the median of

the score was 3 (range -70 to 70), with a first quartile value (defining the lower 25% of the group) at -5. It might be interesting to propose a targeted intervention to patients with the lower scores, for example negative scores or scores below -5. Patients with PsA may face additional barriers, such as social discomfort due to concomitant skin disease. Published literature on barriers and facilitators associated with participation in physical activity among people with PsA is limited [7]. Given the lack of specific knowledge, physical activity considerations for this population should be based on available knowledge about RA patients. *In this study, the mean score in IFAB questionnaire in PsA patients was 4.7 (14.9) and was not statistically different from the score in patients with RA and axial SpA (7.0 (17.1) and 4.7 (21.1) respectively).*

Cultural environment is important to consider when assessing barriers and facilitators. Different aspects of the IFAB questionnaire, such as social environment and psychological status, can be influenced by culture and habits [47]. The questionnaire was validated only in France. However, the systematic review performed to develop the questionnaire included studies conducted in various countries. Moreover, experts involved for the face validity came from different countries (France, Norway and England). The questionnaire was developed both in English and French following a validated translation and cross-cultural adaptation process [48]. The culture of PA can change from country to country and from year to year [49]. Policies and regulations vary across the world. Through national prevention plans, increasing numbers of people are aware of the recommendations to perform PA [5]. The popularity of a sport evolves over the years as shown nowadays by the growing interest in running or fitness. Technology is more and more developed and used to promote and track PA and the image of an athletic body is more and more valued [50]. The physical environment is also being adapted to allow regular PA, e.g. through the installation of biking lanes or recreational programs in parks. In addition, the cost of activities tends to decrease. As a consequence, it is possible that this questionnaire will have to be updated in the future.

This study has strengths and weaknesses. The generation of themes was based on a systematic literature review of barriers and facilitators to PA for patients; however, the review concerned RA only, due to the more extensive literature in this population. Recently, similar barriers and facilitators have been evidenced in patients with AxSpA [12] and to our knowledge barriers and facilitators to PA have not been studied in patients with PsA. Cognitive debriefing was applied to improve the understandability of items by patients. Cognitive debriefing is an important step and generally under-used [19]. The development process of the questionnaire involved a variety of experts, including physiotherapists, which is rarely the case. The assessment of psychometric properties was complete, including internal consistency, construct validity, data completeness and reliability [18]. Many questionnaires applied in rheumatology have not undertaken such a complete psychometric assessment [18]. The sample size of patients to assess the validity of the questionnaire (n=63) was low but is considered by COSMIN as adequate [18]. The sample size for reliability may be considered as low (n=32) [18]. However, proper statistical analysis was used (ICC) and reliability was satisfactory [18]. No analysis of differential effect in different diseases was carried out. However, all the 3 IA

diseases were represented and levels of pain and functional status were equivalent among IA diseases (data not shown). The absence of correlation between the IFAB and questionnaires assessing fear avoidance/beliefs about PA and kinesiophobia was unexpected. However, the IFAB questionnaire assesses several dimensions and some of these are not related to fears (avoidance or kinesiophobia), such as social support or level of symptoms. We believe the global nature of the IFAB could explain the lack of correlations. Furthermore, construct validity showed some correlation with functional status, which was expected and strengthens the face validity of the IFAB questionnaire.

In conclusion, this short questionnaire may be useful to assess barriers and facilitators in order to increase PA in IA patients. Further studies should assess the relation between IFAB scores and objective PA, and assess the efficacy of interventions to improve PA, based on the IFAB score. This questionnaire could be used to design intervention with bigger chance of success and to help implement physical activity recommendations.

Note: preprint is available here: https://www.researchsquare.com/article/rs-32149/v1

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Table 1 : Systematic review of barriers and facilitators to physical activity in patients with RA

Major themes	Barriers	N studies*	Facilitators	N studies*
Disease	Symptoms of RA	8	Stable symptoms and effective medication	3
Psychological status	Negative beliefs and fears (fear of increase of symptoms), loss of motivation	7	Positive beliefs, knowledge about benefits of PA	5
			Positive emotions and experiences of PA	5
Environmental context	Bad weather	3	Heat, warm climate, exercise in warm water	2
	Inaccessible facilities	2	Convenient setting: community or gym setting, outside hospital	4
	Lack of time	2		
Social support	Fear of contact with others	3	External monitoring, adherence support (e.g., reminders)	3
	Lack of support or exercise knowledge from healthcare providers, or conflict in advice from healthcare providers	4	Group socialization, social support	8
			Support from healthcare providers (advice, empathy)	3

*The N refers to the number of studies (of 10 studies) referring to the concept

Table 2: Characteristics of 63 patients with inflammatory arthritis participating in the validation of the IFAB questionnaire

Characteristic	Value
Age, years, mean (SD)	52.9 (16.5)
Inflammatory arthritis	
• Rheumatoid arthritis, N (%)	26 (41)
• Spondyloarthritis, N (%)	24 (38)
• Psoriatic arthritis, N (%)	13 (21)
Gender, female, N (%)	33 (53)
Disease duration, years, mean (SD)	12.5 (12.2)
Pain intensity: VAS (0-10), mean (SD), median [IQR range]	3.9 (2.7), 4 [2;6]
Patient global assessment: VAS (0-10), mean (SD), median [IQR range]	4.0 (2.2), 5 [6;8]
mHAQ (0-3): mean (SD), median [IQR range]	0.42 (0.46), 0.25 [0.00;0.63]
Kinesiophobia: TSK (17-68), mean (SD)	44.5 (8.1), 44 [38.3;51.0]
FABQ-PA (0-24), mean (SD), median [IQR range]	9.0 (6.2), 3 [-4.5;14.5]

SD: standard deviation, VAS: visual analogue scale, mHAQ: modified health assessment questionnaire, TSK: Tampa scale of kinesiophobia, FABQ-PA: fear-avoidance beliefs questionnaire for physical activity, IQR, interquartile range.

Table 3: The 10 items of the IFAB questionnaire to assess barriers and facilitators to physical activity

Barriers or facilitators*	Facilitators	Barriers
1. Level of symptoms (pain, fatigue, lack of mobility)	5. A belief that physical activity will make symptoms worse	8. Knowledge of benefits of physical activity for health
2. Weather conditions	6. Lack of motivation	9. Knowledge of benefits of physical activity for mood
3. Presence or absence of support from others (friends, family)	7. Lack of knowledge on which exercises to do and how much	10. Confidence on how to exercise safely
4. Presence or absence of support and/or advice from healthcare professionals		

*These items can be either a barrier or a facilitator.

Items which can be considered as either barriers or facilitators are rated from -10 to 10, items which are barriers only are rated from -10 to 0, and items which are facilitators only are rated from 0 to 10. The score of the final questionnaire can vary between -70 and 70.

Table 4: Performance of the IFAB items and final IFAB questionnaire

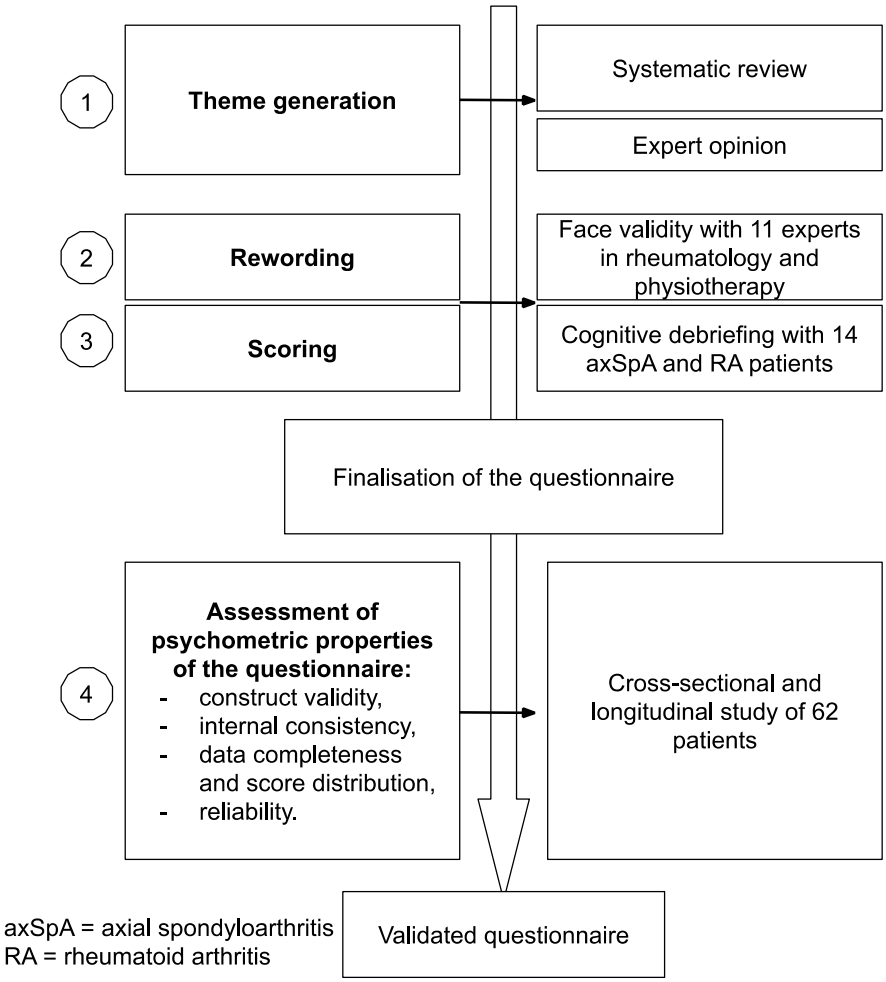
Item or final IFAB (range of possible values)	Score, mean (SD) [median]	Range (min;max)	Missing values at retest (%)*	Floor/ceiling effect (%)$	Intraclass Correlation coefficient (95% confidence interval)	Correlation with IFAB: rho (p value)
Item 1 (-10;10)	-3.2 (3.9) [-4]	(-10;7)	0	2/0	0.65 (0.42;0.81)	0.43 (0.01)
Item 2 (-10;10)	-2.7 (3.7) [0]	(-10;7)	0	2/0	0.49 (0.18;0.72)	0.33 (<0.001)
Item 3 (-10;10)	0.0 (5.1) [0]	(-10;10)	3	2/8	0.60 (0.33;0.79)	0.57 (<0.001)
Item 4 (-10;10)	1.9 (4.2) [0]	(-6;10)	3	0/7	0.34 (0.03;0.62)	0.56 (<0.001)
Item 5 (-10;0)	2.3 (3.7) [0]	(-10;0)	0	2/73	0.01 (-0.33;0.35)	0.36 (0.01)
Item 6 (-10;0)	1.9 (4.3) [-3]	(-10;0)	3	7/42	0.62 (0.36;0.80)	0.37 (0.01)
Item 7 (-10;0)	-1.6 (2.7) [0]	(-10;0)	3	2/71	0.61 (0.35;0.79)	0.29 (0.04)
Item 8 (0;10)	-3.6 (3.7) [6]	(0;10)	3	24/9	0.51 (0.21;0.73)	0.66 (<0.001)
Item 9 (0;10)	-2.4 (3.2) [5]	(0;10)	6	25/15	0.71 (0.50;0.86)	0.64 (<0.001)
Item 10 (0;10)	-1.5 (2.7) [0]	(0;10)	3	53/6	0.59 (0.31;0.78)	0.53 (<0.001)
Global IFAB score (-70;70)	5.1 (3.6) [3]	(-29;57)	13	0/0	0.79 (0.59; 0.88)	-

The items are detailed in Table 3.

* Missing data in the questionnaire at retest

$Floor and ceiling effects are the % of patients with a minimal or maximal value for the item, which reflects the item is assessed as not being a barrier or a facilitator.

Figure 1: Development and validation of the IFAB questionnaire



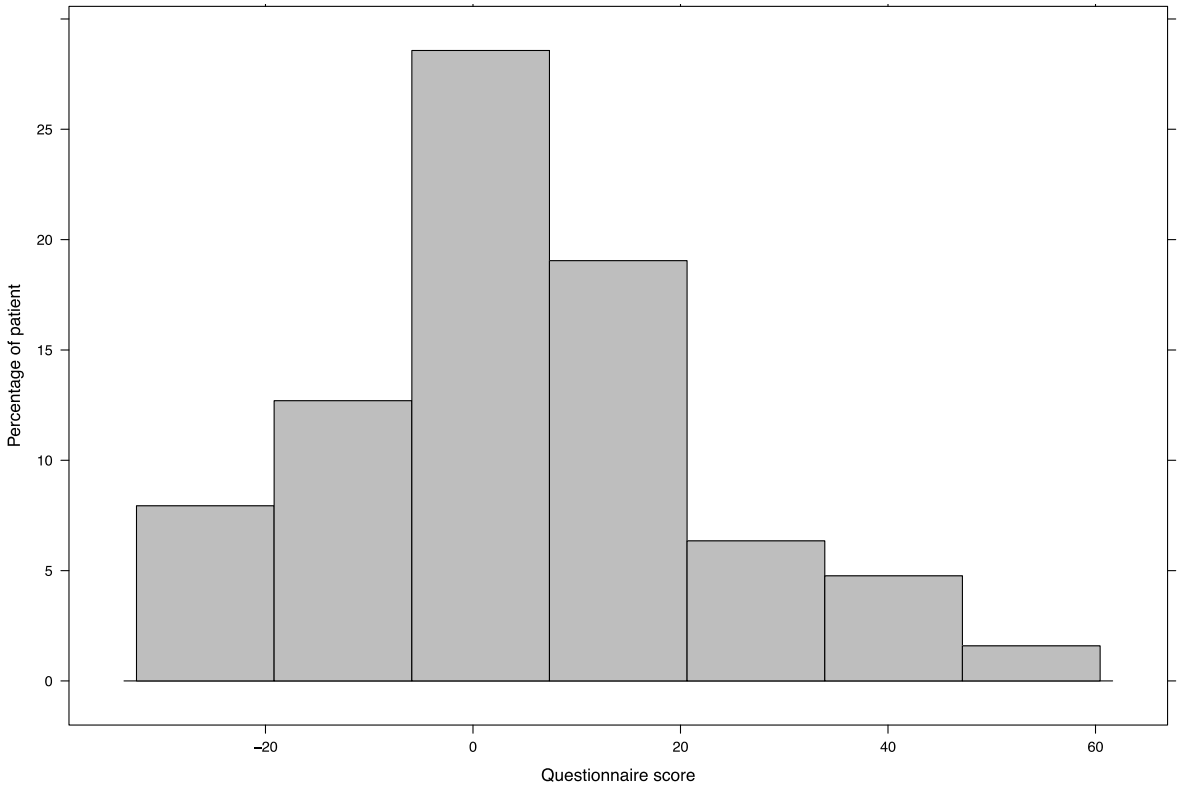
axSpA = axial spondyloarthritis
RA = rheumatoid arthritis

Figure 2: Distribution of the IFAB questionnaire in 63 patients

Footnote

X axis: IFAB total score

Y Axis: % of patients



Supplementary Table 1: Legacy questionnaires used to assess the construct validity of the IFAB questionnaire

Questionnaires	Description
Modified Health Assessment Questionnaire (mHAQ)	Used to quantify functional status [24]. This subscale contains 8 items regarding daily activity, scored from 0 (“without any difficulty”) to 3 (“unable to do”). The final score range from 0 to 3 (worse functional status) and is calculated by adding all scored items together (at least 6 of the 8 items are required) and dividing by the total number of items answered to obtain the final score.
Fear-Avoidance Beliefs Questionnaires subscale for PA (FABQ-PA)	Used to assess patient's fear avoidance and beliefs about PA [25]. The FABQ-PA is a 4 item questionnaire scored from 0 to 24 where the higher scores indicate the highest degree of fear and avoidance beliefs.
The Tampa Scale for Kinesiophobia (TSK)	Used to assess the subjective rating of kinesiophobia or fear of movement [26]. The TSK is a self-completed 17 item questionnaire and the range of scores is from 17 to 68 where the higher scores indicate an increasing degree of kinesiophobia.
Bath Ankylosing Spondylitis Disease Activity Index (BASDAI)	Used to assess disease activity for patients with axSpA (0-10 with higher score indicating higher disease activity) [27].
Disease Activity Score 28 (DAS28)	Was used to assess disease activity for patients with RA or PsA (0.96-8.47 with higher score indicating higher disease activity) [28]

Supplementary Table 2: Items of barriers and facilitators to physical activity included in the initial version of the IFAB questionnaire

Barriers or facilitators	Facilitators	Barriers
1. Level of symptoms (pain, fatigue, lack of mobility)	7. A belief that physical activity will make symptoms worse	11.Knowledge of benefits of physical activity for health
2. Weather conditions	8. Lack of motivation	12. Knowledge of benefits of physical activity for mood
3. Presence or absence of activity facilities (e.g., green area for walking, gym …)*	9. Lack of time*	13. External reminders (e.g.: from health professionals, calendars…)*
4. Presence or absence of support from others (friends, family)	10. Lack of knowledge on which exercises to do and how much	14. Confidence on how to exercise safely
5. Presence or absence of support and/or advice from healthcare professionals		
6. Contact and proximity with others during physical activity*		

* Items were deleted from the final IFAB as follows: item 3 (low clinical relevance, low reliability), item 6 (low clinical relevance, low reliability), item 9 (low clinical relevance, low correlation with other questionnaire, low reliability, low correlation with IFAB), item 13 (1 patient misunderstanding).

The reliability of some items was low (ICC <0.5). This can be explained by a change of state of the patient between test and retest or a lack of understanding of the item itself. However, we needed to retain these items since they were clinically important to assess and since the reliability of the whole questionnaire was satisfactory.

Supplementary table 3: Correlation between IFAB and the legacy questionnaires, Spearman's rho (p values)

Items	MHAQ	FABQ	TSK	BASDAI	DAS28	Disease duration	Pain	PGA	Barriers to PA*	Support of PA*
Item 1	-0.50 (0.00)	-0.14 (0.29)	0.25 (0.05)	-0.54 (0.05)	0.00 (0.98)	-0.23 (0.08)	-0.56 (0.00)	0.31 (0.02)	-0.37 (0.00)	0.26 (0.04)
Item 2	-0.13 (0.33)	0.04 (0.77)	0.09 (0.47)	0.15 (0.49)	0.07 (0.68)	0.01 (0.96)	-0.15 (0.25)	0.25 (0.05)	-0.10 (0.42)	0.20 (0.11)
Item 3	0,05 (0.69)	0.13 (0.35)	0.18 (0.16)	0.01 (0.97)	-0.30 (0.09)	0.16 (0.22)	0.17 (0.21)	0.10 (0.48)	0.04 (0.77)	0.33 (0.01)
Item 4	0.21 (0.11)	0.08 (0.53)	-0.06 (0.64)	0.31 (0.12)	0.11 (0.55)	0.22 (0.09)	0.25 (0.05)	-0.06 (0.65)	0.22 (0.08)	0.16 (0.20)
Item 5	-0.43 (0.00)	-0.23 (0.07)	0.28 (0.03)	-0.45 (0.02)	-0.09 (0.63)	-0.29 (0.02)	-0.36 (0.00)	0.07 (0.65)	-0.28 (0.03)	0.04 (0.74)
Item 6	-0.27 (0.05)	-0.08 (0.52)	0.06 (0.66)	-0.45 (0.02)	0.31 (0.08)	-0.33 (0.01)	-0.16 (0.22)	0.09 (0.62)	-0.25 (0.05)	0.03 (0.84)
Item 7	-0.27 (0.03)	-0.14 (0.28)	0.21 (0.11)	-0.01 (0.95)	-0.23 (0.20)	0.01 (0.94)	-0.14 (0.28)	0.14 (0.52)	-0.17 (0.19)	0.11 (0.38)
Item 8	-0.10 (0.45)	0.05 (0.72)	0.20 (0.13)	0.02 (0.91)	0.06 (0.73)	-0.02 (0.87)	0.16 (0.22)	0.07 (0.30)	-0.10 (0.44)	0.27 (0.04)
Item 9	-0.05 (0.70)	0.11 (0.40)	0.08 (0.54)	-0.05 (0.80)	0.08 (0.66)	-0.06 (0.65)	0.13 (0.33)	0.17 (0.30)	-0.18 (0.40)	0.31 (0.02)
Item 10	-0.27 (0.13)	-0.11 (040.)	-0.03 (0.79)	-0.31 (013.)	0.22 (0.24)	-0.31 (0.01)	0.02 (0.88)	-0.07 (0.60)	-0.11 (0.39	0.12 (0.35)
IFAB	-0.24 (0.05)	-0.12 (0.40)	0.19 (0.19)	-0.21 (0.32)	0.12 (0.56)	-0.23 (0.11)	-0.05 (0.71)	0.19 (0.19)	-0.29 (0.04)	0.32 (0.02)

mHAQ: modified Health Assessment Questionnaire; FABQ: Fear and beliefs questionnaire; TSK: Tampa Scale of Kinesiophobia; BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; DAS28: Disease Activity Score 28; PGA: patient global assessment; PA: Physical activity; *global questions related to PA

Supplementary Table 4. Final IFAB and scoring

Please take few moments to think about all the physical activity you did in the previous month: walking, jogging, gardening, other kind of sport… Now, think about all the things that have encouraged you, and all the things that prevented you form doing physical activity in the previous month. This questionnaire has 10 items. It aims to collect all the things that have encouraged you or prevented you from doing physical activity in the previous month.

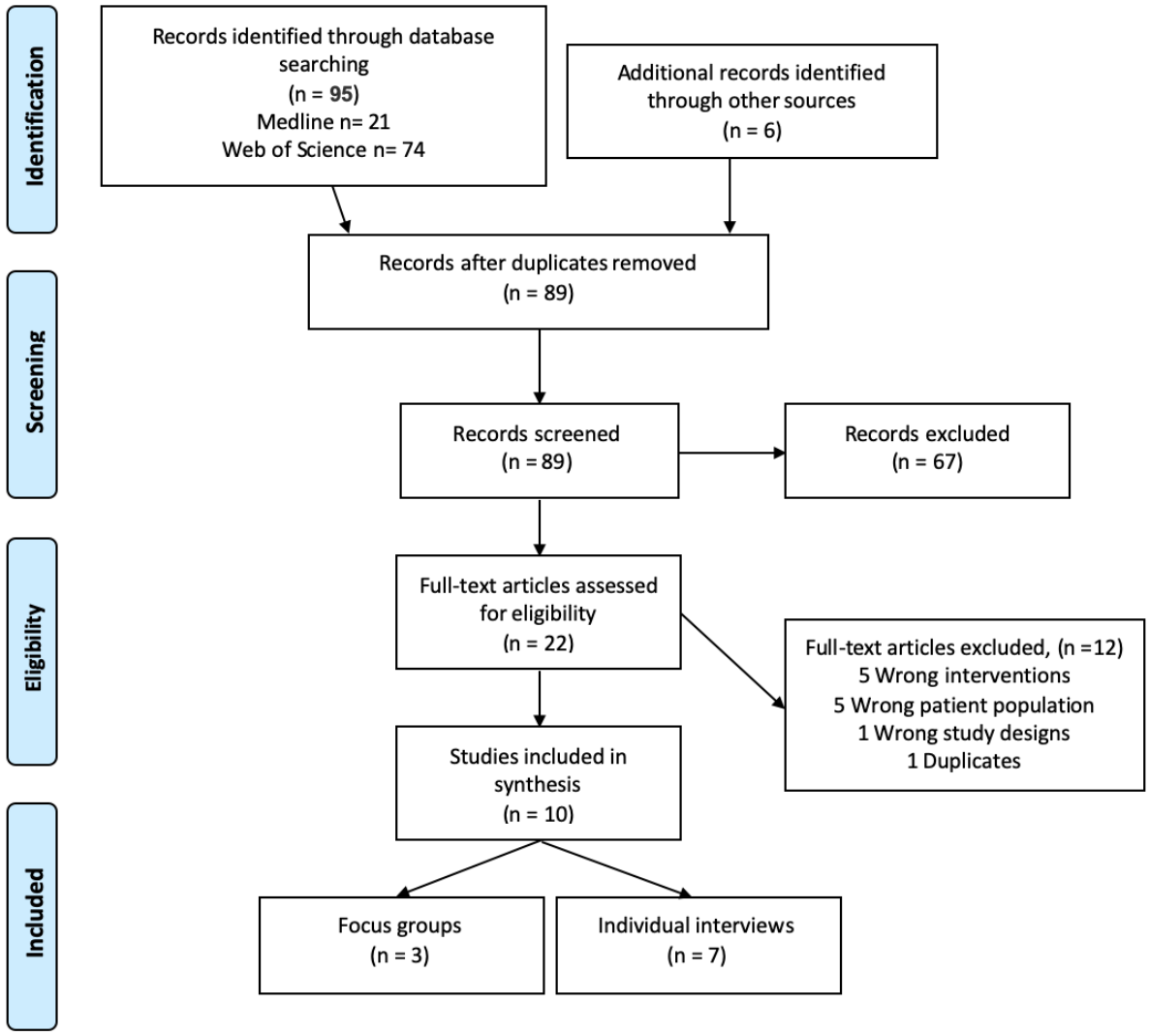
Please indicate for each item if it has rather encouraged you, prevented you, or had no impact on your physical activity in the previous month (only one answer). If needed, rate the importance.

A: Items that may have encouraged me or prevented me from doing physical activity in the last month.		
1. Level of symptoms (pain, fatigue, lack of mobility) □ rather prevented me from doing physical activity in the previous month □ rather encouraged to do physical activity in the previous month □ had no impact on my physical activity in the previous month	Had no impact on my physical activity	0 1 2 3 4 5 6 7 8 9 10 — Had a maximal impact on my physical activity
2. Weather conditions □ rather prevented me from doing physical activity in the previous month □ rather encouraged to do physical activity in the previous month □ had no impact on my physical activity in the previous month	Had no impact on my physical activity	0 1 2 3 4 5 6 7 8 9 10 — Had a maximal impact on my physical activity
3. Presence or absence of support from others (friends, family) □ rather prevented me from doing physical activity in the previous month □ rather encouraged to do physical activity in the previous month □ had no impact on my physical activity in the previous month	Had no impact on my physical activity	0 1 2 3 4 5 6 7 8 9 10 — Had a maximal impact on my physical activity
4. Presence or absence of support and/or advice from healthcare professionals □ rather prevented me from doing physical activity in the previous month □ rather encouraged to do physical activity in the previous month □ had no impact on my physical activity in the previous month	Had no impact on my physical activity	0 1 2 3 4 5 6 7 8 9 10 — Had a maximal impact on my physical activity
B: Items that may have prevented me from doing physical activity in the last month.		
5. A belief that physical activity will make symptoms worse □ rather prevented me from doing physical activity in the previous month □ had no impact on my physical activity in the previous month	Had no impact on my physical activity	0 1 2 3 4 5 6 7 8 9 10 — Had a maximal negative impact on my physical activity
6. Lack of motivation □ rather prevented me from doing physical activity in the previous month □ had no impact on my physical activity in the previous month	Had no impact on my physical activity	0 1 2 3 4 5 6 7 8 9 10 — Had a maximal negative impact on my physical activity
7. Lack of knowledge on which exercises to do and how much □ rather prevented me from doing physical activity in the previous month □ had no impact on my physical activity in the previous month	Had no impact on my physical activity	0 1 2 3 4 5 6 7 8 9 10 — Had a maximal negative impact on my physical activity
C: Items that may have encouraged me from doing physical activity in the last month.		
8. Knowledge of benefits of physical activity for health □ rather encouraged to do physical activity in the previous month □ had no impact on my physical activity in the previous month	Had no impact on my physical activity	0 1 2 3 4 5 6 7 8 9 10 — Had a maximal positive impact on my physical activity
9. Knowledge of benefits of physical activity for mood □ rather encouraged to do physical activity in the previous month □ had no impact on my physical activity in the previous month	Had no impact on my physical activity	0 1 2 3 4 5 6 7 8 9 10 — Had a maximal positive impact on my physical activity
10. Confidence on how to exercise safely □ rather encouraged to do physical activity in the previous month □ had no impact on my physical activity in the previous month	Had no impact on my physical activity	0 1 2 3 4 5 6 7 8 9 10 — Had a maximal positive impact on my physical activity

Items which can be considered as either barriers or facilitators are rated from -10 to 10, items which are barriers only are rated from -10 to 0, and items which are facilitators only are rated from 0 to 10. When an item is not affecting physical activity, score it at 0. If one question is missing impute the item as 0. If two questions are missing, we recommend not calculating the total score. The global score ranges -70 to 70. Results below -5 might justify a targeted intervention.

This questionnaire is free to use, please cite the paper. (thomas.davergne@gmail.com)

Supplementary Figure 1: Flowchart of inclusion process in systematic review of barriers and facilitators to physical activity



Supplementary Figure 2: Flow of participants in the study