ORIGINAL REPORT

AN EARLY BIOPSYCHOSOCIAL INTERVENTION DESIGN FOR THE PREVENTION OF LOW BACK PAIN CHRONICITY: A MULTIDISCIPLINARY EMPIRICAL APPROACH

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Objective: **Comprehensive intervention models for prevention of chronification of low back pain, in which the early identification of holistic risk factors is considered are needed. The aim of this study is to design a tailored biopsychosocial intervention for patients with low back pain to prevent pain chronicity.**
Design: **A multidisciplinary empirical approach.**
Methods: **A multidisciplinary team designed a biopsychosocial intervention following an application from the Medical Research Council's complex intervention framework. The methods used included problem identification, identification of the evidence, theory, and needs, examination of the current context and modelling of the theory. Biomechanical, psychological, social and environmental, and lifestyle and personal risk factors were taken into account.**
Results: **The intervention process was introduced in a logic model. The model presents all the required resources, their activities and outputs, as well as the outcomes and impacts of the intervention. The intervention was tailored according to the underlying risk factors for pain chronification in patients with low back pain.**
Conclusion: **A comprehensive tailored intervention may decrease the risk of pain chronicity. Further studies are needed to obtain information on the feasibility, effectiveness and cost-effectiveness of such interventions.**

Key words: low back pain; chronic pain; biopsychosocial model; rehabilitation; multidisciplinary research.

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LAY ABSTRACT

Low back pain is the leading cause of years lived with disability worldwide. In cases of non-specific low back pain, a specific structural reason for the pain cannot be identified. It is recognized, however, that individual factors, such as biomechanical, psychological, social, environmental, lifestyle, and personal factors, can increase the risk of pain chronicity. Therefore, a multidisciplinary intervention was designed to address these individual factors in addition to traditional treatment methods. The intervention was also designed to improve the timing of the rehabilitation to prevent pain chronification. This study presents the background, the different phases of the design process, and the model for the intervention. Further studies will be conducted to determine the applicability and effectiveness of the design.

Public health requires immediate global intervention actions (1) for the early identification of risk factors associated with chronicity of low back pain (LBP) (2). In terms of disability, LBP is the most burdensome global health problem (3). To date, many LBP interventions have been introduced, but, in many cases, the knowledge of key professionals has not been exploited holistically enough. Likewise, very few interventions are truly comprehensive mutualistic models in which the multiple risk factors driving pain and disability and their interactions are considered (4). Furthermore, there is a scarcity of usage of intervention frameworks that increase the validity of the design and decrease resource waste (5). The key problems concerning the effective rehabilitation of patients with LBP are mostly related to the correct timing of risk stratification, the tailoring of interventions, and the mutuality between healthcare professionals and patients.

Achieving the correct timing of rehabilitation is difficult, especially in patients with multiple morbidities where the steps involved are considered highly complex. In particular, the problems associated with LBP should be explored in more detail regarding the timing and shared decision-making for rehabilitation in rapidly ageing populations of people with biased health information. Therefore, to scrutinize the health problems associated with LBP, the following questions should be answered: how can healthcare professionals identify the relevant factors that affect the risk of chronicity in patients with LBP in a comprehensive and timely manner? How can

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healthcare professionals proceed effectively in the rehabilitation process with colleagues if this data is unavailable at the beginning of the process?

With the increasing costs of healthcare, new interventions should aim to add effectiveness to the margins of the available resources. Although not all patients with LBP need comprehensive, multidisciplinary rehabilitation, the delayed detection of patients at risk of chronicity can result in excessive costs, not to mention the burden for the patient in terms of decreased quality of life and functioning. The foundations of new interventions should be based on value clarifications (where the patient's values and preferences are heard during the decision-making process) (6) and value-based healthcare (VBHC). Thus, the interventions should be equitable, sustainable, and transparent, while using the resources available to achieve better outcomes and experiences for all patients. The aim should be to deliver the best possible outcome for patients individually with the resources available (7).

This study develops a comprehensive intervention for non-specific LBP suitable for primary and occupational healthcare. The effective healthcare policy aim is to prevent chronicity of pain and disability by considering the whole spectrum of disability and health in accordance with the International Classification of Functioning, Disability, and Health (ICF). A secondary aim is to identify the individualized needs of patients according to the underlying risk factors in the rehabilitation process using the following research questions:

- Which healthcare professionals and stakeholders are needed in primary healthcare for the effective prevention of LBP chronicity?
- What are the roles of different healthcare professionals in the intervention processes of patients with risk factors for LBP?

METHODS

The design of the intervention (Table I) followed the development phase of United Kingdom Medical Research Council's (MRC) complex interventions framework (8), which is the most cited guidance using an iterative approach (5). A new update of the framework came at the end of the design process, and the intervention design reflected the most recent implications (9). The optimization of the design was adopted from a framework application, which enriches the development phase of the MRC framework. The approach adds crucial elements to the development phase to strengthen the internal and external validity, to minimize research waste, and to add value to healthcare research (5). The rehabilitation design was divided into 4 sections to represent those risk factors affecting patients with non-specific LBP: biomechanical, psychological, social and environmental, and lifestyle and personal.

Table I. Study methods

Intervention design	
I. Problem identification	Review of the literature
	Identifying the problem in different risk factors
II. Identifying the evidence	Review of the literature
	Identifying the existing interventions and evaluation of their usefulness in this context
III. Identifying the theory	Research on different health psychology theories
	Identifying the theoretical framework and behaviour change techniques
IV. Identifying the needs	Retrospective population study
	Identifying the specific needs within the ICF framework
	Exploring the ICHOM standard set for LBP
V. Examining current context	Identifying existing resources, identifying the gaps
	Barriers, and facilitators of providers and recipients
VI. Modelling the theory	Modelling the intervention design to a logic model

ICF: International Classification of Functioning, Disability and Health; ICHOM: International Consortium for Health Outcomes Measurement; LBP: low back pain.

Multidisciplinary professional teams involving different stakeholders were gathered to design the intervention. To be included in the team, participants had to have strong knowledge of treating patients with LBP, at least several years of work experience, and the will and vision to advance the management of patients with LBP in their working environment. The teams included physicians, physiotherapists, mental health physiotherapists, nurses, a psychologist specialized in pain management, a social worker, and a rehabilitation counsellor (Table II). The teams worked via remote meetings between April 2021 and February 2022. Before the collaborative discussion, the chairperson gave an introduction based on scientific literature concerning the subject of the meeting.

At the beginning of the design process of the intervention (phases I and II, Table I), a previous systematic review of the risk factors for LBP chronicity (2) was examined and compared with the experience the professionals in the current study encountered in their daily work. Another review of the literature was performed to increase our understanding of previous interventions. The aim was to provide a representative picture of the literature rather than execute a comprehensive systematic review. The previous interventions were discussed in the teams in terms of their usefulness for the design. The search (Table III) was made with an advanced search (query from title/abstract with LBP, intervention, and hypernym of different risk factors, e.g. psychological) from PubMed and Google Scholar, and the references of suitable articles were searched for additional articles. The principal patient group was patients with back pain; however, due to the lack

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Table II. The professionals and their working experience

Team	Biomechanical	Psychological	Social	Lifestyle
Professionals (*n*)				
PT	3	1	1	1
Mental health PT	–	3	–	–
General physician	1	–	2	–
Occupational consultant	1	1	–	1
PMR consultant	1	1	1	1
Psychologist	–	1	–	–
Nurse	1	–	1	1
Rehabilitation counsellor	–	–	1	–
Social worker	–	–	1	–
Work experience				
Years (mean)	19	17	15	14
Sectors, at present (*n*)				
Primary healthcare	3	2	4	1
Special healthcare	1	3	2	1
Occupational healthcare	3	2	1	2
Sectors, overall (*n*)				
Primary healthcare	6	5	5	4
Special healthcare	4	4	2	2
Occupational healthcare	3	3	3	3
Duties, overall (*n*)				
Clinical experience	7	7	7	4
Development	4	5	1	1
Management	3	1	–	–
Research	1	1	2	1
Teaching	–	–	2	–

PT: physiotherapist; PMR: physical medicine and rehabilitation.

of articles that would be applicable to the healthcare system in question, a few articles from patients with other painful musculoskeletal disorders were also included. In addition, systematic reviews with other patients groups could also be accepted. In the search for articles concerning social or lifestyle factors associated with back pain, articles with interventions targeting the risk factors associated with LBP chronicity (LBP was excluded from the query) were also accepted.

The psychological theories of health behaviour were studied and their applicability for the intervention was discussed. Behaviour change techniques were examined in terms of the desired change, and were reflected in the chosen psychological theories (phase III). The main challenges for patients with LBP in functioning and health within the ICF framework were examined from a secondary analysis of a retrospective population study of patients with chronic LBP (10). The ICF framework was used to further discuss the domains where the intervention was to be targeted (phase IV). In addition, current resources were discussed as well as the problems in the clinical pathways of patients with complex LBP. The facilitators of, and barriers to, the intervention givers and receivers were identified (phase V). In the final phase of the intervention design (phase VI), the implementation road map was planned.

RESULTS

Problem identification

A systematic review was used as a basis to identify the risk factors for LBP chronicity (2). The teams discussed those factors that, in their opinion, play a crucial role in LBP chronicity (Table IV). A flow chart of patients with non-specific LBP from primary contact to the intervention was identified. The primary contact is a direct access physiotherapist (PT) when red flags or specific reasons for LBP are not identified during the treatment needs assessment. In cases where red flags are identified, the primary contact is a physician. A healthcare professional (direct access PT or physician) then performs an initial assessment and interview, excludes mechanical and specific reasons for LBP (11), gives pain education and plans the treatment and rehabilitation needs. Assessment of the risk factors for chronic LBP will be conducted during the follow-up visits (2–3 weeks from initial visit) and, if these factors are recognized, a broader multidisciplinary team will be contacted according to the factors identified.

Identifying the evidence

In the literature review, an introduction consisted of the Finnish National Current Care Guideline for treating LBP (12), previous systematic reviews considering the prolongation of pain and disability (2, 13, 14), and an article explaining the development of chronic pain (15). The reviews used to support the development of the na-

Table III. Patient/Population, Intervention, Comparison, Outcomes (PICO) search strategy for previous interventions in different risk factor groups for back pain chronicity

	Biomechanical	Psychological	Social and environmental	Lifestyle and personal
Patient	Working-age adults with back pain, or other painful MSK disorder	Working-age adults with back pain	Working-age adults with back pain, other painful MSK disorder, and/or social factors associated with LBP chronicity	Working-age adults with back pain, other painful MSK disorder, or lifestyle factors associated to LBP chronicity
Intervention	Workplace interventions, mainly targeted to biomechanical factors	Intervention targeted to psychological factors, and/or included a psychological component	Intervention targeted to social or environmental factors	Intervention targeted to lifestyle or personal factors
Control	Not specified, e.g. natural course	Not specified, e.g. natural course	Not specified, e.g. natural course	Not specified, e.g. natural course
Outcome	Reduction in pain or work disability	Reduction in pain, disability, or psychological symptoms	Reduction in pain or disability	Reduction in pain, disability or outcome on the lifestyle/personal factor

MSK: musculoskeletal; LBP: low back pain.

Table IV. Identified risk factors targeted by the intervention from the clinical experts' point of view, compared with findings from a systematic review (2)

Psychological factors		Social and environmental factors	
Clinical experience	Systematic review	Clinical experience	Systematic review
Depression	Depression	Difficulties in social affairs	Good quality of life (protective)
Anxiety	General anxiety	Challenging family obligations	–
Traumatic experiences	Post-traumatic stress disorder	Difficulties in work adaption	Support at work (protective)
Fatigue	Any psychiatric diagnosis	Workload too excessive	Work-related back pain
Catastrophizing	Catastrophizing	Returning to work after long sickness leave	–
Certain personality disorders	Somatization	Contradictions in the workplace	Non-recognition of work
Prolonged stress	Perceived stress	Financial problems	Disability compensation
Pain-related fear behaviour	Low tolerance of pain	Cultural background and age	–
Low self-efficacy, resources	Perceived risk of persistence	Level of education	–
Addictions	Coping by ignoring pain	Form of residence	–
Sleep disorders	–		
Biomechanical factors		**Lifestyle and personal factors**	
Clinical experience	Systematic review	Clinical experience	Systematic review
Physically heavy work	Particularly physical work	Multimorbidity	–
Inactive lifestyle	Physical exercise (protective)	Smoking	Nicotine dependence
Disabilities in the musculoskeletal system	Baseline disability	Diabetes	Diabetes
Unhealthy lifestyle combined	Physical wellbeing (protective)	Obesity	Obesity
–	Difficult working positions	Inactive lifestyle	Poor health
–	Carrying heavy loads	Disability	Baseline disability
–	Vibrations and jolts	Previous LBP episodes	Previous episode of LBP
		Sleep disorders	–
		–	Female sex

tional public rehabilitation guidelines organized by the Social Insurance Institution of Finland were introduced. The first review concerned the rehabilitation of musculoskeletal disorders as a whole (16), and the latter the rehabilitation of patients with subacute back pain with biopsychosocial aspects and patient stratification (17). In addition, the Cochrane review on multidisciplinary biopsychosocial rehabilitation was presented (18).

In addition to the preface, 26 studies were found suitable for strengthening the scientific foundation of the design (19–44). Details of the studies and the comments of the teams are shown in Appendix I.

Identifying the theory

The perception of different behaviour change theories was initiated with the COM-B system (45). This system works as an umbrella theory to understand different aspects of how a theory works on capability, opportunity, and motivation. Behaviour change techniques were explored to increase the understanding of the theoretical background of the techniques already used in everyday practice (46, 47). Finally, different theories were studied more closely. The theory of planned behaviour, social-cognitive theory and self-regulation theories were found suitable to form a base for the intervention (48). From the basis of the theories, the chosen behavioural change techniques were as follows:

- Goals should be timely, realistic, concrete, with graded tasks, and meet with the recipient's resources.
- Provider's support, monitoring and feedback are important, concrete exercises with the provider.
- Activities should be planned beforehand (what, where, when, how and with whom).
- Positive beliefs and self-efficacy should be amplified, discrepant views should be confronted.
- Motivation and positive changes should be amplified from the recipient's perspective, and providers should only support the recipient's own remarks.
- Recipient's limitations and strengths should be recognized, and empowering resources cherished.
- Self-monitoring with the recording of thoughts verbally and literally should be used to increase cognitive learning.
- Techniques based on self-belief (mental rehearsal, self-talk) as well as distraction should be used.
- The social and physical environment should be examined and opportunities for change should be created with the necessary services.
- Feelings of pain and discomfort should be encountered and normalized.
- Communality and reward systems should be benefitted.

Identifying needs

A secondary analysis of a retrospective population study of patients with chronic LBP (10) was examined to identify the main aspects of disability in the ICF framework. The recognition of the population's difficulties in functioning and health was used to theoretically reflect the domains targeted by the intervention. During the design phase, the recipients were not included in the team. Instead, the ICHOM (International Consortium for Health Outcomes Measurement) standard set for LBP was followed (49) This is the reference for ICHOM to identify those outcomes that matter the most to patients.

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Table V. Facilitators and barriers of recipients and providers

Facilitators of recipients	The fulfilment of the need to be heard
	Individualized treatment from the beginning
	Fluent flow of the process among different intervention providers
	Working towards the essential outcomes: pain, disability, work status, quality of life and the need for medications
	Understanding increases
	Good biopsychosocial resources to participate
Facilitators of providers	Positive feedback, recipients positive progress
	Sensibleness in one's work
	True interest in the recipient
	Finding the right help for the right patient at the right time
	Small acts can make great changes
	Early interventions produce better results
	Better use of resources, low thresholds between professionals
Barriers of recipients	Mixed information from different professionals
	Nocebo, negative feedback
	Lack of understanding, approval is in progress
	The intervention does not meet with the recipients resources
	Weak biopsychosocial resources
	Previous negative experiences of interventions
	Accumulation of problems, too many comorbidities
Barriers of providers	Shortage of staff or time resources
	Inflexible timetables, to be used for the recipients in need of more time
	Difficulty in recognizing the risk factors for chronicity
	Providers negative attitudes and morale
	Sense of inadequacy

Examining current context

The facilitators and barriers of the recipients and intervention givers were discussed (Table V). Clinical experience was used to identify the facilitators and barriers of the recipients. The themes were in line with previous studies on the subject (50). Some healthcare units have the required resources and, according to the team members, their availability is adequate. The mental health resources (mental health PT, psychiatric nurse and psychologist) were seen as the most vulnerable members of the multidisciplinary team. The time resource for risk recognition was also discussed as a possible dilemma. Different aspects to increase multidisciplinary collaboration were discussed through the team members' previous experiences from their working environment.

Modelling the theory

The intervention was introduced in a logic model (Fig. 1). The model graphically represents the needed resources, their activities and intended effects, and the assumptions and contextual factors where the intervention operates (51). The healthcare professionals needed depend on the patient's personal needs and the underlying risk factors. When certain risk factors are recognized, the process owner (e.g. in the biomechanical group PT; bold text in Fig. 1) will take charge of the multidisciplinary assessment and invite all the required professionals to the process. Additional inputs are principally contacted via a referral from the physician.

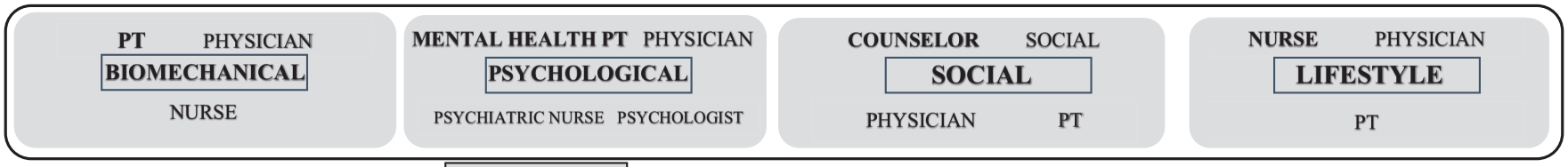
DISCUSSION

This study outlines the design process of a multidisciplinary, tailored biopsychosocial intervention for the prevention of LBP chronicity. The design process was conducted using an iterative approach, since the elements have reciprocal relations (5). In future, a new reflection on the design elements will be collected from a feasibility study. Furthermore, economic considerations will be conducted with a cost-benefit analysis before a larger intervention study.

Adequate resources in the primary and occupational care for the early recognition of LBP chronicity should lead to cost-effective clinical pathways. At present, the prevalent clinical pathways in high-income countries are costly, and the financial burden is projected to increase in the coming decades (52). Global disability caused by LBP is highest among the working-age populations. In Europe, LBP is one of the most common causes of medically certified sick leave and early retirement (52). In addition, there is a correlation between longer-term disability and work absence extending beyond 1 month (53). These findings should encourage healthcare providers to find functional solutions to the primary contact site of patients with LBP.

Local resources may vary, which may complicate the implementation of the intervention. It is, therefore, desirable that the feasibility study should verify the resource needs identified in this design. Other implementation challenges are related to the reception of the intervention. To be accepted by the recipients, sufficient resources must be allocated for patient education before the intervention process begins. With limited time resources, the use of high-quality patient material (54) is strongly suggested. In addition, healthcare professionals must have adequate skills to recognize specific reasons for LBP, which might need different treatment approaches, such as interviews and examinations. In case the feasibility study, cost-benefit analysis, and larger intervention study find the designed intervention superior to present clinical practice, a strategy and evaluation protocol for the implementation should be created. A team of professionals is needed to define widely the outcome measures of the implementation (e.g. use of valid questionnaires such as Determinants of Implementation Behavior Questionnaire) (55), to monitor, as well as continuously develop, the process.

In this study, multidisciplinary teams brought their clinical experience to common use and the conversation was enriched with current scientific knowledge. Healthcare professional teams embedded within a



Additional inputs: Physiatry clinic, Mental health clinic, Occupational clinic, dietitian, sports instructor

INPUT	ACTIVITIES	OUTPUT
Physio-therapist	Assessment of rehabilitation need Pain education Motivation towards rehabilitation Self-care exercises including relaxation techniques, physical pain therapies Work place assessment	Modeling a plan for rehabilitation Patient sets goals Consultations at low threshold
Physician	Pain education Diagnostics and treatment of all diseases Medication therapy Motivation towards rehabilitation Medical reports, referrals Work place assessment, modifications Formulation of rehabilitation plan	Modeling a plan for the needs and acting accordingly (e.g. recipes, reports, referrals) Care plan on other diseases Working as a consult and leader for collective appointments
Nurse	Pain education Motivation towards rehabilitation Assessment of psychosocial and lifestyle factors, referrals when needed	Modeling a plan for the needs Consultations at low threshold Patient sets goals New appointments when needed
Mental health PT	Mapping of symptoms, motivation, resources, fear and coping mechanisms Pain education Body awareness exercises	Patient begins to understand the entity of symptoms Modeling a plan for the needs
Psychiatric nurse	Pain education Mapping of psychosocial factors Treatment needs assessment Start of conversational support	Modeling a plan for the needs Consultations at low threshold Collective appointments when needed
Psychologist	Mapping of emotional, psychosocial factors and fatigue with questionnaires Assessment and plan for therapy	Modeling a plan for the needs Consultations at low threshold
Counselor*	Mapping of challenges and functioning Service and rehabilitation needs assessment Gathering of relevant stakeholders Participation to network cooperation and to rehabilitation planning	Modeling a plan for the needs Guiding to appropriate services Arranging of network meetings
Social worker	Assessment of service needs Guidance on social services, benefits Participation to network cooperation and rehabilitation planning Decisions on e.g. housing modifications	Modeling a plan for the needs Initiation of planned services

OUTCOMES

SHORT
- **U**nderstanding of pain increases
- **U**ncertainty and fear decreases
- **M**otivation towards rehabilitation initiates
- **P**articipation strengthens (attitude)
- **U**nderstanding of the connection of mood, fatigue, stress and pain increases
- **C**ommitment to the treatment and rehabilitation plan increases

INTERMEDIATE
- **P**articipation strengthens (behavior)
- **B**ody functions and motion (quality) gradually improves
- **R**eturning to empowering chores
- **C**hecking occasionally that the plan is up-to-date
- **E**xpanding the multidisciplinary team when necessary

LONG
- **P**ain alleviates
- **W**ork functioning and daily functioning improves

IMPACTS
Prevention of low back pain chronicity

Assumptions
Providers executes the intervention as planned and have the needed know-how, all the needed resources are available in different health care sectors, the recipient accepts the intervention and executes it accordingly, the recipient has the needed resources to execute the intervention.

Contextual factors
The recipients' barriers towards the intervention.
The providers'/site of interventions' barriers towards the intervention.

Fig. 1. Logic model for the intervention. The first contact in the different risk factor groups is shown in **bold** text.
*Rehabilitation counsellor, customer counsellor, social counsellor or nurse, depending on local resources.

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complex system enabled team members to understand that rehabilitation as a complex system is not unitary, but an interdisciplinary concept constructed by different scientific terms. The teams explored answering "what if" questions to avoid the traps of rehabilitation defined solely by one discipline or profession. By doing this they were able to evaluate how alternative rehabilitation plans might be developed.

Although accurate plans for the recognition of the risk factors associated with pain chronicity were not in the scope of the intervention design phase, they were discussed within the teams. Different questionnaires (see Appendix I for team's comments) were found to be suitable, going through the health records before the appointment was seen as important, as were bringing up the issues of mood, social situation, and lifestyle factors in the assessment conversation. In addition, evaluation of the outcomes was considered. The ICHOM working group (49) recommends using the Numerical Pain Rating Scale (NPRS), the Oswestry Disability Index (ODI), and EuroQol-5D for the evaluation of pain, disability and quality of life. 15D for health-related quality of life and Net Promoter Score (NPS) for patient satisfaction were also found to be suitable for the evaluation.

In future, artificial intelligence (AI) will help scientists to find answers for risk recognition. Moreover, AI technologies (10) could fill the gap in tailored solutions and help to achieve successful clinical pathways. However, AI cannot be exploited successfully until a mutual holistic understanding between all key healthcare professionals involved in the rehabilitation process is achieved.

This study has some limitations. The facilitators and barriers of the implementation site were not listed, as the exact site for the study was not decided during the design phase. However, the barriers connected to the resources, and the agreement regarding the possible variations were discussed, so that the intervention can still maintain the integrity of the core components while varying across different contexts (9). The absence of the recipients during the design phase was a weakness of this study. However, the completed intervention design was introduced to a LBP patient forum (10 experts by experience), where the intervention received mainly positive feedback. The exploitation of current resources on behalf of patients with LBP, the structure of the intervention, and low thresholds between professionals were mentioned. Education of professionals, especially regarding the patient encounters, the availability of resources in terms of time, and skilful professionals were listed as development targets. In addition, patient satisfaction, and their overall opinion on the intervention will be collected during the feasibility study before larger intervention. The intervention will be conducted as a case-control study to avoid the confounding factors of local phenomena.

In the near future, it is hoped that more biopsychosocial primary healthcare interventions from similar healthcare systems will be developed, so that benchmarking analyses can be conducted. It would also be beneficial to find an agreement on the evaluation of implementation and outcomes for an effective comparison.

In conclusion, this study developed a multidisciplinary rehabilitation for non-specific LBP, which holistically considers the entities of functioning, disability, and health in accordance with the ICF framework. The design has the potential to broaden our understanding of disability, lower the threshold for collaboration between different healthcare professionals and healthcare sectors, move the rehabilitation pathway towards preventive services, and decrease the risk of pain chronicity.

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