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Original article

Validation of a mobile application prototype for nonspecific chronic low back pain in healthcare professionals*

Validação de protótipo de aplicativo móvel para dor lombar crônica inespecífica em profissionais de saúde

Validación de un prototipo de aplicación móvil para el dolor lumbar crónico inespecífico en profesionales sanitarios

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Abstract

Objective: This study describes the creation and face and semantic validation of a prototype application for healthcare professionals with nonspecific chronic low back pain. **Method**: This is a technological research study with a qualitative and quantitative approach conducted in a public hospital in southern Brazil with 11 participants. The analysis used the Content Validity Index, with a minimum agreement rate of 0.80. The reliability of the instrument was verified by Cronbach's alpha (≥ 0.70) and the Intraclass Correlation Coefficient (≥ 0.70). **Results**: The overall CVI was 0.98, with items ranging from 0.81 to 1.00. The instrument's Cronbach's alpha was 0.93, confirming high internal consistency. The results indicate excellent inter-rater agreement and adequate face and semantic validity. **Conclusion**: The prototype application was considered adequate in terms of appearance and semantic content, configuring itself as a promising technology to support self-care and promote occupational health.
Descriptors: Low Back Pain; Self Care; Validation Study; Wireless Technology; Occupational Health

Resumo

Objetivo: descrever a criação e a validação de face e semântica de um protótipo de aplicativo para profissionais de saúde com dor lombar crônica inespecífica. **Método**: pesquisa tecnológica com abordagem qualitativa e quantitativa, realizada em um hospital público do sul do Brasil com 11 participantes. A análise utilizou o Índice de Validade de Conteúdo, com taxa mínima de concordância de 0,80. A confiabilidade do instrumento foi verificada pelo alfa de Cronbach (≥ 0,70) e pelo Coeficiente de Correlação Intraclasse (≥ 0,70). **Resultados**: O IVC global foi 0,98, com

itens entre 0,81 e 1,00. O alfa de Cronbach do instrumento foi 0,93, confirmando elevada consistência interna. Os resultados indicam excelente concordância entre avaliadores e validade de face e semântica adequadas. **Conclusão**: o protótipo do aplicativo foi considerado adequado em termos de aparência e conteúdo semântico, configurando-se como uma tecnologia promissora para o apoio ao autocuidado e à promoção da saúde ocupacional.
Descritores: Dor Lombar; Autocuidado; Estudo de Validação; Tecnologia sem Fio; Saúde Ocupacional

Resumen

Objetivo: Describir la creación y la validación aparente y semántica de un prototipo de aplicación para profesionales de la salud con dolor lumbar crónico inespecífico. **Método:** Investigación tecnológica con enfoque cualitativo y cuantitativo, realizada en un hospital público del sur de Brasil con 11 participantes. El análisis utilizó el Índice de Validez de Contenido, con una tasa mínima de concordancia de 0,80. La fiabilidad del instrumento se verificó mediante el alfa de Cronbach (≥ 0,70) y el Coeficiente de Correlación Intraclase (≥ 0,70). **Resultados:** El IVC general fue de 0,98, con ítems que oscilaron entre 0,81 y 1,00. El alfa de Cronbach del instrumento fue de 0,93, lo que confirma una alta consistencia interna. Los resultados indican una excelente concordancia entre los evaluadores y una adecuada validez aparente y semántica. **Conclusión:** El prototipo de aplicación se consideró adecuado en términos de apariencia y contenido semántico, configurándose como una tecnología prometedora para apoyar el autocuidado y promover la salud ocupacional.
Descriptores: Dolor de la Región Lumbar; Autocuidado; Estudio de Validación; Tecnologia Inalámbrica; Salud Laboral

Introduction

Chronic low back pain (CLBP) is persistent pain lasting more than 12 weeks, affecting approximately 20% of the world's population. The majority of cases (80% to 90%) are of "nonspecific" origin, meaning they cannot be attributed to a specific pathology.[1] This condition causes significant disability and socioeconomic impact.[2] Furthermore, it is one of the leading causes of years lived with disability.[3]

CLBP is highly prevalent among healthcare professionals, especially nurses, with rates ranging from 66.8% to 78%.[4-5] Ergonomic factors, workload, and psychological stress contribute to develop and worsen this condition, reducing professional efficiency. CLBP among nurses is associated with absenteeism, sick leave, and reduced quality of life, with economic impact and increased workload for healthcare teams. As it constitutes one of the main causes of disability and loss of productivity, intervening to improve this condition is essential to ensure safe working conditions, preserve occupational health, and maintain the quality of care provided.[5]

Self-care is defined as the strategies and skills that an individual uses to actively, responsibly, and autonomously manage and monitor their own health, in partnership with healthcare providers.[6] Current guidelines highlight a biopsychosocial approach to chronic low back pain, with psychosocial interventions, exercises, and multidisciplinary rehabilitation. Self-management emerges as an accessible solution to deal with the physical and psychological aspects of pain.[7]

Technological advancement has globalized communication, promoting instantaneous information exchanges.[8] Digital tools transform human reasoning and drive virtualization in various fields, while the digital network favors a global exchange of information and dialogue, resulting in collective intelligence.[8-9]

Incorporating mobile technology (mHealth) has proven to be an effective strategy in promoting healthy habits, treatment adherence, and self-management of chronic diseases.[10-11] Devices such as smartphones and tablets assist patients and professionals by providing information, preventive services, and self-care support for medical and public health practices.[12] They are easy to use, widely accepted, and overcome geographical barriers, being especially useful in remote areas and in pain management, in addition to contributing to reduce costs with chronic diseases and increasing treatment engagement and adherence.[3,7,12]

Although several pain applications exist, there is a lack of clear guidance on their effectiveness and alignment with best practices, which can generate risks.[13] mHealth does not yet surpass traditional care and requires more studies on usability, privacy, and adherence.[14-15] There is a demand for specific apps for low back pain, with personalized pain management. However, integrating these solutions into clinical practice is a challenge which requires collaboration between developers, researchers, and healthcare professionals.[12,16] The creation of educational technologies must follow scientific rigor, with quality content, attractive design, and interactive functionality.[17]

Evaluation of educational materials is essential for their availability, as it enables improving understanding and relevance of the content to the target audience.[10] To do so, semantic, appearance, and usability evaluations with the target audience are essential.

The participation of end users enables identifying improvements, adjusting language and images to make the material more accessible and understandable, and providing greater reliability and credibility.[10]

When searching for applications in the virtual Google® Play and Apple® stores, no technologies specifically aimed at promoting self-care among healthcare professionals with CLBP were identified. This absence reveals a gap in the supply of digital resources targeted at this audience considering the high prevalence of LBP in this professional category and its repercussions on functional performance and quality of life.[2-5]

Thus, developing and validating this lumbar self-care tool aimed at healthcare professionals represents an innovative, accessible strategy aligned with international guidelines for self-care through digital technologies. Therefore, the objective of this study was to describe the creation and face and semantic validation of a prototype application for healthcare professionals with nonspecific chronic low back pain.

Method

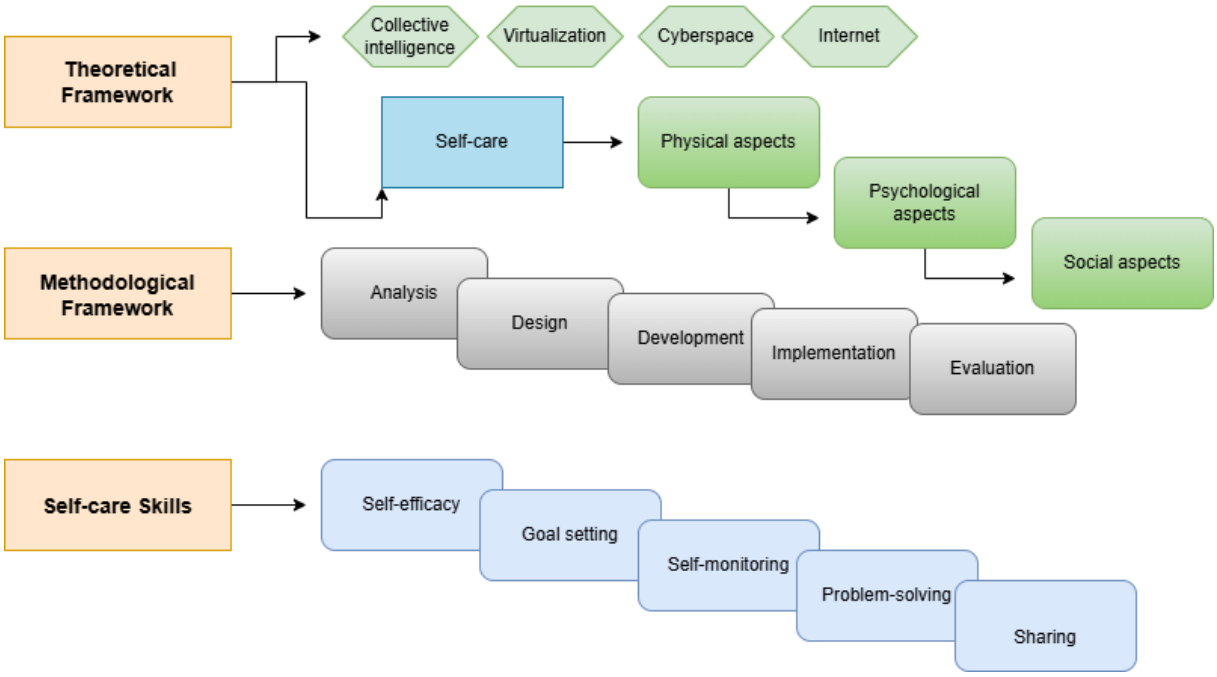
This is a technological study focused on evaluating a prototype mobile app entitled “Lower Back Self-Care” developed for healthcare professionals. Validation was conducted through feedback from end-users on the second version of the prototype (available at: https://youtu.be/fpZ5QZjnHqc) after content review, with the aim of improving the final version.

Creation of the Mobile Application

The prototype was developed between 2022 and 2023, based on the Systematic Instructional Design (SID) method, the theoretical concepts of Pierre Lévy, and the self-management guide, which includes self-care skills focused on chronic pain.[9,18-19] The conceptual map of the study is presented in Figure 1.

The prototype’s main menu brings together educational content on chronic and low back pain, a diary for pain monitoring, reminders, goal setting, exercise plans, positioning guidelines for healthcare professionals, and mental health practices such as breathing, relaxation, and meditation.

Figure 1 – Conceptual map for self-care of lower back pain. Florianópolis, SC, Brazil, 2024



The study was conducted based on the five phases of the ADDIE instructional model (Analysis, Design, Development, Implementation, and Evaluation), which distinguishes the conception stage (analysis, design, and development) from the execution stage (implementation and evaluation).[18]

Analysis: after establishing the instructional objectives, the didactic content was developed based on a systematic review (SR) according to the precepts of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and a Technological Prospecting, with the first screens created in Figma® and validated by 11 experts in the field of LBP.

Design: a graphic designer produced the images and a User Experience and User Interface (UX/UI) specialist organized the layout with the support of a detailed storyboard that guided the structure, menu, navigation screens, flows, and features of the prototype to the programming team. Each screen was designed with buttons, colors, and icons to improve user experience, usability, and navigability. The interface was validated with the support of flowcharts and wireframes, ensuring intuitive navigation and usability suitable for the target audience.

Development: Two programmers technically implemented the prototype, performing coding, testing, corrections, and database integration in a collaborative

process with the researchers. Continuous adjustments were made through interaction between programmers and researchers. The prototype was developed in a hybrid model using the React Native framework, which enabled creating versions for Android® and iOS® from a single codebase. This approach ensures consistent performance and facilitates distribution in the Play Store® and Apple Store®. The backend, responsible for processing information and integrating with the database, was developed in Node.js, an environment which enables executing JavaScript code on the server side. A serverless architecture based on Amazon Web Services Lambda was adopted, in which the code is executed on demand, eliminating the need for server management and providing greater scalability, security, and reduced operating costs.

Implementation: The prototype was compiled, generating a file in Android Application Pack (APK) format, and hosted on Amazon Web Services® to allow continuous updates and stable performance. All necessary documentation was prepared for future maintenance.

Analysis: This included usability validation conducted by eight experts in the field of Human-Computer Interaction and/or Usability, with an evaluation based on heuristics and severity. The other evaluation (corresponding to the present study) was the face and semantic validation of the prototype with users with CLBP. Sub-characteristics such as clarity, language, design, reliability, functionality, efficiency, and compatibility were evaluated.

Face and Semantic Validation

The participants were selected in January 2024 using intentional non-probabilistic sampling. Healthcare professionals with chronic low back pain (CLBP) for more than 12 weeks were included, with pain of at least two points on the Visual Analogue Scale (VAS) and a minimum frequency of twice a week. The VAS is a 10-point numerical scale to measure pain intensity, where 0 is no pain and 10 means the worst pain. Cases with specific causes of CLBP, such as herniated disc, spondylolisthesis, or spinal canal stenosis, were excluded. A minimum of six participants is recommended for the validation of technologies and instruments.[20]

The 11 participants were recruited in person at a medium- to high-complexity public hospital in Florianópolis, Santa Catarina, chosen for its diversity of specialties and large number of professionals. The screening used a structured questionnaire to assess criteria such as duration, frequency, and diagnosis of CLBP, as well as warning signs (red flags) for exclusion. After obtaining consent and signing the Informed Consent Form (ICF), the prototype was presented on a Galaxy S10+ smartphone (model SM-G975F), and the evaluation questionnaire was accessed via a link on Google Forms®.

An instrument adapted from Diniz[21] was used for the face and semantic validity evaluation by the target audience, consisting of two sections: one for sociodemographic characterization (sex, age group, profession, degree, length of education, more than one employment relationship, usual work shift and work regime) and clinical characterization (frequency of LBP in the last month, duration of pain and comorbidities). The second section was for evaluating the prototype in terms of organization (Does the app's visual appeal catch your attention? Is the visual pleasant? Are the colors attractive? Does the color facilitate reading? Does the app show what subject it refers to? Is the main menu structure organized?); Writing style (Is the font size ideal for easy reading? Is the information easy to understand? Is the information clearly organized, aiding reading? Is the content in each topic of adequate length? Is the text interesting?); appearance (Are the images clear? Are there an adequate number and size of images? Do the images help to understand the content? Does the screen appearance facilitate use? Does the appearance make use more fun? Is the app's presentation attractive?); and motivation for use (Were you motivated to explore all the items (buttons) in the main menu to the end? Did the app motivate you to think about self-care for low back pain?). Responses were given on a four-point Likert scale, with the following response options: 1 = strongly disagree; 2 = disagree; 3 = agree; 4 = strongly agree. Finally, participants answered the following questions: What are the positive and negative points? Would you recommend the app to others? What other information could be added? Do you consider it important to have exercises in the app?

The data from the assessment instrument were organized in an Excel® spreadsheet and statistically analyzed using IBM SPSS Statistics software (version 25), adopting a significance level of 5%. Descriptive analysis (absolute and relative

frequencies, mean, and standard deviation) and assessment of agreement among experts were performed using the Content Validity Index (CVI), considered adequate when ≥ 0.80. The CVI represented the proportion of experts who assigned scores of 3 (agree) or 4 (strongly agree) to the evaluated items. The CVI for each item was obtained by the ratio between the number of responses of 3 and 4 and the total number of responses for that item. The reliability of the instrument was verified by Cronbach's alpha (≥ 0.70) and the Intraclass Correlation Coefficient (ICC ≥ 0.70).[22]

The variables extracted from the data collection form were organized into two groups: the first with sociodemographic data, professional data, and LBP characteristics of the participants; the second with aspects of the face and semantic validity assessment of the prototype, such as organization, content, writing style, appearance, and motivation for use.

The study was approved by the Research Ethics Committee with Human Beings of the institutions involved, with opinion number 5718456 and CAAE 56237222.1.0000.0121 of October 2022 and opinion number 5.834.656 and CAAE 56237222.1.3001.5360 of December 22, 2022, in accordance with the ethical principles in Resolution No. 466/2012 of the National Health Council. Participants signed the Informed Consent Form (ICF).

Results

Prototype Creation

The app prototype, titled "Lower Back Self-Care," has a simple and interactive interface compatible with Android and iOS. It was developed through prototyping, enabling simulations, evaluation, and improvement of interfaces and functionalities before the final version. The design was created on the Figma® platform (www.figma.com), which facilitates collaborative creation of interfaces and navigation testing.

The design included original illustrations for the body repositioning section and visual elements obtained from the Freepik® library. The structure was redesigned to improve usability with simplified icons, reorganization of categories in the self-care

section, and a quick access bottom menu. The logo represents a stylized spine, and the Inter font was chosen for its legibility (Figure 2).

The design follows a minimalist palette in white and light blue, favoring readability and reducing visual fatigue. The content is distributed between texts and media, and uses scientific language adapted to the health target audience, thereby promoting better understanding and engagement.

The app's flow begins with a splash screen displaying the logo, followed by introductory screens (onboarding), which automatically appear only upon first access to the application. These screens aim to welcome the user, present the prototype's purpose, clarify the concept of nonspecific CLBP, and provide guidance on excluding specific causes. The user is subsequently directed to registration and login, entering personal data (Figure 2).

Figure 2 – Screenshots of the Lower Back Self-Care app. Florianópolis, SC, Brazil, 2024

After logging in and accepting the terms of use and privacy policy, the user accesses a prototype interface with 67 screens distributed across four main sections, accessible via the bottom navigation bar: Home, Self-Care, Knowledge, and Diary. Features include goal

planning, customization of biomechanical and respiratory exercises, self-monitoring of pain through the diary, setting reminders, stress management, exercises with animated GIFs, pain education, and viewing graphs and reports.

The "Home" section displays personalized messages based on the user's reported pain level, as well as providing shortcuts to features such as goal planning, educational content, diary, and exercises. The "Self-Care" section is divided into three subsections: "Planning," for setting and organizing goals; "Staying Active," with workouts and guidance on physical activity; and "Breathing," with breathing exercises, meditation, and relaxation techniques.

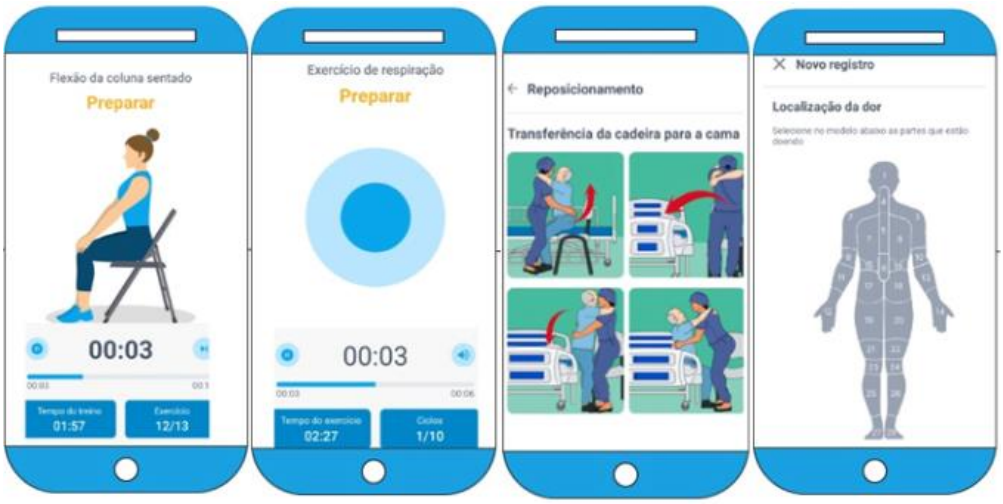
Personalized goal planning involves seven components: goal identification, underlying motivation, deadline for completion, frequency of repetition, reminder scheduling, and reward definition. These elements facilitate their recording and systematic monitoring. The process is guided by self-efficacy-based guidelines. A notepad is available for recording motivating activities as an additional incentive, with the option to attach images (Figure 2).

The prototype offers guidance for pain management, a fixed exercise program, a list of exercises, and the calculation of body mass index (BMI) in the "Stay Active" subsection. The user can add personalized exercise plans with animated GIF feedback. The exercises are detailed by position and time, and the user can name, edit, delete, and control the execution of the workouts as they see fit. The prototype also offers resources for dealing with stress and anxiety in the "Breathe" subsection, such as diaphragmatic breathing exercises, relaxation techniques, and meditation practices. The breathing exercises have predefined times, but enable customizing duration, breathing cycles, and background sounds. Meditation and relaxation practices utilize music with nature sounds, with or without videos (Figure 3).

The "Knowledge" subsection includes the "Understand Your Pain" screen, structured in a question-and-answer format, offering clear information about chronic pain and low back pain, illustrated with drawings and figures, and aims to improve understanding and knowledge about pain. The last question, entitled "Learn More," directs the user to relevant references and articles. The ergonomics section provides instructions on patient repositioning intended for healthcare professionals (Figure 3).

The "Diary" section enables the user to record and track pain episodes, identifying aggravating and relieving factors. The data is stored, displayed in history with graphs, allowing comparisons over time, and can be recorded through short answers, multiple choice, or checkboxes. Reports can be generated for different periods and saved as images for clinical use (Figure 3).

Figure 3 – Screenshots of the Lower Back Self-Care app. Florianópolis, SC, Brazil, 2024



The "Good Ideas" section aims to increase motivation, self-efficacy, and pain management through daily reminders containing insights, guidance, and motivational messages. These notifications are based on scientific evidence and best practices for managing the condition, address topics such as physical activity, sleep, emotional state, and adherence to care and medication use, and can be personalized by the user. The prototype also sends congratulatory messages and encouraging symbols to recognize progress achieved.

Participants' Profile

A total of 11 healthcare professionals participated in the validation. Participants responded in the initial screening questionnaire that the pain was sufficient to limit their activities or daily routine for at least one day. One of the evaluators indicated maintaining their usual activities despite the presence of pain (n=8; 72.2%). None of the participants had a specific diagnosis for their LBP. More than half of the professionals (n=7; 63.3%) related the

pain symptom to their work, and the others also recognized a possible occupational influence. Regarding psychological factors, they reported feeling depressed in the last month (n=9; 81.8%) and pointed to a lack of interest or pleasure in daily activities (n=8; 72.7%).

The participants were predominantly female (n=9; 81.8%), with a mean age of 47.8 years (SD=7.4), ranging from 35 to 57 years (Table 1).

Table 1 – Distribution of sociodemographic and occupational characteristics of specialists. Florianópolis, SC, Brazil, 2024. (n*=11)

Variables	n*	%
Sex		
Female	9	81.8
Male	2	18.2
Age range		
30 to 40	2	18.2
41 to 50	3	27.3
> 50	5	45.4
Occupation		
Physiotherapist	2	18.2
Nurse	2	18.2
Nursing technician	6	54.5
Social worker	1	9.1
Degree		
High School	5	45.4
Undergraduate Degree	2	18.2
Specialization	3	27.3
Master's Degree	0	0
Doctorate	1	9.1
Time since graduation		
1 to 5 years	1	9.1
1 to 5 years	1	9.1
6 to 10 years	3	27.3
More than 10 years	7	63.6
More than one employment		
Yes	3	27.3
No	8	72.7
Normal work shift		
Day	6	54.5
Night	4	36.4
Day and night	1	9.1
Work regime		
12 hours	10	90.9
8 hours	1	9.1
Do overtime		
Yes	10	90.9
No	1	9.1

*n: sample of specialists

The majority of the 11 participants (n=10; 90.9%) used their smartphone as their main device on a daily basis, while only one predominantly used a computer. The main purposes of smartphone use included calls (n=9; 81.8%), instant messaging (n=9; 81.8%), social networks (n=8; 72.7%), professional activities (n=7; 63.6%), and entertainment (n=2; 18.2%). The average intensity of the reported low back pain was 7.4 (SD=1.9), ranging from 4 to 10 on a scale of 0 to 10.

Most participants reported more than five episodes of low back pain (n=5; 45.4%) in the last month, while others had one to two (n=4; 36.4%) and three to four occurrences (n=2; 18.2%). Regarding pain duration, they reported symptoms for one to two years (n=2; 18.2%), for three to four years (n=2; 18.2%), for more than five years (n=4; 36.4%), and for more than ten years (n=2; 18.2%). In turn, stress and depression stood out for comorbidities (n=3; 27.3% each), followed by hypertension and diabetes (n=2; 18.2% each), and no associated health problems were reported (n=2; 18.2%).

Content Validity Index

The overall CVI (Content Validity Index) for the four domains evaluated was 0.98, indicating high agreement. However, item 18 regarding the motivation for fully exploring the menu presented a CVI of 0.818, suggesting a specific area for improvement, as it showed a tendency towards lower agreement.

Participants highlighted the following as positive aspects of the app prototype: fluid navigation, encouraging self-care of the spine, the possibility of performing exercises simultaneously, integration of nature sounds with breathing exercises, encouraging reflection and organization of daily activities, practical applicability, ease of use, and the diary functionality for recording pain monitoring. Among the negative aspects, they cited the excess of information in the “Understand your pain” section; disinterest in recording; and the preference for larger screens, aiming for a more effective stimulus to perform the exercises. Most did not report negative aspects. Everyone valued the presence of exercises, there was no dissatisfaction, and everyone would recommend the tool to other people.

The Content Validity Index (CVI) of the items ranged from 0.81 to 1.00. Evaluation of the items using the categories “agree” or “strongly agree” resulted in average CVI scores of 1.00 for the organization, writing style, and appearance domains, and 0.90 for the motivation domain (Table 2).

Table 2 – The agreement ratio according to the CVI*. Florianópolis, SC, Brazil, 2024. (n=11)

Evaluated items	Strongly agree	Agree	Disagree	Strongly disagree	CVI
Organization					
1. The app’s visual design catches your attention?	7	4	_	_	100
2. Is the visual design pleasing?	7	4	_	_	100
3. Are the colors attractive?	7	4	_	_	100
4. Does the color make it easy to read?	9	2	_	_	100
5. Does the application show what subject it refers to?	10	1	_	_	100
6. Is the main menu structure organized?	10	1	_	_	100
Writing style					
7. Is the font size ideal for easy reading?	9	2	_	_	100
8. Is the information easy to understand?	9	2	_	_	100
9. Is the information organized clearly, aiding readability?	8	3	_	_	100
10. Is the content in each topic the right size?	8	3	_	_	100
11. Is the text interesting?	10	1	_	_	100
Appearance					
12. Are the images clear?	9	2	_	_	100
13. Are there enough images of adequate size?	9	2	_	_	100
14. Do the images help to understand the content?	9	2	_	_	100
15. Does the screen appearance make it easy to use?	9	2	_	_	100
16. Does the appearance make it more enjoyable to use?	8	3	_	_	100
17. Is the app’s presentation attractive?	8	3	_	_	100
Motivation					
18. Did you feel motivated to explore all the items (buttons) on the main menu until the end?	6	3	2	_	81,82
19. Did the app motivate you to think about self-care for lower back pain?	9	2	_	_	100
Total	161	46	2	0	209/98

*CVI: Content Validity Index

The majority of participants assigned positive scores for the four domains evaluated (organization, writing style, appearance, and motivation): 42.20% of responses were “agree” and 55.96% were “strongly agree,” while only 1.83% were “disagree”.

Validity Index of the Instrument

Cronbach's alpha coefficient was calculated to verify the internal consistency of the assessment instrument applied to the participants considering the responses obtained on the 4-point Likert scale used to analyze the items of clarity, relevance, and semantic adequacy. The value obtained was 0.930 [95%CI: 0.851; 0.977], indicating excellent reliability, since the items exhibit correlation with each other and almost perfect internal consistency.

Discussion

This study describes the creation and face and semantic validation of a prototype self-care app for healthcare professionals with nonspecific chronic low back pain, based on the SID method and the concepts of Pierre Lévy. Professionals from different areas contributed to the interface and functionalities of the tool, which included skills from the self-management guide.[9,18-19] The results indicated satisfactory face and semantic validity, with high agreement rates among the participants.

The prototype app seeks to promote users' self-care and foster healthy habits. Digital health strategies promote engagement and offer new tools for effective management of chronic musculoskeletal conditions.[23] People seek health content that is clear, concise, and tailored to their individual needs, which reinforces the importance of apps with accessible guidance.[16,24] Resources such as sharing with other patients, blogs, and videos are well received, as they help in the search for information, distraction, and pain monitoring, reflecting users' desire to actively participate in treatment and learn pain management skills.[25] In this sense, the development of the prototype prioritized an intuitive, interactive, simple, and easy-to-use interface adapted to the target audience. Elements which stimulate interaction make recommendations clearer and contribute to develop the user's cognitive skills.[12]

The face and semantic evaluation of the prototype was positive, with an overall CVI of 98% and 100% agreement in 18 of the 19 items, indicating coherence in measuring the construct. The analysis addressed aspects such as interface, language, and figures. The participation of end users at all stages favors the effectiveness, usability, and impact of the technology.[24] Although the "Motivation" dimension showed lower

performance, this does not compromise the overall validation, but points to the need for adjustments in the usability or attractiveness of the main menu in subsequent updates.

The sample proved to be adequate, with a well-defined characterization of CLBP. Despite the small size, moderate intensity pain, high frequency, and long duration were observed, indicating chronicity and cumulative impact. These findings highlight the importance of accessible and continuous self-management strategies, such as those offered by the developed prototype.[5,7]

The presence of psychological comorbidities, such as stress and depression, is also noteworthy, as they affect motivation and adherence to treatment, reinforcing the biopsychosocial vulnerability of patients with CLBP. It is emphasized that functional disability is more related to cognitive, emotional, and social factors than to pain intensity, making it essential to consider mental health and the multidimensionality of pain in managing the condition.[1,26] The developed prototype contemplates physical and psychosocial dimensions of pain, focusing on self-efficacy, or confidence in one's own ability to achieve goals. Self-efficacy is a key element in rehabilitation of chronic conditions and in functionally improving people with persistent CLBP.[27]

More than 50% of participants associated pain with work, highlighting the need for interventions in the workplace. Most reported monthly functional limitations and attributed the symptoms to professional activities, suggesting occupational impact and possible pain sensitization mechanisms. Low back pain (LBP) is prevalent among nurses and is associated with occupational factors (such as poor posture, physical exertion, and stress) and personal factors (such as female gender, advanced age, smoking, low educational level, and overweight), affecting functionality, quality of care, and generating additional costs to the health system.[5]

Participants highlighted some of the app's strengths, such as: the simultaneous performance of exercises, the combination of nature sounds with breathing exercises, encouraging reflection and organization of daily activities, and the diary function for monitoring pain, all constituting aspects with the potential to encourage self-care. There was interest in learning pain management strategies

and motivation to apply them, signaling a desire for active participation in treatment. Digital interventions with varied content, scientific basis, and expert support can strengthen user confidence and engagement.[25]

Participant feedback suggested that technical refinements and an improved user interface could make the intervention more appealing. Mobile technologies should be developed based on principles of simplicity, usefulness, ease of viewing, and suitability for the target audience.[12]

Animated GIFs, links, figures, and audio were also included. Including interactive elements facilitates learning and retention of instructions, contributing to long-term memory.[28] In addition, the inclusion of interactive biomechanical exercises was considered a positive aspect of the prototype, with all participants highlighting its importance. Exercise therapy is widely recommended as a first-line treatment for CLBP, promoting self-efficacy, reframing pain as a protective mechanism, and increasing confidence in engaging in exercise and physical activity.[29-30] Evidence indicates short-term benefits with a low risk of adverse effects, but adherence is essential for lasting results. Technologies such as mHealth apps have been effective in stimulating engagement.[29-30] In another app, personalized plans based on difficulties reported by users help reduce fear of movement and improve physical function.[23] Sedentary lifestyles aggravate CLBP, and regular exercise contributes to improved mobility, muscle strengthening, and relaxation. Patient motivation and understanding the factors which favor their adherence are fundamental for effective guidance.[11]

Combining education and exercise in digital interventions can have therapeutic and preventive effects, desensitize the nervous system, and relieve pain, surpassing the benefits of exercise alone.[3,29,31] Pain education is fundamental to informing and empowering patients in the proper management of their condition. This approach, especially with a focus on the neuroscience of pain, aims to modify attitudes and beliefs by explaining how cognitive, social, and contextual factors influence the painful experience.[11]

The prototype stands out for its pain diary tool, which allows users to continuously monitor symptoms, increasing self-awareness. This functionality provides continuous information, less susceptible to recall biases, and is valued by users as a

useful auxiliary memory in consultations with healthcare professionals.[16] Self-monitoring through apps offers valuable data, improving understanding and adherence to treatment for patients with chronic pain.[11]

The "Lower Back Self-Care" app prototype uses strategies such as personalization, gamification, goal setting, symptom self-monitoring, and real-time exercises to promote user adherence. Personalization, coupled with clear instructions and short-term action plans, is essential to motivate continued use.[30] A review highlights that elements such as personalized content, data visualization, reminders, education, self-monitoring, and goal setting are associated with greater user engagement.[32] Establishing goals accompanied by an action plan is fundamental to motivating the continued use of self-care apps.[33] Personalization and customization based on individual needs, preferences, and user feedback contribute to more effective CLBP management. The study reinforces the importance of advances in these aspects by developers and researchers.[11]

Most participants use a smartphone as their main device, especially for communication and social networks, which favors using mobile applications as a tool for self-care and health education. Familiarity with the device can facilitate engagement and adherence to the proposed content, although challenges such as unintuitive navigation, technical problems, and lack of integration with social media can reduce adherence. In this context, promoting engagement has become fundamental to the effectiveness of digital health technologies.[32]

The prototype's "Good Ideas" are strategic reminders and suggestions to promote user adoption. Incorporating gamification techniques, such as interactive reminders, personalized feedback, push notifications, and data-driven activity recommendations is crucial for maintaining user motivation and engagement. These elements are designed to guide them through the program, increase overall engagement, and promote sustainable behavioral changes.[34]

The low motivation of two evaluators highlighted the influence of individual factors, such as pain and lack of familiarity with technology. This fact led to reflections on user diversity and the relationship between individual factors and intention to use. App acceptance varies among individuals and is impacted by personal perceptions, social influences, habits, age, gender, and health context.[35]

The study indicates that app acceptance is more influenced by emotional factors, such as hedonic motivation (fun or pleasure derived from using technology), trust, and habits than by perceived usefulness. Trust in technology and digital health literacy are important determinants, especially given the diversity of users. More research is needed to better understand these factors.[35]

As a second-order construct, personal empowerment exerts a significant influence on the acceptance of mHealth technologies, especially in the context of chronic diseases. Individuals become more active in self-care and decisions about their treatment by developing self-confidence and self-efficacy through personal empowerment, which in turn favors an intention to use and engage these technologies.[36]

Advancements in digital technology highlight the importance of developing controlled tools for prescribing apps in pain management considering the physical, psychological, and social aspects of the patient, aiming to increase therapeutic effectiveness. These apps can act as convenient and economical solutions, serving as an alternative to waiting lists or a complement to more comprehensive treatments.[13] Further research is still needed on the factors considered by patients and healthcare professionals in use and prescription of these tools.[11] It is also noteworthy that considering psychosocial factors in the prototype design can enhance its impact on behavior change and promoting self-care in users with CLBP.

The main methodological limitation of the study refers to the absence of participation from professionals in other areas of the multidisciplinary team, such as physicians, speech therapists, and psychologists, which restricts the breadth of evaluative perspectives. In addition, the participants with CLBP were recruited from a single service, which limits generalizing the results. Another aspect to consider is the scarcity of publications on evaluating apps aimed at CLBP, which made more comprehensive comparisons with the existing literature difficult. Regarding the prototype, future inclusion of functionalities which favor interaction and sharing between professionals and users stands out as an opportunity for improvement, expanding the potential for integration into clinical practice.

Finally, it is believed that this technology can add value to public health practices and play a relevant role in the self-management of clinical practice, especially in occupational health contexts considering the digital profile of professionals in the area. Although the app prototype has not yet been published in digital stores, this stage of face and semantic validation is essential in the process of developing digital health technologies. Validation studies prior to publishing the final product are recommended to ensure the quality, content adequacy, and usability of the prototype, thereby enabling corrections and adjustments based on user experience. Thus, this article contributes important evidence for the improvement and subsequent availability of the tool.

Conclusion

The study achieved its objective by validating the appearance and semantics of the "Lower Back Self-Care" application prototype, demonstrating that the appearance and semantics were considered adequate and understandable by the evaluators, with an overall Content Validity Index of 0.98. These results indicate that the prototype presents clarity, organization, and coherence in communicating information, configuring itself as a potentially useful tool to support the self-care of healthcare professionals with chronic low back pain (CLBP). However, as this stage was solely limited to validating appearance and semantics, further studies on its usability, effectiveness, and user satisfaction are necessary to confirm the applicability and practical validity in a real-world context, as these constitute fundamental steps for the future implementation of the tool in digital app stores.

References

1. Xiao C, Zhao Y, Li G, Zhang Z, Liu S, Fan W, et al. Clinical efficacy of multimodal exercise telerehabilitation based on AI for chronic nonspecific low back pain: randomized controlled trial. JMIR mHealth uHealth. 2025;13:e56176. doi: 10.2196/56176.

2. Koppenaal T, Pisters MF, Kloek CJ, Arensman RM, Ostelo RW, Veenhof C. The 3-month effectiveness of a stratified blended physiotherapy intervention in patients with nonspecific low back pain: cluster randomized controlled trial. J Med Internet Res. 2022;24(2):e31675. doi: 10.2196/31675.

3. Rohaj A, Bulaj G. Digital Therapeutics (DTx) expand multimodal treatment options for chronic low back pain: the nexus of precision medicine, patient education, and public health. Healthcare (Basel). 2023;11(10):1469. doi: 10.3390/healthcare11101469.

4. Ali Alabdali A, Al-Noumani H, Al Harrasi TK, Al Daghaishi AA, Al Rasbi MA, Alaamri HK, et al. Low back pain knowledge and associated disability among nursing staff in Oman. Int J Orthop Trauma Nurs. 2024;53:101085. doi: 10.1016/j.ijotn.2024.101085.

5. Zaitoon RA, Said NB, Snober RH, Hussein RF, Abdoon AH, Shehadeh AM, et al. Low back pain prevalence and associated factors among nurses: cross sectional study from Palestine. BMC Public Health. 2024;24(1):3076. doi: 10.1186/s12889-024-20481.

6. Rathnayake APS, Sparkes V, Sheeran L. What is the effect of low back pain self-management interventions with exercise components added? A systematic review with meta-analysis. Musculoskelet Sci Pract. 2021;56:102469. doi: 10.1016/j.msksp.2021.102469.

7. Dobija L, Lechauve JB, Mbony-Irankunda D, Plan-Paquet A, Dupeyron A, Coudeyre E. Smartphone applications are used for self-management, telerehabilitation, evaluation and data collection in low back pain healthcare: a scoping review. F1000Res. 2024;11:1001. doi: 10.12688/f1000research.123331.2.

8. Moreira NEL, Costa DF. Pierre Levy, a filosofia e as novas interações sociais: abrindo caminho para novas experiências de ensino. Prisma [Internet]. 2020 [acesso em 2025 jun 16];2(1);60-73. Disponível em: http://periodicos.ufam.edu.br/index.php/prisma/article/view/8330.

9. Levy P. Cibercultura. São Paulo: Ed. 34; 2010.

10. Lucchese I, Góes FGB, Souza AN, Silva ACSS, Silva LF, Soares IAA. Evaluation of the mobile application "Descomplicando a amamentação" by family members of newborns. Rev Lat Am Enferm. 2023;31:e4086. doi. 10.1590/1518-8345.6883-4086.

11. Kheirinejad S, Visuri A, Suryanarayana SA, Hosio S. Exploring mHealth applications for self-management of chronic low back pain: a survey of features and benefits. Heliyon. 2023;9(6):e16586. doi: 10.1016/j.heliyon.2023.e16586.

12. Sousa MM, Lopes CT, Almeida AAM, Almeida TDCF, Gouveia BLA, Oliveira SHDS. Development and validation of a mobile application for heart failure patients self-care. Rev Esc Enferm USP. 2023;56:e20220315. doi: 10.1590/1980-220X-REEUSP-2022-0315en.

13. MacPherson M, Bakker AM, Anderson K, Holtzman S. Do pain management apps use evidence-based psychological components? a systematic review of app content and quality. Can J Pain. 2022;6(1):33-44. doi: 10.1080/24740527.2022.2030212.

14. Giebel GD, Speckemeier C, Abels C, Plescher F, Börchers K, Wasem J, et al. Problems and barriers related to the use of digital health applications: a scoping review. J Med Internet Res. 2023;25:e43808. doi: 10.2196/43808.

15. Santana BL, Moura JR, Toledo AM, Burke TN, Probst LF, Pasinato F, et al. Efficacy of mHealth interventions for improving the pain and disability of individuals with chronic low back pain: systematic review and meta-analysis. JMIR mHealth uHealth. 2023;11:e48204. doi: 10.2196/48204.

16. Tran-Nguyen K, Berger C, Bennett R, Wall M, Morin SN, Rajabiyazdi F. Mobile app prototype in older adults for postfracture acute pain management: user-centered design approach. JMIR Aging. 2022;5(4):e37772. doi: 10.2196/37772.

17. Silva ACSS, Góes FGB, Ávila FMVP, Goulart MCL, Pinto LF, Stipp MAC. Construction and validation of a mobile application for health education about COVID-19. Rev Gaúcha Enferm. 2022;43:e20210289. doi: 10.1590/1983-1447.2022.20210289.en.

18. Filatro A. Design instrucional para professores. São Paulo (SP): Senac; 2023.

19. Devan H, Farmery D, Peebles L, Grainger R. Evaluation of self-management support functions in apps for people with persistent pain: systematic review. JMIR mHealth uHealth. 2019;7(2):e13080. doi: 10.2196/13080.

20. Pasquali L. Instrumentação psicológica: fundamentos e práticas. Porto Alegre: Artmed; 2010.

21. Diniz CMM. Desenvolvimento e avaliação de aplicativo móvel de apoio ao aleitamento materno [dissertação]. Recife: Universidade Federal de Pernambuco; 2020 [acesso em 2025 mar 01]. Disponível em: https://repositorio.ufpe.br/handle/123456789/38995.

22. Souza AC, Alexandre NMC, Guirardello EB. Psychometric properties in instruments evaluation of reliability and validity. Epidemiol Serv Saúde. 2017;26(3):649-59. doi: 10.5123/S1679-49742017000300022.

23. Comachio J, Mesa-Castrillon CI, Beckenkamp PR, Roberts K, Ho EKY, Field R, et al. "My back exercise app"-mhealth for low back pain: development and usability testing. J Healthc Inform Res. 2024;9(1):67-87. doi: 10.1007/s41666-024-00179-0.

24. Martins VR, Góes FGB, Silva ACSS, Macedo EC, Silva LJ, Silva LF. Information needs on self-care for cildren with leukemia for the creation of a mobile application. Rev Enferm UERJ. 2024;32:e85465. doi: 10.12957/reuerj.2024.85465.

25. Stoppok P, Frewer AL, Schweda A, Geiger S, Skoda EM, Müßgens D, et al. Needs and demands for ehealth pain management interventions in chronic pain patients. J Pers Med. 2023;13(4):675. doi: 10.3390/jpm13040675.

26. Anselmo A, Pagano M, Cappadona I, Cardile D, Russo F, Laudisio A, et al. A systematic review on the neuropsychological assessment of patients with lbp: the impact of chronic pain on quality of life. J Clin Med. 2024;13(20):6149. doi: 10.3390/jcm13206149.

27. Van Hooff ML, Vriezekolk JE, Kroeze RJ, O'Dowd JK, Van Limbeek J, Spruit M. Targeting self-efficacy more important than dysfunctional behavioral cognitions in patients with longstanding chronic low back pain; a longitudinal study. BMC Musculoskelet Disord. 2021;22(1):824. doi: 10.1186/s12891-021-04637-3.

28. Toledo TR, Peres AL, Barros PES, Russo RC, Carvalho LWT. PrevTev: construção e validação de aplicativo móvel para orientações sobre tromboembolismo venoso. Rev Bras Educ Méd. 2022;46(1):e032. doi: 10.1590/1981-5271v46.1-20210405.

29. Cashin AG, Booth J, McAuley JH, Jones MD, Hübscher M, Traeger AC, et al. Making exercise count: Considerations for the role of exercise in back pain treatment. Musculoskeletal Care. 2022;20(02):259-70. doi: 10.1002/msc.1597.

30. Vad VB, Madrazo-Ibarra A, Estrin D, Pollak JP, Carroll KM, Vojta D, et al. "Back Rx, a personalized mobile phone application for discogenic chronic low back pain: a prospective pilot study". BMC Musculoskelet Disord. 2022;23(1):923. doi: 10.1186/s12891-022-05883-9.

31. Itoh N, Mishima H, Yoshida Y, Yoshida M, Oka H, Matsudaira K. Evaluation of the effect of patient education and strengthening exercise therapy using a mobile messaging app on work productivity in Japanese patients with chronic low back pain: open-label, randomized, parallel-group trial. JMIR mHealth uHealth. 2022;10(5):e35867. doi: 10.2196/35867.

32. Oakley-Girvan I, Yunis R, Longmire M, Ouillon JS. What works best to engage participants in mobile app interventions and e-health: a scoping review. Telemed E Health. 2022;28(6):768-80. doi: 10.1089/tmj.2021.0176.

33. Szinay D, Perski O, Jones A, Chadborn T, Brown J, Naughton F. Perceptions of factors influencing engagement with health and well being apps in the United Kingdom: qualitative interview study. JMIR mHealth uHealth. 2021;9(12):e29098. doi: 10.2196/29098.

34. Lewkowicz D, Slosarek T, Wernicke S, Winne A, Wohlbrandt AM, Bottinger E. Digital therapeutic care and decision support interventions for people with low back pain: systematic review. JMIR Rehabil Assist Technol. 2021;8(4):e26612. doi: 10.2196/26612.

35. Schomakers EM, Lidynia C, Vervier LS, Calero Valdez A, Ziefle M. Applying an extended UTAUT2 model to explain user acceptance of lifestyle and therapy mobile health apps: survey study. JMIR mHealth and uHealth. 2022;10(1):e27095. doi: 10.2196/27095.

36. Salgado T, Tavares J, Oliveira T. Drivers of mobile health acceptance and use from the patient perspective: survey study and quantitative model development. JMIR mHealth uHealth. 2020;8(7):e17588. doi: 10.2196/17588.~

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