Braz J Phys Ther 30 (2026) 101262

Contents lists available at ScienceDirect

Brazilian Journal of Physical Therapy

journal homepage: www.elsevier.com/locate/bjpt

Original Research

Patient-targeted smartphone applications for pain management: A review of brazilian app markets

Caroline Maia Neves Favrat [a], Jessica Fernandez [b], Leandro Calazans Nogueira [a,b], Ney Meziat-Filho [b,c], Felipe J.J. Reis [a,d,e,f,*]

[a] Physical Therapy Department, Instituto Federal do Rio de Janeiro (IFRJ), Rio de Janeiro, RJ, Brazil
[b] Postgraduate Program in Rehabilitation Sciences, Centro Universitário Augusto Motta (UNISUAM), Rio de Janeiro, RJ, Brazil
[c] School of Rehabilitation Sciences, Faculty of Health Sciences, Institute of Applied Health Sciences, McMaster University, Hamilton, ON, Canada
[d] Pain in Motion Research Group, Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium
[e] School of Physical and Occupational Therapy, Faculty of Medicine, McGill University, Montreal, Canada
[f] Postgraduate Program in Science, Technology, and Innovation in Health, Instituto Federal do Rio de Janeiro (IFRJ), Rio de Janeiro, RJ, Brazil

ARTICLE INFO

Keywords:
eHealth, Mobile Applications, Pain
Self-management

ABSTRACT

Background: Smartphone apps hold significant potential to improve access to evidence-based interventions and support self-management in patients with pain.
Objective: The aims of this study were: (i) to map patient-targeted apps for pain management available in Brazilian app marketplaces, and (ii) to describe the characteristics, content and quality of information provided by these apps.
Methods: We conducted a systematic review of mobile apps in two Brazilian app markets (App Store and Google Play) using the keywords "dor", "dor crônica", and "manejo dor". The following data were retrieved: (i) app characteristics (description, developer, professional, and data security), (ii) pain management content (pain assessment, pain diary, pain education, activity pacing, goal setting, cognitive restructuring, physical activity, relaxation or meditation practice, psychological approaches, and behavioral skills), and (iii) quality of information (credibility, outcome measures, quality of description, visual information, and feedback).
Results: The total sample consisted of 41 apps. The user mean rating was 4.2/5.0. A significant portion of the apps (63.4 %) required in-app purchases. We found significant gaps in developer transparency (professional backgrounds and data security protocols). Most apps covered only one content including mainly physical activity and pain tracking diaries. Visual content information ranked highest in terms of accuracy and clarity. Credibility was not mentioned in 82.9 % of the apps.
Conclusion: Overall, most of the pain-related apps included in our review exhibited both unclear descriptions in several aspects and a limited coverage of self-management contents (e.g., psychological approaches). A considerable portion of these apps lacked rigorous evaluation against established scientific standards.

Introduction

Digital health technologies, such as mobile apps (mHealth), can play a crucial role in reducing geographical barriers and improving access to healthcare services.[1,2] mHealth involves the utilization of mobile devices, including smartphones, tablets, and wearable technology to provide healthcare services and access information.[2,3] The development of mobile-based solutions encompasses a spectrum from basic short message services (SMS) to complex smartphone applications. These advancements leverage mobile technology for delivering medical care, monitoring health status, and disseminating health-related education and information to patients, healthcare providers, and the lay public.[2,3] Increasing evidence indicates that mobile apps can enhance quality of life, boost medication adherence, improve health outcomes, facilitate symptom tracking, provide support, and offer educational resources.[4–9] These benefits collectively contribute to effective self-management and

* Corresponding author at: Federal Institute of Rio de Janeiro, Campus Realengo - Rua Carlos Wenceslau, 343, Realengo. CEP 21715-000, Rio de Janeiro – RJ – Brazil, Physical Therapy Department - Federal Institute of Education, Science, and Technology. Rio de Janeiro - IFRJ, Rio de Janeiro, Brazil.
E-mail address: felipe.reis@ifrj.edu.br (F.J.J. Reis).

https://doi.org/10.1016/j.bjpt.2025.101262
Received 2 February 2024; Received in revised form 27 December 2024; Accepted 27 July 2025
Available online 22 October 2025

potentially lower healthcare costs in the management of chronic diseases.[4,6,10–16]

Pain, specifically chronic pain, has been recognized as one of the most significant causes of suffering and disability worldwide.[17,18] Chronic pain significantly affects quality of life, leading to physical, psychological, and social consequences.[19] Data on the global prevalence of chronic pain in low- and middle-income countries (LMICs) is limited.[20] In Brazil, chronic pain prevalence ranges from 23 % to 42 % in the general adult population.[21]

Given the widespread use of smartphones devices, smartphone applications (apps) have significant potential to improve access to evidence-based interventions and promote self-management practices in patients with chronic pain.[6,22,23] Self-management interventions frequently include a variety of contents such as goal setting, physical activity, education, relaxation, meditation techniques, psychological therapies, behavioral modification strategies, and activity pacing.[24–26] The current literature presents several reviews focusing on exploring chronic pain self-management apps across different pain conditions.[5,26–35] Lalloo et al.[27] evaluated the available pain apps across different platforms. The authors found that the most common self-care included muscle stretching, self-guided hypnosis, sound-assisted pain mitigation, acupressure, and pain-specific education. Devan et al.[5] reported that most of self-management strategies included meditation, relaxation in the form of audio-guided imagery and hypnosis, pain neuroscience education, and yoga. MacPherson et al.[26] conducted a systematic review to identify psychological elements in pain-related apps available in Canada. Their findings revealed that the most common contents included psychoeducation, sleep hygiene, behavioral activation, coping skills training, and the provision of social support.

Considering the substantial impact of chronic pain on both individuals and society, apps have emerged as potential resource in the management of this condition.[6] The accessibility and practicality of apps position them as effective means to mitigate extended waiting periods, decrease healthcare expenses, and reduce geographical barriers, thereby facilitating patient access to specialized care. In this context, apps hold the potential to be a valuable resource in LMICs or settings with limited resources. The aim of this systematic review was twofold: (i) to map patient-targeted apps for pain management available in Brazilian app marketplaces, and (ii) to describe the characteristics, content, and quality of information provided by these apps.

Methods

Study design and ethical consideration

We conducted a systematic review of pain mobile apps in Brazilian app marketplaces. We reported the review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines where possible.[36]

Search procedure

We searched two Brazilian app markets (App Store and Google Play) using the keywords “dor” (pain), “dor crônica” (chronic pain), and “manejo dor” (pain management) between May and June 2023, with an update on December 5, 2024. The Apple App Store search was performed on iPhones running iOS 17 and, for the update, iOS 18.1.1. The Google Play Store (https://play.google.com/store/apps) was used to identify apps for Android devices.

Apps selection

To be included in the study, the app was required to: (i) include the word “dor” (pain) in the app description, (ii) be aimed at individuals experiencing pain, (iii) be specific to pain management (i.e., content and interventions were framed in the context of pain management including education, return to daily activities, exercises, psychological and behavioral approaches, relaxation, and meditation techniques), (iv) be presented in Brazilian Portuguese. Apps were excluded if they: (i) were specifically designed for use by patients attending a particular pain clinic (e.g., for scheduling appointments), or (ii) were aimed at caregivers or healthcare professionals.

Data extraction

Apps were screened by two independent reviewers (C.M.N.F and J.F) to identify those that fulfilled the inclusion criteria. Duplicates were removed between the two app markets. For the final analysis, data were extracted from the app description or from the app’s website using a custom Microsoft Excel spreadsheet created by the authors. Data extraction process was also conducted independently by the same two reviewers. Information about the apps were retrieved from Google Play, as Android has more than 92 % of the mobile operating system market in Brazil (https://gs.statcounter.com/os-market-share/mobile/brazil). Data were extracted from Apple Store in case of apps available only in iOS. Any discrepancies were resolved through discussion. One author (F. J.J.R) cross-checked the data.

Synthesis of the results

Data syntheses were based on three domains: (i) App characteristics, (ii) pain management content, and (iii) quality of information. The first domain (App characteristics) consisted of four items (description, developer, professional, and data security). In the description, we collected information regarding the operating system, version, recommended age, price, in-app purchases, price range within the app, and download size. The prices of the app were obtained in Brazilian reais (R $) and converted to international dollars (Int$) considering the World Bank’s purchasing power parity for the year 2023. The developer item included the company name, whether it was an individual or team, and if the company develops other health apps. Regarding professional aspects, we analyzed whether there were details about the profession (qualification) of the app’s technical team responsible for content and if there were ways to contact the professional. In the data security item, we checked for information about security, privacy, and data storage.

The second domain (pain management content) consisted of a checklist to identify pain management contents in the app. The items in this domain were adapted from previous studies and included pain assessment, pain diary, pain education, activity pacing, goal setting, cognitive restructuring, physical activity, relaxation or meditation practice, psychological approaches (e.g., Cognitive Behavioral Therapy and Acceptance and Commitment Therapy), and self-management and behavioral skills.[6,27] Each content present in an app was assigned one point, resulting in a total possible score ranging from 0 to 9, with higher scores indicating a greater number of contents.

The third domain (quality of information) consisted of the following items: credibility, outcome measures, quality of description, visual information (screenshots of the app), and feedback. Questions were adapted from Section D of the Mobile App Rating Scale (MARS)[37] to align with the objectives of this study. Credibility was assessed based on the question, “*Is there any reference to the app having been developed or tested previously in scientific studies (development study, usability, effectiveness, satisfaction)?*”. For the item outcome measures, the question used was, *“Does the app provide information about specific, measurable, and achievable objectives?”*. In assessing the quality of information, the question was, *“Is the content of the app correct, well-written, and relevant to the app’s objective/theme?”*. In visual information, the question was, “*Is the visual explanation in the app – through tables, graphs, images, videos, etc. – clear, logical, and correct?*” Finally, feedback was evaluated based on the question, *“Does the app provide any form of feedback to the patient?”*. Each of the above-mentioned item was coded by the two reviewers according to 1 of 4 categories, as follows: (i) Accurate/Clear described; (ii)

Partially accurate/Description lacks clarity; (iii) Inaccurate/Misleading description; (iv) Not mentioned.[38,39]

Data analysis

The data were stored in a Microsoft Excel spreadsheet (version 2024, Microsoft Inc., Redmond, WA) and analyzed descriptively using absolute and relative frequencies.

Results

Summary of app search

A total of 90 apps were identified. Out of these, four duplicates were excluded, totaling 86. After initial screening, we excluded 43 apps. The reasons for excluding the app were: the app was not about pain ($n = 13$), not available in Brazilian Portuguese language ($n = 22$), intended for scheduling appointments ($n = 5$), and developed for healthcare professionals ($n = 3$). We identified 43 apps developed for patients. Two of these apps were removed from the Apple and Google Play stores during data extraction, leaving 41 apps to be included in this review (Fig. 1). Seven of the 41 included apps were available on iPhone only, 15 were available on Android only, and the remaining 19 were available on both platforms.

First domain: app characteristics

We observed that the mean user rating was 4.2/5.0. Notably, 13 apps (31.7 %) either lacked a user rating or had not been rated at the time of assessment. It was also noted that apps with download counts below 10,000 typically did not have user reviews. In terms of cost, our analysis revealed that 15 apps (36.6 %) were available free of charge without any additional in-app purchases, whereas 26 apps (63.4 %) offered additional content or subscriptions through in-app purchases, with the cost ranging from R$0.49 to R$475.03 (approximately Int$0.20 to Int $190.68). From those with in-app purchases, two apps (4.9 %) did not provide additional information on their in-app purchase price. Of the apps that received evaluation equal to or above average, 14 apps (53.8 %) did not provide complete access without payment. Regarding age-appropriateness, 32 (78.0 %) apps were rated as suitable for all ages. None of the apps were rated as suitable only for individuals over 18 years. A smaller group, consisting of 9 apps (22.0 %), provided specific age recommendations, suggesting they are not suitable for children under the ages of four, 10, 12, or 17 years. The size of the apps varied considerably, ranging from 5.8 MB to 124.0 MB, with the largest being “Enxaqueca Buddy” (124.0 MB) and “Exercícios para reduzir a dor” (87.0 MB). Our findings revealed varied update patterns among the apps: 21 (51.2 %) received updates in the past six months, 8 (19.5 %) had updates older than six months and less than 3 years, nine (22.0 %) had not been updated for over three years, and three (7.3 %) lacked information on the date of their last update. The characteristics of the included apps are detailed in Supplementary Material 1.

Considering the information related to the developers, 30 (73.2 %) had experience in creating other health-related apps. Specifically, Fitric and Steveloper each developed four apps focused on pain management, Blog Dor Crônica created three apps, and mEL Studio developed two

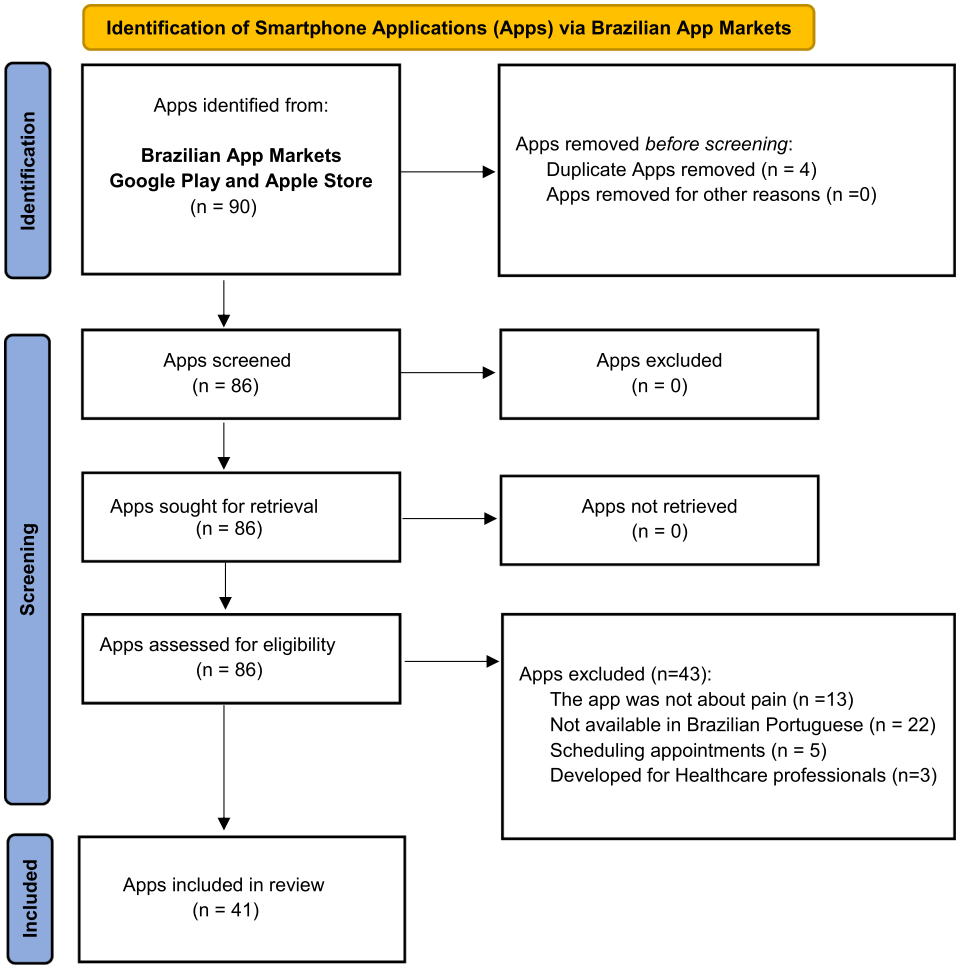

Fig. 1. Flowchart of the selection of the Apps included in the study.

apps. The most common method provided for professional contact included email, physical address, and website for 22 of the apps (53.7 %). Seven apps (17.1 %) did not provide any contact information. Only one app (2.4 %) disclosed the profession of the individual responsible for the technical aspects, while none provided information about their educational background. In a particular app, this information was available on the app's website, indicating the participation of neurologists in the project. Another app (Straloo), on the app's website, reported that the app is based on evidence and presented two articles that supported the decision.

Data security policies were evaluated based on whether there was information about the guarantee of data security and management. Accordingly, 11 apps (26.8 %) did not provide any data security information, while 30 apps (73.2 %) offered some level of information. This information included how collected and shared data were used, whether users could request data deletion, and the security of data transfer over a secure connection. Of these, 11 apps (26.8 %) did not ensure data storage security and 30 apps (73.2 %) guaranteed data security.

Second domain: pain management contents

In this category, our analysis revealed that 25 apps (61.0 %) offered a singular pain management content, while 12 (29.2 %) incorporated two distinct contents, and four apps (9.8 %) encompassed three varied contents. Twenty one apps (34.4 %) were primarily based on physical activity, 12 (19.7 %) focused on pain diary, nine (14.8 %) provided contents related to information or education about pain, eight (13.1 %) on goal setting, seven (11.5 %) included relaxation or meditation techniques, three (4.9 %) presented cognitive restructuring, and one (1.6 %) aided in pacing activities. None of the apps focused on psychological therapies or were dedicated to pain assessment. Detailed information about the pain management content across the apps is presented in Table 1.

Third domain: quality of information

Findings related to quality of information are presented in Fig. 2. Visual information showed the highest number of apps classified as accurate/clearly described (n = 22; 53.4 %), followed by quality of description (n = 15; 36.6 %), and outcome measure (n = 14, 34.1 %). Credibility was the item that presented highest number of apps categorized under 'not mentioned' (n = 34; 82.9 %), and it was observed that none of the apps were rated as having accurate or clearly described information. Supplementary Material 2 provides the results for the third domain for each included app.

Discussion

Main findings

In this review, we mapped patient-targeted apps for pain management available in Brazilian app marketplaces, providing a detailed analysis of their characteristics, content, and information quality. A total of 41 apps were identified across the Apple Store and Google Play, with high user ratings on average. However, a substantial proportion of apps were unrated, and most required in-app purchases, potentially creating a cost barrier. Gaps in developer transparency were notable, particularly regarding contact details, professional background, and data security. The apps predominantly featured modules focused on physical activity, pain tracking diaries, goal setting, and educational resources related to pain management, but few incorporated a combination of these contents. While visual content generally demonstrated good accuracy and clarity, other aspects, such as credibility, were often lacking, with many apps showing no evidence of development based on scientific standards.

Comparison with the literature

Considering the characteristics of pain management apps identified in this study, several noteworthy findings emerge. Although a considerable number of apps (n = 41) are available in Brazilian Portuguese, only 15 were free. The remaining require some form of subscription or in-app purchases, potentially posing a socioeconomic barrier for self-management strategies, especially in LMICs.[5,40,41] Most of the apps (32/41) do not specify age restrictions for users, yet it is unclear for which age group these apps are intended. It seems to be common to find a limited number of apps for children and adolescents with pain. MacPherson et al.[26] found only one app (Achy Penguin) available in Canada, which is designed for young children, specifically for managing acute pain.

A notable concern found in this review was that, although these apps are aimed at self-management interventions for people in pain, none disclosed having healthcare professional oversight or technical responsibility. Moreover, a considerable proportion of these apps have not undergone rigorous evaluation against established scientific standards. This gap raises questions about the clinical efficacy and safety of these apps. Several studies have raised concerns regarding key aspects of pain management apps, including content validity, the engagement of healthcare professionals and patients in their development and evaluation, their grounding in contemporary research or behavioral theories, and their scientific assessment through feasibility or effectiveness testing.[27,35,42–45] On the other hand, it is important to recognize that the dynamic nature of this field may be bringing positive changes. For instance, Devan et al.[5] reported that 52 % of the apps they reviewed involved healthcare practitioners in their development and 21 % had undergone some form of testing.

In general, current guidelines endorse a combination of education, physical activity, and psychological therapies as effective approaches for managing patients with chronic pain.[46–50] Intriguingly, our analysis revealed that none of the examined apps encompassed psychological approaches. The findings indicate that many of the included apps (n = 21) predominantly focused on delivering a single self-management approach, such as physical activity. However, they lacked integration of additional crucial contents like goal setting, educational information, activity pacing, and cognitive restructuring. Apps encompassing a broader range of features that support fundamental self-management skills can significantly enhance the potential for behavioral change, as evidenced in app-based systematic reviews that focus on promoting physical activity.[51–53] The lack of relevant contents in patient-target apps appears to be a common issue. Devan et al.[5] found that some contents such as goal setting and problem solving, pain education, pacing activities, social support, and culturally tailored information, were less covered or absent in pain self-management apps. McPherson et al.[26] found that relaxation training, mindfulness, pain diary, physical activity, cognitive restructuring, acceptance, activity pacing, self-compassion, tailored feedback, and goal setting were rarely included on apps available in Canada.

Strengths and limitations

In Brazil, two previous studies included apps for individuals with pain—one focused on spine disorders[54] and the other on rheumatic diseases.[55] The current study contributes to existing knowledge by mapping and evaluating patient-targeted apps available in Brazilian marketplaces, addressing a gap in the literature. By focusing on apps designed for patients with pain, this study provides relevant information for local users, detailing app characteristics, pain management content, and information quality to highlight the apps' strengths and limitations.

This study presents some limitations that should be acknowledged. First, while we conducted a thorough search, it is essential to recognize the possibility that certain apps may have been overlooked. Second, we did not use a standard assessment tool, such as the Mobile Application

Table 1
Presence of pain contents in the Apps and overall scoring ($n = 41$).

App	Pain assessment	Pain diary	Pain education	Activity pacing	Goal setting	Cognitive restructuring	Physical activity	Relaxation or meditation	Psychological approaches and behavioral skills	Score
A Dor Sumiu – Tudo o que você	N	N	N	N	Y	N	Y	N	N	2
Aliviar a dor nas costas	N	N	N	Y	N	N	Y	Y	N	3
Alivio Dor	N	N	Y	N	N	N	N	N	N	1
Alivio Mulher	N	N	Y	N	N	N	N	N	N	1
Alivio para enxaqueca: Musica	N	N	N	N	N	N	N	Y	N	1
Alongamento & Flexibilidade	N	N	N	N	Y	N	Y	N	N	2
Caminho da dor	N	N	Y	N	N	N	N	N	N	1
Coluna vertebral sana−Postura	N	N	N	N	Y	N	Y	N	N	2
Como corrigir a postura	N	N	N	N	Y	N	Y	N	N	2
Como corrigir sua postura	N	N	N	N	Y	N	Y	N	N	2
Diário Cefaleia	N	Y	N	N	N	N	N	N	N	1
Diário da Cefaleia – Elimine s	N	Y	N	N	N	N	N	N	N	1
Diário da Dor	N	Y	N	N	N	N	N	N	N	1
Diário da Enxaqueca	N	Y	N	N	N	N	N	N	N	1
Diário Enxaqueca	N	Y	N	N	N	N	N	N	N	1
Dolori	N	Y	N	N	N	Y	N	Y	N	3
DOL – Dor OnLine	N	N	Y	N	N	N	N	N	N	1
Dor de Cabeça Check Up	N	Y	N	N	N	N	N	N	N	1
Dor nas Costas – Diário	N	Y	N	N	N	N	N	N	N	1
Dor nas costas ioga	N	N	N	N	Y	N	Y	Y	N	3
Dor nas costas lombar Ciática	N	N	N	N	N	N	Y	N	N	1
Entendendo a Dor crônica	N	N	Y	N	N	N	N	N	N	1
Enxaqueca Buddy	N	N	N	N	N	N	Y	N	N	1
Exercícios de alongamento	N	N	N	N	N	N	Y	N	N	1
Exercícios de pescoço−Sem dor	N	N	N	N	N	N	Y	N	N	1
Exercícios para Cervical	N	N	N	N	N	N	Y	N	N	1
Exercícios para dor nas costas	N	N	N	N	Y	N	Y	N	N	2
Exercícios para dor no joelho	N	N	Y	N	N	N	Y	N	N	2
Exercícios para dor no ombro	N	N	N	N	N	N	Y	N	N	1
Exercícios para dores nas costas	N	N	N	N	N	N	Y	N	N	1
Exercícios para reduzir a dor	N	N	N	N	Y	N	Y	Y	N	3
Lembrete de Medicamentos	N	Y	N	N	N	N	N	N	N	1
Lembrete de Postura	N	N	Y	N	N	N	N	N	N	1
Livre da Dor Lombalgia	N	Y	N	N	N	N	Y	N	N	2
Mais vida Menos dor	N	N	N	N	N	N	N	Y	N	1
O Diário da Dor	N	Y	N	N	N	N	N	N	N	1
Repare	N	Y	N	N	N	N	Y	N	N	2
SOS Enxaqueca	N	N	Y	N	N	Y	N	N	N	2
Straloo	N	N	N	N	N	N	Y	N	N	1
Tratar dor nas costas	N	N	Y	N	N	Y	N	N	N	2
Yoga Down Dog	N	N	N	N	N	N	Y	Y	N	2

N – No; Y- Yes;.
Score: Number of pain contents identified (minimum score = 0 and maximum score = 9).

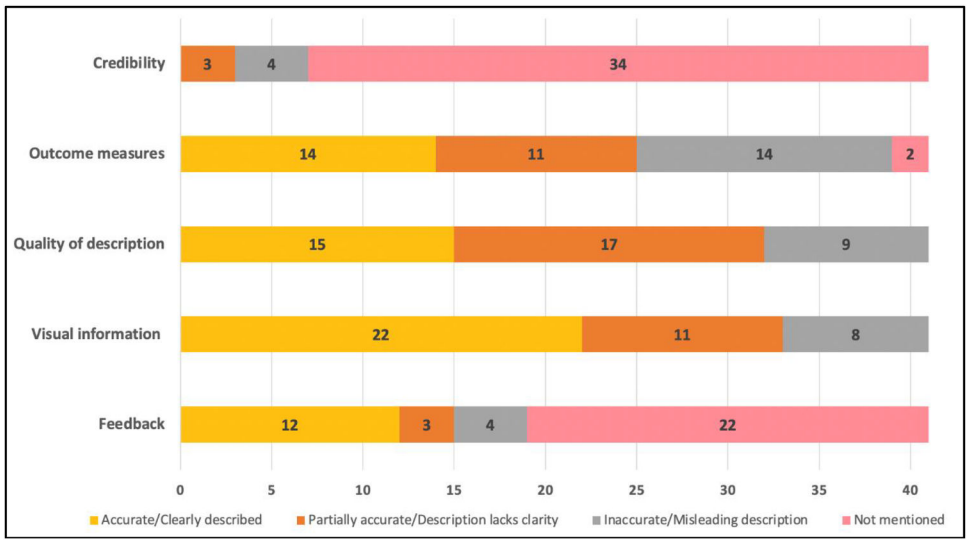

Fig. 2. Quality of information on Apps assessed ($n = 41$).

Rating Scale (MARS).[37] Our evaluation relied solely on the app descriptions available on their respective platforms or websites, without downloading the apps for an in-depth review. This approach was based on the assumption that individuals with pain might choose an app based on its platform description. However, we acknowledge that this method may not fully capture the app's functionalities, especially for apps with limited descriptions. Finally, we lacked standardized tools for assessing pain-related content and, instead, relied on a custom-designed list of contents specific to our study.

Clinical applications and research recommendations

Given the rapid advancement of digital technologies and the widespread use of smartphones, an app emerges as a viable option for the management of patients with pain even in LMICs. The current literature provides evidence showing positive effects on several painful conditions including chronic neck pain, fibromyalgia, interstitial cystitis, bladder pain syndrome, osteoarthritis, and chronic low back pain.[6] Apps can also be used as a supplementary tool in pain management to engage patients and enhance communication between patients and professionals. However, to integrate apps into clinical practice, it is essential that their implementation adheres to rigorous scientific standards. In this sense, this review underscores the urgent need for rigorous and independent scientific development of patient-targeted apps for pain management in Brazil. Our findings could significantly improve the development of Brazilian apps aimed at patients with pain. Future studies should focus on several key areas, including: (i) transparent details about the healthcare professional accountable for overseeing the app, (ii) include end-users (e.g., healthcare professionals, patients, family members) throughout the phases of development and evaluation process, (iii) ensure that apps do not further marginalize individuals who already face challenges in accessing health services (e.g., low socioeconomic status, minority communities and stigmatized groups), (iv) providing explicit details regarding the target age group (e.g., children, adolescents, adults and older individuals), (v) conducting scientific assessments, including feasibility and cost-effectiveness tests, (vi) identify strategies to optimize patient engagement, and (vi) enhance clinicians' capacity to monitor patient behavior remotely and offer immediate feedback on their progress.

Conclusion

The current review identified 41 patient-target apps for pain management available in Brazil. In our evaluation, most of these pain-related apps displayed unclear descriptions across various aspects, including contact information, and professional backgrounds. The analysis of pain management content within these apps revealed a predominant focus on a single aspect of pain management, with physical activity being the most prevalent and none included psychological therapies. Visual content emerged as the most accurately and clearly described information. Credibility information was often absent, suggesting that a significant proportion of these apps may not have undergone rigorous evaluation against established scientific standards.

Declaration of competing interest

The authors declare no conflict of interest. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.bjpt.2025.101262.

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