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Smartphone apps for the self-management of low back pain: A systematic review

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A B S T R A C T

Guidelines for low back pain (LBP) often recommend the use of self-management such as unsupervised exercise, booklets, and online education. Another potentially useful way for patients to self-manage LBP is by using smartphone applications (apps). However, to date, there has been no rigorous evaluation of LBP apps and no guidance for consumers on how to select high-quality, evidence-based apps. This chapter reviews smartphone apps for the self-management of LBP and evaluates their content quality and whether they recommend evidence-based interventions.

This chapter shows that generally app developers are selecting interventions that are endorsed by guidelines, although their quality is low. There are many apps available for the self-management of LBP, but their effectiveness in improving patient outcomes has not been rigorously assessed. App developers need

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to work closely with healthcare professionals, researchers, and patients to ensure app content is accurate, evidence based, and engaging.

Introduction

Low back pain (LBP) is a major global public health issue and the leading cause of disability in most countries according to the Global Burden of Disease Study 2015 [1]. Guidelines for LBP often recommend the use of self-management [2], which is broadly described as patients being proactive in employing strategies to manage and monitor their own health and well-being [3]. Examples of self-management strategies for LBP include unsupervised exercise, booklets, and online education (e.g., websites) [4,5]. A potentially useful way for patients to self-manage their health condition is by using smartphone applications ("apps"). To date, there has been no rigorous evaluation of apps for the self-management of LBP and no guidance for consumers on how to select high-quality, evidence-based LBP apps.

There are over 165,000 apps available from the iTunes and Google Play stores, and nearly a quarter of these address the management of health-related disorders [6]. Given the minimum regulatory control over their content [7,8], consumers and clinicians should question whether the content in these apps is based on current best practice guidelines [9]. Consumers may rely on in-app or online user ratings and reviews to select an app, but this information is subject to bias, which means consumers may struggle to make informed decisions. One method of assessing the quality and "fitness-for-purpose" of apps is by using validated scales and benchmarking app content against current best practice guidelines [10]. A number of systematic reviews have evaluated the quality and content of apps that help patients manage various health conditions, such as diabetes, concussion, bipolar disorders, and depression [11–15]. However, to date, there have been no reviews focusing on apps for managing LBP. Given the large number of publicly available apps for the self-management of LBP, it is prudent and timely to evaluate their quality and ascertain whether they reflect current best practice guideline recommendations.

The purpose of this review was to identify apps for the self-management of LBP and assess their quality (e.g., functionality, design) and content (compliance with best practice guidelines) to help consumers make informed decisions.

Methods

This systematic review follows standard recommendations for traditional reviews outlined in the PRISMA statement [16]. First, we constructed a search strategy using prespecified eligibility criteria and performed an initial screening of all apps and a full review of relevant apps. Following this, we extracted the data and assessed the quality of the included apps using a reliable tool (see below) specifically designed for mobile health apps. The review protocol was prospectively registered on the PROSPERO Register of Systematic Reviews: CRD42016048420. As no personal data were collected as part of this review, ethical approval was not required for this study.

Search strategy

The Australian iTunes and Google Play stores were searched for apps related to the self-management of LBP in November 2016. Together, these two online app stores have more than 4.8 million apps available for download [17,18] and account for 97% of the Australian smartphone market [19]. We used three keywords recommended by the Cochrane Back and Neck Group [20] used in traditional systematic reviews of LBP interventions: "low back pain," "back pain," and "lumbago." Two reviewers (GCM and MBP) performed the initial screening independently on the basis of the name and description of apps. Apps that met the inclusion criteria were then downloaded onto their devices

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(iPhone 6 iOS 10.0.2 and ASUS ZenFone 2 Android 6.0) for full review. Disagreements regarding inclusion were resolved by consensus.

Inclusion criteria

Apps were included if they were in English, were available to the general public, and were a self-contained product (i.e., did not require add-ons or an external device). No limitations on the costs of apps were applied. Only apps created or updated in 2015–2017 were included because a recent update ensures software functionality and ongoing technical support. The focus of the study was to include apps specifically developed for the self-management of LBP. Although self-management is considered a broad construct [3], we only included apps that clearly offered at least one treatment option that encouraged patients to be actively involved in the management of their condition such as unsupervised exercise programs. We also included apps that taught patients skills to be used during their daily management through advice or educational interventions, which are important components of self-management of LBP [21]. However, apps providing only general information about LBP (e.g., common risk factors, lower back anatomy) were excluded because these apps do not provide a specific treatment plan to be followed. Additionally, we excluded apps aimed at identifying risk factors, or prevention or those focused on diagnostic tests of LBP. We also excluded apps that were developed for healthcare practitioners and those that offered treatments for pregnancy-related LBP, sciatica, other health conditions, or general health and well-being. Where the same app was available on different platforms (iOS or Android), the iOS version of the app was kept for inclusion and analysis. When both paid and free versions of an app were available, we included only the paid version. If the free app offered in-app purchases, we evaluated the full content of the app.

Data extraction and analysis

Two independent reviewers (GCM and MBP) used an electronic spreadsheet (Microsoft Excel 2010, Redmond, WA, USA) to extract relevant information from the included apps. The information extracted included name of the app, version, developer, update date, cost, presence of in-app purchases, and platform availability. When available, we extracted the number of consumer reviews and rating (5-star rating system). We also extracted information on the type of intervention offered in the included apps. Disagreements relating to the categories assigned to each app were resolved by consensus.

Content and quality assessment

We used the recently published National Institute for Health and Care Excellence (NICE) guidelines for LBP to identify whether the included apps provided evidence-based interventions (categorized as "yes/no") [22]. For this, we mapped app interventions to recommendations listed in the NICE guidelines. This guideline provides the most recent best practice recommendations for the assessment and management of LBP and sciatica in people aged 16 or older. The NICE guidelines reviewed the evidence for a broad range of interventions, used individually or in combination, ranging from advice and noninvasive interventions to injections and surgery. NICE guideline recommendations are based on the quality of the underpinning evidence and a trade-off between the benefits and harms of an intervention [22].

A trained reviewer (GCM or MBP) assessed the quality of apps that provided evidence-based interventions using the mobile application rating scale (MARS) [23]. MARS is a 23-item questionnaire, each question containing a five-point response scale (1-inadequate, 2-poor, 3-acceptable, 4-good, and 5-excellent). The items are categorized into five domains: engagement (fun, interesting, customizable, interactive, and well-targeted to audience), functionality (functioning, easy to learn, navigation, logic flow, and gestural design of app), aesthetics (graphic design, overall visual appeal, color scheme, and stylistic consistency), information quality (quality and quantity of information, credibility of developer), and a general, overall quality scale. MARS has shown excellent internal consistency (alpha = 0.90) and inter-rater reliability (intraclass correlation coefficient, ICC = 0.79) [23].

As a reliability check for the MARS ratings, 20 randomly selected apps were independently assessed by a second reviewer (GCM, MBP, or HL) [23]. We then calculated the inter-rater reliability ($ICC_{2,1}$) of

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the MARS total score, and if ICC values were greater than 0.85, we considered the agreement between reviewers as excellent, and no further consensus was performed. In addition to the MARS total score, we used MARS item 15 specifically ("is app content correct, well written, and relevant to the goal/topic of the app?") to assess the quality of the information provided and whether the app content was appropriate for LBP. MARS item 18 was used to evaluate the credibility and trustworthiness of the app developer. Finally, MARS item 19 was used to assess whether the app has been tested in randomized controlled trials, and we scored this item by searching the name of the app on Google Scholar. The three highest-scoring apps using the MARS scale are described in more detail in the Results section.

Classification of exercise interventions

Given that most of the apps for the self-management of LBP focused on exercise interventions, we classified them according to the categories proposed in the NICE guidelines:

- Biomechanical exercises: exercise interventions primarily directed at altering or improving spinal mechanics (e.g., muscle strengthening, stretching, range of motion exercises, motor control exercises, Pilates, or the McKenzie method).
- Aerobic exercises: exercise interventions directed at improving cardiovascular fitness and endurance (e.g., running, walking).
- Mind–body exercises: exercise interventions that combine physical, mental, and spiritual focus (e.g., Yoga, Tai Chi, and mindfulness).
- Mixed modality exercises: exercise interventions that incorporate any combination of the previous three categories.

Data analysis

The characteristics of the included apps were summarized as means or medians for continuous data and as frequencies and proportions for categorical data. We used multivariable regression analysis to investigate whether the quality of apps (MARS total score) was associated with in-app customer rating (5-star system) and the price of apps. We ranked the apps providing evidence-based interventions using the MARS scale total score. We used STATA v14 (StataCorp, College Station, TX) for all analyses.

Results

Search results

Our search on the iTunes and Google Play stores yielded 723 apps. After the initial screening based on the name and the app description, 612 apps were excluded. The primary reasons for exclusion at this stage were as follows: apps were targeted for healthcare providers and apps were not targeting patients with LBP. We downloaded 110 apps for a full evaluation based on our inclusion criteria, and further 49 apps were excluded. Of these, over one-third (19/49, 39%) were excluded because they were not updated since 2015, and another 16/49 (33%) were excluded because they provided only general information, which was not considered a self-management intervention for LBP. Finally, 61 apps were included in this review (Fig. 1).

Characteristics of included apps

Of the 61 apps included in this review, 24 (39%) were found on iTunes exclusively, 33 (54%) on Google Play exclusively, and 4 (7%) were found on both app stores. Six apps had two versions available for download: a paid (or "pro") version and a free (or "lite") version; in these cases, the paid versions of these apps were included in the review. There were 22 (36%) paid apps, ranging in price from AUD $0.99 to AUD $14.99 (median AUD $1.99). Of the 39 (64%) free apps, 6 offered in-app purchases with prices ranging from AUD $0.99 to AUD $17.99. Only 25 (41%) apps were reviewed by customers, on a 5-

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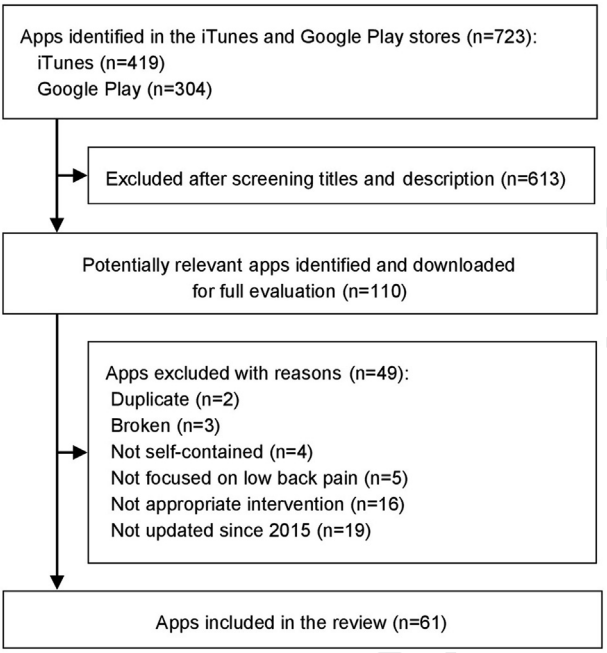

Fig. 1. Flowchart of selection of smartphone apps for low back pain.

star rating system; the median customer rating was 3.8 stars (range, 1–5). The number of reviews per app ranged from 0 reviews for 35 apps to 374 reviews for 1 app (Back Pain Relief Yoga Poses–17.0). The characteristics of each app are presented in the online appendix.

Interventions for LBP

The included apps recommended a range of interventions (Table 1). Only three apps recommended interventions not endorsed by the NICE guidelines: Brainwave Entrainment (Backache Relief–1.0), Qigong exercises (Qigong for Back Pain Relief–1.0.1), and Graded Motor Imagery (Recognise Back–1.1). Of the 31 apps recommending biomechanical exercises, 2 (3%) offered strengthening exercises alone, 14 (23%) offered strengthening exercises in combination with stretching (23%), and the remaining 15 (25%) recommended a combination of interventions, such as core stability, Pilates, and McKenzie

Table 1
Interventions for low back pain used in included apps.

Interventions	No.	%
Education + Biomechanical exercises	6	9.8
Biomechanical exercises only		
Strengthening	2	3.3
Strengthening/Stretching	14	23.0
Combination of biomechanical exercises	15	24.6
Mind–body exercises only		
Yoga	17	27.9
Mixed modality	4	6.6
Other[a]		
Graded motor imagery	1	1.6
Qigong exercises	1	1.6
Brainwave entrainment	1	1.6

[a] Not endorsed by NICE guidelines.

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exercises. There were 17 (28%) apps offering mind–body exercises (Yoga) as a self-management strategy for LBP. Four (7%) apps prescribed combinations of aerobic, biomechanical, and mind–body exercises.

Only 6 (10%) apps provided some type of educational intervention for LBP in combination with an exercise program, an approach that is more closely aligned with the NICE guidelines recommendations.

Quality assessment

The agreement between reviewers using the MARS scale to assess the quality of the included apps was excellent ($ICC_{2,1} = 0.91$). The mean MARS total score was 2.36 (SD, 0.83) on a 0–5 scale. Most apps rated poorly on customer interest, interactivity, and customization; the mean MARS engagement subscale score was 1.61 (SD, 0.52). The mean MARS aesthetics subscale score was 2.46 (SD, 1.01) because apps generally presented unattractive layouts and low-resolution graphics. Overall, the included apps had low-quality information from a questionable source (i.e., legitimacy/trustworthiness of source unknown or not verified) and received a mean MARS information subscale score of 2.55 (SD, 0.65). The included apps were mostly functional, easy to learn how to use, and had a logical flow; the mean MARS functionality subscale score was 3.48 (SD, 0.91). The mean quality of information (item 15) and credibility of the developer (item 18) were low, scoring 2.4 (SD, 0.8) and 1.9 (SD, 0.7), respectively. None of the apps had been trialed or tested in the published scientific literature (item 19). Table 2 presents the assessment of the quality of individual apps by using the MARS scale.

Highest scoring apps for LBP

The three highest scoring apps for the self-management of LBP all recommended biomechanical exercises (e.g., strengthening, stretching, core stability, or McKenzie exercises). They were found to be interesting, entertaining, interactive, and customizable and had a high level of visual appeal and content. All the apps were paid or required in-app purchases to fully access their content:

- "Lower Back Pain App–2.2": This app had the highest total MARS score (mean 3.94) and was developed by a physiotherapist. Consumers answer three screening questions (e.g., presence of leg pain, constant nightly pain, and history of recent accidents or injuries). If the answer is "yes" to any of the questions, a warning message recommends patients to seek a medical doctor. Before starting the exercise program, patients are asked to indicate the amount of pain they are experiencing (visual analog scale, 0–10). This question is repeated in weeks 3 and 10. The app offers a 10-week exercise program, each week consisting of three exercises that should be performed twice daily. The exercises focus on spinal mobility, stability, and muscle strengthening and are accompanied by a text description and high-resolution instructional videos (cost: AUD $1.49 on iTunes).
- "3 Steps to Cure Back Pain–1.1": This app was the second highest scoring app according to the MARS scale (3.83) and was developed by a pain specialist. The app is based on a three-step rehabilitation method containing a series of videos consisting of (1) education and advice, (2) McKenzie exercises for pain relief, and (3) general exercises for muscle strengthening (cost: free, in-app purchases: AUD $17.99 on iTunes).
- "Backache–2.0.6": This app had a mean total MARS score of 3.78, being the third highest scoring app in this review. It contains a program of 31 exercises designed by a physiotherapist. The app uses high-resolution videos and texts to describe the exercises, and users can select how often the app prompts them with a reminder to perform them (cost: AUD $5.99 on iTunes/Android).

Multivariable regression analysis

Twenty-five apps were included in our multivariable regression analysis because they were the only apps with online customer rating. The total MARS score was used as a dependent variable, while pricing and customer rating were included as independent variables. Our results revealed that a higher price was associated with better app quality (coefficient = 0.26, $p = 0.003$), and customer rating was

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Table 2
The Mobile App Rating Scale (MARS) mean[a] scores assessed by domains.

App name-version	MARS engagement	MARS functionality	MARS aesthetics	MARS information[b]	MARS total score
Lower Back Pain App–2.2	2.6	5.0	4.3	4.2	3.94
3 Steps to Cure Back Pain–1.1	2.6	5.0	4.0	4.0	3.83
Backache–2.0.6	3.2	4.8	4.3	3.3	3.78
Yoga for Back Pain Relief HD–1.1	2.8	4.8	4.0	3.3	3.61
Back Fix–2.0.3	3.0	4.0	4.0	3.3	3.50
BackTrainer–1.1	2.2	4.8	4.3	3.3	3.50
Symmetry Exercise for Low Back Pain–1.2	2.6	3.5	3.0	4.0	3.33
The Simplyhealth Back Care App–2.8	2.2	4.0	4.0	3.3	3.28
Yoga for Back Pain–1.1 (AGC apps)	1.8	4.5	3.3	3.3	3.17
Back Pain and Neck – Exercise for Treatment Spine (Pro)–1.1	2.2	4.5	3.7	2.8	3.17
Back Pain Relief Yoga Poses–17.0	1.8	4.3	2.7	3.3	3.00
Back Pain Preventions–1.0	1.4	4.8	3.0	3.0	2.94
Lower Back Yoga – 7 Classes–1.2	1.4	4.3	4.0	2.8	2.94
Relieve Backache – Yoga Guru–1.0.0	1.6	4.0	4.0	2.5	2.83
5 Minute Workout for the Lower Back–1.0	1.6	4.0	3.0	3.0	2.83
Back Pain Relieving Exercises–1.0.0	1.4	3.5	3.0	3.3	2.78
Lower Back Pain Relief–1.0	2.0	4.0	3.0	2.5	2.78
Yoga for a Pain Free Back–1.0.0.1	1.8	4.3	2.0	3.0	2.78
Yoga Spinal Trap–1.0	2.0	4.0	3.0	2.5	2.78
6 Minute Back Pain Relief–1.0	2.0	3.5	3.3	2.7	2.78
Yoga Lower Back Exercises–2.0	1.4	3.5	2.7	3.2	2.67
Back Pain Relief Workout Plus–2.0.1	1.2	4.5	2.7	2.5	2.61
Back Strengthening Exercises – Kill Your Back Pain–1.0	1.6	4.3	2.3	2.0	2.59
Back Pain Exercises–1.0	1.6	3.5	2.3	2.8	2.56
Back Pain Coach–1.7	1.2	3.5	3.3	2.5	2.50
Yoga Poses for Back Pain–1.0	1.4	4.0	1.7	2.7	2.44
7 Minute Back Fitness Free Workout App for Building Strong Muscles–2.0	2.0	3.0	2.7	2.3	2.44
A+ How to Strengthen Lower Back–2.0	1.6	3.0	2.7	2.7	2.44
10 Min Physical Therapy Exercise for Low Back Pain (Pro)–1.2	1.8	3.3	2.7	2.2	2.39
10 Min Lower Workout Challenge (Pro)– 1.3	1.6	3.3	2.7	2.2	2.33
Back Exercises HD for iPad–1.3	1.4	3.5	3.0	2.0	2.33
Physical Back Workout (Premium)–1.0	1.6	3.3	2.7	2.2	2.33
Back Strengthening Exercises – Relief or Rehabilitation–1.0	1.4	3.0	2.7	2.3	2.28
Yoga_for_Back_Pain_Relief–1.0	1.4	3.3	2.3	2.3	2.28
Back Stretches For Pain Relief–1.0	1.4	3.5	1.3	2.5	2.22
Yoga Stretches for Back Pain–1.0 (Esterbi)	1.4	3.5	1.3	2.5	2.22
Yoga Stretches for Back Pain–1.0 (Abi Apps)	1.4	3.5	1.3	2.5	2.22
Yoga Stretches for Lower Body–1.0	1.4	3.5	1.3	2.5	2.22
Yoga Tips for Back Pain–2.0	1.2	3.8	2.0	2.2	2.22
Physical Back Healing Workout–1.0	1.2	3.0	2.0	2.5	2.17
Dealing with Backpain–1.0	1.2	3.3	2.7	2.0	2.17
Yoga Postures for Back Pain–1.4	1.2	3.0	1.7	2.5	2.11
Back Pain Exercise Guide–2.0 (Pyjama819)	1.2	3.3	1.3	2.3	2.06
Back Pain Exercise Guide–2.0 (Apps Viva)	1.2	3.3	1.3	2.3	2.06
Back Pain Exercise Guide–2.0 (MORIA APPS)	1.2	3.3	1.3	2.3	2.06
Back Pain Exercise Guide–2.0 (noel barton)	1.2	3.3	1.3	2.3	2.06
Exercise for Back Pain–2.0 (APPple)	1.2	3.0	2.0	2.2	2.06
Exercise for Lower Back Pain–2.0	1.2	3.0	2.0	2.2	2.06
Back Pain Exercise Guide–2.0 (Harwell Publishing)	1.2	3.3	1.3	2.2	2.00
Lumbar Healthcare–1.1	1.6	2.0	2.3	2.2	2.00
Back Pain Exercise Guide–2.0 (hpmarks25)	1.2	2.5	1.3	2.3	1.89
Lower Back Pain–1.0	1.2	3.5	1.0	1.5	1.88
Exercise for Back Pain–2.0 (Morenaro Semuten)	1.2	2.5	1.3	2.2	1.83

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Table 2 (*continued*)

App name-version	MARS engagement	MARS functionality	MARS aesthetics	MARS information[b]	MARS total score
Exercise for Back Pain–2.0 (hara5b68s)	1.2	2.5	1.3	2.2	1.83
Back Pain by Adam Gavine–1.0	1.2	1.3	2.0	2.3	1.72
How to do Yoga for Back Pain–2.0	1.2	1.5	1.0	1.0	1.17
Yoga and Pilates for Back Pain–2.0	1.0	1.0	1.0	1.2	1.06
Yoga for Back Pain–1.4 (FrozenWaveApps)	1.0	1.0	1.0	0.8	1.00

MARS: Mobile App Rating Scale.
Apps in bold were the three highest-scoring apps in this review.
[a] Mean score ranges from 0 to 5, where a score of 0 means inadequate quality and a score of 5 means excellent quality.
[b] For item 19, we searched the name of app on Google Scholar.

not a predictor of better app quality (coefficient = 0.15, p = 0.189). These two features explained 37.4% (adjusted-R^2 = 0.374, n = 25, F = 8.17, p = 0.002) of the variation of total MARS scores.

Discussion

Summary of findings

This review used a systematic approach to identify apps developed to help patients self-manage their LBP. Our results showed that there are numerous apps available for consumers with LBP on both iTunes and Google Play stores. Nearly, all apps recommended some type of intervention listed in the NICE guidelines. However, the overall quality of these apps was low because they lacked engaging features, presented unattractive layouts, and provided questionable and low-quality information. In general, the apps with the highest quality scores were also the most expensive ones. However, none have been tested for effectiveness in reducing the symptoms of LBP.

Comparison with similar studies

Although a review for LBP has not been previously conducted, there has been a surge in reviews investigating the quality of apps for other health conditions. Examples include diabetes [24], weight loss [11], mental health [12,15], speech disorders [25], and cardiovascular diseases [26]. Given the increasing number of health apps available to consumers, it is imperative to assess their content quality and to benchmark the interventions against best practice guidelines. Q1

Apps could be an accessible and cost-effective alternative to help patients manage their LBP. Although most apps included in this review offered evidence-based interventions, it is unclear whether providing the evidence-based intervention through an app is effective. Currently, none of the available apps for LBP have been tested in a randomized controlled trial. This was made apparent through the assessment of MARS item 19, which assesses whether the app has been trialed or tested. Thus, the effectiveness of these apps remains unknown. The rapid rate at which app technologies emerge and adapt imposes challenges (e.g., rapid dissemination and update of apps) to the evaluation of their effectiveness by using the traditional randomized controlled trial method [27,28]. Nonetheless, it is crucial that apps for LBP are evaluated by using robust research methods. Studies such as the ones planned by Blödt et al. [29], which aim to investigate the effectiveness of an app-based relaxation management strategy for patients with LBP, provide an example and will be important for generating an evidence base. A possible intermediate step to testing LBP app effectiveness would be to conduct studies to better understand their validity and user acceptance.

Strengths and weaknesses

The strengths of this review include the use of key features of a traditional systematic review methodology (prospective protocol registration, systematic search, independent study screening, data extraction, and quality assessment using a reliable and validated scale). This rigorous methodology

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provided a robust framework for evaluating the LBP apps included in the study. Additionally, we selected a random sample of 20 apps for quality agreement evaluation, and we found excellent inter-rater reliability ($ICC_{2,1} = 0.91$). Furthermore, we attempted to benchmark the content of the included apps against the most recently published best practice guideline for the management of LBP (NICE guidelines) [22]. We also provided consumer-friendly information about the three highest-scoring apps in this review according to the MARS scale.

This review has some limitations. The last update date of many apps preceded the publication of the NICE guidelines for LBP. However, most of the recommendations listed on the current guideline were already included in previous versions of the NICE guidelines for LBP [30]. Furthermore, although the NICE guidelines provide a list of recommendations based on the costs of interventions, there was uncertainty about the cost-effectiveness of interventions offered by the included apps. Therefore, the NICE recommendations used in this review do not reflect the trade-off between net clinical effects and costs. We excluded apps that had not been updated since 2015 as regular app updates are important to guarantee app functionality and associated customer support. Our decision to exclude apps that were not specifically targeted for the self-management of LBP may have resulted in the omission of other apps, which may have been of a higher quality. This decision was driven by our assumption that consumers are more likely to search and choose apps that are specific to their condition, rather than generic apps that target several conditions. For practical reasons relating to data-capturing capacity, our search was limited to the Australian iTunes and Google Play stores; therefore, apps that are exclusively available in other countries were not included in this review.

Interpretation and implications of results

Smartphone app developers could use the results of this review when developing or updating apps for the self-management of LBP. Generally, our results suggest that app developers are selecting interventions that are endorsed by guidelines when creating LBP apps. However, the quality of these apps is low, and therefore, app developers need to work closely with the medical community, specialists in the field, and researchers to ensure app content is accurate and evidence based. We also suggest involving patients during the app development process to facilitate end-user engagement. Speaking to patients and gauging what features do and do not work for them will enable the creation of content that is likely to be more engaging and user friendly. The Australian Victorian Health Promotion Foundation recently published a guide for people interested in developing evidence-based and effective health apps [31]. The guide provides detailed instructions for each stage of the app development process, from planning to launching the app. This guide could potentially benefit the development of future LBP apps.

We found that app quality is not associated with in-app or online user ratings. Thus, we suspect that user ratings are invalid indicators of app quality and thus should not guide app selection. The quality assessment revealed that the apps scored the lowest on the "engagement" domain (mean 1.61, SD 0.52). This was partly because most apps did not use specific strategies to increase engagement (e.g., entertainment). To overcome this limitation, apps for LBP should incorporate strategies that would stimulate repeat use; examples might include through gamification or reward systems. The low scores on MARS items 15 and 18 revealed inconsistencies in the quality and trustworthiness of information presented in included apps.

Currently, the content of mobile health apps is poorly regulated [32]. Therefore, the results of this review are crucial to help consumers choose the most appropriate app currently available for LBP. Although it is unclear whether healthcare professionals recommend LBP apps for their patients, our study could potentially help professionals make informed recommendations.

Conclusions

The popularity of health apps is sharply increasing, and they are potentially promising tools to help reduce the burden of LBP; however, apps for the self-management of LBP are of poor quality. Although we identified and describe three apps that are of good quality, with recommendations that align with guideline-based care, there is no evidence that these apps are effective in improving patient outcomes

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because their effectiveness has not been investigated. Consumers and health professionals should be aware of the low quality of most apps currently available for LBP. Health professionals, researchers, and industry partners (e.g., start-up companies) need to engage more with app developers to devise ways to appropriately evaluate these emerging technologies to ensure that they are beneficial to patients.

Summary

Online technologies, such as smartphone apps, can help us manage our health, and they are influencing healthcare in new and exciting ways. Our aim was to evaluate the quality of smartphone apps for the self-management of LBP and assess whether these apps recommend evidence-based interventions.

We searched iTunes and Google Play stores in November 2016 for apps designed for the self-management of LBP. Two independent reviewers screened the retrieved apps for eligibility and extracted data. The 2016 NICE guidelines were used to identify whether interventions recommended by the included apps were evidence-based. Apps that recommended evidence-based interventions were rated for quality by using the MARS scale.

We identified 723 apps, of which 61 were included in the review. There were 39 free apps, and the median cost for 22 paid apps was AUD $1.99 (range, $0.99–$14.99). All but three apps recommended at least one guideline-endorsed intervention, but none were tested in a randomized controlled trial. Generally, apps were of low quality with a mean MARS total score of 2.36 (on a 0–5 scale). Apps generally lacked engaging and customizable features, offered poor quality information, and had poor visual appeal and questionable credibility. There are many apps available for the self-management of LBP. Although most of them recommend interventions that are endorsed by clinical practice guidelines, few are of high quality. Most importantly, the validity and the effectiveness of these apps on patient-relevant outcomes have not been rigorously assessed.

Practice points

- Despite a large number of publically available apps for the self-management of LBP, there is minimum regulatory control over their content, and no independent guidance for consumers, leaving them vulnerable to select substandard apps.
- Of the 61 included apps, nearly all (58 apps) recommended LBP interventions endorsed by clinical practice guidelines. However, the overall quality of the information provided was low.
- Importantly, none of the apps were evaluated in a randomized controlled trial. That being the case, there are strong concerns as to whether any are effective in improving symptoms in people with LBP.

Research agenda

- App developers should use the results presented in this review as a guide to improve the quality of existing apps for LBP.
- To optimize the utility of apps in managing LBP, future studies should focus on generating deeper understandings of the validity and user acceptance of apps and their features.
- There is a need to test the effectiveness for patient-relevant outcomes of available and newly developed LBP apps using robust research methods.

Conflict of interest statement

None declared.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.berh.2017.04.002.

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