



THE BRITISH PAIN SOCIETY

Original Article

A quality review of smartphone applications for the management of pain

Pamela Portelli and Clare Eldred

British Journal of Pain
2016, Vol. 10(3) 135–140
© The British Pain Society 2016
Reprints and permissions:
sagepub.co.uk/
journalsPermissions.nav
DOI: 10.1177/2049463716638700
bjp.sagepub.com



Abstract

Smartphone applications (apps) are recent innovations that have not been studied extensively. The lack of regulatory body assessing the content of existing apps means that their quality is often unknown. This review aims to assess the quality of smartphone apps that claim to provide information and treatment for pain conditions. It assesses the degree to which apps adhere to evidence-based practices in psychological research for pain management and which stand the best chance of being effective for consumers. Another aim is to identify potential apps health-care professionals may wish to recommend to clients. Pain management apps on the official iPhone and Android stores were searched in January 2014. Those containing a psychological component in the app description were downloaded and rated for quality using a checklist devised by two researchers. The checklist was based on cognitive behavioural therapy (CBT) guidelines since the latter is the most effective intervention for computerized programs. A total of 195 apps met inclusion criteria. Although CBT is a promising alternative to traditional psychological interventions, only six apps endorsed theoretical reference to CBT principles. Existing apps are often constructed by lay people or software developers, with little input from health-care professionals. Pain apps sometimes promise a solution to pain without a consideration of app content. The development of evidence-based apps and rigorous evaluation of any long-term outcomes are important in enhancing understanding of the potential of these apps.

Keywords

Smartphones, pain management, psychological, computerized cognitive behavioural therapy, applications

Introduction

Pain is a common somatic complaint, prompting individuals to seek professional help. A holistic understanding of pain requires the adoption of a bio-psychosocial framework. This is especially true when pain brings about major psychosocial changes and disruptions to the individual's life.

Psychological factors play a crucial role in the experience of pain, making chronic pain a complex condition. They can predict the person's adjustment to living with pain and the extent of disability exacerbated.¹ The psychological side effects of persistent pain may lead to a cascade of psychological stressors. Consideration of

social dimensions to chronic pain is important since pain can seriously affect the individual's quality of life.² Adopting a bio-psychosocial framework ensures a comprehensive treatment plan.³

Department of Psychology, City University London, London, UK

Corresponding author:

Pamela Portelli, City University London, Northampton Square, London EC1V 0HB, UK.
Email: pamel.portelli.1@city.ac.uk

Psychological interventions over the Internet

Psychological interventions are helpful in managing affective distress. Cognitive behavioural therapy (CBT) and acceptance and commitment therapy are gaining increasing popularity in pain management.³ Recent years have endorsed the growth of online interventions aimed at delivering behavioural health interventions. Encouraging active involvement from behalf of users results in optimal outcomes for health-care interventions.³

The National Institute for Health and Care Excellence (NICE) is an internationally recognized governing body setting standard for high-quality health care. It does not currently possess specific guidelines for pain management. Nevertheless, NICE⁴ guidelines for the early management of persistent non-specific pain dictate the incorporation of CBT principles. Similar findings are disseminated by the International Association for the Study of Pain (IASP). Computerized cognitive behavioural therapy (CCBT) reveals encouraging results for the management of pain.⁵ Its structured activities make it an attractive web-based treatment.⁶

Smartphone applications for the management of chronic pain

Smartphone applications (apps) are gaining increased popularity among diverse age groups worldwide. They can support telemedicine by providing global health-related advice. Apps facilitate goal-setting, provide timely feedback to sufferers and improve engagement in self-management strategies.⁷

Smartphone applications for the management of pain conditions

Despite increasing number of smartphone applications, there is a lack of high-quality trials evaluating their effectiveness.⁷ Although findings are promising, few studies have examined app quality. Conclusions drawn from previous literature are of some concern. Pain apps seem to pay little attention to evidence-based practices and are often constructed by engineers rather than health-care professionals, misleading individuals.⁸

The need for this review

Research on mobile technology is still in its infancy. The lack of expert overseeing for the selling of smartphone applications and the absence of a regulatory body evaluating their content signify that some apps may mislead service users.⁸ Relying solely on smartphone applications to diagnose or manage pain without

resorting to professional advice may exacerbate problems. Investigating quality of apps released is important in shedding light on their potential effectiveness, if any. Chronic pain sufferers are desperate to find a solution to pain and apps may pose considerable health risks.⁸ They are also the new trend of health care and may be a useful tool when used in adjunct to evidence-based therapies.⁹

Objectives

Building upon the previous work by Rosser and Eccleston,⁸ this study reviews developer's descriptions of smartphone apps that claim to provide information and treatment of pain conditions. It assesses the degree to which apps adhere to evidence-based practices in psychological research for managing pain. It also aims to assess which apps stand the best chance of being effective for consumers and to identify potential apps health-care professionals may wish to recommend to patients.

Methods

Search protocol

A search on the official iPhone (App Store) and Android (Android Market) app stores was conducted in January 2014. These two operating systems were chosen since Android is the most popular operating selling system,¹⁰ while Apple's iPhone is one of the best-selling smartphones.¹¹ Search terms (Appendix 1), identified from systematic reviews^{5,12} on web-based interventions for the management of chronic pain, were used to ensure a comprehensive search.

Previous studies have applied a star rating system to identify most popular apps.^{13,14} However, the star rating system is inaccurate since some apps had never been reviewed or were rated only by very few individuals. Since this methodology could have resulted in the exclusion of potentially better quality apps, a comprehensive search was carried out to identify all relevant apps.

Inclusion and exclusion criteria

Inclusion criteria were as follows: (1) aimed solely at pain patients, (2) included the word 'pain' in app description, (3) advertised that the app was specifically designed for pain management, (4) limited to English language and (5) compatible with Android and iPhone. Both paid and free apps were included. Apps aimed solely to prevent pain, that were targeted specifically for health professionals or provided information offered in particular pain clinics were not included.

The initial search resulted in 360 apps. Apps were retrieved from the ‘medical’, ‘health and fitness’, ‘lifestyle’ and ‘books and references’ categories. After the inclusion criteria were applied, 195 apps were included in this review, the majority of which were available through the Android market.

Results

Most apps were free of charge. The highest priced was US\$9.99, while the lowest priced was US\$0.99. In all, 12 apps offered a ‘lite’ version of a more comprehensive pay-for-download application. Most ‘lite’ versions were free of charge except for two. No details of number of downloads were provided in app links.

File sizes ranged from 178 KB to 44 MB. Few apps provided details of the date of release. Most relied on text-based information.

In all, 39 apps incorporated a medical explanation of the aetiology of pain, offering information about specific pain conditions and/or promoting pain management skills. The source of advice was mostly unknown. Only 15% reported consulting with a medical professional. Professions of app developers varied, and more often than not, the profession was not stated.

Some apps made reference to recognized pain or health societies including the National Health Service, American Chronic Pain Association and National Fibromyalgia Association. Few apps included standardized pain measurement instruments such as the Visual Analogue Scale, Face Rating Scale or the Fibromyalgia Impact Questionnaire.

Application purpose and content

This review aimed to assess app quality and content. Apart from pain relief, the most common cited app purposes included the provision of information, pain tracking and recording, to act as a diagnostic, to improve strength and flexibility, to reverse physiological factors that lead to chronic pain, to control inflammation, to assist in the dissemination of pain management research and to identify pain-related triggers. Two apps used vibrations to provide massage. In all, 61% included the provision of education skills training. Of these, 31 apps provided information on pain conditions, 20 provided information on treatments available, 17 focused on exercise training information, 11 highlighted the benefits of acupuncture and acupressure, while 40 focused on natural remedies for pain alleviation. In total, 32% of the apps involved the self-monitoring of pain frequency and/or intensity. Of these, 52 apps contained a diary tracking component to remind users of upcoming appointments or to take medications. Nine consisted of pain scales, while one

app focused on posture monitoring and angle response. Finally, 17% of the apps contained information related to relaxation training including physical massage provision, yoga and pilates. This included audio material for inducing hypnosis and meditation.

Target pain condition and duration of intervention

Some apps dealt with general health problems. Others focused on specific conditions including arthritis (24%), migraine (16%), back pain (13%), headache (12%) and fibromyalgia (7%). In total, 88 apps could be applied to a range of pain conditions. Only two apps provided details of the duration of their ‘intervention’ (Habit Changer Pain Reduction and Pain Management Hypnosis). The time required for completion of the former was 42 days, while for the latter it was 8 weeks.

Consistent with Rosser and Eccleston’s⁸ review, none of the apps reported a randomized controlled trial aimed to test app effectiveness.

Evaluation of apps claiming to apply psychological principles in pain management

The apps included in this review were further analysed using more stringent inclusion criteria to identify those that included, or claimed to include, interventional elements based on psychological principles in the management of pain.

The presence of a psychological component was determined in two ways. Apps were included when the app description explicitly stated that a psychological component was present. When the latter was absent, a description incorporating a psycho-educational element with a cognitive and/or behavioural component as endorsed by CBT guidelines was considered meeting the inclusion criteria. Identification of a psychological component was assessed via a checklist devised on previous systematic reviews^{5,12} for the management of chronic pain. This included tips on stress management, problem solving, the fostering of cognitive coping and appraisal and dealing with challenging emotions, to mention a few. If this information was unclear from the app description, the app was downloaded and full details analysed.

Apps containing a psychological component

Apps containing a psychological component were purchased and/or downloaded. A data extraction table was devised and used to summarize the relevant information from these apps. A checklist (Appendix 2) devised

by two researchers (C.E. and P.P.) and based on CBT principles was used to rate the psychological quality of each app and score it. While guidelines employed in clinical settings may not be appropriate for a mobile app, CBT components were used because they have been successfully applied to computer-mediated pain management interventions.¹⁵ Moreover, CBT is the first line of treatment for pain management endorsed by the IASP and NICE guidelines. No specific guidelines for mobile apps exist.¹⁶ Items on the checklist were devised as to be mutually exclusive. It was ensured there would be no overlapping between item categories. The checklist rated assessed apps depending on whether they were specific to pain management, included standardized assessment tools for managing pain experiences, used standardized measure of mood, included a pain diary or tracker, incorporated psycho-education regarding the nature of chronic pain and advice regarding pacing or managing activity, sleep hygiene, stress management or relaxation techniques, cognitive appraisal and restructuring, problem-solving skills, healthy eating, social support and positive activity scheduling. The checklist also assessed the credibility of the apps in terms of whether they included advice from qualified health-care professionals or were endorsed by a recognized and relevant health-related association, were subject to control trial evaluation or were based on specific quality guidelines, for example, NICE.

Apps were allocated 0 point if the particular feature was not present and 1 if the feature was recommended. Scores were independently reviewed by the two researchers. The Delphi method was used to resolve any discrepancies. The maximum score a particular app could obtain on the checklist was 20.

Characteristics of quality-rated apps

Only six apps incorporated a specific psychological component (Table 1, Appendix 3). Two had quality scores higher than 11, namely, WebMD Pain Coach and Habit Changer. The other apps meeting inclusion criteria scored below 10 in the checklist. The professional background of the app developer was often unclear. There was no relation between the file size, cost and quality of apps. Indeed, one of the best quality apps was free of charge. Please refer to Table 1 for information on app content and quality scores.

Habit Changer. This app scored quite high on the assessment checklist and aimed to encourage positive life changes, raising awareness of unhealthy habits. Developers claim it is based on CBT principles and neuro-plasticity. It encourages users to focus on the here and now rather than worry about the future.

Pain Tricks. The app is mostly suited for a younger audience aimed to make medical procedures less scary. Distraction techniques, relaxation exercises and engaging in pleasant and absorbing activities are encouraged.

WebMD Pain Coach. This app received the highest quality rating score. Although it was not subject to a control trial evaluation, content is based on evidence-based quality guidelines and endorsed by a medical board.

Back Pain Relief and Living with Fibromyalgia. Both apps consist of downloadable books giving information about specific pain conditions. Advice on how to cope with pain is also provided. None of the apps provided specific psychological advice or tips on coping, hence the low scores in the quality assessment checklist.

Fibromyalgia Guide. App contents are similar to text-based sources. The information given seems to be medically valid, but the source of advice is unclear. It aims to psycho-educate users about the role of psychological factors in pain maintenance, hence its inclusion in the list. No further reference to psychological advice is provided.

Discussion

This study is an extension of a previous review aimed to examine the content and potential of smartphone applications for managing pain. It consists of a quality review of 195 apps from the iPhone and Android market to determine the extent to which apps adhere to pain management theoretical constructs. Consistent with Rosser and Eccleston's⁸ findings, the number of pain management apps has proliferated over these past years. Results support findings reported in previous research whereby most apps contain minimal theoretical content for facilitating self-management or behaviour change.¹⁷ Most app developers are individuals with no background in the delivery of health behaviour change interventions.

Of interest are various marketing slogans used to advertise app content. These included 'unlock the Fun' for back pain relief, 'starve off' for chronic injury or 'melt away in minutes' for pain reduction. Although slogans have a marketing purpose, the potential for app users being misled is high. A worrying factor is that users are sometimes encouraged to purchase products with little or no scientific value. Relying on unprofessional advice may cause a worsening of pain symptoms.

Despite the extensive literature highlighting the importance of a bio-psychosocial approach to the management of pain conditions,^{1,3} very few apps incorporated this component. A strong focus on pharmacological

therapy and natural remedies was evident. Moreover, only six apps endorsed theoretical reference to CBT principles. Emotional Freedom Techniques (EFT) were included albeit briefly in one application (Chronic Pain Indiana). A previous trial revealed that self-administered EFT may produce surprisingly good results when used in conjunction with other treatments and rehabilitation programmes.¹⁸

Few apps included links connecting users to professionally monitored social networks. Most app links served to answer technical questions. Conclusively, social support did not stand out as an important requisite. Although some apps did incorporate a social networking site, the identity and profession of the source offering advice were often unclear. Only WebMD, Pain Tricks and the Habit Changer incorporated the supportive element. Social support and optimism help improve the quality of life of chronic pain sufferers, reduce depressive symptoms and promote long-term functioning.¹⁹ Taken together, these omissions are a serious weakness of existing pain apps. It is worth pointing out that the inclusion of social support is only one of the several features that are needed to improve the quality of existing pain apps. Results of CCBT for the management of chronic pain over the Internet are promising^{5,12} and may provide an additional theoretical backbone for app developers.

If smartphone apps are modified to include features of evidence-based pain management strategies, research will still need to determine their effectiveness and long-term outcomes, if any. The checklist used to rate the quality of apps in this study has been based on guidelines from systematic reviews for online interventions. Conclusively, further research is needed to determine whether findings from the latter may be applicable for smartphone apps, mostly due to the fact that app stores often impose limits on app sizes. It is possible that such limitations may lead to the omission of potentially important information.

WebMD was one of the best rated apps and the only app holding a Utilization Review Accreditation Commission (URAC) health website accreditation, a symbol of quality of health information published on the web and often earned when information delivered is credible, has been closely reviewed and is of high standards. Conclusively, it is probably one of the apps health-care professionals may wish to recommend to their patients. This app has proved to be beneficial in helping users manage and monitor pain while carrying on with their day-to-day life.²⁰ Pain Tricks and Habit Changer are also promising although they serve different purposes. Pain Tricks may be an effective tool for helping young children cope with painful procedures. The provision of daily tips, challenges and reminders in Habit Changer may make it an attractive tool when used in adjunct to other evidence-based apps.

Strengths and limitations

To the author's knowledge, this is the first study that has employed an evidence-based checklist to rate the quality pain apps and their level of adherence to best practice. A checklist may serve as a preliminary identification of the best features that need to be present in good quality apps and helps shed light on the limitations of existing apps. This study helped to identify apps health-care professionals may wish to recommend to patients. A comprehensive search strategy served to eliminate sampling problems. Thus, unlike other studies, this research has included all pain apps available on the two biggest platforms.

As with other research, this study has some limitations. Evaluating the quality of pain management apps is a challenging endeavour. The initial assessment of apps was based on the app description which could have resulted in missing out some good quality apps. Apps incorporating a pain management feature that did not include the word 'pain' or the name of a specific chronic condition in the title of the app may have been missed. Apps did not provide detail of number of downloads. This information could have been useful in identifying apps most popular among service users. The assessment quality checklist was based on information gathered from systematic reviews for the management of chronic pain conditions. Some subjectivity is involved in devising the checklist which may mean that other researchers may come up with different items in the quality checklist and hence different scores. It is also unclear to what extent items in the checklist may have covered all important characteristics of included apps.

Future directions

This review has helped to identify the most effective pain management apps. Only few apps adhere to established IASP and NICE guidelines as suggested in previous systematic reviews for managing pain conditions. The aim of this study was to assess clinical app content and quality. Conclusively, this study does not review user satisfaction. Nonetheless, since quality in health care entails safety, efficacy and positive user recommendations, aspects incorporating user satisfaction such as ease of use, number of downloads, user feedback and frequency of updates merit attention in future studies. Apart from that, health-care professionals should exercise caution when recommending pain self-management apps to clients. Pain sufferers would benefit immensely from apps incorporating theory-based designs. It would be ideal if app developers report their app performance before their app is released on the market. The possibility

of establishing a trusted site from where tested and evidence-based apps are available for download and screened by a regulating body should be explored. Finally, given the release of new apps on the market, a replication of this study may result in the identification of new and potentially relevant apps.

Conclusion and implications for practice

Current smartphone applications for the management of chronic pain rarely adhere to evidence-based guidelines and may be doing more harm than good. Findings from this study support the imminent need for the start of a collaborative effort between app developers and health-care professionals. The establishment of a professional regulatory body certifying the quality of apps may also reduce the chances of individuals being misled. Certification of best quality apps would ensure that app users make an informed choice before deciding whether to download a particular app or not. Although few apps recommend or link the user to proven psychological treatments, future apps may nonetheless serve as useful tool for the management of chronic pain conditions. Development of evidence-based apps, rigorous evaluation of long-term outcomes and the possibility of testing in randomized controlled trials are important in enhancing the potential and effectiveness of these apps.

Acknowledgements

The authors would like to thank Christopher Eccleston and Benjamin Rosser from the Centre of Pain Research at the University of Bath for the framework in structuring this study.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was partly supported by the Malta Government Scholarship Scheme.

References

1. Vlaeyen JW, Crombez G and Goubert L. The psychology of chronic pain and its management. *Phys Ther Rev* 2009; 12: 179–188.
2. Harris S, Morley S and Barton SB. Role loss and emotional adjustment in chronic pain. *Pain* 2003; 105: 363–370.
3. Disorbio JM, Bruns D and Barolat G. Assessment and treatment of chronic pain: a physician's guide to a biopsychosocial approach. *Pract Pain Manag* 2006; 6: 1–10.
4. National Institute for Health and Care Excellence (NICE). Early management of persistent non-specific low back pain, <https://www.nice.org.uk/guidance/cg88/evidence/full-guideline-243685549> (2009, accessed 10 January 2014).
5. Bender JL, Radhakrishnan A, Diorbio C, et al. Can pain be managed through the Internet? A systematic review of randomized controlled trials. *Pain* 2011; 152: 1740–1750.
6. Przeworski A and Newman MG. Efficacy and utility of computer-assisted cognitive behavioural therapy for anxiety disorders. *Clin Psychol* 2006; 10: 43–53.
7. Vardeh DV, Edwards RR, Jamison RN, et al. There's an app for that: mobile technology is a new advantage in managing chronic pain. *Pain* 2013; 21: 1–8.
8. Rosser BA and Eccleston C. Smartphone applications for pain management. *J Telemed Telecare* 2011; 17: 308–312.
9. Ardito S. US healthcare reform: a follow-up. *Searcher* 2010; 18: 10–13.
10. Emerson R. Android apps more popular than iOS apps, ABI research study finds. *The Huffington Post*, http://www.huffingtonpost.com/2011/10/25/android-apps-ios-abi-researchstudy_n_1030595.html (2013, accessed 3 February 2014).
11. Lookout Mobile Security. App genome report, <https://www.lookout.com/resources/reports/appgenome> (2011, accessed 3 February 2014).
12. Macea DD, Gajos K, Armynd Y, et al. The efficacy of web-based cognitive behavioral interventions for chronic pain: a systematic review and meta-analysis. *J Pain* 2010; 11: 917–929.
13. Breton ER, Fuemmeler BF and Abrams LC. Weight loss – there is an app for that! But does it adhere to evidence-informed practices? *Transl Behav Med* 2011; 1: 523–529.
14. Azar KMJ, Lesser LI, Laing BY, et al. Mobile applications for weight management: theory-based content analysis. *Am J Prev Med* 2013; 45: 583–589.
15. Berman RL, Iris MA, Bode R, et al. The effectiveness of an online mind-body intervention for older adults with chronic pain. *J Pain* 2009; 10: 68–79.
16. Abrams LC, Padmanabhan N, Thaweethai L, et al. iPhone apps for smoking cessation. *Am J Prev Med* 2011; 40: 279–285.
17. Pagoto S, Schneider K, Joic M, et al. Evidence-based strategies in weight-loss mobile apps. *Am J Prev Med* 2013; 45: 576–582.
18. Brattberg G. Self-administered EFT (Emotional freedom techniques) in individuals with fibromyalgia: a randomized trial. *Integr Med* 2008; 7: 30–35.
19. Ferreira VM and Sherman AM. The relationship of optimism, pain and social support to well-being in older adults with osteoarthritis. *Aging Ment Health* 2007; 11: 89–98.
20. Sing A, Klapper A, Jia J, et al. Motivating people with chronic pain to do physical activity: opportunities for technology design. *Conference on Human Factors in Computing Systems* 2014; 2803–2812.