ORIGINAL ARTICLE

Mobile applications as good intervention tools for individuals with depression

Mobilní aplikace jako vhodné intervenční nástroje pro nemocné trpící depresí

Petra Marešová • Blanka Klímová • Kamil Kuča

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Summary

At present mental disorders affect approximately 450 million people around the world. Depressive disorder is probably one of the most serious disorders and as a type of chronic disease, it represents a global threat and burdens economic and social systems of both individuals and governments worldwide. One of these most recent non-pharmacological approaches is also the so-called mHealth (mobile health), the use of mobile devices for the practice of medicine and public health, which proves to be effective particularly in the early stages of depression.

The purpose of this article is to explore the most recent randomized controlled trial studies which indicate efficacy of the use of mobile applications in the detection, diagnostics or treatment of depression. The methods used in this study include a method of literature search of the studies focused on the impacts of individual applications for people with depression and on the specification of criteria evaluating quality of these applications.

The findings of the randomized controlled trials (RCT) show that there is a big potential of mobile applications in the detection, diagnostics, and treatment of depression, particularly in mild and moderate stages of the disease. They seem to be especially relevant for self-monitoring of depressive symptoms in the early stages of depression. There is an urgent need of more longitudinal RCT in this field in order to prove conclusive efficacy of these mobile applications in the treatment of depression. The authors list the main strengths and weaknesses of mobile applications in the detection, diagnostics, and treatment of depression.

Key words: mobile applications • depression • treatment

Souhrn

V současnosti trpí duševními poruchami přibližně 450 milionů lidí po celém světě. Deprese patří mezi jeden z nejzávažnějších typů chronického onemocnění, představuje zásadní hrozbu zátěže ekonomických a sociálních systémů vlád po celém světě. Jeden z aktuálních nefarmakologických přístupů, který je využíván i u osob trpících depresemi, je tzv. mHealth, tedy používání mobilních zařízení pro léčebné a podpůrné účely. Jeho účinnost je prokázána zejména v časných stadiích deprese.

Cílem tohoto článku je analyzovat nejnovější randomizované kontrolované studie, které ukazují účinnost využití mobilních aplikací v diagnostice nebo léčbě deprese. Cíle je dosaženo pomocí rešerše studií zaměřených na dopady jednotlivých aplikací pro lidi s depresí a na specifikaci kritérií hodnocení kvality těchto aplikací. Výsledky randomizovaných kontrolovaných studií (RCT) ukazují, že existuje velký potenciál mobilních aplikací v oblasti péče o nemocné trpící depresí, zejména v raných stadiích onemocnění.

Existuje naléhavá potřeba četnějších a dlouhodobějších RCT v této oblasti za účelem prokázání nezvratné účinnosti těchto mobilních aplikací v léčbě deprese. Příspěvek poukazuje i na silné a slabé stránky mobilních aplikací v oblasti detekce, diagnostiky a léčby deprese.

Klíčová slova: mobilní aplikace • deprese • léčba

doc. Ing. Mgr. Petra Marešová, Ph.D. (✉)
University of Hradec Kralove
Faculty of Informatics and Management, Department of Economics
Rokitanskeho 62, 500 03 Hradec Králové 3, Czech Republic
e-mail: petra.maresova@uhk.cz

B. Klímová
University of Hradec Kralove, Czech Republic
Faculty of Informatics and Management

K. Kuča
University of Hradec Kralove, Center for Basic and Applied Research
University Hospital Hradec Kralove, Biomedical Research Center, Czech Republic

Introduction

At present mental disorders affect approximately 450 million people around the world[1)] Depressive

disorder is one of the most serious disorders. It is a very complex psychic disorder which manifests itself in person's depressed mood for a long period of time. This is caused by changes of chemical reactions in the brain, long-term stress or psychic shock. Depression is the fourth frequent cause of death. It can affect almost anybody, including children. However, most often it affects adults between the age of 25 and 40. Surprisingly, women incline to this disorder more than men. The statistics show that 25% of women suffer from depression in comparison with 12% of men. Generally, the prevalence of depression is estimated to be of about 5% in a general population, and a lifetime risk is of about 15%[2]. The main symptoms of depression include feelings of sadness and depression, which cannot be influenced by outer incentives; evident loss of interest and pleasure in activities, which are otherwise pleasant; disinterest in oneself, one's job, family or friends; a lower ability of concentration, indecisiveness; a lack of emotions; lower confidence and self-esteem; feelings of hoplessness; thoughts of death; big fatigue; loss or gain of weight; insomnia or excessive sleep; or loss of sexual desire[3].

Nowadays, depression as a type of chronic disease represents a global threat and burdens economic and social systems of both individuals and governments worldwide[4, 5]. This concerns also costs on pharmacological and non-pharmacological treatment. Nevertheless, in most cases non-pharmacological treatment is preferred since it is less invasive, has fewer side-effects and sometimes it is also less expensive. One of these non-pharmacological approaches is also the so-called mHealth (mobile health); the use of mobile devices for the practice of medicine and public health.

According to the World Health Organization report[6–8] mHealth is a globally adopted technology. Employers, too, recognise that facilitating employees' health maintenance is advantageous and reported successful trials for mental health issues. In addition, many current m-health initiatives focus on outdated, unidirectional models of patient communication (e.g., exclusively collecting data, providing information or sending reminders)[6]. The use of mobile technologies, in particular, is rapidly evolving within the field of tele-mental health. mHealth is conducted on "mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices"[7] Furthermore, it is estimated that the mHealth applications market will grow to a substantial size of more than USD 26bn in 2017. In comparison with the global healthcare market that is estimated to have a gigantic size of USD 6 trillion1, mHealth represents only 0.5% of the whole pie[7]. This development will lead to an explosion of health and fitness data collected by an increasing number of app and sensor users. The present situation of mHealth applications is illustrated in Figure 1 below.

There are three different categories of vital parameters of mHealth applications: Health & fitness tracking data, patient monitoring data and medical examination data[7].

As the prevalence of mental illnesses such as depression and anxiety continues to grow, clinicians have turned to mobile applications as tools for aiding and supporting their patients' treatment. These applications can be especially helpful for teenagers and young adults suffering from mental illness due to their frequent use of technology as a means of communication. The applications can be helpful as a way to engage people who may be unwilling or unable to attend face-to-face therapy, and they can also provide support in between sessions. Experts believe that these applications will work best when used in conjunction with medication and/or in-person therapy[10]. At present there are over 200 mobile applications related to depression, fatigue, anxiety, or other disorders, but the efficacy of most of them has not been determined yet. Therefore it is very crucial to choose the right ones, which can meet certain criteria. According to[11], mHealth applications must be safe, accurate, effective, secure, and protect privacy to be used by patients, recommended by health care professionals, and eventually reimbursed[12].

In the study by[11] these criteria were discussed in a more detail and the applications assessed according to three measures of effectiveness: perceived effectiveness, research evidence base for an app, and whether or not the app claimed that the effectiveness was tested[11]. The key criteria with respect to depressions seem to be as follows: password protection, number of consumer ratings, explicit privacy policy.

Another criteria also include: interactiveness/feedback, encryption, basis of research, software support, import/export capabilities, developer contactable, personalization, specificity of intervention, source of funding for research, discloses potential risks, effectiveness (perceived), continuous availability of data, effectiveness tested (claimed by app), ease of use, advertising policy stated and errors and performance issues[11].

According to[13], the smartphones should support built-in Bluetooth HDP for standard Bluetooth communication with medical devices. This will enable the smartphone applications to work with medical devices from different vendors. Other technical specifications which appear to be quite important are: long battery life, sufficiently large screen size, fast data input, virus-free computer, no magnetic interference with medical devices, efficient patient-physician interactions, avoidance of loss or theft, and data privacy and security[13].

The privacy and security concerns of storing or communicating patient data with smartphones should be addressed cautiously. These security features of smartphones, while not available for all devices, may be useful: data backup, encryption of stored patient data, remote wiping to destroy all data on a device in case of loss or theft, and securely encrypted wireless data transmission over WiFi[14–16] applications.

Finally, personal data must be considered when using mobile applications, which is also closely connected with the rules of handling these data. In many ways, these areas are not still legally specified. According to[17], when using an application, the following criteria must be specified: compliance with privacy, security, accuracy of content, and safety. It warns the user against possible

health dangers (e.g., side effects) related to the use of the app for different purposes or without following the suggested protocol.

The purpose of this article is to explore the most recent randomized controlled clinical trial studies which prove efficacy of the use of mobile applications in the diagnostics or treatment of depression. In conclusion, the authors list the main strengths and weaknesses of mobile applications in the diagnosis and treatment of depression.

Methods

The methods used in this study include a method of literature search of the studies focused on the impacts of individual applications for people with depression and on the specification of criteria evaluating quality of these applications. The focus was primarily on depression. Therefore, studies aimed primarily on anxiety or other psychiatric disorders were excluded, protocol design were also excluded. MEDLINE citations were searched in February 2016, using the PubMed search engine, for articles that discuss the quality and application area for smartphone software applications to be used by patients (12 clinical trials). In addition, articles found in the database ScienceDirect (404 articles) and Web of Science (97) were analyzed. The search keywords were "mobile application AND depression" and "criteria AND mobile application AND depression".

The selection procedure of the final number of studies was performed as follows:

- detection of the available relevant sources on the basis of the key words in the period of 2010–2016
- duplication check
- assessment of relevancy on the basis of abstracts
- full text analysis

Figure 2 below demonstrates the selection procedure of the research studies.

Use of mobile applications in the treatment of depression – findings of clinical trials

Altogether six clinical trials describing the research issue were detected. The study was included if it was a randomized controlled trial, if it matched the corresponding period, i.e., from 2010 up to 2016; if it involved people with depression or depressive symptoms, if it focused on the use of mobile applications in the improvement, detection or assessment of depressive symptoms; and if it was written in English. Therefore other clinical studies exploring this issue were for the reasons described above excluded, e.g.

Khoja et al. (2016)[18] describe e-Health solutions to address the four most common issues: depression, psychosis, post-traumatic stress disorder, and substance abuse. Preliminary evaluation of the intervention shows enhanced access to care for remote communities, decreased stigma, and improved quality of health services. Maulik et al. (2016)[19] discuss the development and testing of the electronic decision support systems (EDSS), for common mental disorders. Kim et al (2016)[20] evaluate the potential of a mobile mental-health tracker that uses three daily mental-health ratings (sleep satisfaction, mood, and anxiety) as indicators for depression, (2) discuss three approaches to data processing (ratio, average, and frequency) for generating indicator variables, and (3) examine the impact of adherence on reporting using a mobile mental-health tracker and accuracy in depression screening.

Table 1 below provides an overview and description of mobile applications that can help improve, detect and assess depressive symptoms. The studies are presented in alphabetical order of their first author.

Discussion

It is estimated that 75% of mental health problems begin in adolescence. Therefore, their early detection and monitoring is essential. The findings in Table 1 show that mobile apps could be one of the solutions since young people nowadays use them naturally on a daily basis. The findings of RCT[21, 22, 24, 26] described above also indicate efficacy of technology-enhance self-monitoring, particularly in the early stages of depression. Mobile apps are thus ideally suited for the first-step intervention programs for treating depression through increasing self-awareness of patients, which can bring rapid improvements for patient´s state of health.

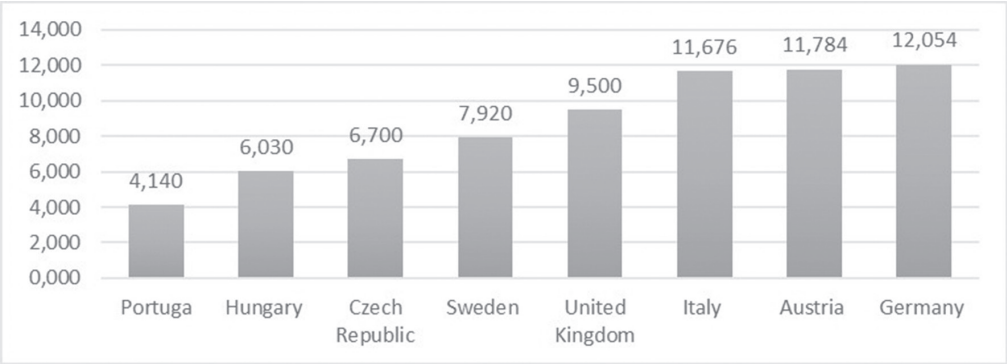

Fig. 1. mHealth applications numbers and their percentage distribution in regions[7]

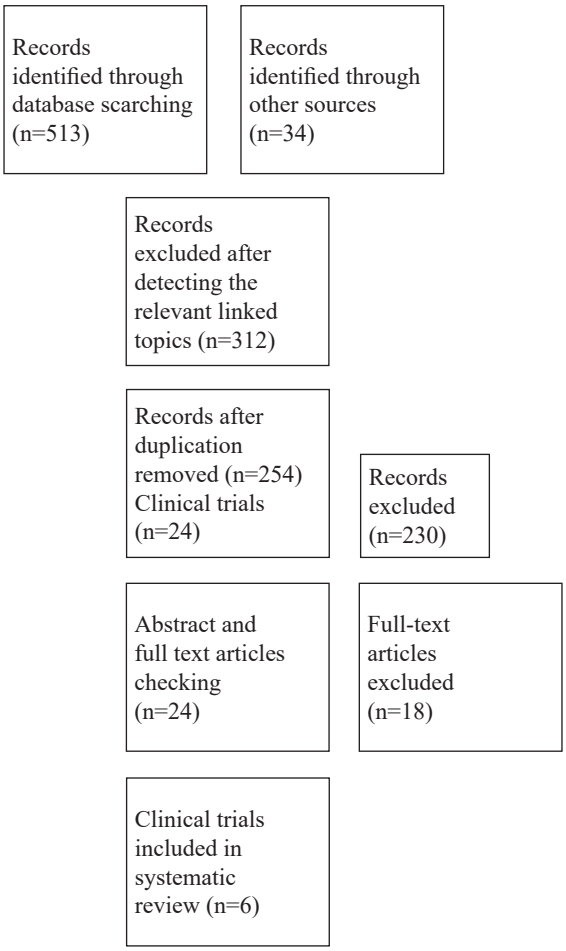

Fig. 2. Results of the selection procedure

For example, in the study by Kobak et al. (2015)[22] the results showed a considerable decrease in depression found in both groups [$t(34) = 8.453$, $p < 0.001$ and $t(29) = 6.67$, $p < 0.001$ for CBT and TAU, respectively). The intervention group in the study by Proudfoot et al. (2013)[24] also showed significantly greater improvement in symptoms of depression, anxiety and stress and in work and social functioning relative to both control conditions at the end of the 7-week intervention phase (between-group effect sizes ranged from $d = .22$ to $d = .55$ based on the observed means). Furthermore, Topolovec-Vranic et al.[27] argue that self-monitoring treatment approaches for depression seem to be more accessible for patients since they can exploit them from anywhere and at any time. In addition, they are more economical. This argument has been also supported by Winslow et al. (2016)[28] whose findings indicate that mHealth approaches have the potential to provide or augment treatment at low cost in the absence of in-person care.

Ly et al. (2014)[29] state that mobile applications intervention programs have especially an impact on patients with mild-to-moderate depression when both patients and their caregivers can still profit from their intervention, specifically derived from CBT, which can solve current problems and change unhelpful thinking and behavior (cf. 18). However, the study by Watts et al. (2013)[25] suggest that delivering a CBT program using a mobile application may also have significantly positive effect on outcomes for patients with major depression.

The results also point out at some publically available self-guided psychological treatment delivered via mobile phone and computer such as myCompass (Proudfoot et al., 2013)[24] designed to reduce mild-to-moderate depression, anxiety and stress, and improve work and social functioning. Similarly effective and supporting mobile application seems to be COMPANION-SMS, which is a software system that sends text messages to monitor the emotional state of individuals. This information, such as feelings of sadness or loneliness, decreased energy, difficulty concentrating, and disinterest in activities, gets sent to clinicians who are able to respond. The model behind this intervention is based on how genuine and immediate support through the mobile phone can improve the way someone feels and can encourage that individual to interact with trained clinicians[9]. As Andersson and Titov[30] state, the Internet-based programs supported by an experienced therapist can monitor and support patients before a crisis starts to develop. However, these interventions must be of good quality and sufficiently stimulating to engage patients with depression. In addition, their privacy data should be protected.

Generally, more promotion of the benefits of mobile health applications for the treatment and diagnosis of depression is needed. East and Harvard[31] propose several ways of improving this:

- raise awareness of evidence-based applications
- infuse mental health mobile applications into graduate counselor education
- disseminate information about mobile health applications during clinical staff meetings
- integrate mobile health applications into therapy
- publish research in this filed and present it at conferences

Table 2 below summarizes the main strengths and weaknesses of using mobile health applications for the treatment, detection, and diagnosis of depression.

Thus, the findings of the studies described above indicate that there is a big potential of mobile applications in the treatment of depression, particularly in mild and moderate stages of the disease.

Conclusion

As the findings of this study indicate, the number of mobile health applications is rapidly growing thanks to the rapid development of these technologies worldwide. As far as the treatment and diagnosis of depressive disorders are concerned, there is a general support for their use[32]. Since it is quite a new field of research, more clinical trials are needed to prove efficacy of mobile health applications for the treatment and diagnosis of depression[33, 34].

Overall, the use of mobile health applications appear to be beneficial for the treatment and diagnosis of depressive

Table 1. RCT clinical trial studies

Study	Objective	Number of subjects	Period of intervention	Type of intervention	Main outcome measures	Findings
Kauer et al. (2012)[20] RCT Australia	To test two main hypotheses: (1) people who monitored their mood, stress, and coping strategies would have increased ESA from pretest to 6-week follow-up compared with an attention comparison group, and (2) an increase in ESA would predict a decrease in depressive symptoms.	114 subjects aged 14 to 24 years from rural and metropolitan general practices with mild or more mental problems	4 weeks + 6 week follow-up	The intervention group monitored themselves using the complete mobiletype program, which assessed 8 areas of functioning, consisting of current activities, location, companions, mood, recent stressful events, responses to stressful events, alcohol use, cannabis use, quality and quantity of sleep, quantity and type of exercise, and diet.	Depression Anxiety Stress Scale and the ESA Scale.	The results support the hypothesis that self-monitoring increases ESA, which in turn decreases depressive symptoms for young people with mild or more depressive symptoms. Mobile phone self-monitoring programs are ideally suited to first-step intervention programs for depression in the stepped-care approach, particularly when ESA is targeted as a mediating factor.
Kobak et al. (2015)[22] Pilot RCT USA	To test a technology-enhanced intervention to facilitate CBT treatment of adolescent depression.	Sixty-five adolescents, aged 12–17 (mean age = 15.4, SD = 1.52) with major, persistent and non-specified depressive disorders	12 weeks	(1) online therapist training (2) in-session use of tablets for teaching clients CBT concepts and skills, and (3) text messaging for between session homework reminders and self-monitoring.	System usability scale (SUS); quick inventory of depressive symptomatology – adolescent version (QIDS-A-Pat); clinician global ratings of improvement (CGI-I) and severity (CGI-S); and clinician and patient ratings on the therapeutic alliance scale for adolescents (TASA).	The findings show that the technology-enhanced CBT Intervention was effective in improving symptoms of depression in adolescents. User satisfaction with the technology was high for both therapists and patients.
Ly et al. (2014)[23] RCT	To evaluate and compare the effectiveness of two smartphone-delivered treatments: one based on behavioural activation (BA) and other on mindfulness.	81 participants; mean age 36.0 years with major depressive disorder	8 weeks	Behavior program administered via a smartphone application.	The Beck Depression Inventory-II (BDI-II) and the nine-item Patient Health Questionnaire Depression Scale (PHQ-9).	For participants with higher severity of depression, the treatment based on BA was superior to the treatment based on mindfulness. For participants with lower initial severity, the treatment based on mindfulness worked significantly better than the treatment based on BA.
Proudfoot et al. (2013)[24] RCT Australia	To evaluate the efficacy of myCompass, a self-guided psychological treatment delivered via mobile phone and computer, designed to reduce mild-to-moderate depression, anxiety and stress, and improve work and social functioning.	720 participants aged 18–75 with mild-to-moderate depression, anxiety and/or stress	7 weeks + 3 month follow-up	myCompass	Depression, Anxiety and Stress Scale and the Work and Social Adjustment Scale.	The myCompass program is an effective public health program, facilitating rapid improvements in symptoms and in work and social functioning for individuals with mild-to-moderate mental health problems.
Watts et al. (2013)[25] Pilot RCT Australia	To evaluate whether a previously validated computerized program (The Sadness Program) remained efficacious when delivered via a mobile application.	35 women with major depression	8 weeks + 3 month follow-up	Participants completed 6 lessons, weekly homework assignments, and received weekly email contact from a clinical psychologist or psychiatrist until completion of lesson 2. After lesson 2 email contact was only provided in response to participant request, or in response to a deterioration in psychological distress scores.	Patient Health Questionnaire 9	These results provide evidence to indicate that delivering a CBT program using a mobile application, can result in clinically significant improvements in outcomes for patients with depression.
Whittaker et al. (2012)[26] RCT New Zealand	To develop and test the novel mobile phone delivery of a depression prevention intervention for adolescents.	855 students (13–17 years of age) with depressive symptoms or at risk at self-harm	9 weeks	2 mobile phone messages/ day for 9 weeks, with a mixture of text, video, and cartoon messages and a mobile website.	Individual interviews were arranged with participants at the end of the 9-week program and took place on school grounds.	Key messages from CBT can be delivered by mobile phone, and young people report that these are helpful.

Table 2. The main strengths and weaknesses of using mobile health applications for the treatment, detection, and diagnosis of depression

Strength	Weaknesses
• clinical trials show promising results; improvement of treatment accessibility • patient empowerment • efficient self-monitoring tools for patients in the early stages of the disease • suitable supporting therapies • cost-effectiveness • reduction of hospital institutionalization and care • lowering of prevention costs • reduction of visits, examinations at the doctor • cut of labor costs	• a lack of data security • a lack of standards • insufficient data backup • resistance from traditional healthcare providers • low awareness of benefits mobile applications for the treatment of depression • a lack of evidence-based programs

disorders despite some of the barriers mentioned above. However, researchers should assess what kind of intervention with the help of mobile applications is the most effective for patients suffering from depressive disorders and conduct more randomized controlled clinical trials in this field, which have appeared to be just a few so far.

Effort to take advantage of using other approaches with technologies in the treatment of diseases is worldwide supported in healthcare in many directions because it is one of the possibilities how to use the limited financial means effectively[35–37].

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Conflicts of interest: none.

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