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Use of new technologies for the promotion of physical activity in patients with mental illness: A systematic review

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Abstract

BACKGROUND

Physical exercise is an underutilized tool for the management of mental disorders. New technologies have made a breakthrough in health care, and one of its possible applications (apps) could be that of customizing exercise programs for special populations, such as patients with mental disorders. However, the app of the so-called e-health to mental health care is still limited.

AIM

To know the efficacy of apps to promote physical activity in patients with mental disorders.

METHODS

We conducted a systematic review of the PubMed and Embase databases with the aim of exploring the use of new technologies for the enhancement of physical exercise in patients with a psychiatric illness. Following the selection process, 10 articles were included in the review.

RESULTS

The most commonly used devices in this type of intervention are wearable devices and web platforms. Good results in terms of effectiveness and acceptability were obtained in most of the studies.

CONCLUSION

Our findings suggest that the use of new technologies in mental health represents a feasible strategy with great potential in clinical practice.

Key Words: e-health; m-health; Physical exercise; Mobile applications; Wearable device

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Core Tip: Physical exercise is an underutilized tool for the management of mental disorders. New technologies have made a breakthrough in health care, and one of its possible applications (apps) could be that of customizing exercise programs for special populations, such as patients with mental disorders. Apps that aim to improve and increase physical activity in patients diagnosed with the disease have shown good results in terms of efficacy and acceptability, so they should be known by clinicians in order to offer them to patients who meet a good profile.

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INTRODUCTION

Mental illness is one of the major global public health problems[1]. People with severe mental disorders are in poorer health, with more cardiovascular risk factors and high morbidity and mortality rates. Factors associated with this poorer health status include a greater tendency to lead a sedentary lifestyle and high comorbidity with chronic physical illnesses[2-4]. Furthermore, mental disorders often do not access the health care they require and, even when they do, treatment is often inadequate[5].

The relationship between physical health and mental illness can also be harnessed to our advantage and contribute to closing the gap in the treatment of these disorders: Numerous studies show the benefits of physical exercise on mental state[6-14]. In a recent population-based survey in Spain, physical exercise was inversely associated with major depressive disorder (MDD), irrespective of body mass index[6]. Several studies have investigated the therapeutic potential of physical exercise in other mental disorders such as anxiety, post-traumatic stress disorder, or even psychotic disorders[7-12]. Finally, several randomised clinical trials agree on the antidepressant effect of physical exercise[13,14].

However, it is difficult to inculcate physical exercise habits in people with psychiatric symptoms, especially in the acute phases of the illness. New technologies can make this task easier. Digital medicine, also called e-health, is opening new horizons in the management of a multitude of diseases, including MDD[15]. The enhancement of physical activity is one of the most exploited functions by this type of technology that is based on applications (apps) and software programmes managed through various platforms, such as websites, wearable devices, smartphones, or social networks. Some of these devices have sensors that allow continuous measurement of physical activity, mainly through accelerometers[16].

Physical activity promotion programmes show better results when they take into account the particularities of each population. Apps and other electronic interventions therefore have been designed for focusing on promoting physical activity in different patient populations, such as people with diabetes or cancer[17,18]. However, the role played by digital medicine in the management of mental illness is more limited, despite the fact that these populations could benefit from the advantages of new technologies. Several studies demonstrate the interest shown by psychiatric patients in the use of mobile technology to improve their mental health[15,19-21]. It is therefore crucial that the large offer available on the digital market is screened by clinicians and researchers.

Nursing professionals have sown a prominent interest in e-health interventions and can play a key role in the app of new technologies to mental health care, as they are often the closest link to the patient [22]. For example, patients often prefer to ask nurses for advice on mobile apps they can use[23]. The continuous development of new technologies, however, is progressing significantly faster than the research conducted to empirically test these advances[24]. A review of the evidence on these tools is crucial to provide the best evidence-based knowledge conducive to good use of this technology. The aim of this paper is to systematically review the available evidence on mobile apps for physical activity enhancement in patients with mental illness.

MATERIALS AND METHODS

Registration

This systematic review was conducted in accordance with the Preferred Items for Reporting of Systematic Reviews and Meta-Analyses recommendations[25]. The protocol for this systematic review was registered in the PROSPERO database (registration number: CRD42021242258).

Search strategy

We conducted a systematic literature search in the PubMed and Embase databases to identify studies on e-health interventions for the enhancement of physical activity in people with mental illness. The concept of “enhancement” encompassed both the outcomes of increased physical activity and the results obtained because of this activity (such as weight loss or improvement in other health parameters).

The inclusion criteria were as follows: (1) Original articles; (2) Published in the last ten years 10 years (November 15, 2012 to November 15, 2022); (3) Peer-reviewed journals; (4) Language: English or Spanish; (5) Exploring mobile apps for physical activity promotion in individuals with mental illness; (6) Adult population; and (7) Providing measurable outcomes, either in terms of effectiveness or feasibility.

The search terms used in PubMed were as follows: (physical[Title/ Abstract] OR exercise[Title/ Abstract]) AND (psychiatr*[Title/ Abstract] OR mental disorder*[Title/ Abstract] OR mental illness*[Title/ Abstract] OR schizophre*[Title/ Abstract] OR anxiety[Title/ Abstract] OR bipolar[Title/ Abstract] OR depressi*[Title/ Abstract]) AND (phone[Title/ Abstract] OR device[Title/ Abstract] OR app[Title/ Abstract] OR web[Title/ Abstract] OR social media[Title/ Abstract] OR virtual reality[Title/ Abstract] OR new technologies[Title/ Abstract] OR digital[Title/ Abstract] OR e-health[Title/ Abstract] OR m-health[Title/ Abstract]).

A similar search strategy was employed for the Embase database, such as: “(physical OR exercise) AND (psychiatr* OR mental disorder* OR mental illness* OR schizophre* OR anxiety OR bipolar OR depressi*) AND (phone OR device OR app OR web OR social media OR virtual reality OR new technologies OR digital OR e-health OR m-health)”.

Selection and extraction process

Two researchers (Guerrero-Jiménez M and Ruiz M) independently analysed the eligibility of the studies. Critical appraisal tools checklists were used to assess the quality of the articles[26]. When there was no agreement between the reviewers, the decision rested with the senior investigator. The variables of interest collected from the articles were: (1) Scientific content and technical characteristics of the apps; (2) Effectiveness; (3) Acceptability (level of approval by users); (4) Level of satisfaction; and (5) Outcome measures.

Quality assessment

Two reviewers (Guerrero-Jiménez M and Ruiz M) assessed independently the quality of the articles (this is described in [Supplementary Table 1](#)). Discrepancies between reviewers were resolved by discussing and reaching a consensus. We assessed several aspects, including methodological design, risk of bias, and reporting quality. For randomized clinical trials, Cochrane Collaboration’s tool for assessing risk of bias was used.

RESULTS

Figure 1 shows the flow chart of the literature search. The initial search yielded 6257 results (PubMed = 5970; EMBASE = 302) of which 9 were finally included in the review, characteristics and main findings of the studies are recorded ([Table 1](#))[27-35]. With the exception of two studies[28,34], the reviewed articles worked with sample sizes of less than 50 participants. All studies had positive results following intervention with mobile technologies. Acceptability was generally high, as was participation in the studies. The different studies reviewed can be divided according to the intervention tool used. Our review includes about 400 participants with different psychiatric illness as bipolar disorder and MDD.

Mobile apps

The pilot study by Macias *et al*[30] found that the use of the app promoted longer walks in obese patients with mental illness, in addition to obtaining good adherence and user satisfaction with the platform ([Table 2](#)).

Wearables

Studies such as those by Macias *et al*[30] and Naslund *et al*[31] or Aschbrenner *et al*[27] used wearables in the intervention with patients with mental illness, obtaining positive results in weight loss, and in one of the studies, improvement in physical condition.

Table 1 Characteristics and main findings of the studies

Ref.	Device	Features	Design	Sample	Measures and scales	Main findings
Aschbrenner <i>et al</i> [27], 2016	Wearable device (Fitbit Zip)	Accelerometer, step and distance registration	Pilot study pre-post	13 patients with overweight and psychiatric disorders	Satisfaction questionnaire 6-MWT; weight (kg)	At 6 mo 45% of the participants were underweight and 45% improved their physical condition
Haller <i>et al</i> [28], 2018	Internet platform	Heart rate monitor and resistance bands	RCT	20 patients with MDD (moderate and severe)	Depression scales: (1) QIDS; (2) Self-efficacy, quality of life and physical activity; and (3) General health status SF-36	Feasible and effective in patients with moderate to severe depressive symptoms, improving quality of life and decreasing depressive symptoms
Lambert <i>et al</i> [29], 2018	eMotion (Web)	Accelerometer. Weekly module course. Interactive worksheets	RCT	62 patients with at least moderate depressive symptoms and anxiety	PHQ-8. Vigorous physical activity	Depression levels were lower in the intervention group than in the control group
Macias <i>et al</i> [30], 2015	WellWave	Digital library with readings, personal messages and a variety of activities	Pilot study	10 patients with obesity and mental illness (schizophrenia, MDD or BD)	Self-assessments. Number of steps and walking time	Seven of the ten participants increased the number and duration of weekly walks. High app participation
Naslund <i>et al</i> [31], 2016	Wearable device (Fitbit Zip)	Accelerometer. Podometer. Progress Log	Prospective	34 patients with psychiatric disorders (various diagnoses)	Weight (kg). 6-MWT	Higher average daily steps were associated with greater weight loss
Naslund <i>et al</i> [32], 2016	Wearable device (Fitbit Zip)	Accelerometer. Podometer. Progress Log	Exploratory study	11 patients with severe mental illness and obesity	Quantitative usability and satisfaction questionnaire. Interviews	The use of the app motivates participants to engage in physical exercise
Naslund <i>et al</i> [33], 2018	Facebook	Messages, posting of posts, photos	Exploratory study	25 patients with mental illness (MDD, BD and schizophrenia, obesity under pharmacological treatment)	FB Interactions. 6-MWT. Weekly group attendance	Participants who actively contributed to the Facebook group have a higher weight loss
Pfirrmann <i>et al</i> [34], 2018	Web	Forum, psychoeducation	Analysis of four clinical trials	5 participants with oesophageal carcinoma, 5 with liver disease, 5 with MDD and 5 with cystic fibrosis	-	Efficacy as an exercise enhancer in all pathologies
Young and Morgan[35], 2018	SHED-IT	Measuring tape, pedometer	Pre-post study	209 male patients with overweight and depressive symptoms	PHQ-8. Weight (kg)	Reduction of weight and depressive symptoms, with a high level of engagement and satisfaction

6-MWT: 6-minute walk test; BD: Bipolar disorder; FB: Facebook; MDD: Major depressive disorder; MINI: Mini international neuropsychiatric interview; PANSS: Positive and negative syndrome scale; SCID: Structured clinical interview for axis-I DSM-IV disorders; RCT: Randomized controlled trial; PHQ: Patient health questionnaire.

Social networks

Naslund *et al*[32] explored the use of the social network Facebook in intervention with patients diagnosed with mental illness and obesity. They found that the use of this social platform prompted patients to greater motivation for weight loss, with participants with the highest number of interactions having lost the most weight.

Other digital interventions

Other studies used web-based platforms, where their effectiveness was observed, both in various pathologies[33] and in the reduction of depressive symptomatology, which was greater in the intervention group compared to the control group[28].

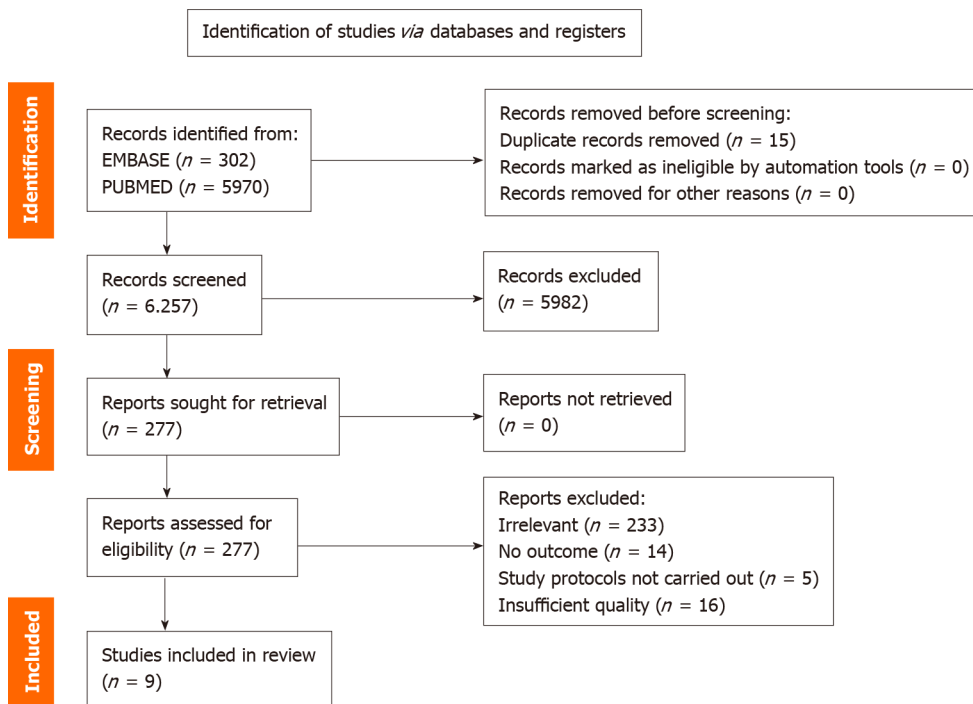
DISCUSSION

However, most of the studies focus their interventions on pathologies other than mental health, which is

Table 2 User satisfaction with the different device

Ref.	Device	Positive	Negative	Suggested improvements
Macias <i>et al</i> [30], 2015	WellWave	Personal messages, reading library	-	Test whether learning how to use the app can increase personal satisfaction
Naslund <i>et al</i> [31], 2016	Wearable device	Self-monitoring	Difficulties of use	Make tutorials on the use of the device
Naslund <i>et al</i> [32], 2016	Wearable device	Self-monitoring	Difficulties of use	Make tutorials on the use of the device. Participants are satisfied with the use of the app
Aschbrenner <i>et al</i> [27], 2016	Wearabledevice	Self-monitoring	Difficulties of use	Make tutorials on the use of the device before. High level of satisfaction
Haller <i>et al</i> [28], 2018	Web platform	Easy to use, self-monitoring	Does not include follow-up	Include monitoring as web-based apps show a trend towards non-use over time. Show a trend towards non-use over time
Lambert <i>et al</i> [29], 2018	eMotion	Self-monitoring	Not assessed	Not assessed
Naslund <i>et al</i> [33], 2018	Facebook	Accessibility, facilitates communication between people in the same condition. Allows information sharing and feedback	Not assessed	Not assessed
Pfirmsmann <i>et al</i> [34], 2018	Web	Forum. Unspecific information	Not assessed	Not assessed
Young and Morgan[35], 2018	SHED-IT	Self-monitoring	Not assessed	Longer-term programme of longer duration

apps: Applications.



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Figure 1 Flow chart of the literature search.

why, despite the large amount of literature published on the subject, only 9 studies were conducted on the population to be studied and included in this review[27-35].

Discussion of effectiveness

Our findings suggest that physical exercise may be a useful tool in the management of mental disorders, and that the delivery of these interventions through e-health platforms may increase adherence and accessibility to treatment. The therapeutic effect of physical exercise can be explained by several

mechanisms. Physical activity may have neuroregenerative properties and increase brain-derived neurotrophic factor (BDNF)[36,37] although a recent meta-analysis did not find that physical exercise significantly increased BDNF in patients with depression[38].

The immune system may also be involved in this association. Inflammatory pathways are thought to play a key role in the neurobiological basis of mental illnesses such as MDD, which would explain the bidirectional association that has been found between certain mental illnesses and inflammation[39,40]. Exercise has been shown to have anti-inflammatory properties[41], and this reduction in inflammation and oxidative stress may explain the beneficial effects of exercise on mental health. This effect may be mediated by changes in the neuroimmune system, such as induction of the release of interleukin-10 and other anti-inflammatory cytokines[42,43].

Comparisons with prior reviews

Many barriers to the adoption of e-health in clinical practice remain despite the great potential of new technologies. Qualitative survey results of investigation involving patients and professionals provide some insight into the challenges that remain to be overcome for the adoption of e-health[44]. While patients appear open to using e-health, their interest differs from actual use. A 2019 survey of veterans with depression found that while 73.1% of them were interested in mental health apps, only 10.7% actually used any of them[45].

Among the most important barriers is precisely the lack of integration in public health systems, which leads to mistrust between users and professionals. In this respect, the United Kingdom is a pioneer in trying to integrate new technologies into its healthcare system[46]. Another barrier is the concern for privacy when using tools with internet access, as there is a risk of dissemination of highly sensitive data [47,48]. The absence of privacy policies is a frequent drawback when creating and using apps. Privacy is an issue of concern to users, and one of the main features they value in this type of media is that there is a method of protecting sensitive information by passwords, for example[49].

Mental disorder may act as a barrier in itself, as shown by a study in which veterans with posttraumatic stress disorder (PTSD), despite demanding more mental health services, were less willing to participate in mental health apps than their peers without PTSD[50]. The lack of confidence of medical professionals themselves in the reliability of e-health interventions sometimes slows down the adoption of mental health in clinical practice. In addition, there is a markedly smaller number of studies evaluating these interventions than the number of devices and apps available on the market[51]. Users often seek advice from their healthcare professionals, such as doctors or nurses. Training doctors, nurses and other healthcare professionals in the use of new technologies is therefore a crucial element in accelerating the adoption of these interventions in clinical practice[52,53].

CONCLUSION

Digital medicine represents a tool of great potential in clinical practice. Thanks to their great versatility and acceptance among users, new technologies can open up new fields in mental health care. In the specific case of physical exercise enhancement in mental health patients, new technologies can facilitate adherence to exercise programmes and increase their personalization. However, there are still wide-ranging barriers to the adoption of these interventions on a day-to-day basis. One of the steps needed to advance research is the development of new apps and tools, and their testing in exploratory articles with larger sample sizes.

Another of the fronts to be explored is the field known as machine learning. From the huge amount of data that these devices can collect, we can detect behavioural patterns characteristic of each person and thus optimise interventions to individual needs. This is a step towards participatory medicine, a paradigm shift that has been pursued for years[53], in which the integration of multidisciplinary treatment teams would also be an important point.

ARTICLE HIGHLIGHTS

Research background

Mobile applications (apps) have proven to be very useful in improving physical health in numerous medical illnesses.

Research motivation

We want to know if apps have proven to be useful in patients with mental illness.

Research objectives

The main objective of the present systematic review is to know the efficacy of apps to increase physical

activity in patients suffering from mental illness.

Research methods

We have carried out a systematic review, following the Preferred Items for Reporting of Systematic Reviews and Meta-Analyses recommendations, of the last 10 years, selecting articles that have studied the efficacy of apps in increasing physical activity in patients with mental illness. The quality of the selected studies was also analyzed.

Research results

From 6257 initial articles we included finally 9 articles that met the criteria for inclusion. We resume the principal studies that have showed an improvement in reduction of weight and depressive symptoms and an increase of level of satisfaction and physical exercise in patients that are suffering a mental disease.

Research conclusions

Apps can be a good strategy to improve the physical health of patients with mental illness.

Research perspectives

In the future, digital tools should be developed to analyze clinical efficacy using multivariate analysis, larger samples, including different psychiatric diseases and more specific treatments using artificial intelligence (machine learning).

FOOTNOTES

Author contributions: Guerrero-Jiménez M and Ruiz M contributed equally to this work; Gutiérrez-Rojas L, Jiménez-Muñoz L, Baca-García E and Porrás-Segovia A designed the research study; Ruiz M, Jiménez-Muñoz L and Porrás-Segovia A performed the research; Guerrero-Jiménez M and Ruiz M contributed analytic tools; Guerrero-Jiménez M, Ruiz M, Gutiérrez-Rojas L and Porrás-Segovia A analyzed the data and wrote the manuscript; and all authors have read and approve the final manuscript.

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