Mobile Health Interventions in Mental Health Conditions: A Review on Development So Far and Gaps to Be Bridged

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Background:

- Mental health conditions (MHCs) are a major public health concern and have a significant social burden.[1] Prevalence rates of mental disorders have risen at an alarming rate, with 970 million cases reported in 2019.[2] Anxiety and depression were reported to be the two most prominent mental disorders worldwide.[3] These conditions are not only detrimental to the mental and physical well-being of affected individuals but are also associated with a poor quality of life for patients and caregivers alike. Factors such as fear of stigma, limited accessibility to psychologists, lack of acceptance of the disease, low treatment compliance, and lack of support from family and peers compound the challenges facing people with such conditions.

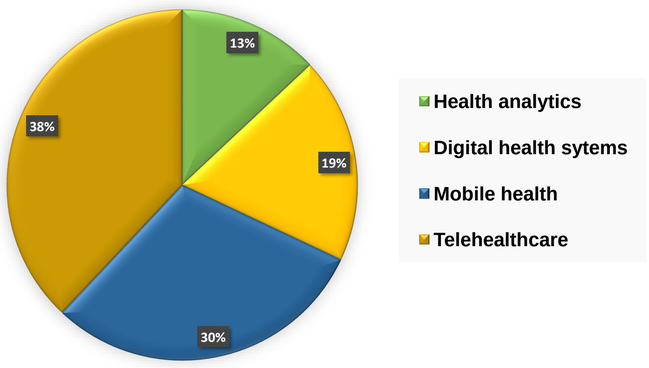
- An unusual surge in cases of depression, anxiety disorders, stress, and panic attacks occurred during the coronavirus disease 2019 (COVID-19) pandemic.[4] In 2020, additionally 53.2 million cases of major depressive disorder and 76.2 million cases of anxiety were reported because of the pandemic.[3]

- Additionally, the direct costs (healthcare costs, treatment, physician visits, etc.) and indirect costs (loss of income due to mortality, disability, etc.) associated with MHCs pose a high economic burden on the healthcare system, making it very expensive or unaffordable for many sections of society.[5] The economic burden of MHCs is estimated to reach $6 trillion by 2030, making them one of the costliest ailments.[6]

- Digital health interventions are growing at a tremendous pace, thus allowing people to self-monitor and self-manage their health conditions. A few popular digital health interfaces include mobile health (mHealth), cloud computing, telemedicine, and gamification. The global digital health market was worth $270.60 billion in 2021 and is expected to grow to $1354.68 billion by 2030, with a compound annual growth rate (CAGR) of 19.2%.[7] Different digital health technologies and their projected market size in 2020 are presented in **Figure 1**.

- Mobile health interventions (mHIs) have evolved tremendously as accessible, efficient self-management therapeutic tools for MHCs. Such interventions aid in virtual consultations, disease diagnosis, monitoring treatment, and assessing treatment effectiveness from the comfort of home, thus improving adherence. In 2021, the mHealth market was worth $83.92 billion and is expected to grow at a CAGR of 17% from 2022 to 2030.[7]

Figure 1: Digital Health Market, 2020



Objectives:

The aims of this review are to provide an overview of the burden of MHCs and a glimpse of the growing use of mHIs in MHCs. We have also evaluated the adoption in clinical settings and benefits of mHIs, besides highlighting the challenges limiting its widespread adoption.

Methods:

Peer-reviewed studies published during the last decade were retrieved from PubMed, Google Scholar, and other credible scientific sources with the help of key search terms such as digital health technology, mental health, mHI, and smartphone applications.

Results:

There is a dearth of credible evidence on mobile health technology, and only a handful of interventions have been validated for efficacy and feasibility. A few notable studies on mobile-based interventions exhibiting promising outcomes have been discussed in this section. Additional details are provided in **Table 1**.

- A systematic review (30 clinical trials between 2018 and 2019) examined the use of mHIs for depression, including objective engagement (number of times a programme is used), subjective engagement (qualitative data on users' experiences), and associations between engagement and other clinically important variables (symptom improvement, participant characteristics). The majority reported objective engagement (n=22, 73.3%), followed by subjective engagement (n=16, 53.3%), while fewer examined associations between engagement and clinical improvement, participant characteristics, or other clinically relevant variables (n=12, 40.0%). Although most studies reported at least one measure of engagement, there was considerable heterogeneity. This emphasises the need for intentional, theory-driven, consistent measurement of engagement with mHIs for depression to better evaluate clinical improvement.[8]

- In 2013, an early randomised trial using digital technology intervention was conducted using SuperBetter (SB), which is accessible through a smartphone or website.[9] Adults with significant depression symptoms (n=283), as per the Center for Epidemiologic Studies-Depression Scale (CES-D), were randomly assigned to the SB targeting depression group and a waiting list control group (no alternate intervention). All participants completed online psychological distress and well-being measures every 2 weeks through follow-up. SB was associated with greater reductions in CES-D scores as compared to control by post-test (Cohen's d=0.67) and by follow-up (d=1.05), thus indicating an important role of smartphone/Internet-based self-help in treating depression.[9]

- The effects of an online intervention for depression on mood and symptoms improvement in schizophrenia were assessed through an online survey involving CES-D as a primary outcome.[10] Fifty-eight German individuals with schizophrenia were randomised to either the online depression intervention (HelpID programme based on the cognitive behavioural therapy [CBT] theoretical framework) or to a waitlist control condition. A significant difference emerged for the primary outcome with a large effect size (p=0.003), along with reduced symptoms (p=0.002), in the intervention group, relative to the waitlist group. An 84% completion rate (post-assessment, after 3 months) indicated that the programme benefitted most participants.[10]

- A first-of-its-kind Australian randomised trial compared the efficacy of three widely used, publicly available standalone MHapps to a waitlist control condition in a community sample (n=226).[11] The three MHapps included the CBT toolkit app MoodKit, the mood tracking app MoodPrism, and the CBT strategy app MoodMission. Compared to the control group, all MHapp groups experienced improved mental wellbeing, while the MoodKit and MoodMission groups experienced decreased depression.[11]

- A 3-month randomised trial compared a smartphone-delivered intervention (FOCUS) versus a clinic-based group intervention (WRAP) in a population (n=163) with long-term, serious mental illness (49% schizophrenia, 28% bipolar disorder, and 23% depression).[12] Participants accessing FOCUS were more likely to commence treatment versus those accessing WRAP (90% vs. 58%), suggesting easier accessibility and initiation. More participants from the FOCUS group remained fully engaged over 8 weeks of care versus the WRAP group (56% vs. 40%). Clinical outcomes and satisfaction ratings were similar in both groups. Significant improvements in recovery and quality of life were reported for the FOCUS group at 6 months, thus signifying superior patient engagement and comparable patient satisfaction and clinical and recovery outcomes to those from a widely used clinic-based group intervention for illness management. [12]

- The 2020 randomised blinded Spanish trial tested the efficacy of a self-managed psychoeducational, mindfulness-based mHI named PsyCovidApp (n=248) against a similar control app (n=234), but with access limited to general information and content for healthcare workers providing face-to-face consultation to COVID-19 patients.[13] PsyCovidApp was significantly effective (p=0.004) in alleviating symptoms of depression, anxiety, stress, and other mental health problems in healthcare workers when used in combination with clinical treatments, including psychotherapy or psychotropic medications. This finding was extremely encouraging, considering the surge in MHCs during the pandemic.[13]

Table 1: Trials using mHealth interventions

Published study (Author and Year)	Technology type and name	Geography and study period	Primary objectives and outcomes	Publicly available (Yes/No)
Roepke et al., 2015[9]	App; Super Better (SB)	US; November 2012–March 2013	**Primary objective:** evaluation of role of SB in reducing depression symptoms. **Outcome:** SuperBetter participants achieved greater reductions in CES-D scores than waitlist control participants by post-test (Cohen's d=0.67) and by follow-up (d=1.05).	Yes
Moritz et al., 2016[10]	Internet intervention; Help ID	Germany; 3 months (period not specified)	**Primary objective:** evaluation of role of HelpID in alleviating depression symptoms in schizophrenia. **Outcome:** significant difference observed [F(1,46)=9.84, p=0.003, $\acute{\eta}^2_{partial}$ =0.176], with a large effect size in favour of HelpID group. Paired t-test showed significant decrease in symptoms in the HelpID group (p=0.002). German clinical trials registration number: DRKS00007888.	Not specified
Bakker et al., 2018[11]	Apps; Mood Kit, Mood Prism and Mood Mission	Australia; August 2016–June 2017)	**Primary objective:** assessment of decrease in depression and anxiety and increase in mental well-being using smartphone apps. **Outcome:** PHQ-9 mean (SD) score (baseline vs. follow-up) in study groups were: Moodkit: 11.25 (6.54) vs. 8.63 (5.47); MoodPrism: 8.04 (4.9) vs. 6.30 (3.86); Moodmission: 10.94 (6.22) vs. 8.17 (5.62) and control: 8.55 (6.62) vs. 7.42 (5.84) GAD-7 mean (SD) score (baseline vs. follow-up) in study groups were: Moodkit: 9.00 (5.47) vs. 7.32 (4.56); MoodPrism: 6.80 (5.33) vs. 5.47 (4.13); Moodmission: 8.58 (5.74) vs. 6.89 (4.55) and control: 6.84 (5.55) vs. 6.25 (4.55). WEMWBS mean (SD) score (baseline vs. follow-up) in study groups were: Moodkit: 40.63 (7.27) vs. 46.22 (7.41); MoodPrism: 45.09 (8.21) vs. 49.37 (7.93); MoodMission: 41.24 (9.24) vs. 46.96 (8.31) and control: 44.50 (9.44) vs. 46.33 (9.82).	Yes
Ben-Zeev et al., 2018[12]	App; FOCUS	US; 3 months (period not specified)	**Primary objective:** comparison of smartphone-delivered mHealth (FOCUS) to a clinic-based group self-management intervention (WRAP). **Outcome:** 90% (N=74) of participants assigned to FOCUS commenced use of the mHealth app, and 58% (N=47) of those assigned to WRAP attended at least one group session (x2=22.11, df=1, p=0.001). FOCUS group participants were more likely than WRAP participants to fully engage in treatment for at least eight weeks (56% vs. 40%) (x2=4.50, df=1, p=0.03) Mean post-treatment satisfaction ratings were similar between groups: overall ratings of 25.763.8 for FOCUS and 25.563.6 for WRAP. No significant differences in changes in primary (general psychopathology) and secondary (depression, psychosis, recovery, and quality of life) clinical outcomes in FOCUS and WRAP groups were observed. Clinicaltrials.gov registration number: NCT02421965.	Yes
Fiol-DeRoque, 2021[13]	App; PsyCovid	Spain; May–July 2020	**Primary objective:** evaluation of the effectiveness of PsyCovid app in reduction of mental health problems in healthcare workers during COVID-19 pandemic. **Outcome:** subgroup analysis: significant improvements among healthcare workers using app combined with psychotropic medications (n=79) in the primary outcome (–0.29; 95% CI –0.48 to –0.09; p=0.004) and those combining app with psychotherapy (–0.25; 95% CI –0.49 to –0.02; p=0.02), and in insomnia, anxiety, and stress. Clinicaltrials.gov registration number: NCT04393818.	Not specified

Abbreviations: CES-D: Center for Epidemiologic Studies Depression Scale; DASS: Depression Anxiety Stress Scales; GAD: Generalised Anxiety Disorder; PHQ: Patient Health Questionnaire; RCT: Randomised controlled trial; SD: US: United States; WEMWBS: The Warwick-Edinburgh Mental Well-being Scale

Challenges and Benefits:

Though available literature indicates immense benefits and potential of mHIs, certain lingering challenges exist.[14-16] **Figure 2** and **Figure 3** represent the benefits and challenges associated with usage of mhealth technologies.

Figure 2: Benefits with use of mHealth

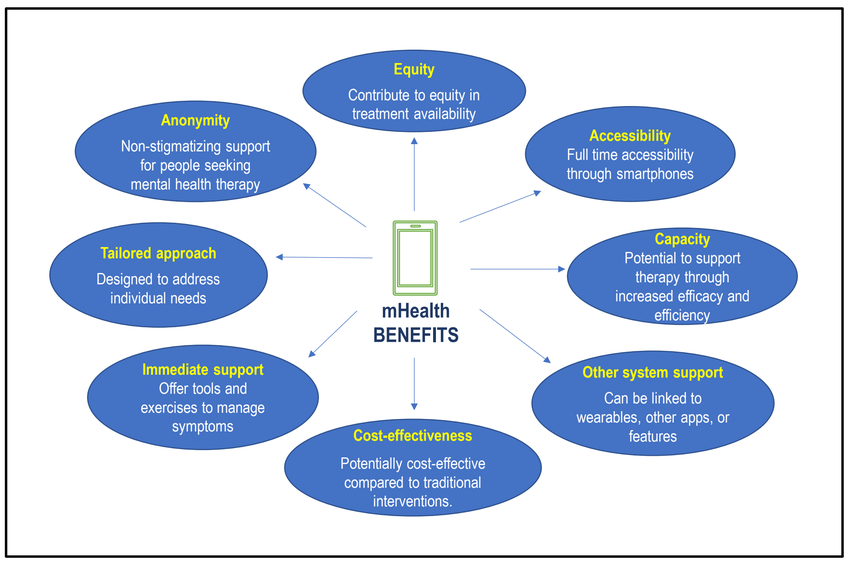
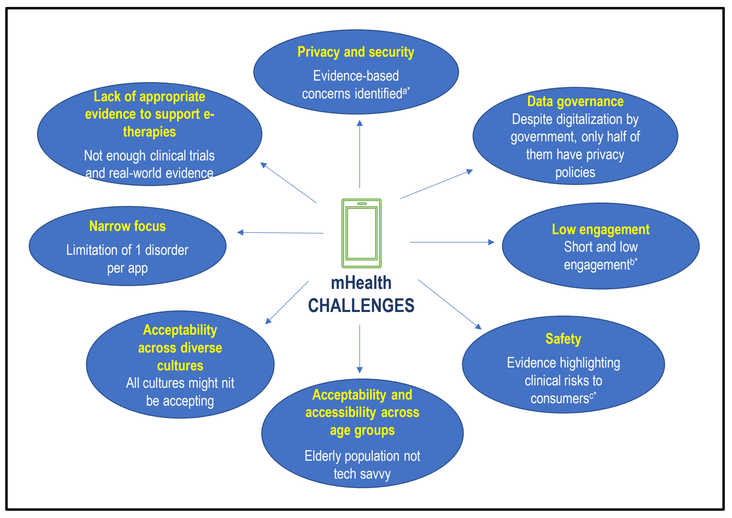


Figure 3: Challenges associated with mHealth



Challenges notes:

a* A cross-sectional study characterised the privacy conduct of all the available mHealth apps on Google Play in Australia and gauged the associated risks to privacy. It was discovered that 88% of mHealth apps could potentially access and share personal data, and 3.9% of apps transmitted data in their traffic.[17]

b* Review of individual use data from over 100,000 participants of health app studies, including depression, discovered a 5.5-day average period of engagement. An examination of engagement with popular mental health apps from the commercial marketplace found that only 4% of users who downloaded a mental health app accessed it later.[18,19]

c* A literature review studying safety concerns with consumer-facing health apps and their consequences identified a total of 80 safety concerns: 67 related to the quality of information presented, including incorrect or incomplete information, variation in content, and incorrect or inappropriate response to consumer needs. The remaining 13 related to app functionality, including gaps in features, lack of validation for user input, delayed processing, failure to respond to health dangers, and faulty alarms. Of the 52 reports of actual or potential consequences, 5 had the potential for patient harm. There were 66 reports about gaps in app development, including the lack of expert involvement, a poor evidence base, and poor validation.[20]

Conclusion:

While mHIs have exhibited favourable outcomes overall in MHCs, further studies are warranted to address challenges and limitations to foster wider acceptance and trust among physicians and patients.

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Acknowledgements:

We thank Fida Kazmi Khazi for medical writing support and Shlok Kumar for editorial assistance.

ISPOR Europe 2022, Vienna, Austria and Virtual | Mobile Health Interventions in Mental Health Conditions | 8th November 2022.

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