



Digital Mental Health Interventions: Efficacy and Equity

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Abstract

Original Research Article

In today's society, insomnia, depression and anxiety are widely present and digital mental health interventions have become essential tools to meet these needs. Of these interventions, smartphone-based, cost-effective, and scalable Cognitive Behavioural Therapy (CBT) is an accessible alternative to face-to-face therapy. This review aims to highlight the effectiveness of smartphone-based CBT for insomnia and mood disorders, access barriers for equity, and ethical considerations with regard to scaling up large-scale digital mental health programmes. There have been randomized controlled trials and systematic reviews conducted to assess the effectiveness of smartphone delivered CBT, which reveal its effectiveness at improving sleep quality, reducing insomnia severity, and improving depression and anxiety symptoms. However, there are inequalities in digital literacy, access to the internet, socioeconomic status and culture which remain to limit the uptake and impact of interventions, particularly for vulnerable groups. The review also delves into the ethical and regulatory challenges and the need for privacy and data security to make the use of digital mental health services safe and beneficial. The evidence-based case study of insomnia in smartphone users is provided to illustrate the use of smartphone CBT, its benefits and implementation problems. The review finds that smartphone based CBT is an effective intervention for improving mental health outcomes, but long-term success will require access to CBT, robust data protection, supportive health policies and continual technological innovation.

Keywords: Digital mental health, Smartphone-delivered cognitive behavioural therapy (CBT), Insomnia, Depression, Anxiety, Digital health equity, Digital literacy, Privacy, Data security, Mental health interventions.

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1. Introduction

Mental health disorders are among the biggest causes of disability in the world and have a profound impact on the quality of life, productivity and well-being of individuals. Insomnia, depression and anxiety are significant contributors to the global burden of disease and millions of people suffer from ongoing symptoms that impact their everyday lives (WHO, 2022). Insomnia is a common sleep disorder and is

closely linked to mental and physical health indicators, which include not being able to start or stay asleep even though you have enough time to sleep. Chronic insomnia is associated with an increased risk of depression, anxiety disorders, cardiovascular diseases, decreased cognitive functioning, and decreased work productivity. In addition, the ubiquity of smartphones has introduced additional hurdles to sleep health: high prevalence of



excessive screen use, especially in the evening hours, negatively affects sleep quality and causes higher psychological distress

Increased rates of mental health difficulties have created a need for readily available, effective, and cost-effective psychological services. Despite this, for many people, traditional in-person mental health care is not accessible because of the scarcity of mental health providers, the cost of mental health treatment, geographical barriers, and social stigma surrounding mental health care and seeking psychological support. Such challenges have spurred the evolution of digital mental health interventions, defined as using internet-based platforms, mobile apps, telehealth and wearable technologies to provide psychological assessment, treatment, and continuing support remotely (Torous et al., 2020). One of the most popular innovations has been smartphone-delivered CBT, a widely used evidence-based technique used for insomnia and common mood disorders.

CBT is regarded as the most effective psychological intervention for insomnia, depression and anxiety as it tackles maladaptive thinking and behaviors that lead to emotional distress and sleep problems. Better digital technologies have made possible the delivery of CBT techniques via smartphone apps, which offer sleep diaries, behavioural exercises, cognitive restructuring, relaxation techniques, psychoeducation, and real-time symptom monitoring. Randomized controlled trials have found that the sleep quality and severity of insomnia can be significantly enhanced, as well as depression and anxiety symptoms, by using smartphone-based CBT programs, compared to traditional therapy programs (Carlbring et al., 2018), and that these programs are more convenient and flexible. These interventions are especially beneficial for those who may face barriers to accessing conventional mental health care services or those who would prefer to pursue self-guided therapy.

Although the efficacy of mobile CBT is promising, there are still a number of barriers to the widespread adoption of smartphone-based CBT. There are still

significant disparities in digital inequalities, with different socio-economic groups, age groups and geographical regions' access to smartphones, adequate internet connection and digital capability being different (WHO, 2021). Accessing and utilizing digital mental health (dMH) technologies may be challenging for older adults, those in rural areas, and those in low- and middle-income countries. What is more, there are growing concerns about data protection, confidentiality, cyber security, informed consent and ethical data governance in the context of digital platforms' gathering of large amounts of personal health data (Torous & Roberts, 2017). The safety, fairness, and effectiveness of these interventions are vital to public trust and to maximizing their long-term benefits.

This review critically summarizes the effectiveness of smartphone delivered CBT for insomnia and mood disorders from randomized controlled trials (RCTs) and the more recent literature. It also investigates obstacles to digital access and literacy, reviews ethical and data protection issues, and discusses an evidence-based case study of insomnia in smartphone use. This review will bring together the current evidence and practical considerations to contribute to the understanding of the opportunities and challenges of scaled-up digital mental health interventions and their contribution to mental health outcomes worldwide.

2. Digital Mental Health: Conceptual Framework

Digital mental health is the application of digital technologies in the promotion of mental wellbeing, mental disorders prevention, psychological assessment, treatment and continuing support via electronic platforms. These technologies encompass smartphone apps, internet-based cognitive behavioural therapy (iCBT), telepsychiatry, wearable technologies, online counselling services, and artificial intelligence (AI)-assisted mental health applications (Torous et al., 2020). The widespread adoption of digital technologies has revolutionized the provision of mental health services, making them

more accessible, affordable, and available even in areas where traditional mental health care may be limited. Insomnia, depression and anxiety are also major public health challenges worldwide, and the use of digital mental health interventions is growing in importance for enhancing access to evidence-based psychological interventions (WHO, 2022).

Many digital mental health interventions are based on a theory, which is known as CBT, a proven psychological treatment for insomnia and common mental disorders. The core premise of CBT is that there is a relationship between maladaptive thoughts, feelings, and behaviours that perpetuates psychological distress and changing the patterns of these can enhance mental health outcomes (Beck, 2011). Smartphone CBT is an application of these principles, which presents the therapeutic content to users in the form of structured therapeutic modules, sleep diaries, mood tracking, relaxation exercises, behavioural activation and cognitive restructuring activities. The digital programmes promote the user to acknowledge and change negative thinking patterns, to practice more healthy coping strategies and to establish sustainable behavioural changes, while enabling the user to utilize the treatment in their own time (Carlbring et al., 2018). The flexibility has been a particular selling point for CBT delivered via smartphone, especially for people who suffer from insomnia and could be monitored and offered self-guided interventions outside of the walls of a clinic.

Furthermore, the Technology Acceptance Model (TAM) provides relevant insights for digital mental health intervention acceptance and success. Davis (1989) states that usefulness and ease of use are among the factors that greatly determine the choice of a technology. A more user-friendly application that is customized to the specific person with an individualized response and easy to understand treatment benefits increases engagement in the application and adherence to treatment. Conversely, if the user experience is poor or there are technical issues or limited functionality within the app, continued uptake may be lacking and consequently, clinical effectiveness may be less. Thus, UCD is a

key factor in meeting the effectiveness and acceptance of digital mental health programmes in a variety of populations.

Finally, digital mental health needs to be considered in the context of health equity. The accessibility of mental health care via smartphone technology has improved, but socioeconomic disadvantage, geographic distance, disability, and digital literacy are all important factors that impact who can access mental health interventions through smartphone technology (Richardson et al., 2022). Low income groups, rural populations and older adults might be less likely to access cell phones or be able to access Internet services to enable the use of digital interventions. Policies will be needed to address these inequalities, and to promote the development and maintenance of digital infrastructure, as well as digital literacy and culturally appropriate, affordable and accessible mental health apps for marginalised groups. The conceptualization of digital mental health goes beyond technology to include theory, user acceptance, and equity issues in the provision of health care, which has given researchers the groundwork needed for assessing the smartphone-based CBT for insomnia and mood disorders.

3. Smartphone CBT for Insomnia and Mood Disorders: Evidence from Randomized Controlled Trials

Smartphone-delivered CBT has emerged as one of the most studied digital mental health interventions for insomnia, depression and anxiety. This is due to the fact that the smartphone allows for ongoing access to therapeutic support, enabling people to participate in evidence-based psychological therapies anytime and anywhere. Smartphone based programmes include interactive modules, sleep diaries, behavioural exercises, mood tracking, relaxation techniques and personalised feedback, which increases the accessibility and cost-effectiveness of treatment compared to traditional face-to-face CBT. Randomized controlled trials (RCTs) are the strongest evidence for assessing the impact of clinical interventions and have consistently

found that CBT delivered via a smartphone is effective in enhancing sleep quality and mental health outcomes, and is a way to increase access to care for people who might otherwise not be treated (Carlbring et al., 2018).

Smartphone CBT for Insomnia

Insomnia is one of the most prevalent sleep disorders worldwide and it involves persistent sleep initiation, sleep maintenance and/or quality sleep despite of having enough sleep opportunity. People who suffer from chronic insomnia have a strong association with decreased daytime function, depression, anxiety, cardiovascular conditions, and diminished quality of life (Riemann et al., 2017). CBT for Insomnia (CBT-I) is the first-line treatment, and is widely considered the first evidence-based treatment for insomnia, since it targets sleep-related thoughts and behaviours (Edinger & Means, 2005).

In recent RCTs, CBT-I has been shown to be highly effective in the treatment of insomnia symptoms with the use of a smartphone. Among adults with chronic insomnia, a large randomized controlled trial conducted by Espie et al. (2019) found a significant reduction in insomnia severity, sleep efficiency, sleep onset latency, and daytime functioning with the fully automated digital CBT-I compared to usual care. Improvements in sleep quality were also linked to decreases in fatigue, anxiety, and depressive symptoms, highlighting the potential for this intervention to have a positive effect on overall psychological well-being.

Likewise, a systematic review and meta-analysis of several RCTs by Soh et al. (2020) found moderate to large effects of SICBT-I compared with conventional face-to-face CBT-I on sleep quality and symptom severity for insomnia. The review also revealed that there were long-lasting benefits after follow-up assessments in the group engaging with digital CBT, indicating that behaviour changes acquired through digital CBT on a smartphone may have long-term clinical effects.

Smartphone apps also improve treatment adherence with interactive tools like automatic reminders, sleep tracking, feedback and progress monitoring. They

promote regular participation in therapeutic activities and allow individuals to track progress as time goes on. Smartphone CBT offers more flexibility than traditional therapy, which is typically scheduled, as it enables people to access the treatment modules at their convenience, which also benefits working adults, students and those living in rural areas.

Smartphone CBT for Depression

Chronic insomnia often coexists with depression, and this is a major cause of disability worldwide. There is a bidirectional relationship between sleep disturbances and depression, and sleep disturbances exacerbate depressive symptoms, and depression, in turn, causes persistent sleep problems, having a negative impact on mental health (WHO, 2022). CBT delivered via the smartphone has therefore been well explored as a scalable treatment for depression.

Studies using RCTs show that CBT using a smart phone is effective at reducing symptoms of mild to moderate depression. In a thorough meta-analysis of randomized controlled trials (RCTs) examining the efficacy of smartphone interventions for depression, Firth et al. (2017) reported that participants in a CBT based smartphone group had significantly larger decreases in overall depressive symptoms when compared with control groups receiving standard care or an inactive intervention. The improvements were most notable among the participants who completed the entire treatment programme and who used the features of the application regularly.

Likewise, Carlbring et al. (2018) compared Internet-based and face-to-face CBT in various psychiatric disorders and found that digitally delivered CBT was as effective as traditional CBT for many patients. The smartphone apps offer structured psychoeducation, behavioural activation exercises, mood diaries, cognitive restructuring activities, and relapse prevention skills designed to give the user practice in coping skills. These interventions have been particularly useful in overcoming barriers like stigma, difficulty of accessing a therapist, waiting lists and geographical isolation.

Although positive results were found, there is a need to address adherence as an important challenge.

Multiple RCTs show a loss of engagement for users after the first few weeks of treatment, especially with fully self-guided programmes. Studies found that, in general, smartphone interventions with therapist support, personalised coaching or automated motivational messages have higher rates of completion and improved clinical outcomes when compared to completely unguided apps (Torous et al., 2020). Thus, a hybrid scheme, where digital tools are used in conjunction with face-to-face professional interventions, is likely to achieve optimal treatment effects.

Smartphone CBT for Anxiety Disorders

Generalized anxiety disorder, panic disorder, and social anxiety disorder are all forms of anxiety disorders that are common globally. As with all insomnia and depression, anxiety disorders involve maladaptive cognitive patterns that can be positively impacted by CBT interventions. The smartphone apps provide exercises for cognitive restructuring, exposure, mindfulness practices, breathing, and relaxation, which are designed to assist users with anxiety symptoms in their normal surroundings.

Randomized controlled trials have shown that the use of a smartphone-based CBT is effective in decreasing anxiety severity in a variety of populations. Linardon et al. (2019) conducted a meta-analysis of CBT delivered via smartphone, and they concluded that CBT delivered via smartphone showed moderate effect sizes when compared to inactive controls for anxiety symptoms. Structured CBT modules led to an improvement in emotional regulation, a decrease in worry, and psychological resilience among participants. Importantly, digital delivery allows people to repeatedly practice therapeutic techniques in real life, which aids in the maintenance of the behaviour change outside of therapy.

Moreover, smartphone apps enable ongoing assessment of symptoms via ecological moments, enabling people to document their mood swings, anxiety triggers, and responses to behaviours throughout the day. This real-time monitoring increases self-awareness and offers valuable information that can be utilized for personalised

interventions and treatment outcomes. This flexibility may make smartphone CBT more appropriate to younger adults and university students, who may have high psychological distress and be high users of the smartphone.

Comparative Effectiveness of Smartphone and Traditional CBT

Randomized controlled trials suggest that smartphone-based CBT is as effective as in-person CBT for a variety of people with insomnia and common mood disorders. While therapist-led CBT is the treatment of choice for people with more severe or complex psychiatric problems, mobile interventions have significant benefits in terms of accessibility, cost, convenience and scalability. They provide cost savings, decrease wait times, and offer treatment options for those in underserved communities who lack mental health professionals (Kazdin & Rabbitt, 2013).

Smartphone CBT should not be considered a substitute for traditional psychological treatment, however. The effectiveness of the treatment is influenced by user engagement, digital literacy, motivation and application design. High drop-out rates is a concern, especially in fully automated programmes that are not professionally guided. Also, most RCTs have recruited patients with mild to moderate symptoms, reducing the extent to which results can be generalised to persons with severe mental illness and/or more than one psychiatric condition. Long-term effectiveness, treatment adherence, and the incorporation of artificial intelligence, wearable devices, and personalised digital coaching are areas that require further investigation and enhancement for optimal clinical outcomes in the future.

In conclusion, there is strong evidence for the effectiveness of smartphone-based CBT for insomnia, depression, and anxiety based on RCTs. Smartphone CBT could complement mental health services, increase the availability of mental health care, and decrease the global burden of common mental disorders by means of evidence-based psychological techniques and an accessible digital technology.

4. Access Barriers and Digital Literacy

The Digital Divide

While smartphone based CBT is becoming more effective, the inequitable access to digital technologies is a major challenge to the wider use of CBT. The digital divide is the gap between people who have access to smartphones, Internet, electricity and other technological tools needed to support digital health interventions. While smartphone use has grown worldwide, this uptake of smartphones is not equal in countries or even among populations. Access to internet, mobile network coverage and digital infrastructure is often inconsistent in people's lives in rural areas and among those in lower and middle income countries, which makes it problematic to use mobile phones for mental health programmes regularly (Richardson et al., 2022). This means that people who have the highest mental health needs are often the least likely to gain access to digital interventions, resulting in a narrow range of possibilities to narrow the treatment gap.

Socioeconomic Barriers

Another significant factor in access to digital mental care is socioeconomic status. Individuals in low-income communities might have difficulty buying smartphones, subscribing to Internet services, or paying for mobile data to connect to digital therapy providers. Many mental health apps are available for free, but some are on a subscription basis and may not be accessible to everyone due to cost. Limited resources also influence the type of devices that people are able to access; older smartphones, for example, may not have enough storage space or operating systems to run the latest mental health software and mobile applications. This means that inequality remains a factor in who is able to use a smartphone-based CBT, and there persists a disparity in access to mental health care (Kazdin & Rabbitt, 2013).

Digital Literacy and Technology Skills

To fully benefit from interventions provided using the smartphone, digital literacy is critical. It includes

knowledge and skills in using digital devices, seeking information online, using applications and assessing digital health resources effectively (Norman & Skinner, 2006). It is expected that users of the smartphone CBT programmes will download the apps, sign up for secure accounts, perform therapeutic exercises, track symptoms, and self-interpret feedback. People who have less digital competence may be frustrated, miss treatment instructions, or stop treatment too early. So, it is essential to boost digital literacy through education and technical support to maximize treatment adherence and the effectiveness of digital mental health interventions.

Educational and Age differences

The use and effectiveness of digital mental health technologies are strongly impacted by age and education level. Younger adults tend to be more familiar with smartphones and mobile apps and have more success engaging with digital CBT programmes than older adults. However, it has also been found that excessive smartphone use among younger people can also be associated with poor quality sleep and psychological distress (Exelmans & Van den Bulck, 2016). On the other hand, seniors may face problems with navigating applications, software updates, password management, and Internet security. Education level is also a factor influencing digital competence, with those with a higher level of education generally more confident to understand health information and to complete self-guided therapeutic programmes. Simplifying interfaces, providing visual cues, and making applications easy to use and understand can enhance access to the app for users of every age and educational level.

Cultural and Language Barriers

Cultural and linguistic issues also play a role in the effectiveness of digital mental health interventions. There are numerous apps that are created in high-income countries that mainly cater to the English-speaking population. This can result in cultural challenges with language, culturally inappropriate

therapeutic examples, and culturally inauthentic treatment approaches for users from different cultures. Moreover, the stigma associated with mental health issues in the culture may make it less likely that people will use smartphone interventions, even because they feel that they are private. Culturally relevant applications that reflect local languages, culturally relevant examples and content that is inclusive can enhance engagement and treatment outcomes in a diverse population (Naslund et al., 2022).

Accessibility for People with Disabilities

Individuals with disabilities face more hurdles when trying to access digital mental health services. Individuals with problems such as visual, hearing, motor, or cognitive impairments will not benefit as much from the present adoption of smartphone applications. The majority of mental health applications available today do not have any form of accessibility, including things such as the presence of screen readers, adjustable font size, voice commands, subtitles, or ease of navigation. It is important to make sure that digital mental health apps are accessible to everyone.

Building Trust and Improving Adoption

Public trust is an important factor influencing the adoption of digital mental health interventions. Others do not want to use apps because they doubt whether they are clinically effective or whether patients can obtain the same level of care as they might do with a psychotherapist. Misinformation, business interests, low-quality apps, and absence of professional supervision can also deter involvement. Building trust in public takes place when evidence-based application development, strong clinical evaluation, public disclosure of effectiveness, and endorsement from health care professionals and regulatory bodies are implemented. There is also a need for access to culturally inclusive application design, affordable internet infrastructure, and digital literacy programmes, among other investments in the design, implementation, and scaling of CBT services, to limit inequalities and ensure that

smartphone-based CBT will be effective across all populations.

5. Data privacy, ethics and security.

Privacy in Digital Mental Health

Smartphone-based CBT has come of age, and is estimated to have reached a billion users, while offering access to mental health care to anyone who suffers from insomnia, depression, and anxiety. However, the digital interventions have their serious concerns about users' privacy aspects. Typically, these mental wellness apps collect information that is private and sensitive – such as sleeping patterns, level of mood, drug use, behaviour patterns, and even demographic details. These data address very personal areas of an individual's psychological wellbeing, so disclosure without permission could lead to stigma, discrimination, identity theft or emotional distress (Torous & Roberts, 2017). Preserving user privacy, therefore, is crucial to retaining the trust of the public and for the future of digital mental health interventions.

A lot of smartphone apps keep users' data on off-site cloud-based servers to provide data access and ongoing monitoring. Cloud storage is convenient, but if security measures aren't in place to protect it from being hacked or accessed by others, then it poses a risk as well. Moreover, some commercial applications will share user information with third-party companies for advertising or data analysis without the users being aware of it. Often privacy policies are long and written in technical terms to restrict informed decision making. Developers are therefore urged to implement transparent privacy policies, ensure informed consent is meaningful, and only gather data that are essential to providing effective psychological support (WHO, 2021).

Ethical Considerations

Ethics principles offer a crucial framework for implementing mental health interventions with the smartphone responsibly. Respect for autonomy involves giving users information about treatment procedures, data collection and potential risks so that

they can make informed decisions about their participation. The informed consent must not only be informed by agreeing to long terms and conditions, but must also give the user a clear idea of how the data will be stored, processed and shared.

Digital mental health interventions must be clinically beneficial and cause harm as little as possible, in accordance with the principle of beneficence. The development of smartphone CBT applications ought therefore to be based on scientifically patterned psychological approaches, with robust clinical evidence. Many commercial mental health apps, however, have not been suitably clinically evaluated, and there are concerns about effectiveness and safety of these apps (Torous et al., 2020). Some people with intense psychological distress may resort to use of poor self-help measures rather than professional help which can delay clinical intervention.

Equity is also a key ethical value highlighted in digital health, which involves equality in access. While smartphone CBT has helped expand mental health services, there remains a significant disparity in access due to income, education, disability, age and geographical location for many people. Implementing the digital solution safely, sensitively, and in a way that supports the needs and requirements of communities that have not been well-served will necessitate government, health care systems, and technology producers to ensure that digital interventions are ethically applied.

Legal and Regulatory Frameworks

Having the right legal and regulatory frameworks is essential to enable responsible use of digital mental health technologies. While the European Privacy and Security Scheme (GDPR) and U.S. Health Insurance Portability and Accountability Act (HIPAA) establish rules for collecting, storing, processing and sharing of personal health information in Europe and the United States respectively. Under these regulations, organizations must put in place security measures and report data breaches promptly and ensure informed consent. Additionally, WHO(2021) states that digital health technologies should be designed following principles of transparency, accountability, privacy, fairness and respect for

human rights. To prevent the risk of biased clinical decisions and patient safety issues, AI systems integrated into mental health applications must continue to be supervised by humans. Smartphone mental health apps should also be approved for broad use only after evidence of clinical effectiveness is shown.

Future Directions

Effective data protection and sound ethical governance are crucial to achieving the success of CBT delivered via smartphones as a new method of treatment. Developers should use a 'privacy by design' approach and embed privacy protections into the design of applications from the outset. Users also should be able to control their private data, such as using flexible privacy settings, and permanently remove their information. To create safe, ethical, and trustworthy digital mental health systems, it will be crucial for healthcare providers, researchers, tech companies, and policymakers to work together. Enhanced privacy measures, better cybersecurity, and ethical guidelines will boost trust and a growing, sustainable digital mental health market across the globe.

6. Insomnia among Smartphone Users

Insomnia was considered a frequent sleep disorder characterized by persistent difficulty in falling asleep, staying awake or having a good sleep even if sufficient time is allowed to spend in sleep. Insomnia is an increasingly common problem among young people and teenagers, as they have become increasingly reliant on smart mobile phones for communication.

Too much screen time before bedtime can also result in exposure to blue light that depletes users of melatonin, the hormone that regulates the body's circadian rhythm. Social media use, video streaming, gaming and messaging can also cause cognitive stimulation, which makes it more challenging to fall asleep (Exelmans & Van den Bulck, 2016). As such, the problem of smartphone use and insomnia has emerged as a significant public health issue, as poor sleep is linked to depression and anxiety, academic

underachievement, and diminished quality of life.

adaptive thoughts.

Case Description

This case is of a 24 year old university student who complained of sleep problems for six months. The learner had trouble falling asleep at night, woke up several times during the night, was tired during the day, could not focus well, and was under a growing amount of academic stress. When students were asked about their sleep routines, they reported that they had used their smartphone for educational purposes, social media, watching videos and messaging for four to five hours every night. Use of a smartphone was often done until bedtime and notifications were often done during the night.

Patients with moderate clinical insomnia were assessed with Insomnia Severity Index (ISI). Mild depressive symptoms and moderate anxiety were detected in further psychological screening, indicating that lack of sleep may be a source of emotional stress. Due to the degree of symptoms, the healthcare provider suggested participating in a smartphone assisted 8-week CBT-I programme instead of starting any drug treatment.

Intervention

The CBT-I smartphone programme consisted of clinically validated modules in the smartphone app. This intervention consisted of sleep hygiene education, stimulus control therapy, sleep restriction, cognitive restructuring, relaxation therapy and daily sleep log. Participants were asked to have one therapeutic session daily and rate their sleep quality and length.

Behavioral modification was a significant aspect of therapy. Participants were recommended to stop using the smartphone an hour before bedtime, set to "Do Not Disturb" during the night, not use caffeine in the evenings and establish regular sleep and wake times. To reduce physiological arousal, there were guided breathing exercises and progressive muscle relaxation prior to bedtime. The participant was able to use cognitive restructuring techniques to change negative beliefs about sleep to more realistic and

Outcomes

The intervention period had a positive impact on sleep quality and psychological wellbeing after 8 weeks. The sleep onset latency was reduced from around 60 minutes to less than 20 minutes and the average nightly sleep duration was extended from about five hours to over seven hours. Night awakenings decreased as did repeated assessment of insomnia with the Insomnia Severity Index (ISI) from moderate to mild during treatment.

The participants also indicated that their concentration and academic performance improved, fatigue decreased, mood was better, and anxiety levels were lowered. The use of the smartphone application was a major factor in these improvements as was following sleep hygiene guidelines. The participant was pleased with the flexibility and convenience of seeing the therapist via the smartphone app instead of in person to undergo therapy.

Lessons Learned

This case shows that smartphone-based CBT-I can be effective for insomnia associated with excessive smartphone use. Excessive screen exposure was associated with sleep problems, but the use of smartphone technology was a good medium for delivering evidence-based psychological treatment. The intervention was effective, with digital CBT plus behavioural interventions such as limiting screen time at bedtime and establishing regular sleep patterns resulting in better sleep quality and mental health.

To be successful, it was necessary to motivate the participant and follow the intervention. The effectiveness of the smartphone-based CBT may be less in those not receptive to the intervention, who lack digital literacy or whose serious psychiatric illness requires specialist intervention.

In general, the findings from this case are consistent with the results of randomized controlled trials (RCTs) demonstrating that smartphone-based CBT-I

is a viable, viable, and cost-effective treatment for enhancing sleep quality and alleviating psychological distress in smartphone-dependent people with insomnia.

7. Discussion

This review shows the effectiveness of smartphone delivered CBT as a digital mental health intervention for insomnia, depression and anxiety. The evidence from RCTs is consistent that the use of a smartphone CBT has a positive effect on sleep quality, lessens insomnia severity, and reduces symptoms of common mood disorders. These results are consistent with previous systematic reviews and meta-analyses, which reported clinical outcomes of digital CBT similar to face-to-face CBT in patients with mild to moderate mental health disorders (Carlbring et al., 2018; Soh et al., 2020). Smartphone-based interventions offer great potential to tackle the mental health needs of the world due to their flexibility, low cost and ease of scaling up.

The case study described in this review is another good example of the potential benefits of smartphone-based CBT for insomnia for smartphone owners. After 8 weeks of CBT-I, the participant had significant improvements in sleep duration, sleep quality, daytime functioning and psychological wellbeing. The results are comparable to those of previous clinical trials which have shown the efficacy of behavioral interventions administered by smartphone apps to change unhealthy sleep behaviors and enhance mental health outcomes (Espie et al., 2019). The results also point to the ambivalent nature of smartphones in mental health. While excessive smartphone use can lead to sleep issues due to longer screen time and cognitive stimulation, the same technology can be a useful tool for delivering evidence-based psychological treatment when used properly.

While these are promising results, there are still some challenges to the broader implementation of mental health interventions delivered through smartphones. The issue of digital inequalities is still very much on the agenda as it is apparent that smartphone use, internet access and digital literacy is unevenly distributed across socioeconomic groups, age groups

and geographical locations (Richardson et al., 2022). Older people, people with disabilities and those in low-income settings or rural communities may find it more challenging to access and/or effectively use digital mental health programmes. If not properly supported by specific measures to enhance digital inclusion, smartphone-based interventions can have the potential to further exacerbate existing health disparities.

There are other privacy, ethical and data security issues that also must be constant. The cybersecurity of digital mental health apps and their data governance are vital, as they deal with sensitive personal information. The technologies might result in a loss of public trust because of concern for unconsented transfer of information, lack of informed consent, and commercial use of personal health information (Torous & Roberts, 2017). It is therefore crucial that digital mental health platforms respect ethical standards and adhere to data protection regulations, allowing developers, healthcare professionals and policymakers to keep transparency regarding data collection and storage practices.

Finally, the availability of smartphone delivered CBT is an important advancement in the field of mental health treatment and a potential method to reach evidence-based psychological treatment. But to be successful in the long-term, it will rely on not only clinical effectiveness, but also on ensuring the population has good access, is engaged, has digital literacy and is well regulated. Studies on long-term outcomes of treatment, adherence strategies and the incorporation of new technologies like artificial intelligence and wearable devices to further boost the effectiveness and accessibility of digital mental health interventions are warranted.

8. Recommendations

The results of this review provide evidence that smartphone based CBT holds great promise for treating insomnia and more common mood conditions. But achieving maximum benefit will require collaboration among governments, health professionals, technology designers, researchers, and health policy makers to resolve some of the current

challenges regarding accessibility, digital literacy, privacy, and clinical quality.

Governments need to be able to do more to improve digital infrastructure and increase availability of affordable internet access, especially in underserved and rural areas. The disparity in access to smartphones and dependable internet access continues to be one of the biggest challenges to equitable digital mental health care. More people could access evidence-based smartphone interventions (WHO, 2022) with public investment in infrastructure and subsidized internet services. Mental health policy makers should also integrate digital mental health services into national mental health policy and healthcare systems to increase accessibility and decrease the treatment gap.

Second, healthcare providers should consider using smartphone-based CBT as part of their existing mental health care programs or services, not as a substitute for existing face-to-face treatment. Before recommending digital interventions, clinicians must consider key factors such as patients' digital literacy and their clinical needs and treatment preferences. Smartphone CBT can have a significant impact on people with mild to moderate insomnia, depression and anxiety, and people with severe psychiatric disorders should be referred for expert evaluation and continued clinical supervision. The use of digital interventions in conjunction with some therapist support could help increase treatment adherence and long-term benefits.

Thirdly, technology developers need to focus on user-centred and evidence based application design. Psychologists and psychiatrists, sleep specialists, and software engineers should all be involved in the development of the mental health applications, so that the therapeutic content is based on established clinical guidelines. Applications must also be easy to use, meet cultural needs, be accessible to people with disabilities, and be available in several languages. Automated reminders, personalized feedback, symptom tracking, and secure communication can enhance user engagement and adherence to treatment.

Confidentiality and security of users' personal information and data should be of paramount

importance when designing and implementing a digital mental health program. To safeguard sensitive health information, developers need to ensure strong encryption, multi-factor authentication, secure cloud storage, and regular cybersecurity assessments. The privacy policies should be clear and should be written in a way that the user can easily understand, giving him or her a choice in how his or her personal information is collected, stored and used. All digital mental health platforms need to comply with national and international data protection laws.

Finally, future research should evaluate the sustainability, cost-effectiveness, and long-term effectiveness of the use of smartphone delivered CBT with different populations. There should be existing evidence that is generalizable, and there needs to be more randomized controlled trials with older adults, persons with disabilities, and low and middle income population groups. There is also a need for further research into the potential of combining AI, wearable technology and digital personalization to enhance treatment results and ensure adherence to ethical and patient safety guidelines. Smartphone delivered CBT is a possible and feasible component of contemporary mental health care, if the healthcare, technology and policy sectors are cooperating to build a sense of partnership.

Conclusion

Digital mental health interventions have transformed the delivery of mental health interventions, providing people with a convenient, adaptable and affordable alternative to in-person services. This review has revealed that CBT for insomnia delivered via mobile phone is a viable treatment for insomnia, depression and anxiety, with several RCTs reporting an increase in sleep quality, insomnia severity, and psychological wellbeing, and a decrease in depression and anxiety, after receiving CBT for insomnia through a mobile phone. The case study also illustrates that a CBT smartphone application for insomnia has been successful in a group of smartphone users that contained evidence-based therapeutic strategies and behavioral changes that encourage healthy sleep behaviors.

While these are promising findings, achieving effective implementation of CBT delivered via smartphone is more than just effectiveness. However, there are several challenges to equitable access to digital mental healthcare, including inequity in access to digital technology, low digital literacy, socio-economic inequities, and substandard internet connectivity. Moreover, privacy concerns, ethical governance, and data security pose a challenge to address to build user trust and to ensure safe handling of health-sensitive data. To ensure the responsible development of digital mental health care, it is essential to provide strong security for dealing with cybercrime, clarity in data management and legal and ethical standards.

CBT delivered by a smartphone will become even more significant to tackle the increasing burden of mental illness in the world as digital technologies evolve. Digital interventions should be used alongside – not in place of – regular mental health care, however, especially for people with serious or complex psychiatric problems. Effective collaboration between governments, health care practitioners, researchers, innovators and policy makers will be crucial for innovations to be accessible, digital literacy to rise, data protection to be improved, and evidence-based innovations to be promoted. In these solutions, smartphone based CBT could be a key component of the future of mental health care: accessible, effective and equitable, providing mental health services to everyone and paving the way to sustainable development.

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