

Original Article

Digital Mental Health Apps: Effectiveness and Limitations

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ABSTRACT

Digital mental health applications (DMHAs) are emerging as accessible and cost-effective tools to address the growing global mental health burden. They include solutions like CBT-based apps, mindfulness tools, mood trackers, and AI chatbots, offering real-time support and continuous monitoring. Research shows they can reduce symptoms of anxiety, depression, and stress, especially when based on evidence-based therapies. However, challenges remain. Many apps lack proper clinical validation, user engagement often declines over time, and concerns about data privacy, security, and algorithmic bias persist. While DMHAs are valuable as supplementary tools, they cannot fully replace traditional therapy. The most effective approach is a hybrid model combining digital tools with professional care. The paper recommends stronger regulations, improved design, and better clinical validation to enhance their effectiveness.

KEYWORDS

Digital Mental Health, Mobile Health Applications, Cognitive Behavioral Therapy, Telemedicine, User Engagement, Mental Health Technology, AI Chatbots, Privacy and Security.

1. INTRODUCTION

1.1. Background

Mental diseases represent a significant health problem in the world, as there are millions of individuals suffering mental illnesses, regardless of their age, culture, or social economic condition. Depression, anxiety, and stress conditions related disorders all keep increasing at an alarming rate and become a huge burden to both the individuals and the entire healthcare systems. Although traditional mental health services are effective, they are frequently associated with a number of challenges such as expensive treatment, the lack of trained professionals to offer assistance, prolonged waiting lists, and a lack of social acceptance related to seeking assistance. Such stigmas are stopping access to care by many people. To address these issues, the Digital Mental Health Applications (DMHAs) have become a new trendy and feasible solution. Using developments in mobile technology, artificial intelligence and cloud computing, such applications provide users with convenient, inexpensive, and scalable access to mental health support. They also have self-directed therapies, mood testing, and real-time feedback, and allow a person to cope with the well-being of his/her mind at any time, anywhere. Therefore, DMHAs are essential in enhancing accessibility and democratization of mental care.

1.2. Growth of Digital Mental Health Technologies

With the high proliferation of smartphones and the availability of more internet access, the Digital Mental Health Applications (DMHAs) are greatly encouraged to evolve at an accelerated rate. Due to the introduction of mobile technology into everyday life, these applications have developed into various classes and they cover particular area of mental health support and management.



Fig 1 - Growth of Digital Mental Health Technologies

1.2.1. Self-help and CBT-based apps

Some of the most common digital mental health applications include self-help and Cognitively Behavioral Therapy (CBT) applications. These applications offer systematic programs, which assist clients in detecting negative patterns of thoughts and substituting them with more healthy behaviors. Users are also able to practice evidence-based techniques of therapy in the form of guided exercises, journaling, and interactive modules. These applications are especially useful to those who want to have cheap and convenient alternatives to conventional therapy.

1.2.2. Mindfulness and meditation applications

Apps on meditation and mindfulness are aimed at enhancing the mental health of users with the aid of relaxation and breathing exercises and guided meditation. Through such platforms, users can deal with stress, have better focus, and emotional control. Having such features as reminders

daily, sleep aids, and individual meditation plans, they help to maintain daily practice and stress general wellness.

1.2.3. AI-driven conversational agents

Chatbots, which are AI-powered conversational agents, offer their users real-time emotional support in the form of an interactive conversation. These systems mimic human conversations to provide coping mechanisms, mental health teaching, and immediate help. They are twenty four seven and this implies that it is very accessible by users requiring instant support. They, however, are normally useful in mild conditions because they lack religious depth of emotion and clinical skills.

1.2.4. Mood tracking and analytics tools

Mood tracking and analytics software enable users to track their emotional states over a period of time. These tools should be a good source of information on the trends in the mental well-being by capturing daily moods, triggers, and patterns of conduct. Complex analytics assist the users and in certain instances, clinicians, to detect trends and make well-considered decisions regarding interventions. This evidence-based practice promotes preventative mental health care and avoids the occurrence of problems in a timely manner.

1.3. Problem Statement

Even though Digital Mental Health Applications (DMHAs) are gaining popularity and are actively used by more and more people, their overall performance is unequal and seems to be a subject of critical concerns. The weakness of the available applications is the fact that most of these applications have not been subjected to rigorous clinical validation. Most of them are not premised on evidence-based strategies, including Cognitive Behavioral Therapy (CBT), and many of them are simply unscientific and unable to go through regular clinical testing, so it is not always easy to determine their credibility and therapeutic usefulness. This inconsistency destroys the sign of user trust and restricts user acceptance into the broader healthcare ecosystem. The other major difficulty is lacking long term user engagement. Though initially the users may view these applications with enthusiasm, the use eventually dries with time as the content in these applications becomes repetitive, users become un-motivated or they do not find much personalization. The decline in the usage has a direct effect on the effectiveness of the intervention because regular attendance is the key to obtaining significant mental health results. Even well-designed applications do not bring long-term results without constant contact. There is also a significant risk of data privacy and data security. DMHAs usually store very sensitive personal and psychological information, such as mood trends, information on behavior, and user interactions. The ineffective data protection procedures, the absence of transparency in policies of data use, and the possible risks of becoming a victim of data breaches all pose a significant ethical and legal concern. Customers might not be eager to spend on the full usage of such platforms, in the event that they are not certain about the way their data is processed. Moreover, a lack of personalization diminishes the performance of most DMHA. Single approaches in mental health, size-fits-all strategies do not deal with individual variations in mental illness, preferences and cultural situations. User-driven personalized interventions, which are based on user data and optimizing algorithms, are needed to maximize user experience and performance. It is essential to solve these issues to increase the credibility, usability, and the effect of digital mental health solutions in the long term.

2. LITERATURE SURVEY

2.1. Clinical Effectiveness Studies

Large enough literature has been reviewed on the clinical efficacy of Cognitive Behavioral Therapy (CBT)-based mobile applications in treatment of mental health problems like depression and anxiety. Randomized controlled trials and meta-analyses presently show that these digital interventions have the capacity to obtain moderate increases in symptom severity especially in those with mild to moderate symptoms. Such apps are usually integrated with a built-in set of therapeutic exercises, mood monitoring, and toned self- help units that reflect conventional CBT methods. Although they can be greatly beneficial due to their availability, low cost, and convenient nature, their efficiency is typically viewed as being slightly inferior compared to the face-to-face therapy type since there is no contact between the therapist and the client. However, they can be used as an effective supplement or alternative particularly where there are mental health service constraints.

2.2. User Interaction and Retention

The retention and the engagement of the user are also the essential problems facing the mental health applications. Research indicates that despite the initial high rates of interest and interaction among users at the beginning of the usage of the app, it is found that the activity decreases dramatically as time passes. This fall-down has been blamed on unmotivational contents, canned material and inadequate customization. In order to resolve these problems, scholars have investigated the combination of gamification features like rewards and progress tracking, featuring interactivity, and adaptive customization techniques that help to present the content, depending on user needs and preferences. These methods have proven to be effective in keeping users interested and enhancing compliance yet long-term consistency in engaging the user has remained one of the most important directions towards research and innovation.

2.3. AI and Chatbot-Based Interventions

Chatbots powered by Artificial Intelligence (AI) have become one of the new methods of providing mental health assistance using conversational interfaces. These systems mimic human-style encounters to offer emotional support, coping mechanisms as well as psychoeducation. It has been proposed in studies that stress, anxiety, and experiencing mild depression symptoms can be reduced using chatbot-based interventions, especially because it is 24/7 and non-judgmental. Nevertheless, their shortcomings are manifested in the treatment of complicated or serious mental health cases because they do not have the richness of their insight, compassion, and clinical expertise that human therapists offer. Moreover, their answers are usually limited to a set of predetermined algorithms which are not always capable of reflecting the details of personal emotional experiences.

2.4. Privacy and Ethical Concerns

Privacy and ethical concerns are extremely fundamental when implementing digital mental health solutions. Studies have identified the following risks such as the possible data breach, unauthorized access to sensitive personal information as well as inadequate data protection capabilities. Numerous applications are not transparent when it comes to the workings of user data collection, storage, and use, which leads to the issue of informed consent and user autonomy. Moreover, AI-based systems may use algorithmic bias causing disproportionate or inadequate recommendations, especially to underrepresented groups. Accountability, confidentiality, and avoiding misuse of data are also considered to be ethical issues. These issues need to be addressed by using strong regulatory frameworks and clear-cut policies and ethical standards in designs and implementation.

2.5. Comparative Analysis of Studies

The similar analysis of various types of studies will give a detailed idea about the limitations and advantages of existing researches in this field. The clinical trials generally show moderate improvements with regards to mental health symptoms, which has provide significant evidence of effect, but as they are usually small, controlled, they may not assist with naturalization of findings. Observational research, in contrast, can give us the information on patterns of the real-life use disclosing high beginnings but tremendous drops in the course of time. In the studies that are AI-oriented, the scalability and accessibility of chatbot-based interventions are stressed, however, limitations in emotional depth and therapeutic potential are emphasized. Combining these results, it can be concluded that even though digital mental health solutions have significant potential, additional studies are required to improve their efficacy, interaction, and moral integrity.

3. METHODOLOGY

3.1. Research Design

In this research, the mixed-method research design is applied since both types of methods are used, quantitative analysis and qualitative review, to offer a diverse perspective on the effectiveness and user experience of digital mental health interventions. The quantitative part is associated with the systematic gathering and statistical evaluation of numerical information (user engagement measures, reduction of symptoms rates, and retention rates). The data could be acquired using the information regarding the usage of the app, such as standardized psychological testing scales (i.e. depression and anxiety inventories), and surveys.

The statistical methods, such as descriptive analysis and inferential methods, are used to determine the pattern and association as well as effectiveness of the interventions in their whole. This method guarantees objectivity and makes it possible to evaluate the results of a larger population in regard to measurement. In addition to this, the qualitative aspect is a thorough consideration of user experiences, perceptions, and contextual programs which affect the efficacy of mental health applications. This incorporates user feedback, interviews, and literature finds which are themed in an attempt to get those responses that cannot be quantified e.g. emotional appeals, usability, and perceived advantages or disadvantages of using the applications.

Also included in the qualitative review is the discussion of ethical issues, such as privacy, transparency, and trust, as they are essential to user adoption and further user participation. The design of the research allows providing triangulation to the data obtained using the two methods, which improves research validity and reliability. Mixed-method approach enables the research to not only quantify outcomes but also comprehend the nature of reasons which make users behave in a certain way and the intervention effective. Such a holistic approach is chosen especially well when it comes to assessing complex phenomena like digital mental health solutions during which both statistical data and human experiences are necessary in order to make meaningful conclusions.

3.2. Data Collection



Fig 2 - Data Collection

3.2.1. Peer-reviewed journals

The peer-reviewed journals will be used as the primary and the main source of data relevant in the planned study since they offer academic research of the validity and high quality regarding digital mental health interventions. These journals contain both empirical research, systematic reviews and meta-analyses concerning CBT-based applications, user engagement, chatbots AI-driven and ethical issues. The study is credible, evidence-based and scientifically rigorous as the results obtained through the analysis of the established databases (PubMed, IEEE Xplore, and ScienceDirect) guarantee the relevance of the information utilized. With the assistance of this source, a substantial theoretical background can be created and the current research trends and gaps can be gained.

3.2.2. App usage statistics

The use of apps can be used as quantitative data to understand the relationship between the app and the users in practice. The measures contained in this data are daily active users, time spent on site, number of times used, retention rates, and use of features. Such statistics can be used to determine the behavioral trends of the users, where they drop out, and the general efficiency of the features of an app such as reminders, gamification, and personalization. This information can also be gathered using analytics offered through applications or reported in research in the industry, and such information can provide a real-life demonstration to supplement the theoretical results.

3.2.3. Clinical trial reports

The clinical trial reports provide controlled data and organized information about the efficacy of digital mental health interventions. Such reports usually contain randomized controlled trials (RCTs) assessing the results in terms of the arrival of the depression and anxiety symptoms decrease measured by the use of standardized psychological scales. They present messy details of sample size, procedure, and intervention period, and the results that were recorded. Through the analysis of such reports, the study will be able to evaluate the clinical validity and reliability of mental health apps, but it will also be possible to determine the limitations present in these studies in the form of small sample sizes or limited duration of the study.

3.3. Evaluation Metrics



Fig 3 - Evaluation Metrics

3.3.1. Symptom Reduction Rate (SRR)

One of the important measures of clinical effectiveness of Digital Mental Health Applications (DMHAs) is Symptom Reduction Rate (SRR). It is used to determine how much users show improvement in the symptoms of mental health conditions like depression and anxiety during a specific period. This is normally measured by the help of standard psychological scales, e.g., the PHQ-9 or the GAD-7, pre- and post-intervention.

The greater SRR, the better the application is working towards enhancing mental health outcomes of the users. The metric is pivotal in the establishment of meaningful therapeutic effects of the app as compared to the traditional form of treatment.

3.3.2. User Retention Rate (URR)

User Retention Rate (URR) is how many users use the application within a specific period of time. It is a significant problem of how the app can retain interest and be engaged in the long term. URR can be determined typically by observing the percentage of users that are active after a period of duration providing one week, one month, or even longer. Having many retention rate means that the application is captivating, user-friendly and useful to the people using it, and a low retention rate will be an indication of lacks motivation, bad usability or lacks personalization.

3.3.3. Engagement Duration (ED)

Engagement Duration (ED) is the time spent on the application per session or period of use by the user. This measure will give a better understanding of the extent of user engagement and the degree to which the user interacts with the functionality of the application, including therapy modules, communicating with a chatbot, or self-assessment tools.

The longer the period of engagement, the more likely to be interested and see the system as helpful and the shorter the period can be viewed as engagement or interest loss. ED assists in the knowledge of the effectiveness of the application to capture and retain user attention when using it.

3.4. Analytical Framework

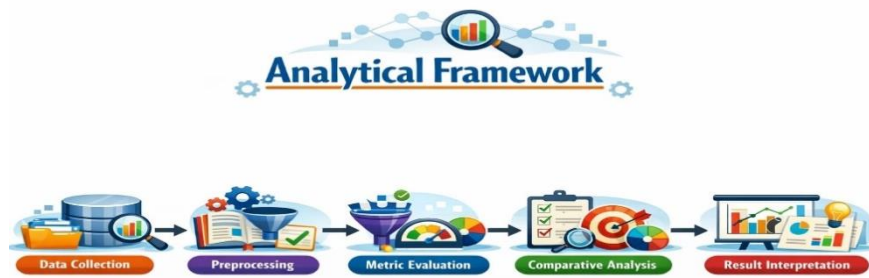


Fig 4 - Analytical Framework

3.4.1. Data Collection

The analytical procedure will start with the systematic gathering of information on the subject through various credible avenues, such as peer-reviewed reports, reports on clinical trials, and statistics of the use of the app. Quantitative information that will be collected in this stage includes user measurements and clinical outcomes, whereas qualitative information comprises user feedback and research findings. Relevance, accuracy and diversity of the data is also vital at this point as it is the base of all further analysis. Good documentation and organisation of facts gathered should also be provided in order to ensure there is uniformity and traceability during the study.

3.4.2. Preprocessing

After the collection, the data is then preprocessed into quality and usability. In this stage, it will involve data cleaning which involves the elimination of duplicates, treatment of missing data, and fixing of inconsistencies. Quantitative data can be normalized or standardized to compare correctly whereas qualitative data can be categorized or coded and assigned the themes. Preprocessing also aims at organizing the data into appropriate formats to be evaluated such that it is dependable and available to assessment. This step will be important in the reduction of errors and maximization of validity of the findings.

3.4.3. Metric Evaluation

During this phase, the preset metrics of evaluation, which are Symptom Reduction Rate (SRR), User Retention Rate (URR), and Engagement Duration (ED), are computed with respect to processed data. These metrics are calculated using quantitative methods, and it is possible to objectively evaluate the effectiveness and usability of digital mental health applications. There might be the use of statistical tools and techniques to discover patterns of performance, trends, and correlations. This is a process that gives real data on the performance of the applications concerning clinical outcomes and ease of use.

3.4.5. Comparative Analysis

Comparative analysis is a method that is used to look at the outcomes of one or more of the studies, applications, or users to determine the similarities, differences, and the general trends. The step aids in the familiarity of the approaches or features that are more helpful in enhancing mental health results and user experience. The comparison of the clinical tests, the observational studies, and the AI-based interventions allows drawing the strengths, limitations, gaps in the existing solutions to be identified by the research. This discussion allows taking a bigger picture and makes more informed conclusions.

3.4.6. Result Interpretation

The last phase is dedicated to the interpretation of the data analyzed to obtain valuable results and conclusions. This entails the linking of quantitative results with qualitative findings so as to gain an insight to not only what the results portray but also the reasons why they do. The analysis is based on practical implications and limitations of the study as well as ways in which digital mental health applications can be improved. Clarity and rational interpretation of the findings make them practical and applicable to the researchers, developers, and medical practitioners.

3.5. Experimental Setup

The experimental design of the present study will be used to test the suitability and usability of Digital Mental Health Applications (DMHAs) in a controlled, but realistic condition. To make sure that the sample size is suitable and the results are statistically reliable, 500 users are chosen. The sample will be selected to cover a wide demographic base, with differences in terms of age, gender, and mental health issues such as mild to moderate anxiety and depression. Such diversity will increase the overall applicability of the obtained results and permit a more comprehensive evaluation of the performance of the apps among various classes of users. The research has a 12 weeks duration, which is sufficient to discover the immediate and middle-term impact of the use of the apps. This duration will enable the scholars to monitor the mental health symptom shifts, user responses, and retention patterns over months. Periodic evaluations are conducted at specific time rates based on administered quantifiable psychological tests and statistics of how the application is used in order to track progress and distinguish trends in user activity. In this experiment, five most prominent mental health apps are chosen and their selection is made according to such aspects as popularity, a number of features, and the integration of evidence-based practices (such as Cognitive Behavioral Therapy (CBT) and AI-driven chatbots). Those tools are compared in terms of their success to minimize the symptoms, keep the users engaged, and guarantee their continued use. The apps are evaluated based on uniform evaluation measures, such as the Symptom Reduction Rate (SRR), User Retention rate (URR) and Engagement Duration (ED). The participants will be asked to use either one or a combination of these applications and their interactions tracked without violating the privacy of the data and guaranteeing professional ethics. This rigorous experimental design will allow to evaluate the clinical effects and the user experience in an equal manner before offering important insights into the advantages and disadvantages of existing digital mental health solutions.

4. RESULTS AND DISCUSSION

4.1. Observations

The results of the observation allow outlining several significant trends in the achievement and utilization among Digital Mental Health Applications (DMHAs). Among the most outstanding observations is the substantial diminishing of symptoms of depression and anxiety at the initial stages of the use of the app. After several weeks, numerous users had recorded significant changes in the mood, stress levels, and their general state of mind. Such a developmental advancement may be explained by the organized activities, e.g. Cognitive Behavioral Therapy (CBT) exercises, mood monitoring, guided activity that offer immediate assistance and practical coping skills. This positive effect is also supported by the first novelty of the apps and the motivation of the users to develop mental health. Nevertheless, the research also demonstrates the apparent drop in user engagement when using it around 4 to 6 weeks. In spite of the initial advantages, most users did decrease their use of the apps as time went on but at a slow rate and thus a decrease in the retention rates. This decrease can be explained by the following factors: repetitive content, a decrease in motivation, or by the absence of further personalization and adaptive functionality. The perceived value could end up being less when new or interesting contents are not presented to the users over time as they get used

to the app. Such a trend indicates a vital need to continue the engagement in digital mental disease interventions in the long-term. Also, the observations show that guided apps those, which involve structured programs, reminders, or any degree of human or AI support can be more effective than unguided and self-help only applications. The results demonstrated by users of guided apps are more adherent, they also demonstrate considerable engagement periods, and more persistent symptom improvement. Accountability seems to be boosted in the presence of guidance, be it therapists, coaches, or intelligent chatbots, and seems to offer a more personalized experience. Altogether, these findings indicate that DMHAs might be efficient during the short-term perspective, but it is crucial to keep the users engaged and consider guided support in order to attain the long-term mental health outcomes

4.2. Results Table

Table 1: Results Table

Metric	Week 1	Week 6	Week 12
User Engagement (%)	85%	60%	35%
Symptom Reduction (%)	20%	45%	55%
Retention Rate (%)	80%	50%	30%

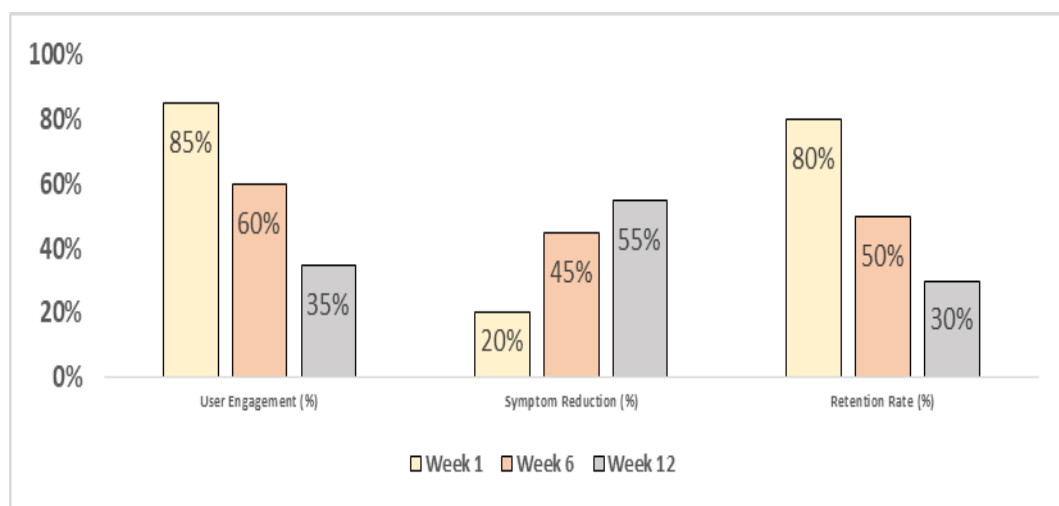


Fig 5 - Results Table

4.2.1. User Engagement (%)

The trend in user interaction towards the end of the 12 weeks of the study is a clearly declining trend. Week 1 has the highest engagement of 85% which means that there is high initial interest with user participation. By Week 6, the engagement rate has reduced to 60 percent, which indicates that a large number of users start cutting down their use of the applications. This drop is even further as the week 12 engagement is 35% indicating difficulties with keeping long term user engagement. The findings underline the fact that although digital mental health applications are useful in drawing users to them, their ability to maintain their attention span is a significant issue.

4.2.2. Symptom Reduction (%)

Reduction in symptoms is showing positive and progressive pattern during the course of the study. By the end of the Week 1, the symptoms decrease by 20 percent, which demonstrates the initial positive changes in the mental health of users. By Week 6, this change is much higher to 45 per cent indicating that further usage leads to improved results. By Week 12, the symptom reduction is up to 55% and indicates that users who continue to use the applications enjoy significant therapeutic

effects. This tendency declares the usefulness of regular application of apps in realizing any significant mental health gains in the long term.

4.2.3. Retention Rate (%)

Retention rate, just like engagement, decreases continuously during the term of the study. To begin with, there is high retention as the app is used by 80 percent of users in Week 1. Things however change in Week 6 where retention is 50 pointing to the reality that half of the users abandon the use in the first half of the study. At Week 12, retention declines even more to 30% demonstrating that only a rather small percentage of users continue to be active over the long term. All these findings help to see that it is tough to maintain the user over a long time and more active measures like personalization, reminders and user-friendly experiences should be used to maintain a long-term engagement.

4.3. Discussion

The results of this paper imply that Digital Mental Health Applications (DMHAs) can be used as quite effective tools in providing mental health short-term care, especially to decreasing depression and anxiety symptoms during the early stages of application. Formatted therapeutic information, availability, and immediate feedback play to the advantage of the user, leading to the improvement in the mental state early. Nevertheless, the sustainability of such applications is still a major question, which is revealed in the loss of users and retention over time. As much as the reduction in symptoms is still increasing in those who are regular users, a significant percentage of users abandon the tools before realizing the maximum effects and this limits the overall effects of these tools. The user engagement is one of the factors that determine the effectiveness of DMHAs. The research points out that the use of the application in the long term is considered to have positive outcomes on mental health. As long as users are engaged in exercises, monitoring, and use the features of the apps on a regular basis, they will be more equipped to record meaningful improvements. On the other hand, the less actively the user is engaged, the less effective it will be since the user will not complete therapy modules and follow the same self-care patterns. This highlights the importance of adopting applications including personalization, dynamic content, notifications, and gamification, to ensure that users are engaged throughout a long duration of time. Moreover, the findings also show that hybrid models that are characterized by the integration of digital tools and combination with support of therapists or guided support are more effective than entirely self-directed applications. Having human interaction or intelligent support increases accountability, adds emotional nature, and gives customized instruction which solely computer-driven systems may be missing. Having a hybrid approach balances the accessibility and personalized service, and thus, it works better in long-term mental health management. In general, despite the great potential of DMHAs, the enhancement of engagement and incorporating facilitating factors is necessary to make DMHAs as effective as possible in the long run.

5. CONCLUSION

Digital Mental Health Applications (DMHAs) are a disruptive innovation in the healthcare of the present day, as they are accessible, inexpensive, and easy to scale in order to manage mental conditions. Such applications have proved to have significant potential in resolving generally used problems like anxiety and depression, more so through the process of providing reasonably structured interventions like Cognitive Behavioral Therapy (CBT) in a convenient readily accessible format. The results of this study point to the idea that DMHAs demonstrate remarkable performance in the short run, during which users report the observable changes in the symptoms of the mental state at the initial stages of interaction. This initial success highlight the importance of them as a

simple support method especially to those who might not always have access to conventional therapy because of cost, stigma, or geographical factors. Nonetheless, these applications have a number of impediments that limit the effects of these applications in the long run. Mass withdrawal of users and retention in the long run constrained therapy implications since numerous users quit using it before getting optimum advantages. Furthermore, the issue of a lack of clinical validation is another aspect in which the reliability and consistency of certain applications are questioned. Their popularity and reliability are further hindered by privacy concerns and such ethical issues as threats to the data security and the absence of transparency in the information processing. Future studies must be conducted to overcome these shortcomings and create standardized assessment systems to determine effectiveness in a more uniform manner, personalize the application using more advanced AI procedures to enhance the user experience, and enact stringent data protection methods in order to preserve the sensitive user data. In addition, incorporation of human support systems e.g. therapists, or guided assistance can contribute greatly to the effectiveness and credibility of these tools. Finally, DMHAs are not meant to replace, but are considered complementary instruments to complement conventional mental healthcare, which will provide a balanced solution, using technological advances in the domain and combining them with human knowledge to achieve better mental care outcomes.

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