Brief Communication

Developing and testing preliminary effectiveness and acceptability of a mental health application in Ethiopia

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Abstract

Background Mental health mobile applications are a cost-effective and scalable answer to the world's psychiatrist shortage and limited access to care in remote areas. However, there is currently no mobile application for providing mental health interventions in Ethiopia. Therefore, this project aimed to develop and test the preliminary effectiveness and acceptability of an Android-based mobile application for mental health information, psychological self-testing, and treatment recommendation during COVID-19 and beyond.

Methods We conducted a preliminary assessment to review experiences and demands associated with the mental health mobile apps. Object-oriented modeling and the Agile Development software development methodology were employed. Android Studio's layout editor, resource management, palette, and theme editor were used. We utilized Java as the programming language for writing application code, eXtensible Markup Language (XML) to construct the overall structure of the app, and SQLite to save data locally on the user's device. To ensure quality, tests were performed on a regular basis throughout the development process.

Results The project developed an Android-based mobile app for mental health information, psychological self-testing, and treatment recommendations for COVID-19. A preliminary assessment found no existing mobile apps for mental health care. Of participants, 94.6% believed mental health apps benefit the public, patients, and healthcare professionals. However, some individuals opposed the app due to concerns about self-treatment and medication misuse.

Conclusion The study indicates a high demand for a mental health mobile app, but few participants fear self-treatment or drug abuse. Apps that support native languages are recommended, and nonpharmacological treatments should be used in conjunction with clinician consultation.

Keywords Android-based apps · Preliminary testing · Effectiveness · Acceptability · Ethiopia

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Abbreviations

COVID-19	Corona virus disease
DSM-5	Diagnostic statistical manual for mental disorder
ESA	Emotional self-awareness
GB	Gigabyte
ICD	International classifications of disease
RAM	Random access memory

1 Introduction

Globally, there is a significant disparity between the demand for mental, neurological, and substance use disorder services and the overall availability of services [1]. Good mental health is essential for the society to function well. Despite being primarily a physical health concern, the COVID-19 pandemic had the potential to worsen into a significant mental health issue if nothing was done [2, 3].

This catastrophe has had a significant influence on the mental health and well-being of entire societies, making them a priority that requires immediate attention [4]. There are signs of mental and emotional distress linked to this large COVID-19 outbreak [5]. According to preliminary data, self-reported stress (8%) and symptoms of depression and anxiety (16–28%) are frequent psychological responses to the COVID-19 pandemic [6]. The literature on these issues showed that utilizing technology is helpful to connect the community and healthcare services, and disseminating accurate public information can prevent maladaptive reactions to COVID-19 [7].

In today's technology-driven world, people are becoming more aware of health issues, particularly mental health concerns, seeking professional medical attention, and self-monitoring their symptoms [8]. The World Health Organization (WHO) surveyed 15,000 mental health applications in 2015 and found that 29% of the apps focused on mental health diagnosis, treatment, or support. That means the number of applications pertaining to mental health has grown significantly [9]. According to a prior study, 12% of Ethiopians experience mental health issues, and mental illness accounts for 12.5% of the country's overall disease burden [10]. The WHO executive board urged member states to investigate the effects of the pandemic on mental health through the use of digital tools for mental health during the pandemic, as well as to develop and strengthen services for mental health and psychosocial support (MHPSS) by promoting equitable access to remote health services during the COVID-19 pandemic and beyond [11]. The availability of smartphones is rapidly growing in Ethiopia [12]. Therefore it is thought that the country should start using mobile phone technologies for public health initiatives [13]. Mental health apps offer a variety of services, including information sharing, awareness raising, mood monitoring, behavioral analysis, and diagnosis support [14–16]. These applications focus on a number of psychological illnesses and offer self-monitoring capabilities that allow users to handle access [9, 17, 18]. Mobile apps are increasingly being utilized for psychological therapies [19] and provide a special chance to increase the accessibility and caliber of mental health care [18, 20].

Mobile apps are a valuable option to close mental health treatment gaps, particularly in remote areas with a shortage of mental health professionals [21, 22]. Mobile apps are useful for screening for mental health issues, as they encourage users to seek professional help if symptoms exceed a certain threshold. They use graphical trend displays to track symptoms and behaviors over time, allowing patients to share with clinicians or family members [15]. Apps-based features also help raise emotional self-awareness (ESA), which is associated with substance misuse, sadness, and anxiety [16]. Increased ESA can decrease mental illness symptoms and improve abilities [21, 22]. To the best of our knowledge, currently there is no mobile-based system for providing mental health therapies in Ethiopia due to the late emergence of mobile apps.

This project aimed to create a mobile-based system for hand mental health intervention in Ethiopia during and after the COVID-19 epidemic, providing access to psychological self-testing, treatment recommendations, and mental health information for various mental health conditions, including depression, bipolar disorder, anxiety disorders, obsessive–compulsive disorder, post-traumatic stress and neuro-developmental disorders, sexual dysfunction, and postpartum depression. The app was developed in both English and Amharic for use by patients, clinicians, and the general public. The created "*mental health_ እነ አፅምር ጠና app*" will be available free to download and install.

1.1 Objectives

To develop Android-based mobile app for mental health information, psychological self-testing, and treatment recommendation during COVID-19 and beyond, 2020/21.

2 Methods and materials

2.1 Study setting and design

This project developed a robust, automated, mobile-based system at the University of Gondar, northwest Ethiopia, from November 2020 to June 2021. The University of Gondar is one of Ethiopia's oldest universities, founded in 1954 as a health science college. In 2004, the institution grew to become a university with five campuses (health sciences, natural science, technology, agriculture, and social sciences). Three randomly chosen psychiatric treatment facilities that offer significant mental healthcare services in the nation—the psychiatric clinics of the University of Gondar Comprehensive Specialized Hospital, the psychiatric clinics of Felegehiwot Hospital, and St. Amanuael Mental Specialized Hospital—were the sites of an initial survey. About thirty-seven interview subjects were chosen from the three institutions using a non-probability purposive sampling technique. Respondents were divided according to the number of mental health experts on staff and the number of cases seen at respective hospitals.

Of the thirty-seven participants, 16 were from St. Amanuel Mental Specialized Hospital, 11 were from the University of Gondar Comprehensive Specialized Hospital psychiatric clinic, and 10 were recruited from Felegehiwot Hospital psychiatric clinic. Out of the participants, 25 were mental health professionals, 5 were caregivers, and 7 were patients who understood well at the time of the study.

2.2 Preliminary assessment techniques and procedure

This project is new; moreover, without adoption and customization, the interface was designed and the back-end system was developed by the project team. Before designing the mobile app, the authors did a thorough review of existing apps and the necessity of Android-based mobile apps to provide mental health information, psychological self-testing, and treatment recommendations. Thirty-seven face-to-face interviews were conducted by investigators among mental health professionals, patients, and caregivers. A brief self-developed and structured yes/no questions were used, such as Do you have knowledge of healthcare-related mobile applications (apps)? Do you know of any mental health apps that were developed in Ethiopia and are now in use? Did you use normal symptom methods to screen for mental illness in the clinic rather than the DSM-5/ICD? Do you believe mental health apps are important? If so, what mental health areas? The data were collected by three investigators using Kobo Tool techniques.

2.3 Data processing and analysis

The collected data were transferred from Kobo Toolbox into the Statistical Package for Social Sciences (SPSS) version 23 and checked for completeness and consistency. The cleaned data were analyzed to provide descriptive statistics to explain the sociodemographic characteristics, experiences, and needs and attitudes towards mental health mobile applications in text, frequency, percentage, and table.

3 Results

3.1 Sociodemographic variables and attitudes towards mental health apps

A total of 37 interviews were conducted, 16 (43.2%) with ages ranging from 24 to 33, 28 (75.7%) were male, and 9 (24.3%) had master's degrees in clinical and community mental health (Table 1). The survey revealed that despite not knowing about mental health apps developed in Ethiopia, 94.6% of participants agreed that mental health mobile apps are beneficial for recognizing mental illness symptoms, improving professional help-seeking behaviors, enhancing lifestyle improvements, and enabling clients to monitor symptom patterns.

Table 1 Sociodemographic characteristics of study participants (n = 37)

Sn	Variables	Category	Frequency (%)
1.	Age	24–33	16 (43.2)
		34–43	13 (35.1)
		≥ 44	8 (21.6)
2.	sex	Male	28 (75.7)
		Female	9 (24.3)
3.	Profession	Masters in clinical and community mental health	9 (24.3)
		Psychiatry nursing	8 (21.6)
		Psychologist	4 (10.8)
		Psychiatrist	4 (10.8)
		Clients	7 (18.9)
		caregivers	5 (13.5)
4.	Address (Institution)	St. Amanuel mental specialized hospital	16 (43.2)
		University of Gondar Hospital	11 (29.7)
		Felegehiwot Hospital	10 (20.1)

On the other side, just two (5.4%) individuals thought mobile apps were harmful for self-treatment and drug misuse (Table 2). Out of the participants, 31 (83.8%) and 4 (10.8%) suggested that the most prevalent mental health illnesses (mood, psychosis, anxiety, trauma, substance use, and psychosomatic disorders) and sensitive mental health conditions (such as sexual dysfunctions) that people are embarrassed to seek treatment for should be included in mobile-based mental health applications, respectively (Table 2).

3.2 System development methods

We built an Android-based "$Mental\ health\_የስነ\text{-}አዕምሮ\ ጤና\_app$," using object-oriented modeling, which treats and stores data as objects. The Agile Development software development methodology was employed due to its iterative flexibility and allows for the rapid construction of a functional but unfinished application. As a result, Agile's iterative nature provides for constant user feedback, allowing us to improve features based on real-world use and comments from healthcare professionals to guarantee the app remains relevant. The system analysis process was based on the requirements and data gathered from stakeholders. A system model was created with all of its components, and the current systems were inspected. This was the point at which prospective remedies were discovered and the flaws in the current system well understood. So, during this phase, we executed thorough system design, which includes user interface design, component design, integration design, and other related work.

Table 2 The study participants' experiences and attitudes about utilization of mental health applications (n = 37)

Sn	Variables	Category	Frequency (%)
1.	Knowledge on health care-related apps	Yes	29 (78.4)
		No	8 (21.6)
2.	Experiences of mental health apps developed in Ethiopia	Yes	0 (0)
		No	37 (100.0)
3.	Use of standard mental illness symptom screening tool at clinic/home	Yes	22 (59.5)
		No	15 (40.5)
4.	Benefits of mental health apps	Helpful	35 (94.6)
		Unhelpful	2 (5.4)
5.	Recommended mental health conditions for the mobile app	Prevalent and common	33 (89.2)
		Sensitive conditions	4 (10.8)

3.3 Application development tools

The materials for mental health information, psychological self-testing, and treatment recommendations were collected from reviewing different updated textbooks, training manuals, and guidelines. A psychological self-testing standard tool such as the patient health questionnaire (PHQ-9) for depression, the PRIME early psychosis screening test, the 15-item bipolar disorder screening test, the GAD-7 screening test for anxiety disorder, the post-traumatic stress disorder checklist for the DSM-5 (PCL-5), the postpartum depression scale, the 15-item self-reported checklist of obsessive–compulsive disorder, and the patient health questionnaire-15 to screen for somatic symptom disorder were used. This mobile app was developed with both English and Amharic versions after forth and back translation to Amharic was done by two different language experts.

The mental health app platform was developed using Android Studio. We created the graphical user interface using Android Studio's layout editor, resource management, palette, and theme editor components. We used Java as our programming language for creating application code. eXtensible Markup Language (XML) is the standard markup language that we used to create the general structure of our mobile application, including the layout, views, and resources. SQLite was used to save data locally on the user's device. Our mental health app stores sensitive user data and provides a secure and efficient way to manage it on the device.

We used the Google Play Console Platform to make available, upgrade, distribute, and manage our app's whole lifecycle, which included updates and user involvement. To create the proposed mobile app, we used a desktop computer with 8 GB of RAM and 400 GB of storage space, a modern multi-core processor, and high-quality graphics and screen resolutions. We used smartphones to deploy and execute the program.

3.4 Methods to test the technology

The technology transfer coordinator and project team assessed the mobile app's progress, confirming it aligns with its objectives. We developed a comprehensive assessment methodology based on research and lessons learned for project adaptation. We employed various widely recognized testing methodologies, such as unit testing to ensure individual components or functions work as intended, integration testing to verify that the self-testing module and the mental health information modules or services interact correctly, and functional testing by letting the users give basic mental health information and enabling them to test their mental health status using the self-testing modules. The developed app was released to a targeted audience before the official launch to gather feedback and identify any remaining issues. User acceptance tests have been done with real users (physicians, patients, and the general public) to validate the app's usability and effectiveness. For unit testing, we used predefined test cases to test on individual components, ensuring proper functionality. Integration testing involved collaborative sessions between developers and testers to simulate interactions between the self-testing module and mental health information services, identifying any data flow discrepancies. Functional testing was conducted through user scenarios with real users, including physicians and patients. Furthermore, security testing needed to identify vulnerabilities and ensure the users' data are protected. For security testing, we conducted penetration tests to identify potential vulnerabilities, simulating unauthorized access attempts. Additionally, we performed authentication and access control testing by creating various user roles and verifying that each role could only access the data pertinent to their permissions. These techniques ensure that the mental health mobile application is reliable, user-friendly, and effective in delivering mental health interventions. Regular testing throughout the development process contributes to a higher-quality product and enhances user satisfaction. Thus, this mobile app passed all the tests aforementioned in the above (Fig 1).

The figure illustrates the interaction between users and the mobile application modules. Users can request general information about mental health and receive the necessary details. Additionally, they can assess their mental health status using the mental health testing form, which provides them with their results and personalized treatment recommendations based on the information provided.

3.5 Proposed impact evaluation strategies

User engagement metrics, such as download and installation rates: track the number of downloads and installations over time, active users: Measure daily, weekly, and monthly active users to assess ongoing engagement. User Feedback
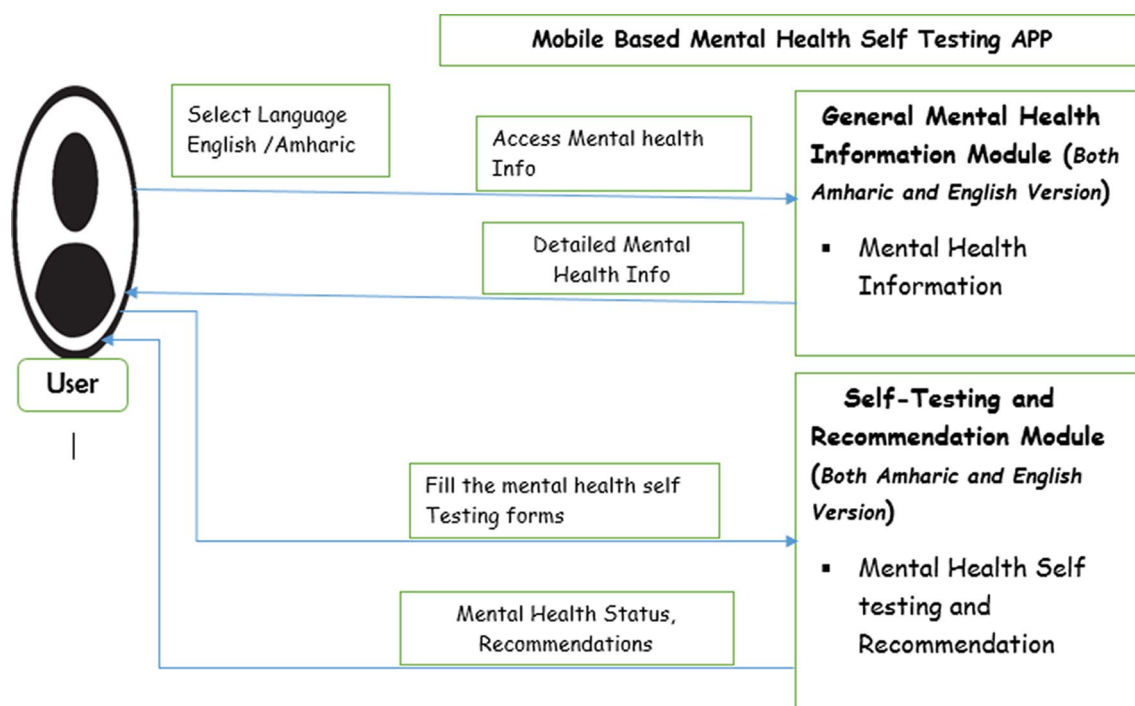
Fig. 1 schematic presentations of general information flow between the user and the Mobile App

and Satisfaction, Surveys and Questionnaires: Conduct pre- and post-implementation surveys to gauge user satisfaction and gather feedback on app usability and effectiveness. Behavioral Changes: Adherence to Recommendations, Track how many users follow therapy recommendations or engage in suggested self-care activities. Help-Seeking Behavior: Measure any changes in users' willingness to seek professional help as a result of using the app. Accessibility and Reach, Demographic Analysis: Evaluate the demographics of users to understand who is accessing the app and whether it reaches underserved populations. Cost-Effectiveness Analysis Cost Savings: Assess potential cost savings in mental health care delivery by comparing expenses before and after the app's introduction. Partnership Feedback Stakeholder Input: Gather feedback from healthcare professionals and organizations involved in mental health to assess the app's integration into existing care pathways. By employing a mix of these methods, we can gain a comprehensive understanding of the impact of your mobile mental health application on users and the broader community.

4 Discussion

This project has developed an Android-based mobile app that provides mental health information, psychological self-testing, and treatment recommendations for COVID-19 and beyond. A preliminary assessment of the existing system and acceptability of the mental health app was conducted among mental health professionals, patients, and caregivers.

The findings revealed that there are currently no mobile applications for mental health care. 94.6% of participants believed that mental health applications benefit the public, patients, and healthcare professionals by identifying symptoms of mental illness, improving professional help-seeking habits, and improving lives. In this early review, the stakeholders with whom the writers met requested them to develop Android-based mobile apps with English and Amharic language versions. The writers built this Android-based mobile app due to high demand and a lack of previous works.

On the other hand, a few individuals opposed making mental health apps available to the public, claiming a fear of self-treatment and medication misuse. The authors never ignored this concern, and the names and dosages of pharmacological medications are left out of the treatment recommendations parts of both the mental health and psychological self-testing modules.

Individuals with mental health conditions may recognize their illness and seek medication to treat it; they may use drugs without a prescription in higher doses, more frequently, and for longer periods of time than recommended by the physician [23]. The main reasons are to relax, alleviate stress, respond to sleep, enhance well-being

or euphoric state, and help regulate personal feelings or emotions [23], most of which were without recognizing serious adverse effects of the drugs [24]. This concern has been supported by the high incidence of self-medication practice worldwide [24–26], with Ethiopia ranging from 12.8% to 77.1% [27–29]. Previous research showed that previous experience treating a similar illness and feelings that the illness was mild [26, 30], the belief that hospital drugs do not work [29], and individuals did not need a doctor to investigate their symptoms [24], were all positively related with self-medication.

5 Limitations

The app provides mental health resources in both English and Amharic, with 24-h access to services and information without the need for the internet, which can clear misconceptions and raise awareness for large-scale campaigns. Besides that, the app may not be able to adapt its recommendations and information to each user's specific mental health requirements. Although the app provides ideas and recommendations, it cannot completely replace the therapeutic benefit of in-person contacts with a mental health expert. Furthermore, the use of a purposive sampling technique in early studies of experiences and attitudes toward mental health apps has limitations to generalize for larger populations.

6 Conclusion

The preliminary study revealed significant demand for a mental health mobile app. But few participants' fears about self-treatment and consumption of drugs are understandable. Native language-supported mobile apps are strongly recommended. Thus, mobile-based apps are important and acceptable to the majority of people in general, and treatment recommendations must include nonpharmacological treatments as well as consulting clinicians.

Data availability The datasets used in this study are available from the corresponding author on reasonable requests.

Declarations

Ethics approval and consent to participate This was approved ethically by the University of Gondar's Institutional Review Board under the reference number VP/RCS/2092/2020. The preliminary assessment participants had the option to consent or decline participation prior to the data collection after being given adequate information about the goals, significance, and methods of the study. Written informed consent was obtained from the participants. Confidentiality was maintained by omitting the name and other identifiers. The 1964 Declaration of Helsinki's rules and procedures were followed when conducting this study.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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