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Journal of Technology in Behavioral Science (2024) 9:428–439
https://doi.org/10.1007/s41347-023-00360-z

Self-help: a Systematic Review of the Efficacy of Mental Health Apps for Low- and Middle-Income Communities

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Received: 5 March 2023 / Revised: 22 September 2023 / Accepted: 25 October 2023 / Published online: 11 November 2023
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Abstract
Low- and middle-income countries (LMICs) are tasked with providing adequate and accessible mental health care. However, this has been a slow process due to the lack of resources. With the recent advances in technology, mental health apps offer the opportunity to provide mental health care that is accessible and affordable. This study explored the efficacy of mental health apps in LMICs using the AAAQ framework. A systematic review following PRISMA guidelines explored studies published from 2015 to 2021. Seven studies met the inclusion criteria and were analysed using content analysis and thematic synthesis. Themes centred around the availability of mental health care systems in LMICs, some of the barriers to accessing mental health care, the need for mental health apps to be congruent with the communities that they are used in and quality criteria for apps. The study offers valuable insight towards mediating some of the struggles faced in the implementation of appropriate mental health care in LMICs using mental health apps.

Keywords AAAQ framework · Digital health · eHealth, Mental health · Mental health app

Introduction

According to the World Health Organisation, there is an access gap for basic mental health care and treatment of about 35% to 50% in developed countries. This increases to 75% to 80% in developing countries (Wiktorowicz et al., 2020). In an attempt to increase access to care, low- and middle-income countries (LMICs)[1] have opted for community-based interventions (Robertson & Szabo, 2017). Thornicroft et al. (2016) argue that community health care is a practice that caters for access to mental care within the local population and is particularly useful as a form of inclusion to disadvantaged communities. They advocate for an evidence-based and practical application of mental healthcare in which comprehensive and integrated mental health care engages not only the individual but also the family as well as interaction with other providers of health care such as traditional healers. However, increasing mental healthcare needs cannot be solely taken up by community healthcare and require a supporting practice that further improves the training for clinicians and re-envisions the delivery of mental health care (Lake & Turner, 2017). Hence, digital technologies are often cited as a means of providing access to mental healthcare. The rapid increase in the daily use of mobile and smartphones facilitates this mode of intervention. Further digital interventions have the potential to change the therapeutic platform and engage with individuals in real-time (Torous et al., 2018). Thus, this study focuses on mental health apps as a form of digital intervention.

Mental Health App Review

Mental health apps can be defined as computational mobile software that is downloadable and has been designed to provide support to those with mental illness (Kenny et al., 2016). Mobile applications that resonate with mental health

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[1] Low- and middle-income countries (LMICs) are classified by the World Bank as countries that have the gross national income (GNI) per capita of $1.026 and $3.995 compared to high-income countries with a GNI per capita that exceeds $12.056 which is based on the categorisation calculated using the Atlas method (Prydz & Wadhwa, 2019; The World Bank, 2019). According to Prydz and Wadhwa (2019), the classification of low- and middle-income countries consists of economic growth, inflation, and exchange rates on the overall population of the country.

assistance have become readily available with a record of about 10 000 to 20 000 mental health apps which are downloadable from Google play store and IOS Apple store (Lecomte et al., 2020; Torous et al., 2019a). Despite a large number of mental health apps, only 3 to 4% recorded estimates are evidence-based apps (Lecomte et al., 2020; Nicholas et al., 2015). This indicates that much of the apps go clinically untested with minimal expert supervision. This not only exposes the user to further harm, but their information can be further exploited.

However, researchers have begun to apply more clinically based measures towards the provision of appropriate mental health apps to users with a particular focus on commonly diagnosed disorders such as depressive disorders, bipolar disorders, anxiety, posttraumatic stress disorders, schizophrenia, suicidal behaviours, and addictions (Anmella et al., 2023; Dworkin et al., 2023; Gu et al., 2020; Ibrahim et al., 2022; Torous et al., 2019b). Wang et al. (2018) conducted a systematic review study that looked at the effectiveness of mental health apps in monitoring and managing mental health symptoms. The study draws focus on apps that assisted with anxiety, mood disorders, sleep disorders, and addictions using primarily a game-based design. Overall individuals who used the apps experienced greater stress reduction (Wang et al., 2018). An early intervention mHealth app THRIVE for sexual assault survivors was tested for its feasibility in reducing post-traumatic stress and alcohol misuse (Dworkin et al., 2023). The feasibility of THRIVE was supported by the app's core functionality such as the cognitive behavioural modules and the coaching calls. These were not only helpful in encouraging acceptability but they were seen as satisfactory with regards to app user-friendliness (Dworkin et al., 2023). Moreover, apps such as Wysa were found to be useful in offering people support when it came to symptoms of anxiety and depression during the COVID-19 pandemic (Sinha et al., 2023).

Support Offered by Mental Health Apps

In a survey of 15,000 mental health apps conducted by the World Health Organisation in 2015, it was found that about 29% of them have their focus on mental health diagnosis, treatment, or support (Anthes, 2016; Chandrashekar, 2018). Mental health apps also include functions such as symptom tracking, diary entries, and appointment or medication reminders as well as motivational quotes (Hollis et al., 2015). These apps are aimed at being a form of self-help towards mental health outpatients, extending to those who have not been diagnosed. They can be used in conjunction with other comparative methods of intervention such as internet-based intervention which offers direct contact with a mental health practitioner (Donker et al., 2013). Arguably, mental health apps also extend the ability for the patient to track their symptoms through ecological momentary assessment (EMA) (Donker et al., 2013; Hollis et al., 2015;). There is engagement with the aspect of mental health literacy in which the apps implement psychoeducation and self-assessment (EMA) on top of information on referral allowing the patient to assess what they have and request assistance from the nearest treatment centre (Bautista & Schueller, 2023; Mindu et al., 2023).

Researchers such as Marshall et al. (2019) and Mindu et al. (2023) indicate that mental health apps provide immediate assistance, convenience, and affordability, which is of particular importance to LMICs. Vaidyam et al. (2019) argue that mental health apps have a potential that can be continually harnessed via technologies like machine learning which can record any digital signals observed and notify the patient of any sudden change concerning disorders like anxiety as well as notifying the clinicians for immediate intervention for at-risk individuals. The intervention can be subsequently offered with immediacy despite the distance. In an Australian study, mental health apps were outlined to be efficient in reinforcing evidence-based monitoring for patients with mild mental health conditions (Donker et al., 2013).

According to Kenny et al. (2016), mental health apps have the potential of challenging some of the difficulties faced by the administration of mental health care in LMICs due to the cost-effectiveness of the interventions and their accessibility. Furthermore, they allow for the engagement of treatment-based intervention within a natural setting (Hollis et al., 2015; Kenny et al., 2016). Hence, this study aimed to explore the efficacy of mental health apps for LMICs using a systematic review method. The review considered specifically which areas studies have been conducted in, on which populations, the nature of the app (for example, online screening tool, telepsychology, self-care, medication monitoring, AI-based, cognitive behavioural therapy), as well as the affordances and limitations offered by the app for the context. The AAAQ framework was used to structure the exploration of affordances and limitations with regards to mental health apps.

The International Covenant on Economics, Social and Cultural Rights (ICESCR) argues that the value of a well-rounded healthcare intervention can be recognised through the availability, accessibility, acceptability, and quality (AAAQ) that it provides towards the recipients (Priebe & Strang, 2016; Schierenbeck et al., 2013). Availability considers the existence of services such as hospitals, staff, and sanitation and whether they are sufficient for the community. Accessibility refers to the ability for individuals to be able to effectively use facilities without any discrimination towards physical accessibility, financial accessibility, social accessibility, and information accessibility. Acceptability refers to the equal treatment and provision of health that

is culturally and ethically respectful to all members of the community. Quality focuses on the provision of care that is scientifically and medically appropriate in an adequate environment and the guarantee of privacy and confidentiality in the administration of care (Priebe & Strang, 2016; Schierenbeck et al., 2013).

The following research questions guided the study:

1. What are mental health apps that are used?
2. Are there any mental health apps that have been standardised for psychological use?
3. What are the affordances and limitations identified in the articles with regards to the availability, accessibility, acceptability, and quality of mental health apps in LMICs?

Methods

Study Design

A systematic review is defined as a summary of the literature that consists of reproducible methods to "systematically search, critically appraise and synthesise on a particular topic" (Gopalakrishnan & Ganeshkumar, 2013, p.10). The synthesisation of the results using the strategies allows for the reduction of bias and error (Gopalakrishnan & Ganeshkumar, 2013). Thus, the systematic review was suitable for this study because it reviews articles on the effective use and efficacy of mental health apps in low- and middle- income communities. Further, using this method reduces error and allows for the replicability and generalisability of the results found. The process of the systematic review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines as well as the four-phase flow chart which engages with the identification, screening, eligibility, and inclusion of primary research when aiming to answer the proposed research questions (Liberati et al., 2009; Moher et al., 2015).

Search Strategies and Study Selection

The study followed an eight stage-structured framework proposed by Uman (2011). The initial stage (stage 1) included the formulation of review questions as indicated earlier in the literature review section.

Stage 2: Defining Inclusion and Exclusion Criteria

The literature review and research questions informed the second stage of defining the inclusion and exclusion criteria. Inclusion criteria were that studies needed to focus specifically on LMICs; samples should have some app experience, app trials with user engagement, and app regular use or user testing to ascertain their viability in the community. Qualitative, quantitative, or mixed methods studies were included. Unpublished grey literature such as research reports was eligible for inclusion in the study. Articles that focussed on (1) high-income communities (HIC), (2) in-app written reviews, and (3) users being diagnosed with or comorbidity with any physical illness were excluded from the study.

Stage 3: Search Strategy

Four databases were explored for this study namely: Cochrane Library, Scopus, Sabinet, and DATAD-R drawing in grey literature within the LMICs. The selection of search terms and phrases that were used to identify and select eligible studies included "Mental health app", OR "mHealth", OR "Health app", OR "Technology mental health", OR "alternative intervention mental health", OR "Mental health LMIC" OR "mental health intervention LMIC" AND "LMIC", AND "disadvantaged communities", AND "rural communities". The search terms were inserted in the chosen databases using Boolean operators.

Stage 4: Selecting Studies

To facilitate the search for the articles that meet the inclusion and exclusion criteria, the titles, abstracts, and the full-text articles were reviewed and downloaded to a reference managing software (Zotero) as well as an Excel record sheet to track the selected abstracts and articles. A total of 76 articles were located. After the deletion of duplicate articles, 72 articles were screened. For all 72 articles, the authors, year of publication, sample, age, study design, and the reason for including or excluding it for this study were captured (Liberati et al., 2009). Figure 1 summarises the article screening process. Seven articles met the inclusion and exclusion criteria.

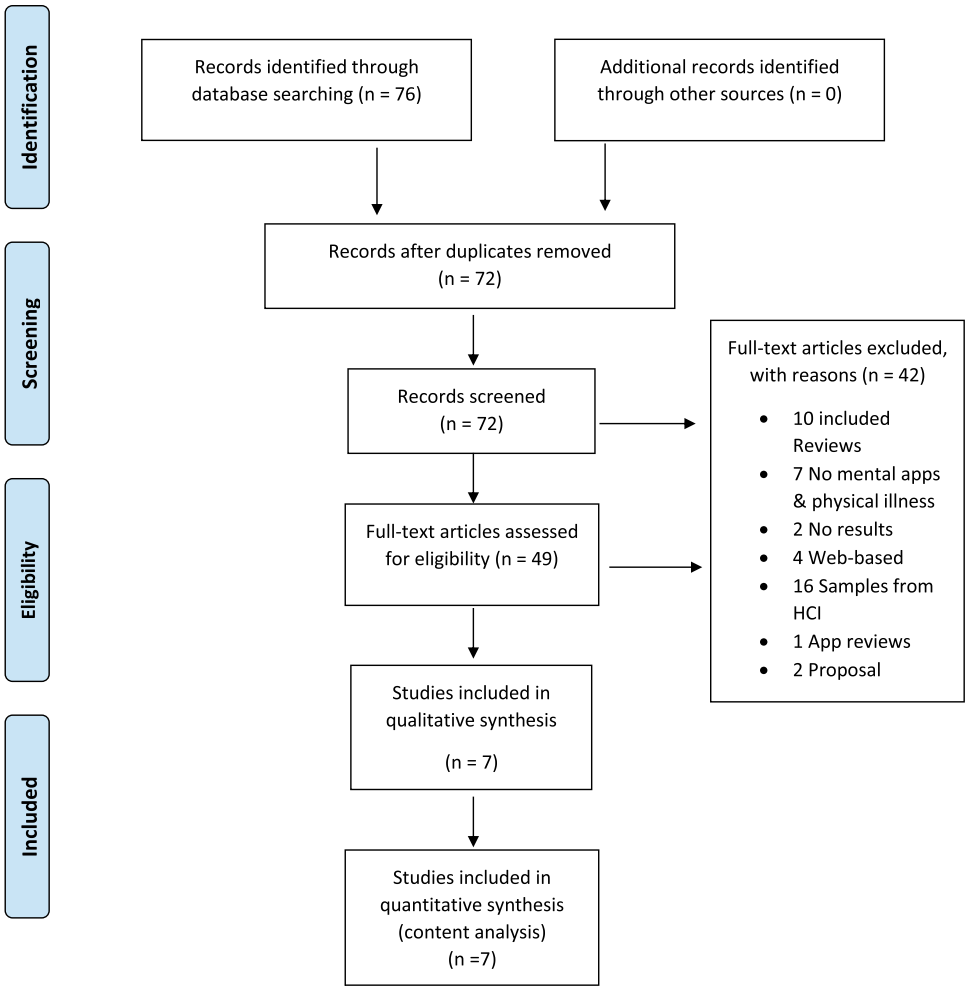
Stage 5: Extracting Data

Data extraction across the seven articles followed the PICOS structure (Population, Intervention, Comparison, Outcome, and Study type) as it assisted in providing contextual detail about the populations where the studies had been conducted (Laher & Hassem, 2020).

Stage: 6 Assessing Study Quality

The study utilised the CASP checklist tools (Critical Appraisal Skills Programme) to assess the quality of both qualitative and quantitative research studies (Nadelson & Nadelson, 2014; Laher & Hassem, 2020). The quality score range for the qualitative tool was 0–10 while the quantitative score range was from

Fig. 1 Four-phase flow chart



0 - 12. Scores for each of the included studies were above seven which is an indicator that the studies were of high quality.

Stage: 7 Analysing and Interpreting Results

The analysis of the articles used two methods of data analysis (content analysis and thematic synthesis). The first research question (What are mental health apps that are used?) and the second research question (Are there any mental health apps that have been standardised for psychological use?) were analysed using content analysis. Content analysis manages to quantify and analyse the prevalent relationship between the concepts (Allen, 2017). Table 1 condenses the information relating to the user-tested apps in LMICs, and a frequency paragraph outlines an account for the use of mental health apps. This process included looking at phrases relating to the effectiveness of mental health apps in low- and middle-income communities as well as the impact that they have made or how they could potentially help in retrospect of the current mental health care. Erlingsson and Brysiewicz (2017) provide a guide on following this method of data collection which includes (1) condensation, (2) code, (3) category, and (4) the formulation of themes.

Following this, a thematic synthesis using a priori coding (AAAQ framework) was used. Thematic synthesis consists of three stages of analysis (Ryan et al., 2018; Thomas & Harden, 2008). The first stage involves the coding of data relating to the research questions. The second stage involves the grouping of similar codes into the category of descriptive themes and describing the observed pattern across the studies. The third stage depicts the development of analytic themes. This involves synthesising the obtained findings from the different studies and bringing meaning into the identified patterns concerning the proposed research questions (Ryan et al., 2018).

Stage: 8 Dissemination of Findings

The findings of the study were used to compile this journal article and are presented hereunder.

Ethical Consideration

The study received an ethics waiver from the Human Research Ethics Committee (Non-medical) at the University of the Witwatersrand (Protocol number: MASPR/20/05W).

Table 1 Descriptive information for included articles

Authors and date	Study context	App intent	MHApp target population	Standardisation of the app	Participants	Research design	Data collection	CASP score
Gonsalves et al. (2019)	New Delhi and Goa in India	Target on anxiety and depression	Teenagers	Yes, only through language	Student participants ($N=118$); service providers ($N=16$)	Qualitative	Focus group ($N=26$ students and $N=8$ service providers); co-design workshops ($N=22$ students and $N=8$ service providers); user-testing ($N=50$ students)	9
Caplan et al. (2018)	Santo Domingo and Boca Chica Dominican Republic	Depression	Primary care individuals and mental health help-seekers	Yes, through language and contextual acknowledgement	Primary health care helpers (nurses, doctors, CHWs, mental health providers); participants 18 years and above	Mixed method	Semi-structured interview; demographic questionnaire; PRIME-MD PHQ-9	10
Brown et al. (2020)	Toowo omba South West Queensland, Australia	Suicide prevention and support	Indigenous people and teenagers	Yes, only through language	Gatekeepers/suicide preventers	Qualitative	Semi-structured interview; participatory workshops	9
Kümm (2018)	Khayelitsha Township Cape Town, South Africa	Autism	Children 12–72 months	No	Children; families (children's caregivers)	Mixed methods	Questionnaire; algorithm emotional quantification; focus group	10
Arenas-Castañeda et al. (2020)	Milpa Alta Delegation Municipalities, Mexico City	Suicide-risk screening	Rural individuals	Yes, only through language	People between the age of 15 and 69	Quantitative	Surveys: the Patient Health Questionnaire-9; the Generalised Anxiety Disorder Scale (GAD)-2; Alcohol Use Disorders Identification Test (AUDIT-C); Drug Abuse Screening Test questionnaire; the Columbia-Suicide Severity Rating Scale (C-SSRS); two additional questions about self-harm (adapted from DMS 5); the Well-being Index (WHO-5 scale)	6

Table 1 (continued)

Authors and date	Study context	App intent	MHApp target population	Standardisation of the app	Participants	Research design	Data collection	CASP score
Povey et al. (2020)	Torres Strait Island, Australia	Prompting mental health help-seeking suicide prevention	Aboriginal and Torres Strait Islander Youth	None that was mentioned	Youth between the age of 10–18 ($N=29$)	Mixed methods	Online survey; co-design workshops	9
Paddick et al. (2021)	Hai, Kilimanjaro, Tanzania	Cognitive behavioural screening for dementia	Elderly individuals in the Hai Kilimanjaro villages	Yes, only through language	Individuals in 12 villages ($N=28,236$); ($N=3122$) were ≥ 60 years; ($N=3011$) (96.4%) consented to participate; ($N=610$) present for stage 2	Quantitative	IDEA cognitive screen	9

As the research involves secondary data collection through selecting articles and no human subjects were involved, no ethical clearance was required.

Results

Content Analysis

A description of the sample of texts as well as research questions 1 and 2 were explored using content analysis. The results are presented below.

Description of Sample

The study included a total of seven articles that met the inclusion criteria—see Table 1. Within this sample, two studies were conducted on samples from Africa, specifically South Africa and Tanzania; two were conducted in Australia within the indigenous communities; two were conducted in South America specifically in Mexico and the Dominican Republic, and one was conducted in India. Three out of the six included articles employed a mixed methods research which involved interviews and design workshops for the apps to test their suitability.

What Are Mental Health Apps that Are Used?

Two of the apps focused on depression and anxiety (Caplan et al., 2018; Gonsalves et al., 2019); three looked into suicide prevention (Arenas-Castañeda et al., 2020; Brown et al., 2020; Povey et al., 2020); one focused on autism (Kümm, 2018), and one looked at dementia screening (Paddick et al., 2021). The majority of the studies focused on the youth, with only one looking into the provision of support for mental health assistants (Brown et al., 2020), and one was used for an elderly population by administrators referred to as enumerators (Paddick et al., 2021).

Are There Any Mental Health Apps that Have Been Standardised for Psychological Use?

None of the articles mentioned the psychological standardisation of the mental health apps, with two articles mentioning the advice of experts in the co-design process (Caplan et al., 2018; Gonsalves et al., 2019). There was linguistic consideration in some of them. The *POD* app implemented in India consisted of English but it also included languages that are commonly spoken in the area, Hindi and Konkani (Gonsalves et al., 2019). Within the Dominican community, the app was translated into Spanish as that was the local language used (Caplan et al., 2018). In Tanzania, the enumerators were trained to administer the app, and instructions

were translated into Kiswahili and other tribal languages like Chagga and Maasai (Paddick et al., 2021).

Thematic Synthesis

Research question 3 was explored using thematic synthesis. The themes were guided by the AAAQ framework proposed by the United Nations Committee in ensuring that potential barriers to service delivery are addressed (World Health Organization, 2019).

Availability: What Are the Issues Identified in the Articles with Regards to the Availability of Mental Health Apps in LMICs?

Low- and middle-income communities often struggle with the provision of adequate public health care; however, with mental health care, the gap is even larger in secluded rural communities, with a wider disparity in comparison to urban communities (Brown et al., 2020; Povey et al., 2020; Paddick et al., 2021). Rural communities rely on assistance from within the community by the community members due to the minimal mental health practitioners available. Furthermore, there remains a lack of infrastructural development resulting in a lack of facilities that appropriately tackle some of the issues faced when it comes to mental health within low-income communities (Arenas-Castañeda et al., 2020; Brown et al., 2020; Kümm, 2018; Povey et al., 2020).

Physical availability also extends to the kind of mental health interventions that are received. Brown et al. (2020) present the case of the indigenous aboriginal community in Australia where community members act as suicide preventers who assist with the youth. However, this does not guarantee that they possess adequate psychological knowledge to assist. Technological growth and development allows for the use of devices like smartphones to make mental health care more available (Arenas-Castañeda et al., 2020; Gonsalves et al., 2019; Kümm, 2018). This allows for more engagement with different kinds of interventions and could further assist some of the community mental health helpers with more tailored information.

In the Mexican study, researchers had to make some of the screening tools available through a web-based design for the convenience of both elders and those that do not own their mobile phones (Arenas-Castañeda et al., 2020). This further extends to the unequal resource distribution such as infrastructural development within LMICs where the network towers may not provide fast internet compared to HICs (Caplan et al., 2018). Network connectivity was not something was mentioned; however, a question of sustained connectivity was raised during co-designs and implementation (Arenas-Castañeda et al., 2020; Brown et al., 2020; Caplan et al., 2018; Gonsalves et al., 2019; Kümm, 2018; Povey et al., 2020).

Accessibility: Do Mental Health Apps Provide an Accessible Intervention in the LMIC?

The World Health Organisation has noted the potential value of eHealth which is medical care delivered through mobile phones as a means of reaching communities that are in the outskirts and under-resourced places (World Health Organization, 2019). Community members acknowledge the effort that is brought by mental health apps as being an easier option to access for its community and those in need of help (Arenas-Castañeda et al., 2020; Caplan et al., 2018; Gonsalves et al., 2019; Kümm, 2018; Povey et al., 2020). However, financial accessibility impedes getting any help that is outside of the village more especially when it came to the implementation of mental health care through smartphone applications. The accessibility to phones and apps is limited to those who can afford them. The expense that comes with purchasing data further restricts the use of the apps. Caplan et al. (2018) reported that data spent on using an app for a week is meant to last for a month. Hence, the use of apps cannot be sustained (Caplan et al., 2018).

Mental health apps were introduced as an alternative intervention that considers both technical feasibility and contextual differences. Language is one of the main issues that need to be considered in this regard. The mental health apps that were user-tested within the different communities were taken from high-income countries with many of them being in English, yet English is often not the language of communication for individuals in most LMICs (Brown et al., 2020; Gonsalves et al., 2019; Kümm, 2018; Paddick et al., 2021; Povey et al., 2020). Gonsalves et al. (2019) reported that in New Delhi and Goa, the sample being explored required children that were either fluent in English, Hindi, or Konkani in an area that has a variety of languages. Furthermore, in a South African study on an app to assist autistic children, almost everything was in English, yet English was the second or third language for participants (Kümm, 2018).

Added to this is the issue of technological literacy in the administration and use of mental health apps. Fear of minimal technological proficiency among community members was raised as an access concern (Arenas-Castañeda et al., 2020; Caplan et al., 2018; Povey et al., 2020). LMICs have a larger youth population in comparison to high-income countries. Being more technologically savvy than the elders, the mental health apps target a population that was able to navigate through some of the requirements of the app. Researchers recognised that the reach of mental health through mental health apps was therefore more effective among youth (Kümm, 2018; Povey et al., 2020).

Aside from technological literacy, literacy levels were also a concern. Gonsalves et al. (2019) reported that among the students, those that came from government-run and aided schools experienced literacy difficulties. Text-heavy

problem-solving concepts had to be reworded into a point-specific language (Gonsalves et al., 2019). Further, the use of pictorial formats and audio recordings for better comprehension was opted for (Caplan et al., 2018; Gonsalves et al., 2019; Kümm, 2018; Povey et al., 2020).

Acceptability: Are Mental Health Apps Adequately Acceptable in LMICs?

Culture impacts the experience and the conceptualisation of mental illness (Arenas-Castañeda et al., 2020; Brown et al., 2020; Caplan et al., 2018; Gonsalves et al., 2019; Kümm, 2018; Povey et al., 2020). The studies demonstrated that to ensure appropriate implementation and efficient usability of the mHealth apps, the developed features of the apps need to consider cultural sensitivity and acceptability among the community members (Gonsalves et al., 2019). Adolescents from indigenous communities were seen to be less likely to seek mental health help compared to their non-indigenous counterparts due to shame, language difference, intergenerational stigma, and lack of accessible facilities (Brown et al., 2020; Povey et al., 2020). In a South African study, researchers noted that in an app used to monitor facial expression among children diagnosed with autism, the positive facial expressions of South Africans were not expressed similarly to children from the US group (Kümm, 2018). Though there is acceptance of mental health apps as means of self-help for those who have little access to mental health, a study within the Indian community acknowledged that the act of self-help is not something common among their adolescents, as such they are used to being given a directive by their elders (Gonsalves et al., 2019). This also concurs with some of the doubt around the "dissatisfaction with western approaches" (Brown et al., 2020) as they do not consider some of the traditional and pluralistic understandings of mental illness (Brown et al., 2020; Kümm, 2018).

Researchers outlined that the relevance of mental health apps should consist of the indigenous study of suicidology in indigenous communities for example to help address cultural sensitivity in their administration (Caplan et al., 2018; Kümm, 2018). Within the administration of *POD adventures*, researchers ensured that the characters were culturally relevant to the children with a representation of characters across different gender, ages, social class, and who had common names.

The studies emphasise a further need for culturally appropriate intervention that will improve the sustainability of mental health intervention as well as its effectiveness (Brown et al., 2020; Kümm, 2018; Povey et al., 2020). During the user-testing phase, the aboriginal and islander mental health initiative for youth *(AIMhi-Y) app* included pictorial selection options, drop-down boxes, and audio recordings for each question to support and encourage completion for those who struggle with language literacy (Povey et al., 2020).

Participants expressed other concerns such as the potential of mental health apps being culturally insensitive, dismissive, and disrespectful to emergent gatekeepers and at-risk individuals (Brown et al., 2020). Further, the lack of understanding of the intentions of the app, home responsibilities, childcare, and employment issues impacted uptake (Caplan et al., 2018). The engagement that the mental health app offered was noted as not being sufficient for individuals who experience severe mental illness, as such, can be deemed unfit (Povey et al., 2020).

With a majority of mental health apps developed in high-income countries, researchers conducted co-design workshops with locals (Brown et al., 2020; Povey et al., 2020). This was a means of enhancing acceptability within the community with its members as well as culturally informing the development of the mobile app (Povey et al., 2020). The continuous consultation with the community through co-design assisted in the development of *INSIST*, a mental health app designed for suicide prevention helpers in indigenous communities (Brown et al., 2020). The workshops aimed at understanding the participant's needs such as the provision of voice-based interfaces and having local language support (Caplan et al., 2018; Povey et al., 2020).

With the novelty of using smartphone technology as a mode of delivering mental health care, the studies indicated concerns around security and data privacy. Povey et al. (2020) found that participants enquired where the data was going as well as who was going to see it during the user testing of a suicide prevention tool. However, reassurance was given to the participants on the anonymity provided by the app and confidentiality of the information provided. Due to the lack of resources, some participants indicated that they use their phones with family members which makes their information not entirely protected (Caplan et al., 2018; Kümm, 2018). There is still a huge ethical challenge when it comes to mental health apps as a form of alternative care in ensuring data privacy to users which requires careful consideration.

Quality: Have Mental Health Apps Been Shown to Offer a Level of Quality Care in LMICs?

The implementation of mental health apps requires the assurance that they are of adequate quality to be used in communities where mental health resources are minimal. The user-centred design of mental health apps has been recognised as a means of improving intervention applicability and usability within a low-literacy population (Caplan et al., 2018; Gonsalves et al., 2019; Kümm, 2018). Various design features have been considered within the different communities; however, the use of gamified intervention brought an

appeal especially among the adolescent group (Brown et al., 2020; Gonsalves et al., 2019; Kümm, 2018). The participants revealed a preference for games that were built upon real-life stories which offered them relevance and relatability to their social environment. These included pictures of the schools and local surroundings per the participant's media preference. To encourage engagement with the mobile app, the feature of user-choice rewards and quizzes was found to be useful (Gonsalves et al., 2019). End-user experience being a driver of appropriate mental health design, the *Autism & Beyond app* included a non-verbal communication means as some children were not able to verbally converse (Kümm, 2018). This acts further as assurance in meeting the requirements of cultural consideration (Brown et al., 2020).

User-testing expressed the participant's perspective on the attributes that work in mHealth apps as well as the improvements that can be offered. The development of *POD adventures* encompassed both users and service providers. In the layout of the mental health app, the users and the service providers advocated for the game-based mental health app as it appeals to the youth (Gonsalves et al., 2019).

Despite the advocacy that mental health apps have received in user-testing, the practical implementation of it still takes precedence. The unavailability of smartphones to individuals who require mental health assistance was a hindrance to adequate and privately accessible care (Caplan et al., 2018; Povey et al., 2020). This limits the scalability of the intervention in remote areas with minimal to no mental health care access as well as appropriate response time.

Discussion

The evidence from the reviewed studies suggests that mental health apps have the potential to provide mental health care to locations that have limited resources. The articles indicated that the majority of the mental health apps were designed for the youth as they are the ones more likely to interact with them, thus, prompting help-seeking behaviour (Arenas-Castañeda et al., 2020; Caplan et al., 2018; Gonsalves et al., 2019; Povey et al., 2020). Due to the low and still growing evidence of efficacy (Torous et al., 2018), the implementation of mental health apps requires the recognition of the contextual differences between where the apps are adapted from to where they will be adapted to. Hence, co-designing apps with local experts and community members is vital (Caplan et al., 2018; Gonsalves et al., 2019; Torous et al., 2019a). The results showed that within the indigenous communities, individuals who assist with suicide prevention also require some support that would make their work easier (Povey et al., 2020).

Mental health apps have varying uses within different categories, with most of them being used as a form of support for those diagnosed with mental illness (Lecomte et al., 2020). The review demonstrates further the disparity in mental health apps between HICs and LMICs. Mental health apps prioritise the provision of support to their users while being accessible through the Apple store and Google store (Alqahtani & Orji, 2020). They offer a variety of services from meditation, information to symptom tracking, online coaching, and social support (Alqahtani & Orji, 2020) with a further expansion on having some apps reviewed by psychological experts (Ibrahim et al., 2022; Weber et al., 2018). However, as it currently stands, the results demonstrate that communities located in the LMICs face the challenge of accessing appropriate and effective mental health care even through apps. While there might be a growth in smartphone ownership, the lack of network infrastructure combined with the cost of data and the sharing of devices limits access to mental health apps. It is also necessary to acknowledge the existence of free to use apps for mental health. However, their efficacy is still to be tested and formally documented in the literature for LMICs.

Contrary to the anonymity that mental health apps provide to their users, there are concerns about the provision of data privacy and confidentiality. Torous et al. (2018) allude to the lack of structured ethical guidelines in line with digital health interventions as a form of protection. Marshall et al. (2020) outline that the development of mental health apps often occurs outside the involvement of academic institutions and with little expert advice. Thus, the regulation of interoperability remains an issue. Some of the articles indicate that they implemented their country's data regulation laws which can often be left to interpretation as there are not designed for the digital delivery of health and mental health.

In cases where devices are shared, privacy concerns are also tied in with cultural concerns. Gopalkrishnan (2018) discusses the shame and stigma associated with mental illness. Families would not want family members seeking help. Even though apps offer the space for individuals in such communities to get help, the use of shared devices precludes this. Hence, the results emphasise the need for culturally sensitive intervention due to the shame and stigma associated with mental illness.

Contextual differences influence the uptake and efficacy of mental health apps further. Gopalkrishnan (2018) outlines elements such as emotional expression, shame, power distance, collectivism as well as spirituality, and religion in the relationship between culture and mental health that play a key role in individuals using mental health apps. An example of this was cited in Kümm (2018) where an autism app failed to detect some of the facial expressions of South African children because it was standardised using American children. Further, using a dog in the American context was suitable as it is considered a friendly animal, but within the South African context, a dog was not seen as a friendly

animal among a large segment of the population. Hence, the app not only biases South African children, but it also included examples that were not culturally acceptable.

Majority of apps are in English, but this excludes those that who are not conversant in English. In LMICs, English is not the first language for a substantial sector of the populations. Linked to language is the literacy level of individuals who need to use the apps. Literacy with regards to both the language used in the app as well as technological literacy. Ganasen et al. (2008) argued that low literacy in individuals diagnosed with mental illness impacts patient care as well as lack of accuracy and validity in mental health app screening tools. As such, the adaptation of mental health apps to the context of use is recognisably important as a user-oriented intervention. Thus, user-testing and co-design workshops are essential when developing apps for use in LMICs (Brown et al., 2020; Povey et al., 2020).

The studies also alluded to the lack of regulation in the field with regards to mental health apps. There is therefore a need for both legislation and ethical guidelines governing issues of privacy and data security for users of mental health apps. Laher and Hassem (2020) discuss the ethical challenges associated with online mental health screening and present some guidelines to be used when for the development of online mental health screening tools. A similar initiative is necessary for mental health apps. The National Institute of Mental Health (U.S. Department of Health and Human Services et al., 2017) advocates for the development of a checklist for the evaluation of mental health apps which will help further in ensuring the quality of apps that are available. Newer research has been targeting these gaps of creating digital health frameworks in LMICs taking into consideration culture (Chelberg et al., 2022). This indicates the continuous explorative trail with mental health apps and digital health interventions.

Conclusion

The explosive growth of mental health apps introduces an aspect of healthcare that provides efficiency in the intervention methods being implemented. In their basic functionality, Marshall et al. (2019) present that mental health apps provide immediate assistance, convenience, and affordability, which is of particular importance to its relevance to low- and middle-income countries. This intervention format brings focus towards the self-care that the user can engage with when using the apps as they can both be used a stand-alone self-care or in support of traditional interventions (Donker et al., 2013). Arguably, mental health apps also extend the ability for the patient to track their symptoms through ecological momentary assessment (EMA) (Donker et al., 2013; Hollis et al., 2015). There is engagement with the aspect of mental health literacy in which the apps implement psychoeducation, self-assessment (EMA), and treatment centres on top of information on referral allowing the patient to assess what they have and request assistance to the nearest centre (Olff, 2015). However, as indicated in this review, there has been very little research into the efficacy of mental health apps in LMICs, and where this research exists, it is focussed on younger populations. Hence, there is an urgent need to determine if mental health apps are indeed providing the services needed in resource challenged communities in LMICs. Further, the results highlighted important elements with regards to availability, accessibility, acceptability, and quality that app developers need to consider ensuring the utility and uptake of mental health in LMICs.

Author Contribution BG conducted the study as part of her Masters degree and wrote the first draft of the manuscript; SL supervised the Masters project, assisted with the conceptualisation and methods, and wrote the subsequent drafts of the paper.

Funding Open access funding provided by University of the Witwatersrand. This work is based on the research supported wholly or in part by the National Research Foundation of South Africa (Grant Number: MND190826471096).

Data Availability Data sharing is not applicable to this article, as no new data were created or analysed in this study.

Declarations

Competing Interests The authors declare no competing interests.

Disclaimer The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the author/s.

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