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Self-help: A systematic review of the efficacy of mental health apps for low-and middle-income communities

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Research Report

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Declaration

I, Beauty Sibongile Lindiwe Gama declare that this research report is my own, unaided work. It is being submitted in partial fulfilment of the requirements for the Masters of Arts in Social and Psychological Research at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other university.

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Abstract

Background: Low and middle-income countries are faced with the challenges of providing adequate and accessible mental health care. This, however, has been a slow process due to the unavailability of resources. With the shift towards a more technologically reliant society, mental health apps offer the opportunity to provide mental health care that is accessible at any geographical and economic location.

Aim: The study aims to determine the efficacy of mental health apps in low and middle-income communities (LMICs) using a systematic review.

Methods: The study utilises a systematic review following the PRISMA guidelines. Articles published within the last 5 years (2015-2020) were eligible for inclusion in the study. This yielded six articles (qualitative, quantitative, and mixed methods) that met the inclusion criteria that were analysed using content analysis and thematic synthesis.

Results: The development of themes followed a deductive approach guided by the Availability Accessibility Acceptability Quality framework (AAAQ) with regards to the provision of adequate service delivery. The results speak to the current available mental health care system in LMICs, some of the barriers to accessing mental health care and how mental health apps offer a way to bridge that in LMICs, the implementation of mental health apps, and the considerations they have to the communities that they are used in and lastly, the quality of care that mental health apps could potentially provide in LMIC contexts.

Conclusion: 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. A recommendation is for the expansion of similar studies in other contexts will assist in developing appropriate and accessible mental health care.

Keywords: Alternative mental health intervention; AAAQ Framework; Digital health; LMICs; mental health; mental health app

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Chapter 1: Contextualising health and digital mental health

1.1 Introduction

This chapter presents background information on the advancement of technology and smartphones within the LMICs. This allows for the presentation of a rationale on why a study on mental health apps is being conducted. Further, outlining what the study aims to do and the proposed questions.

1.2 Background

The information age encompassed within the Fourth Industrial Revolution (4IR) has evolved in a manner that allows for an alternative psychological engagement within the therapy space. With the majority of people owning mobile and smartphones, their usage has become part of a daily routine (Subramani Parasuraman, et al., 2017). Their versatility extends to the use of mobile apps some of which have recently been developed to aid mental health (Torous, Wisniewski et al., 2018). The digitisation of mental health help, from online screening tools to telepsychology, to self-care and medication monitoring highlights the range of accessibility to mental health resources (Chan et al., 2015).

This increased usage of mobile phones and smartphones is of relevance in the South African mental health context. South Africa has been recorded as having a high prevalence of mental issues that go undiagnosed (Bateman, 2015). Arguably, three-quarters of South African individuals living with a mental disorder go untreated, with about 16.5% of adults experiencing mood, anxiety, and substance use disorder (Bateman, 2015; Department of Health, 2013; SADAG, 2016). The high statistics are, however, plagued by the lack of resources in terms of reaching out to communities. Particularly those of lower socioeconomic status who cannot afford private health care. A University of Cape Town population norm study outlined that the country needs about 646 psychiatrists and 466 psychologists which currently equates to a 75% mental health treatment gap (Bateman, 2015; Lund et al., 2015). Furthermore, the South African mental policy has proposed the deinstitutionalisation of mental health care. Mental health apps offer a solution to deinstitutionalisation within the context of decreasing resources.

The relief that is offered by mental health apps extends beyond the availability of resources towards the means of access to mental health care. Duan and Zhu (2020) outline that during the Severe Acute Respiratory Syndrome (SARS) epidemic psychological intervention was offered telephonically in the form of counselling. However, due to the number of people who

were calling, the severity of the disorders was not addressed. This can be further extended to the current epidemic of Coronavirus disease 2019 (COVID-19) where people cannot physically get assistance from community and public health care facilities for professional timeously diagnosis and treatment. The delivery of coordinated mental health care through smartphones implements measures that are effective in the time of a pandemic, especially when looking into low-and middle-income countries (Duan & Zhu, 2020).

The Independent Communications Authority of South Africa (ICASA) (2019) report outlines that the use of mobile phones per household increased from 87% in 2016 to 88.2% in 2017 with household access to the internet being 61.8% countrywide. Further, in rural spaces, mobile devices are noted as being the main source of internet access (ICASA, 2019). This opens the opportunity for mental health interventions to be implemented through the use of mental health apps (Norris et al., 2013). The rapid increase of mobile phone usage in both low- and middle-income sectors gives way to delivering mental health intervention in secluded environments, alleviating the financial burden (Norris et al., 2013). 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. Hence, the proposed study is reviewing the literature on the efficacy of mental health apps specifically in low- and middle-income communities.

1.3 Research Aims

The study aims to determine the efficacy of mental health apps for low and middle-income communities using a systematic review method. The review will consider specifically which areas studies have been conducted, on which populations, the nature of the app (for example, online screening tool, telepsychology, self-care, medication monitoring), as well as the affordances and limitations offered by the app for the context.

1.4 Rationale

Advancement within the technological space needs to be acknowledged as it has made health care more accessible. With the current climate of an epidemic that limits human interaction, the need for health care to be easily accessible is heightened. Where in previous pandemics,

like SARS, there were technological limitations. COVID-19 has demonstrated a high need for health care that can be provided through smartphones by bridging the provision of health care with technology. Despite that, countries located within the low-and-middle economic bandwidth are still experiencing challenges within health care specifically, mental health (Docrat et al., 2019; Lake & Turner, 2017). Mental health care in populations like South Africa faces challenges of stigmatisation as well as the accessibility to basic health interventions (Peterson & Lund, 2011; Schierenbeck et al., 2013)

This is largely due to the inequality faced by the country concerning the distribution of resources, as about 82.1% of South Africans cannot afford private health care (Bateman, 2015). Arguably, the South African Depression and Anxiety Group mental fact sheet (2016) outlines that with the deinstitutionalisation of mental health care there has been a 7.7% decrease in mental hospital beds. This means mental health care is limited to those who can afford private care. Furthermore, the access of mental health caregivers is disproportionately lower than a given population with 0.32 psychologists, 0.28 psychiatrists, and 0.4 social workers per 100 000 population (SADAG, 2016).

The lack of adequate resources means that mental illnesses go undiagnosed and untreated by professionals. SADAG (2016) outlines that South Africa is faced with a high prevalence of mental disorders, with teenage suicide attempts reported to be at 31.5% (Reddy et al, 2013). This, however, does not consider the co-morbidity of mental illness with other health conditions such as tuberculosis and HIV (Jack et al., 2014). This is further exacerbated by the lack of accommodation for those that suffer from both mental and physical health conditions. The National Mental Health Policy Framework and Strategic Plan 2013-2020 in alignment with the WHO Mental Health Action Plan proposed the implementation of integrated mental health care within the administration of primary health care. However, it has been difficult to track the implementation progress within the decentralisation of mental health care as well as the restrictions brought by financial constraints (Lovero et al., 2019; Schierenbeck et al., 2013). The implementation of community-based care centres' is a new method of bringing mental health care (Department of Health, 2013; Lake & Turner, 2017). However, this too requires personnel and resources which are extremely limited.

Thus, the current mental health care model and treatment scheme fail to adequately address the mental health needs of the population (Lake & Turner, 2017). The World Health Organisation (2001) proclaimed that mobile and wireless technologies have the potential to support the

transformation of health service delivery across the globe. Recently, mental health apps have followed the growing trend of mobile and smartphones. With the comfortability of the use of mobile and smartphones daily, mental health apps have been noted to be an intervention that encourages self-care and self-monitoring (Hollis et al., 2015). This encourages interventions that are tailored and user-centred, in which users can track their conditions on their phones (Hollis et al., 2015).

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 South Africa 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, which is effective for patients suffering from disorders such as agoraphobia (Hollis et al., 2015; Kenny et al., 2016). This, therefore, draws in the focus of the study when looking at the efficacy of an alternative form of catering to mental health care through mobile apps in South Africa. Therefore, this study will review the efficacy of mental health apps in low and middle-income communities with the presumption of bridging the gap of access to mental health care.

1.5 Research questions

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 issues identified in the articles with regards to the availability and accessibility of mental health apps in LMICs?

4. Do mental health apps provide an accessible intervention in the LMIC?

5. Are mental health apps adequately acceptable in LMICs?

6. Have mental health apps been shown to offer a level of quality care in LMICs?

1.6 Outline of the Report

This research report presents five chapters, with chapter 1 providing the contextual background, the rationale for the study, aims, and research questions. Chapter 2 outlines the literature on mental health care and policies, advancement to digital health, mental health apps, their use, and the current constraints surrounding their use. This chapter further introduces the AAAQ analytical framework that was used to understand the results. In Chapter 3 the methodology that was used was presented by describing the review procedures. Chapter 4

reports on the results obtained through content analysis (quantified descriptive data) and thematic synthesis that allowed the discovery of themes guided by the analytical framework through a deductive approach. Chapter 5 discussed the findings of the study in the context of literature on already established mental health apps in HICs, their use, and some of the constraints that come with digital health implementation. The report concludes by presenting the limitations of the study and recommendations for future studies.

Chapter 2: Literature review

2.1 Introduction

The following chapter presents background information on mental health care in low and-middle- income communities, including the governing policies in the implementation of adequate mental health care. Furthermore, it introduces the understanding behind digital health and the establishing of mental health apps that are currently in use as an alternative to face-to-face intervention. A brief review of some of the mental health apps currently in the high-income communities (HIC) market is presented, which leads to the outline of contextual adaptation of the mental health apps and how they differ from the current mental health interventions. Lastly, it will highlight the constraints that come with the implementation of the mental health apps and the presentation of the AAAQ framework and its suitability to this study.

2.2 Mental health care

In understanding mental health care, the World Health Organization (WHO) presupposed the definition of what mental health is which was further defined by Galderisi et al. (2015). Mental health is understood as a sense of internal equilibrium that allows one to be in harmony with societal values. It involves the ability to navigate your basic internal cognitions and emotions, allowing for empathetic interaction which expands one's social skills. The idea of mental health draws on ensuring personal health with the ability to cope with life's adversity and function in a social setting further building and maintaining relationships (Galderisi et al., 2015).

The World Health Organization (WHO) alludes to the pressing matter of the administration of mental health care where suggestions of preventative measures were made (WHO, 2013). This includes the reduction of environmental stressors as well as the early identification, prevention, and treatment of emotional and behavioural issues through customized interventions. Mrazek and Haggerty (1994) present a spectrum of interventions that contains mental health interventions for different disorders. These include preventative measures for different mental and physical illnesses. Though these implementation strategies have been proposed by the WHO for improving mental health care, their administration has been slow-tracked due to the societal and organisational barriers (Schierenbeck et al., 2013).

In an attempt to supplement the implementation restrictions, low-and-middle-income countries (LMICs) like South Africa have opted for an intervention delivery measure that is community-based (Robertson & Szabo, 2017). Thornicroft et al. (2016) outline that community health care

is a practice that caters for access to mental care within the local population. It acknowledges the struggles that are faced in mental health care implementation. This intervention allows for a form of inclusion to disadvantaged communities in support of the deinstitutionalisation of mental health care.

The emphasis is drawn upon the evidence-based and practical application of mental healthcare (Thornicroft et al., 2016). 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 (Kohrt et al., 2018). This intervention form is particularly important within the LMIC because of the mental healthcare gap that is due to the limited excess of resources. With minimal mental illness knowledge, stigma is often associated with mental disorders and their diagnoses. Community-based health care continues to face difficulty in assisting with the comorbidity of mental illness with a physical illness such as HIV or heart disease (Schierenbeck et al., 2013).

Lake and Turner (2017) bring into consideration that the current dominant mental healthcare systems do not suffice in tackling some of the challenges faced. The 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-envisioned delivery of mental health care (Lake & Turner, 2017). Researchers have brought to attention the functionality of digital technology as a form of access to mental healthcare. In which, the development of digital intervention tailors user-centred needs as well as presenting a cultural change in the administration of mental healthcare (Hollis et al., 2015).

2.3 Mental health care: Policy insight

At the forefront of any developments in public health and mental health care is the involvement of the state governing body. The implementation of progressive mental health care is currently being guided by establishing a way in which it can be integrated into primary health care practice (Kessler, 2012). This will allow for mental health issues such as substance abuse to be addressed with urgency offered to physical illness. Shen (2013) raises the issue that the implementation of policy directed to mental health care has been slow due to reform that is being politicised because of the unpleasant history behind mental health. This largely involves deinstitutionalising this kind of care and involving the public through community-based mental health care (Kessler, 2012). This follows the WHO's analysis that there is an access gap of

about 35% to 50% in developed countries to basic mental health care, as well as treatment and, it increases to 75% to 80% in developing countries (Wiktorowicz et al., 2020). The World Health Organisation (2005) introduced the World Health Organisation Assessment Instrument for Mental Health Systems (WHOAIMS) which is developed to gather information that will aid in mental health care reform in terms of implementing adequate interventions and treatment within the community-based health care.

Dlouhy (2014) conducted a study that investigated mental health policy reforms in selective Eastern European countries. The study utilised a health policy questionnaire which was developed and designed to be country specific. This constituted of (1) the basic country information, (2) health care financing, (3) mental health services, (4) health service purchasing, and lastly (5) mental health policy (Dlouhy, 2014). Delving into the result on the mental health policies, they show that there is a slow change in the development of policies which has often resulted in the politicisation of the implementation of mental health care policies. Dlouhy (2014) found that in the evaluated countries, the Czech Republic had the oldest policy on psychiatric development which took place in the year 2000, while Bulgaria, Slovakia, Poland, Romania, Moldova, and Hungary subsequently followed from 2004 approving policies from 2004-2014 and 2007-2011. This demonstrates the delays in mental care and treatment and the reaction the countries have had towards it (Wiktorowicz et al., 2020).

With a high mental health care gap in low and middle-income countries, Essien and Asamoah (2020) outline that African countries have issues of inadequate mental health care governing policies and infrastructure for better treatment of patients. In places like South Africa, the system found it difficult to manage high numbers of patients, and others had to be re-admitted three months later (Thomas et al., 2015). In Uganda, it was found some of the mental health care facilities had poor ventilation, insufficient care material, and food (Essien & Asamoah, 2020). Bhugra et al. (2018) discern that 21.1% of countries within the LMIC bandwidth have no mental health laws and policies. Those that are present require a change to enforce a more progressive and technological consideration of mental healthcare (Bhugra et al., 2018; Essien & Asamoah, 2020).

2.4 Digital Intervention: Mental health apps

The rapid increase in the daily use of mobile and smartphones can no longer be ignored. The surge is due to the engagement with mobile apps which range in their use from entertainment, productivity, and social connectedness (Chiauzzi & Newell, 2019) to now lifestyle, health, and

mental health apps under the understanding of mobile health (mHealth) (East & Havard, 2015). They are argued to have the potential to change the therapeutic platform and engage with patients in real-time (Torous, Luo, et al., 2018). 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 (Fagerjord, 2012; Kenny et al., 2016). In a survey of 15 000 mHealth apps conducted by the World Health Organization (2015), it was found that about 29% of them have their focus on mental health diagnosis, treatment, or support (Anthes, 2016a; Chandrashekar, 2018). Hollis et al., (2015) assert that mental health apps include functions such as symptom tracking, diary entries, and appointment or medication reminders as well as motivational quotes. The mobile mental health app engages with the patient in real-time as the app is supported and tailored within the hard drive of their mobile or smartphone (Jobe, 2013).

According to Torous et al. (2018), the increased number of patient's mental health app usage and other technological outreach has demonstrated that there is some form of benefit to it. This is due to the broadened target range of disorders, which includes mood disorders (depression, anxiety, and bipolar), substance use, and eating disorders (Chandrashekar, 2018). The mental health apps are aimed at being a form of self-help towards mental health outpatients, extending to those who have not been diagnosed. These allow room to be used in conjunction with other comparative methods of intervention such as internet-based intervention which offers direct contact with a mental health assistant (Donker et al., 2013).

Internet-based interventions, similarly to mental health apps, are held as the gold standard of a digitised form of mental health intervention. They are, however, defined as treatment form that has been adapted for their delivery through the internet as computerised interventions which include online screening tools (Andersson & Titov, 2014; Martínez et al., 2018). The transformative nature of the intervention has left scope for limitations that Andersson and Titov (2014) have outlined. These including the accessibility of resources to administer such computerised interventions as well as the availability of internet access. However, mental health apps offer the advantage of being installed on the mobile or smartphone allowing the patient to engage with it at any time possible (Torous, Wisniewski et al., 2018).

Mental health apps have been advocated for when it comes to their functionality. The National Institute of Mental Health (NIMH) (2017) outlines that there is no checklist for the evaluation of mental health apps as they are still a new concept encompassed within the constantly changing aspects of technology. However, Chandrashekar (2018) asserts that within the

functionality of mental health apps, the NIMH classifies them based on six categories which are: self-management, cognitive improvement, skills training, social support, symptom tracking, and passive data collection (NIMH, 2017). The categorisation provides an extension towards the provision of clinical care which subsequently includes immediate crisis intervention and post-treatment condition management (Chandrashekar, 2018; Price et al., 2014). The accessibility is made evident in the engagement that the mental health apps provide to everyone in a manner of inclusive care regardless of the context.

2.5 Mental health app review

Mobile applications that resonate with mental health 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, Wisniewski, Bird et al., 2019). 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. The core investigations focusing on commonly diagnosed disorders such as depressive disorders, bipolar disorders, anxiety, posttraumatic stress disorders, schizophrenia, suicidal behaviours, and addictions (Lecomte et al., 2020; Wang et al., 2018). Torous, Wisniewski, Bird et al. (2019) aimed at developing a mental health app that was guided by mental health experts and the users. As a continuing project, the process showcases the importance of including both the user and expert in the development process.

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 or disorders. The study draws focus unto apps that assisted with anxiety, mood disorders, sleep disorders, and addictions. The study included four articles that were looking at four apps for anxiety and the majority of the apps use a game-based design with the results showing that individuals who tried the apps experienced stress reduction compared to the control group (Wang et al., 2018).

Focusing on two apps for mood disorders, the study outlined that the app *T2 Mood Tracker* assisted with rating the user's moods, self-monitor their moods across time, and provide feedback with a health care provider (Bush et al., 2014). When tested on re-deployed soldiers,

they found it to be useful and beneficial to be able to correspond with health care providers immediately (Bush et al., 2014; Wang et al., 2018). An alcohol addiction app *Location-Based Monitoring and Intervention System for Alcohol Use Disorders (LBMI-A)* was shown to be effective in maintaining sobriety and reducing alcohol intake through implementing functions such as awareness, accountability, skill transference tracking progress and prompts (Wang et al., 2018)

A review of bipolar disorder (BD) apps found in the sample, 38% were used for information on the disorder, 43% for symptom monitoring, 12% for screening and assessment, and 5% for community support (Nicholas et al., 2015). They outline that no app combined some of the functions for self-management agency. Furthermore, most of the BD apps were commercially developed with only a small fraction developed clinically. This concurs with Sucala et al. (2017) who reviewed anxiety apps and found a majority of them do not offer evidence-based interventions. There is little information as to the kind of intervention being implemented and the theory in support, as most of the apps are categorised under health, fitness, and lifestyle (Nicholas et al., 2015; Sucala et al., 2017).

2.6 Contextual implementation of an intervention

South Africa, like most developing countries still faces the challenge of meeting the population demand on the provision of basic mental healthcare. The history of unequal distribution of resources merely ascertains the difficulty in providing adequate mental health care. The South African National Department of Health (2012) commenced the implementation of the National Mental Health Policy Framework and Strategic Plan 2013-2020 with regards to integrating mental health into public healthcare. This means the actuality of the problem still lies with not having enough resources to be able to realise this policy (Hlongwa & Sibiya, 2019; Schierenbeck et al., 2013).

The International Covenant on Economics, Social and Cultural Rights (ICESCR) argues for the fundamental value of well-rounded healthcare intervention that is recognised through availability, accessibility, acceptability, and quality that it provides towards the recipients (Schierenbeck et al., 2013). The distance in obtaining mental healthcare is huge as people struggle to be at reach with quality mental healthcare. Despite the effort being put into community-based centres, the issue of resources extends beyond what has been provided. Torous, Wisniewski, et al. (2018) further attests that mental healthcare is faced with difficulties besides the structured treatment barriers that include affordability, resource availability, and

time constraints. However, some barriers are usually not considered when proposing mental care intervention. These include; lack of mental health literacy, poor help-seeking behaviour due to stigmatisation and the low perceived treatment need (Torous, Wisniewski et al., 2018). Mental health apps provide a sense of engagement with these aspects in a way that was previously considered not to be possible.

2.7 Advancement: How mental health apps differ from traditional interventions

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).

Vaidyam et al. (2019) propose that mental health apps have a potential that can be continually harnessed. This is portrayed in them outlining the functionality of an app. In which, machine learning is implemented in an app allowing the patient to combine the use of sensors and assessments in a real-time setting. This will 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 patients (Vaidyam et al., 2019). 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. Further attesting to delivering mental health intervention through health apps supplements the effectiveness of treating various mental health disorders including mood and anxiety disorders (Donker et al., 2013).

Though the stride taken by the development of mental health apps has been embraced due to the impact it brings towards improving mental healthcare, reservations are still being brought forth. Torous et al. (2018) acknowledge that mobile and smartphones are in constant

evolvement, as such, apps also update their functionality which could result in patients being less comfortable with the newer version of the app. In a survey conducted by Torous, Wisniewski et al. (2018), patients were shown to appreciate the features of the health app that allowed them to set up appointment reminders, having text or call log monitoring. However, when it came to GPS tracking features they appreciated them with the use of passive data usage (Torous, Wisniewski et al., 2018).

2.8 Current constraints

The issue of privacy and anonymity is one that constantly presents an ethical dilemma for researchers. This is highlighted with the idea that if a patient's medical records are easily accessible through a mobile phone, who is to say no one can get to them (Chandrashekar, 2018; Giota & Kleftaras, 2014). Giota and Kleftsras (2014) argue that apps use demographic as well as personally identifiable data as a means of accessing personalised intervention which introduces the vulnerability towards the individual's information. The privacy policy developers do not offer regulations in providing security towards personal and sensitive information. This could subsequently introduce a patient's data to third-party advertisers (Giota & Kleftaras, 2014). There is also the aspect of loss of data as a result of technological malfunctions, without any backup for the information, a patient's information could be lost with no way of retrieving it (Giota & Kleftaras, 2014). This could result in not knowing the patient's progress thus far.

Like all psychological interventions, mental health apps need to be subjected to an evaluation of efficiency in assessing psychological disorders. Researchers like Torous et al. (2018) and Chandrashekar (2018) present a daunting matter on the psychological efficiency of the apps. They argue that mental health apps cannot be presented as psychological engaging tools as they have not been standardised to fit into that criteriathat criterion. In as much as numerous apps exist intending to diagnose and manage various mental illnesses, a hand full of apps meet a psychological testing standard (Anthes, 2016a; Chandrashekar, 2018; Chiauzzi & Newell, 2019; Donker et al., 2013; East & Havard, 2015; Torous, Wisniewski, et al., 2018). The American Psychological Association (as cited in Torous et al., 2019), attests to not having a set checklist for evaluating each mental health app. However, they do provide a clinical-based evaluation in consideration of using mental health apps as a clinical intervention.

These include a five-step evaluation: collect background information, assess the app's risks, including the risk of compromised privacy and security, review the evidence supporting the

app's potential benefits, evaluate the app's ease of use, and review the app's clinical integration and ability to strengthen the therapeutic alliance. As such, mental health apps largely remain in the research space (Torous et al., 2019) while others such as *PTSD coach* gradually make it over the clinical setting threshold (Olff, 2015). Mental health apps show the potential impact they might have on LMICs. However, the presented research has its foundation in western and economically stable countries. This consequently shows the gap that is still evident in providing quality mental health care in low- and middle-income countries like South Africa.

2.9 Analytical Framework: AAAQ Framework

The AAAQ framework will be used to structure the analysis of the study. Presented by the United Nations (UN) Committee on Economic, Social and Cultural Rights (CESCR), General Comment No. 14, the framework follows the inequality surrounding the provision of health care. Thus, adhering to the understanding of the right of the highest attainable standard of health care by everyone (Schierenbeck et al., 2013). The AAAQ framework (Availability, Accessibility, Acceptability, and Quality) presents elements that could plan and guide the implementation of a health care system that meets people's needs (Gunilla & Strang, 2016).

The Right to Health concept emphasises that everyone is entitled to adequate health care that is "scientifically sound, properly equipped and to be met with respect on both personal and health belief care" (Gunilla & Strang, 2016, p.320). As such, the AAAQ framework brings forth tools that will help in identifying the barriers to appropriate health care (Gunilla & Strang, 2016; Schierenbeck et al., 2013). The AAAQ framework becomes suitable for this study as it aims at discerning the plausibility of mental health apps in LMICs and thus outlining some of the difficulties encountered in the articles being analysed. This will show some of the shortfalls mental health apps bridge and a way forward into implementing appropriate mental health care in various contexts that are often overlooked.

The framework consists of elements that are interrelated with each other. Availability: it looks at the existence of the type 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 (Schierenbeck et al., 2013). Acceptability: refers to the equal treatment and provision of health that is culturally and ethically respectful to all members of the community (Gunilla & Strang, 2016). Lastly, Quality: looks into 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 (Gunilla & Strang, 2016; Schierenbeck et al., 2013).

2.10 Conclusion

The chapter portrayed how mental health apps are still making a breakthrough within the psychological intervention space. With the increased usage of mobile and smartphone usage, mental health apps have the potential to change the administration of mental healthcare especially to those that are disadvantaged by systematic and economical structures. It further shows the immediacy of care and the cost-efficient rate and accessibility they have to everyone. However, it outlines that such an improvement exposes the vulnerability of a patient's sensitive information due to the unstructured privacy policies implemented by developers. Thus, the need for mental health evaluation and standardisation in terms of reliable and valid psychological assessment and intervention. It concludes by presenting the analytical framework used to analyse the results and its suitability to the study.

Chapter 3: Methods

3.1 Introduction

This chapter begins by presenting a systematic review study design and why it is suitable for this study. Further, outlining the review procedures that were followed in the study as well as the search strategies and study selection which are supported by Uman (2011). The search strategies and study selection follow 8 stages which begin by formulating review questions, defining the inclusion and exclusion criteria, implementing a search strategy, extracting the data, assessing study quality, analysing, and interpreting results, and lastly, the dissemination of the results. A reflexivity section is included as a means of tracking any bias that might be imposed in the screening and analysing phase. Ethical considerations are outlined.

3.2 Study design

A systematic review is defined as a summary of the literature that consists of reproducible methods to "systematically search, critically appraise and synthesize 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 is 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. This clearly outlines the layout use of mental health apps in LMICs, thus, allowing to discern any knowledge gap.

3.3 Review procedures

The process of the systematic review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (see Appendix A) as well as the Four-phase flow cart (see Appendix B) which engages with the identification, screening, eligibility, and inclusion of the primary research when aiming at answering the proposed research questions (Moher et al., 2015; Selçuk, 2019). The included articles were per the research questions looking for the use of mental health apps in LMICs, which were checked for their quality and then analysed.

3.4 Search strategies and study selection

The study followed an 8 stage-structured framework proposed by Uman (2011). The initial stage included the formulation of review questions which captured what the study is looking into.

3.4.1 *Stage 2: Defining inclusion and exclusion criteria*

These, in turn, guided the second stage of defining the inclusion and exclusion criteria, which involved a criterion with a developed checklist of the expected sample which for this study includes the low-and -middle-income communities (LMICs). Secondly, the sample should have some experience with mental health apps, be it through regular use or user testing to ascertain their viability in the community. Thirdly, the inclusion of journalistically unpublished work such as research reports and lastly, the use of the three main methodologies within the various studies.

Articles that included: (1) high-income communities (HIC), (2) in-app written reviews, and (3) users being diagnosed with any physical illness were excluded from the selected article pool.

Inclusion	**Exclusion**
1. LMIC sample	1. App-written reviews
2. MHapps use or user testing	2. Diagnosed with any physical illness
3. Grey literature	3. HIC
4.Qualitative, quantitative, or mixed methods studies	

Table 1: Inclusion and Exclusion criteria

3.4.2 *Stage 3: Search strategy*

The selection of search terms and phrases that were used to identify and select eligible studies to be included: “Mental health app”, “mHealth”, “Health app”, “Technology mental health”, “alternative intervention mental health”, “Mental health LMIC” and “mental health intervention LMIC”. The search terms were, inserted in the chosen databases, using the Boolean search, the optimisation of the search strategy involved the combination of “Mental health app” AND “LMIC” as well as (technology OR alternate) AND “Mental health”. A rigorous search of the phrases through the titles, abstract, and the full text of the article resulted in articles that were collected for further screening using the inclusion and exclusion criteria. These were obtained from four databases namely: Cochrane Library and Scopus, with Sabinet and DATAD-R drawing into grey literature within the LMIC.

3.4.3 *Stage 4: Selecting Studies*

In the search for the articles that meet up the criteria, the titles, abstracts, and the full-text articles were reviewed and downloaded in a reference managing software Zotero as well as an Excel record sheet to track down the selected abstracts and articles as well as those that did not meet the inclusion criteria. A total of (n= 68) articles found that the deletion of duplicate articles resulted in (n=64) which were then put through the inclusion ad exclusion criteria. The screening of the articles consisted of the first level, where articles were excluded because they did not consist of the full structure; some were missing abstracts, the methods sections, and the results section. The second level involved applying the inclusion and exclusion criteria to the full text of the articles, with (n=6) articles being put through quality check and being included in the study's review. Figure 1 of the four-phase flow chart offers a representation of the article screening process.

PRISMA 2009 Flow Diagram

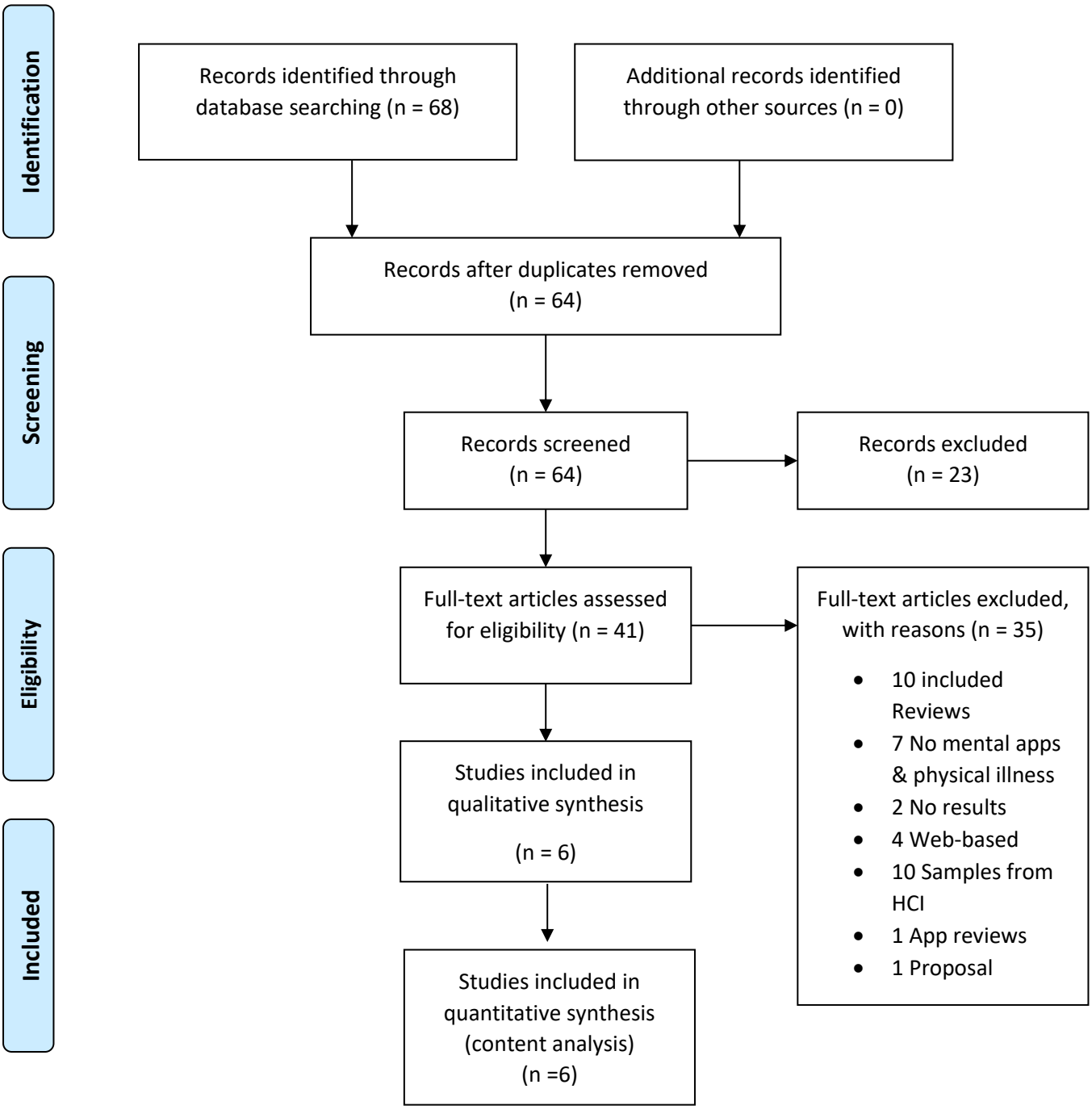

Figure 1: Four-phase flow chart

3.4.4 *Stage 5: Extracting data*

As the process of data extraction is rigorous such that it requires two reviewers as means of avoiding data entry error, the study incorporates a table as means of capturing the necessary information of the articles (Uman, 2011). This includes the authors, year of publication, sample, age, study design and whether it has been included or excluded, and the reason for such, which is guided by the Four-phase flow diagram (Liberati et al., 2009). These followed the PICOS (Population, Intervention, Comparison, Outcome, and Study type) as it assisted in pinpointing the populations where the intervention has been administered, provide a comparative outcome in LMIC's as opposed to the high-income communities (Hassem & Laher, 2020a; Methley et al., 2014). The articles were tracked down using a Microsoft Excel spreadsheet.

3.4.5 *Stage: 6 Assessing study quality*

The study utilised the CASP checklist tool (Critical Appraisal Skills Programme) (see Appendix C) to assess the quality of both qualitative and quantitative research studies as it allows for a broad area for evidence search such as qualitative and case-control as well as ensuring validity in what is being assessed (Nadelson & Nadelson, 2014). Though the quality assessing tool was primarily used for qualitative research appraisal, the adapted version (CASP adapted) (see Appendix D) further caters to quantitative research design (Hassem, 2019; Hassem & Laher, 2020a). It provides flexibility by having an inclusive criterion for statistical analyses done in quantitative research design (Hassem, 2019; Hassem & Laher, 2020a). The quality score range for the qualitative tool was 0-10 while the quantitative score range was from 0-12. Both the qualitative and quantitative score was above 7 which is an indicator that the studies are of high quality.

3.4.6 *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 2 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.

The thematic synthesis followed a priori coding, which is a deductive research approach where the themes and research questions are guided by the analytical framework (Stuckey, 2015). The AAAQ framework guided the development of research questions. The construction of the research questions took into account the overlap within the concepts of the AAAQ framework. The research questions synthesised using a thematic approach included those based on availability (What are the issues identified in the articles with regards to the availability and accessibility of mental health apps in LMICs?), accessibility (Do mental health apps provide an accessible intervention in the LMIC?), acceptability (Are mental health apps adequately acceptable in LMICs?) and quality (Have mental health apps been shown to offer a level of quality care in LMICs?).

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). Thematic synthesis was suitable because it aims to challenge the effects contained within the studied intervention which locates its questions on the need, appropriateness, efficiency, and implementation of mental health apps (Thomas & Harden, 2008).

3.4.7 *Stage: 8 Dissemination of findings*

The findings of the study have been used to complete a research report which is part of partial fulfilment for the completion of a master's degree. They may be further presented at a conference or published as a journal article.

3.5 Reflexivity

As the study is done as part of the completion of a masters' degree, the data was solely collected by me, the researcher. This involved the selection of the relevant studies that aim at producing findings concerning the questions that have been proposed. However, because of this, the study is exposed to investigator bias as well as confirmatory bias whereby I may select studies that support my argument. The method of tracking articles as well as the inclusion and exclusion criteria being put into place should allow me to keep track of my own confirmatory bias. The

selection of the articles involved me going over the databases numerous times to ensure that I do not miss any articles and that those I already have can be accounted for. Most of the articles that were found and excluded were systematic reviews and scoping reviews. This means that there was no direct investigation of the mental health apps and engagement with participants. The reviews were not acting as a means of sifting the needed articles, as the data collection process did not utilise the chain citing method. The analysis of the articles was rigorous as some of the themes were interlinked, henceforth, outlining the distinction was a bit difficult.

3.6 Ethical Consideration

The study received ethical clearance within the Department of Psychology from the Human Research Ethics Committee (Non-medical) at the University of the Witwatersrand to obtain an ethics waiver. The report involves secondary data collection through selecting articles and no human subjects were involved, thus, no special ethical clearance was required before conducting the study. The protocol number is MASPR/20/05W.

3.7 Conclusion

The chapter outlines the processes that were involved in the finding of research articles, developing inclusion and exclusion criteria, and the methods of analysis that were used. All of which are supported by the AAAQ framework through the use of a priori coding. This further outlines the suitability of using content analysis and thematic synthesis as a means of analysing the articles. A reflexivity section was included as a means to report on some of the difficulties that were encountered during the study process. Lastly, offering the ethical procedures that were taken into account.

Chapter 4: Results

4.1 Introduction

The subsequent chapter presents the results that were yielded using content analysis and thematic synthesis. The content analysis aims to answer the first 2 research questions. The description of the sample table reported on the kind of articles contained in the dataset. Lastly, presenting a thematic synthesis that answers the remaining research questions through the outlined themes and subthemes.

4.2 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:

4.2.1 Description of sample

The study included a total of six articles that met the inclusion criteria and are summarised in Table 2. Out of the (n=6) articles, 1 involved a sample from Africa, specifically South Africa, 2 were conducted in Australia within the indigenous communities, 2 were conducted in South America and 1 was conducted in India. Three out of the six included articles employed a mixed-method (qualitative and quantitative) which involved interviews and design workshops for the apps to test their suitability. The details can be seen in Table 1.

The final selection of the studies originally came from a pool of 68 articles that explored the understanding of mental health apps. The first screening excluded 23 articles due to structural issues such as not having an abstract or investigated population. These did not comply with the chosen PRISMA guidelines. This left 41 articles that were eligible for a full-text review. Further screening was done looking at the make-up of the entire article from abstract, to methodology and type of investigated population. A total of 35 articles were further excluded for reasons such as not having any specific mental health app being investigated to the population being in the high-income communities. The final sample of articles being (n = 6). The majority of the articles yielded a quality appraisal score that was above 7. However, Arenas-Castañeda et al., (2020) yielded a score of 6. This study was still included because it met all the requirements of the inclusion criteria and further, the CASP quantitative appraisal tool is new thus still needs further evaluation and standardisation.

4.2.2 What are mental health apps that are used?

The apps were established for various mental health disorders. 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) and one focused on autism (Kümm, 2018). The majority of the articles focused on the youth, with only one looking into the provision of support for mental health assistants (Brown et al., 2020).

4.2.3 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).

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, Lovera & Liberato 2019	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 Generalized 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
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

Table 2: Descriptive information for included articles.

4.3 Thematic synthesis

Research questions 3-6 were explored using thematic synthesis. The thematic synthesis yielded four main descriptive themes with 21 subthemes from the 6 papers. The themes were guided by the AAAQ framework proposed by the United Nations Committee in ensuring that potential barriers to service delivery are addressed (WHO, 2019). Hence, the themes include (1) Availability, which outlines the sufficiency and adequacy of mental health care in low-income communities (2) Accessibility, which expands on the feasibility of mental health resources (3) Acceptability, which focuses on tolerance and contextual appropriateness that mental health care provided through smartphones can build in an LMIC community and (4) Quality, which addresses the implementation appropriateness of such an intervention. Table 3 provides a summary of themes and the subthemes obtained.

Themes	**Subthemes**
1. Availability	• Secluded rural communities • Mental health knowledge • Mental health practitioners
2. Accessibility	• Access to mental health facilities • Mental health interventions • Mobile data restrictions • Increased smartphone use • Technological growth • Help-seeking

3. Acceptability	• Appropriate implementation
	• Target on the youth
	• Contextual adaptation
	  ➢ Language
	  ➢ Literacy
	• Cultural influence
	• Cost-effectiveness
	• Data privacy

4. Quality	• Usability
	  ➢ mHealth design
	  ➢ User experience
	• Technical feasibility

Table 3: Themes and Subthemes exploring the efficacy of mental health apps in LMIC.

4.3.1 Availability: What are the issues identified in the articles with regards to the availability and accessibility 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 largely shown in ***secluded rural communities***, with a wider disparity in comparison to urban communities (Brown et al., 2020; Povey et al., 2020). The homogeneity of the communities (Povey et al., 2020), means that there is minimal outside influence as well as ***mental health knowledge*** that guides the process of seeking mental health help and assists with destigmatising mental health help. There was also recognised mistrust that community members have towards mental health assistances, especially western ones. Individuals who assist with suicide prevention (Brown et al., 2020; Gonsalves et al., 2019), who are predominantly the accessible help, struggle with the ***availability of resources*** for the provision of adequate care.

This reflects on public health care which is already strained. Rural communities rely on assistance from within the community by the community members due to the minimal ***mental health practitioners*** available as well as deployed to work there. 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).

The issues of mental health support access as remaining the core consideration in the implementation of adequate care. Low- and middle-income communities have slowly moved towards deinstitutionalised mental health care which involves community care. This, however, means that there is minimal ***access to mental health facilities*** which are usually the ones that house a lot of practitioners (Brown et al., 2020; Povey et al., 2020). Physical accessibility extends to the kind of ***mental health interventions*** that are received. The indigenous aboriginal community in Australia (Brown et al., 2020) presents the use of suicide preventers, referred to as gatekeepers who assist as suicide preventers among the youth. This does not guarantee that they possess adequate psychological knowledge which indicates that community members can only acquire knowledge that is limited and does prompt ***help-seeking*** among the youth. Financial accessibility further 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 of phones is seen to be that they are available to those who can afford them. While there is a growing number of smartphone usage, the youth is the demographic that can sufficiently use them. The expense that comes with purchasing data restricts the use of the apps. Participants outlined that they spent data that can last them a month in a week on the app which impacts on finances because they cannot sustain its use (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).

4.3.2 Accessibility: Do mental health apps provide an accessible intervention in the LMIC?

The ***increase in smartphone use*** shows the slow development within the low- and middle-income communities as well as towards the facilitation of mental healthcare through smartphones (Arenas-Castañeda et al., 2020; Brown et al., 2020; Caplan et al., 2018; Gonsalves et al., 2019). The World Health Organisation has noted eHealth which is medical care delivered through mobile phones as a means of reaching communities that are in the outskirts and under-resourced places (WHO, 2019). As such ***technological growth*** shows the competency of smartphones as a bridge in making mental health care accessible to everyone (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 which could prompt help-seeking among the youth. ***Help-seeking*** behaviour is often influenced by the severity of the ill matter or the recognition from those close by as it affects the individual. However, mental illness is plagued by stigma especially in small communities due to the lack of appropriate care as well as knowledge in understanding it. 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).

4.3.3 Acceptability: Are mental health apps adequately acceptable in LMICs?

The implementation of an alternative form of mental health intervention must ensure that it caters to everyone in an appropriate manner. The mode of delivery through mobile devices has been recognised as being more appealing and a ***target on the youth***. The low-income communities have a larger youth population in comparison to high-income countries (Brown et al., 2020; Povey et al., 2020). Being more technological 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 more effective among youth. Further, with the increase in technological reach within the LMIC, using mental health apps can tailor appropriate care (Kümm, 2018; Povey et al., 2020).

4.3.3.1 ***Appropriate implementation***

Mental health apps were introduced as an alternative intervention that requires the recognition of contextual differences and technical feasibility within LMICs. The scalability of psychological interventions brings focus into the provision of adequate care that considers various factors that might impact an acceptable intervention (Caplan et al., 2018; Kümm, 2018).

4.3.3.2 *Contextual adaptation*

This involves changing an intervention to suit the local environment where it is being implemented (Lal et al., 2018). ***Language*** is one of the main issues encountered in the process of adaptation largely because such technology is developed in western countries. The mental health apps that were user-tested within the different communities were taken from HIC with many of them being in English (Brown et al., 2020; Gonsalves et al., 2019; Kümm, 2018; Povey et al., 2020). This is seen in New Delhi and Goa where the sample selection required children that were either fluent in English, Hindi, or Konkani in an area that has a variety of languages (Gonsalves et al., 2019). Furthermore, a he South African study on an app to assist autistic children, almost everything was in English (Kümm, 2018). Though, researchers outline that in the study conducted in the Dominican Republic, the dissemination of the depression app was done using the Spanish Language (Caplan et al., 2018). The linguistic barrier is still a core concern in the adaptation and standardisation of psychological tools.

This further raises the issue of ***literacy*** in the administration and use of mental health apps. Within the construction of concepts, researchers outlined that among the students, those that came from government-run and aided schools had literacy difficulties (Gonsalves et al., 2019). 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). Researchers showed fear of minimal technological proficiency among the community members as well as the participants, however, the steady rise of smartphone use within the LMICs brought reassurance (Arenas-Castañeda et al., 2020; Caplan et al., 2018; Povey et al., 2020). As such, mental health apps have been perceived as bringing an accessible alternative in increasing mental health literacy (Povey et al., 2020). The limited mental health knowledge has been linked to the youth not being able to seek mental health assistance (Brown et al., 2020; Gonsalves et al., 2019; Povey et al., 2020). The increase of mental health literacy through a collaborative process within a cultural setting shines a light on an early diagnosis and intervention implementation for both children and adolescents (Povey et al., 2020).

4.3.3.3 *Cultural influence*

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). Indigenous adolescents 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 United States group (Kümm, 2018).

This further extends to understanding emotional response in teenagers, where it was outlined that their occasional moody responses are not something to be wary of but rather appropriate for people at that age (Caplan et al., 2018; 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). Thus, doubting the efficacy of the digital delivery of the intervention. 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 understanding of mental illness (Brown et al., 2020; Kümm, 2018).

However, the systematic administration of the mental health apps within the various studies considered the cultural context. Researchers outlined that the relevance of mental health apps should consist of the indigenous study of suicidology in indigenous communities 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 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).

4.3.3.4 ***Cost-effectiveness***

Given the high cost of implementing general mental healthcare, the use of mental health apps has been deemed ***cost-effective*** to the user. The use of self-help apps such as *POD adventures* for children was reported as being accommodative cost-wise and easier to disseminate (Gonsalves et al., 2019). Studies recognised the use of technology as means of effectively increasing access to mental health care at a low cost while managing to bridge the socio-cultural divide (Arenas-Castañeda et al., 2020; Kümm, 2018; Povey et al., 2020). Using smartphones as a mode of delivery of apps, such as Smart-screen, enables easier interaction between depression help-seekers and mental health practitioners (Arenas-Castañeda et al., 2020).

4.3.3.5 ***Data privacy***

With the novelty of using smartphone technology as a mode of delivering mental health care, the studies indicated concerns that were raised by participants. There were questions about the security of ***data privacy***. Participants began inquiring where the data was going as well as who was going to see it during the user testing of the suicide prevention tool (Povey, et al., 2020). 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).

The mental health apps that were administered have data security measures taken to ensure the safety of the user's information. Researchers provided confidentiality and anonymity forms to sign (Brown et al., 2020; Gonsalves et al., 2019; Kümm, 2018; Povey et al., 2020). One of the studies adhered to the Mexican law and European regulations for data security, this involved the use of synthetic data which has no identifying information to the user preserving their complete privacy (Arenas-Castañeda et al., 2020). In the construction of online profiles, the participants had to use pseudonyms as this ensured that they were kept anonymous within the platform (Caplan et al., 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.

4.3.4. 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. As gatekeepers within the indigenous communities indicated that they are currently overburdened by the lack of reach to adolescents who face mental health struggles, technology can offer them that opportunity (Brown et al., 2020).

4.3.4.1 ***Usability***

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). Researchers outlined that understanding the user's environment, and motivations enhance the relevance of such an intervention in different socio-cultural settings (Caplan et al., 2018). 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).

4.3.4.2 ***Design***

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 (Gonsalves et al., 2019). This acts as assurance in meeting the requirements of cultural consideration (Brown et al., 2020). These included pictures of the schools and local surroundings per the participant's media preference (Gonsalves et al., 2019). To encourage engagement with the mobile app, the feature of user-choice rewards and quizzes was found to be useful.

End-user experience being a driver of appropriate mental health design, the *Autism & Beyond app* included a screening tool for children at risk of being on the autism spectrum for ages 12 to 72 months (Kümm, 2018). The main purpose is to elicit a positive emotional response, there was an inclusion of non-verbal communication means as some children were not able to verbally converse (Kümm, 2018). Researchers alluded that the overarching goal is the provision of accessible ASD screening, diagnoses, and treatment recommendations in LMICs (Kümm, 2018).

With a majority of mental health apps developed in HIC, 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 helped 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).

4.3.4.3 ***Participant experience***

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). This included elements such as personalization, being able to type on a smartphone rather than write on paper, and vignettes. While the service providers suggested that having a narrative format for the game would be efficient, users felt safe in sharing their struggles (Gonsalves et al., 2019). According to participants, the anonymity offered by mental health apps allows for easier help-seeking behaviour and can combat the feelings of loneliness often experienced by the youth that have nowhere to turn to (Povey et al., 2020).

In the use of *POD adventures*, the participants alluded that the support of a counsellor provided efficacy to the mobile intervention (Gonsalves et al., 2019). The study shows that some of the participants saw value in group sessions as they provided a sense of support they are not alone (Gonsalves et al., 2019). While in a separate setting, one participant indicated a slight disdain in

sharing their feelings in public and raised the issue that despite their expression in the platform, the difficulties they experience continue in their homes (Caplan et al., 2018). The clinicians and users of the *Cognitive Behavioural guided Self-help VoiceThread mobile* app (CBT-VT app) meant for depression, highlighted that the app was clinically relevant and appropriate for the local setting (Caplan et al., 2018). This was mandated by the engagement it provided as well as the good advice it offered which is meant to reduce stress and open easy access to assistance (Caplan et al., 2018; Povey et al., 2020).

Participants did express basic 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 resulting in the inability to complete the program. Other circumstances include home responsibilities, childcare, and employment issues which consequently result in poor response times (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).

4.3.4.4 ***Technical feasibility***

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). 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). This limits the scalability of the intervention in remote areas with minimal to no mental health care access as well as appropriate response time.

4.4 Conclusion

The chapter presented the results that were obtained using content analysis and thematic synthesis. The content analysis outlined the descriptive information on the use and standardisation of mental health apps. The thematic synthesis presented results on the availability and accessibility of mental health care resources, the potential access mental health apps could potentially provide, the acceptability of digital health in LMICs, and the quality care that mental health apps offer as an alternative.

Chapter 5: Discussion

5.1 Introduction

The chapter presents a formulated understanding of the results by establishing a link with the outlined literature. This involves an understanding guided by the research question within the analytical framework. Lastly, looking at some of the limitations of the study and within the methodology that was used. Thus, presenting recommendations for future studies on the topic.

5.2 What are mental health apps that are used?

The evidence from the reviewed studies suggests that mental health apps (mhealth apps) have the potential to provide mental health care to locations that have limited resources. The use of mental health apps bridges the scarcity of appropriate care. Mental illnesses being considered as one of the leading causes of disability as well as accounting for a third of the total burden among adolescents, mental health care remain largely overstretched (Whiteford et al., 2013). The attention is being brought forth to the generation of evidence-based intervention with the context and end-user in mind (Rathod et al., 2017).

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, Luo, 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. The results presented a clear appeal that mental health interventions have towards the youth. They mostly consist of anxiety and depression as well as suicide prevention alerts, these are mental illnesses often most prevalent within the youth (The American College of Obstetrician and Gynaecologists, 2017). Further, technology is associated with the young, as such being able to seek mental health assistance without the scrutiny of others highlights the importance the intervention has. Some of the features contained within the apps such as personalisation and group sharing brought comfort to others knowing that they are not struggling alone and can relate their problems to others.

Mental health apps have varying uses within different categories, with them mostly being used as a form of support for those diagnosed with mental illness (Lecomte et al., 2020). Studies portrayed a focus on apps looking into depression, anxiety, and substance abuse as an introduction to self-help (Lecomte et al., 2020). Within HIC, people use some mindfulness apps categorised under lifestyle as a way of coping with stress (Huberty et al., 2019). This also drew focus on suicide prevention apps especially directed to young individuals. The results showed that within the indigenous communities,

individuals who assist with suicide prevention (gatekeepers) also require some support that would make their work easier (Povey et al., 2020). As such mental health apps, assist with offering accessible help due to proximity to mental health facilities.

The growing number of mental health apps raised the question of the standardised and fair use of these tools. The results indicate that within the implementation of the apps, linguistic differences were considered. However, only two articles indicated that co-designing involved experts enabled the designers to acknowledge the contribution brought on by the participants (Caplan et al., 2018; Gonsalves et al., 2019). Torous, Wisniewski, Bird et al. (2019) outlines that developing an integrated design ensures that the apps address the issues that have been designed for, within the context of consideration.

Compared to HICs, the ubiquity of mental health apps demonstrates the continued growth they have in their use. There is an increasing number of downloads on mental health apps despite the minimal proven efficacy of mental health apps. Kuhn et al. (2014) present a study on a *PTSD coach* app that was developed for military veterans in the United States. Though supported by clinical advice, there is no mention of any psychological standardisation steps taken in the design of such an app. This could be an indication of adaptive measures taken to supplement the contextual shift from a face-to-face intervention to a digital one. The usefulness of the app was notable with the reception it received from military veterans and further receiving more than 150 000 downloads across 86 countries (Anthes, 2016b; Kuhn et al., 2014). A similar app *SUPPORT coach* was adapted for the Dutch community (Anthes, 2016b).

The AAAQ framework has been key to understanding the implementation of recommendable social aids. Homer et al. (2018) outline that it addresses the aspect of the supply-side of service delivery (availability and quality of care) as well as the demand-side (accessibility and acceptability).

5.3 Availability of mental health apps

In line with the allocation of mental health care resources, the results showed that LMICs are predominantly located in secluded locations. This means that there in minimal resources available to the community members. Things such as mental health knowledge and information become less prevalent due to the lack of exposure to adequate care and mental health practitioners. Low and - middle-income communities often rely on other community members who have been exposed to mental health care knowledge or part of community mental health care. Thornicroft et al. (2016) outline that community mental health care supports the evidence-based intervention within LMICs. That does not account for the scalability of self-care intervention which is something mental health apps offer. This, however, is largely being restricted by the lack of infrastructural development such

as software development of apps that are contextually friendly and well developed and consistent network systems (Magrabi et al., 2019).

Robillard et al. (2019) acknowledge that the availability of mental health apps could reduce some of the barriers to access appropriate health care. This has allowed for the portability of mental health care support. However, it does not negate the reliance mental health apps have towards consistent network service provision. The availability of mental health apps can often be disrupted by technical issues, largely service provision (Burns et al., 2011). This not only affects HICs but creates a large gap in the availability of mental health apps in LMICs.

The review demonstrates the disparity in the efficacy of 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). In a study looking at user experience on Cognitive Behavioural Therapy apps, they obtained 31 available apps for depression with 26 consisting of therapeutic features (Stawarz et al., 2018). Half of the therapeutic features corresponded with CBT guidelines. The readily available "pocket therapist" assists other users in the instance where they get panic attacks in public (Stawarz et al., 2018). This showcases that the applicable functionality of metal health apps lies in the availability of resources the LMICs struggles with.

5.4 Accessibility

As it currently stands, the results demonstrate that communities located in the low -and -middle-income brackets face the challenge of accessing appropriate and effective mental health care. Rathod et al. (2017) brings awareness to the disparity in access to care in LMICs. The minimal workforce available consequently leads to minimal and inadequate mental interventions being put in place. The results attribute this leading to a lack of help-seeking behaviour, especially among the youth. The encouragement to seek mental health assistance is not something prevalent, henceforth, some of the indigenous communities in Australia experience high suicide rates among the youth compared to their non-indigenous counterparts (Povey et al., 2020).

Proximity and financial constraints tend to restrict the level of access one has to mental health care. Figliozzi and Unnikrishnan (2021) outline that home delivery services offer the option of being able to access services easier. This largely reflects the COVID-19 pandemic, whereby individuals are unable to leave their houses. As such, cannot access their mental health care practitioner despite facing different mental health issues. Mental health apps supplement the home delivery services as it allows individuals the option of self-management of their disorders in their own home. They enforce

this as an adaptive option for the LMIC population in accessing appropriate mental health care in their own spaces (Figliozzi & Unnikrishnan, 2021).

Researchers, however, have acknowledged that LMIC's are showcasing a rise in the use of smartphones especially moving towards digital health (Raza et al., 2017). The growth can be observed both in LMIC and HIC as the industrial developments become more reliant on technology (Subramani Parasuraman et al., 2017). This could be a gap being bridged in mental health care accessibility. With technological growth within LMICs, the results enforce that this can prompt help-seeking behaviour as this limits the stigma often attributed to mental health and help-seeking. The youth is often exposed to less reliable information about mental health. This has made help-seeking a barrier in advancing mental health care (Torous, Wisniewski et al., 2018). As such, the results indicated that the youth involved in the co-designing of the apps acknowledged that having easy access to mental health apps could boost the morale of help-seeking and knowing they have social and professional support within the platforms (Gonsalves et al., 2019; Povey et al., 2020).

5.5 Acceptability

Labrique et al. (2018) outlines that user-centeredness is essential in the implementation of acceptable interventions. Notably, the results showed the struggles with language as most of the apps used were not developed in the context they were used in. The use of English in most populations means that it excludes those that cannot converse with it. This can be further attributed to literacy level, as some of the participants found some of the constructs difficult to understand. However, the use of smartphones as an alternative intervention opens the opportunity of providing mental health literacy to the low-and middle-income communities. Ganasen et al. (2008) discern that low literacy in individuals diagnosed with mental illness impacts on patient care as well as lack of accuracy and validity in mental health apps screening tools. As such, the adaptation of mental health apps to the context of use is recognisably important as a user-oriented intervention.

Different cultures view mental illness differently in terms of the cause and approach to treatment. Gopalkrishnan (2018) mentions that seeking mental health help is often influenced by the outlook it has on the family. Thus, limiting any actions that could damage the family's reputation or be deemed as crazy such as seeing a mental health specialist. The results emphasise the need for culturally sensitive intervention due to the shame and stigma associated with mental illness. As cultural and religious standing often influences help-seeking behaviour (Rathod et al., 2017). This is in line with what was expressed within the Indian population particularly with adolescents as they usually receive directives from adults. Therefore, the digital health alternative offers adolescents a space to be able to receive assistance without fear of being discouraged by an elder.

Further, contextual differences also take precedence in the implementation of mental health apps interventions. 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. This raises consciousness of cultural differences that need to be acknowledged to avoid unsuccessful intervention. This is something Kümm (2018) shows in the autism app study, whereby the implemented app failed to detect some of the facial expressions of the 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 especially among children (Kümm, 2018). The app not only biased South African children but included examples that were not culturally acceptable.

Some participants raised complaints on travel costs when they require mental health experts (Caplan et al., 2018; Kümm, 2018). With the apps notably subjecting users to the overuse of mobile data, the engagement with the digital intervention becomes inconsistent. This is something that was recognised as a problem (Magrabi et al., 2019). However, mental health apps have been recognised as being cost-efficient for individuals living in rural settings, as opposed to face-to-face interventions which can be cost-prohibiting (Marshall et al., 2020). This is due to the compensation for unforeseen expenses that do not include the payment to the specialist or the facility.

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.

5.6 Quality

The quality provided by the intervention requires the acknowledgement of the scarcity of resources as well as the context in which the intervention is being implemented. The results show that the supply of adequate care through mental health apps requires them to be of use to the people in need of them. Usability is recognised as being pivotal in the adoption of mental health apps as an alternative intervention (Burchert et al., 2019). Henceforth, the implementation of user-testing and co-design workshops in the indigenous communities (Brown et al., 2020; Povey et al., 2020).

The co-design workshops helped to understand some of the challenges of adapting western-based mental health apps. Torous et al. (2018) asserted that mental health apps are often regarded as not being user-friendly as such, the inclusion of the local community members averts the aspect of contextual inconsideration. This led to the discovery that game-based designs with relatable stories being more acceptable among the youth (Gonsalves et al., 2019). Evidently, apps that target anxiety have been seen to largely follow a game-based design format as a way to ease the user of any surrounding triggers (Wang et al., 2018). Further, having counsellors check up on the progress encourages personal engagement as this has been notably one of the struggles of successful mental health app intervention (Caplan et al., 2018).

However, the results indicate that for the implementation of quality and adequate care, LMICs still face the challenge of basic technical reach. Researchers maintain that the value and importance of digital health come with its scalability (Labrique et al., 2018). The technical feasibility in these communities showed a kind of limitation that came with minimal access to resources. Thus, making it difficult to use a smartphone with a further limited appeal to the elderly population group (Burchert et al., 2019; Labrique et al., 2018).

Limitations

With growing research being done in low- and middle -income communities on digital health and mental health interventions, the included sample of articles was small. This means that minimal generalisability can be made as a means of drawing applicable conclusions to other communities in need of such interventions. The majority of articles consisted of a young population, which means that there is little insight gained on how the mental health apps would work with working adults. Thematic synthesis is often done with more than one reviewer to ensure that every theme has been analysed. In this case, this was not possible. Hence there is the possibility of a researcher bias. The inclusion of a reflexivity section assisted with this in that the researcher was consistently able to revisit biases in the screening and analysing of the articles.

Recommendations

This study reveals the positive strides that are being taken towards implementing access, affordable and efficient mental health interventions that are adapting to the current technological revolutions. A way forward would be to conduct further research on the advisability of using mental health apps as an alternative intervention. This would include expert advice, community-based mental health assistance as well as community members in different norm groups.

The element of co-designing the apps that were introduced in one of the studies is something that would enforce the user-centeredness of the intervention and take into consideration the cultural difference. Lastly, there is a need for ethical guidelines governing studying and using the data within the different mental health apps as well as the privacy and confidentiality of the information shared by users. Researchers such as Hassem (2020b) in the review of online ethical guidelines study, acknowledge some of the ethical challenges in working towards developing a web-based depression screening tool in South Africa. Therefore, a similar initiative can be taken with regard to mental health apps.

Conclusion

By analysing articles that investigated the use of mental health apps in low and -middle-income communities, the study showed the potential that mental health apps have in the adaption of a new intervention to bridge some of the challenges faced in LMICs. The results bought attention to the duality of supply and demand as the basis of addressing and aiding access to mental health care which is supported by the AAAQ framework. The intervention being implemented required a look into the availability and the quality of current care and the one that will be supplied. Further, the demand for appropriate mental health care needs to take into consideration the kind of accessibility it has and acceptability with the context. The results indicated that when it came to demand, the mental health apps managed to be receptive to the context and the culture. This is valuable in the design of a user-centred intervention. Despite the insight brought about by the results, there remains the issue of standardisation and the psychological basis of mental health apps being minimally addressed.

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Appendices

Appendix A: PRISMA checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	

Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	

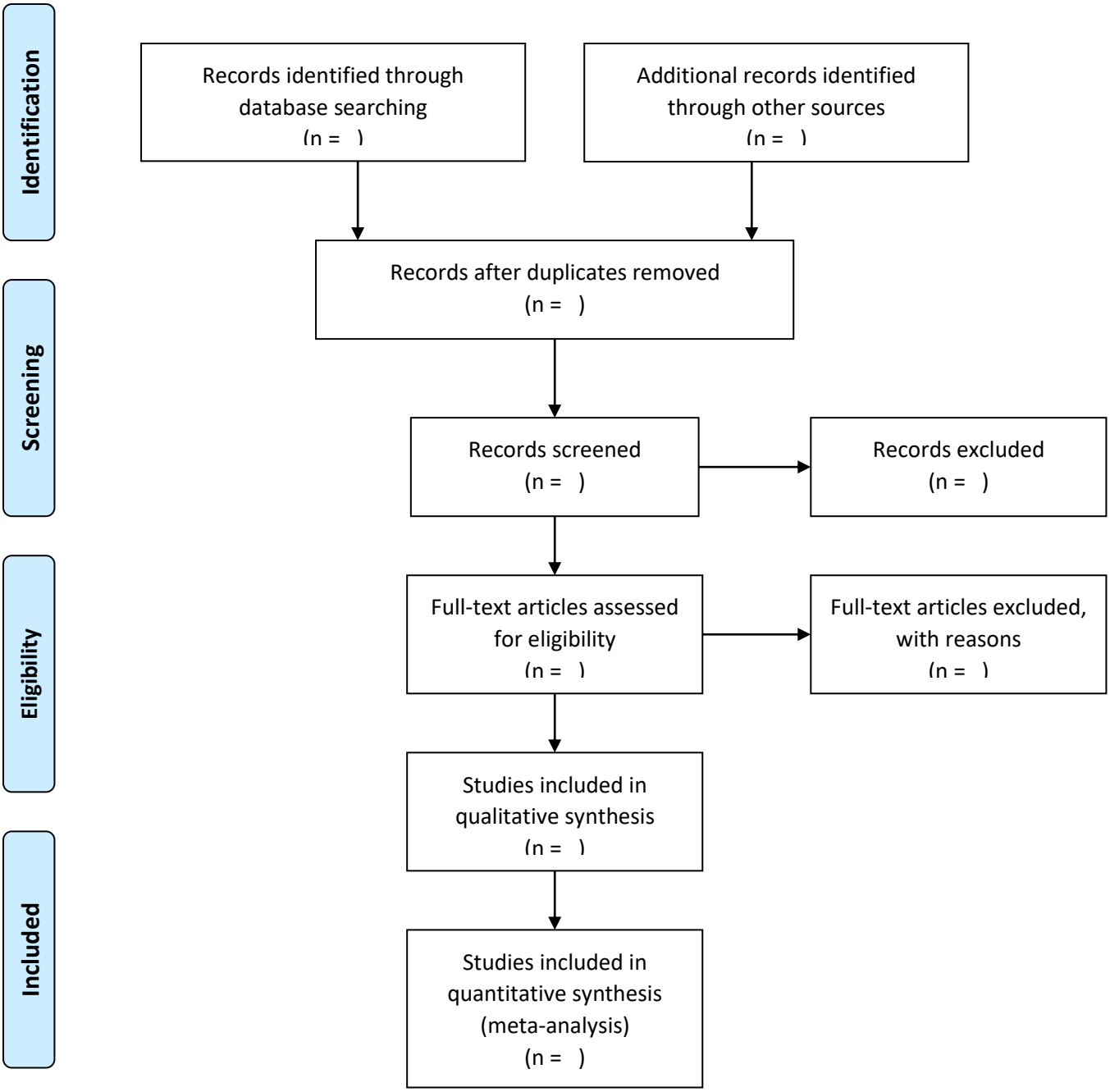
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: **www.prisma-statement.org**.

Appendix B: Four-phase flow diagram

PRISMA 2009 Flow Diagram



Appendix C: CASP Qualitative checklist

Screening Questions:

1. Was there a clear statement of the aims of the research? **□Yes □Can't tell □No**

HINT: Consider

□ What was the goal of the research?

□ Why it was thought important?

□ Its relevance

2. Is a qualitative methodology appropriate? **□Yes □Can't tell □No**

HINT: Consider

□ If the research seeks to interpret or illuminate the actions and/or subjective experiences of research participants

□ Is qualitative research the right methodology for addressing the research goal?

Is it worth continuing?

Detailed questions:

3. Was the research design appropriate to address the aims of the research? **□Yes □Can't tell □No**

HINT: Consider

□ If the researcher has justified the research design (E.g., have they discussed how they decided which method to use)?

4. Was the recruitment strategy appropriate to the **□Yes □Can't tell □No**

aims of the research?

HINT: Consider

 If the researcher has explained how the participants were selected

 If they explained why the participants they selected were the most appropriate to provide access to the type of knowledge sought by the study

 If there are any discussions around recruitment (e.g., why some people chose not to take part)

5. Was the data collected in a way that addressed the research issue? **Yes Can't tell No**

HINT: Consider

 If the setting for data collection was justified

 If it is clear how data were collected (e.g., focus group, semi-structured interview etc.)

 If the researcher has justified the methods chosen

 If the researcher has made the methods explicit (e.g. for interview method, is there an indication of how interviews were conducted, or did they use a topic guide)?

 If methods were modified during the study. If so, has the researcher explained how and why?

 If the form of data is clear (e.g., tape recordings, video material, notes etc)

 If the researcher has discussed saturation of data

6. Has the relationship between researcher and participants been adequately considered? **□Yes □Can't tell □No**

HINT: Consider

□ If the researcher critically examined their own role, potential bias and influence during

(a) Formulation of the research questions

(b) Data collection, including sample recruitment and choice of location

□ How the researcher responded to events during the study and whether they considered the implications of any changes in the research design

7. Have ethical issues been taken into consideration? **□Yes □Can't tell □No**

HINT: Consider

□ If there are sufficient details of how the research was explained to participants for the reader to assess whether ethical standards were maintained

□ If the researcher has discussed issues raised by the study (e.g. issues around informed consent or confidentiality or how they have handled the effects of the study on the participants during and after the study)

□ If approval has been sought from the ethics committee

8. Was the data analysis sufficiently rigorous? **□Yes □Can't tell □No**

HINT: Consider

□ If there is an in-depth description of the analysis process

 If thematic analysis is used. If so, is it clear how the categories/themes were derived from the data?

 Whether the researcher explains how the data presented were selected from the original sample to demonstrate the analysis process

 If sufficient data are presented to support the findings

 To what extent contradictory data are taken into account

 Whether the researcher critically examined their own role, potential bias and influence during analysis and selection of data for presentation

9. Is there a clear statement of findings? **Yes Can't tell No**

HINT: Consider

 If the findings are explicit

 If there is adequate discussion of the evidence both for and against the researchers arguments

 If the researcher has discussed the credibility of their findings (e.g., triangulation, respondent validation, more than one analyst)

 If the findings are discussed in relation to the original research question

10. How valuable is the research?

HINT: Consider

 If the researcher discusses the contribution the study makes to existing knowledge or understanding e.g.

do they consider the findings in relation to current practice or policy? , or relevant research-based literature?

 If they identify new areas where research is necessary

 If the researchers have discussed whether or how the findings can be transferred to other populations or considered other ways the research may be used

Appendix D: CASP Quantitative checklist (Adapted)

Screening Questions:

1. Was there a clear statement of the aims of the research? □Yes □Can't tell □No

Consider: What was the goal of the research? Why it was thought important? Its relevance

2. Is a quantitative methodology appropriate? □Yes □Can't tell □No

Consider: If the research seeks to examine a relationship between variables with the aim of making predictions. Is quantitative research the right methodology for addressing the research goal?

3. Were all the participants accounted for in the results and the conclusion ? **□Yes □Can't tell □No**

Is it worth continuing?

Detailed questions:

3. Was the research design appropriate to address the aims of the research?

□Yes □Can't tell □No

Consider: If the researcher has justified the research design (E.g., have they discussed how they decided which method to use)?

4. Was the recruitment strategy appropriate to the aims of the research? (Assess selection bias)

□Yes □Can't tell □No

Consider: If the researcher has explained how the participants were selected, Are the individuals selected to participate in this study likely to be representative of the target population? If there are any discussions around recruitment (e.g., why some people chose not to take part)

5. Was the data collected in a way that addressed the research issue?

□Yes □Can't tell □No

Consider: If the setting for data collection was justified. If it is clear how data were collected. If the researcher has justified the methods chosen. If the researcher has made the methods explicit . Were data collection tools shown to be valid? Were data collection tools shown to be reliable? If methods were modified during the study. If so, has the researcher explained how and why?

7. Have ethical issues been taken into consideration? □Yes □Can't tell □No

Consider: If there are sufficient details of how the research was explained to participants for the reader to assess whether ethical standards were maintained. If the researcher has discussed issues raised by the study (e.g., issues around informed consent, anonymity, and confidentiality or how they have handled the effects of the study on the participants during and after the study). If approval has been sought from the ethics committee

8. Was the correct statistical technique used to analyse the data

□Yes □Can't tell □No

Consider: Was descriptive data provided? Was the sample size large enough for the statistical technique carried out? Was basic assumptions of the statistical test utilised met? Were both significant

and insignificant results reported? Did the statistical technique used effectively answer the research question?

9. Was the data analysis sufficiently rigorous? □Yes □Can't tell □No

Consider: If there is an in-depth description of the analysis process. Were the statistical methods appropriate for the study design? If sufficient data are presented to support the findings? To what extent contradictory data are taken into account? Were potential sources of bias discussed?

10. Were psychometric properties discussed? □Yes □Can't tell □No

Consider: were reliability and validity of the instruments used discussed or analysed

11. Is there a clear statement of findings? □Yes □Can't tell □No

Consider: If the findings are explicit. If there is adequate discussion of the evidence both for and against the researchers arguments. If the findings are discussed in relation to the original research question

12. How valuable is the research?

Consider: If the researcher discusses the contribution the study makes to existing knowledge or understanding e.g., do, they consider the findings in relation to current practice or policy? or relevant research-based literature? If they identify new areas where research is necessary? If the researchers have discussed whether or how the findings can be transferred to other populations or considered other ways, the research may be used.

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT ETHICS COMMITTEE

CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE: **PROTOCOL NUMBER: MASPR/20/05W**

PROJECT TITLE:	Self-help: A systematic review of the efficacy of mental health appsfor low and middle-income communities
INVESTIGATOR	Gama Beauty (1491833)
SCHOOL/DEPARTMENT OF INVESTIGATOR	SHCD/Psychology
DATE CONSIDERED	12 June 2020
DECISION OF THE COMMITTEE	Approved unconditionally
RISK LEVEL	No Risk
EXPIRY DATE	31 December 2022
ISSUE DATE OF CERTIFICATE 21 June 2020	**CHAIRPERSON**

(Dr Sahba Besharati)

cc: Prof. Sumaya Laher (Supervisor)

DECLARATION OF INVESTIGATOR

To be completed in duplicate and **ONE COPY** returned to the Chairperson of the School/Department ethicscommittee.

I fully understand the conditions under which I am are authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the researchprocedure as approved I/we undertake to resubmit the protocol to the Committee.

Date 29/ 06/ 2020

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

FACULTY OF HUMANITIES

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

STUDENT SUBMISSION OF RESEARCH– please submit an electronic copy of your research to Faculty for examination

Beauty Sibongile Lindiwe Gama

Candidate's full names

1491833

Student number

Self-help: A systematic review of the efficacy of mental health apps for low-and middle-income communities

Title of research

*Please note that if the title has changed from the previously approved title an amendment form must be completed before submission takes place.

I acknowledge that:

I hereby submit my research work (MA research report / MA dissertation / Doctor of Philosophy).

I have checked all of my manuscript and am satisfied that no pages are missing or poorly reproduced.

I declare that I have obtained an ethics protocol number from the Research Office, if my research used human subject, patient records, student data etc.

I confirm that my signed declaration is included in the research submission, in terms of rule G27.

I understand that I need to register as awaiting examiner with the Faculty Office on the day that I submit and that I will be charged tuition fees if I submit after the 30th of April 2021.

I understand that I may not graduate unless my university fees have been paid in full.

I understand that I may not submit my research for examination nor graduate if research ethics requirements have been breached.

Ethical Clearance:

Did your research involve animals, human subjects, or medical institutions (medical or non-medical)?

YES	NO ✓

If yes, provide the ethics clearance number:

Name of Supervisor: Prof. Sumaya Laher	Name of Supervisor

Student name and signature: Beauty Gama


Date: 03 March 2021