“If Someone Walks In On Us Talking, Pretend to be My Friend, Not My Therapist": Challenges and Opportunities for Digital Mental Health Support in Saudi Arabia

Sarah Aldaweesh
University of Oxford
Oxford, UK
sarah.aldaweesh@cs.ox.ac.uk
King Abdulaziz City for Science and Technology (KACST)
Riyadh, Kingdom of Saudi Arabia
saldoweesh@kacst.edu.sa

Deemah AlAteeq
Princess Nourah bint Abdulrahman University
Riyadh, Kingdom of Saudi Arabia
daalateeq@pnu.edu.sa

Max Van Kleek
University of Oxford
Oxford, UK
max.van.kleek@cs.ox.ac.uk

Nigel Shadbolt
University of Oxford
Oxford, UK
nigel.shadbolt@cs.ox.ac.uk

ABSTRACT

Mental health disorders are prevalent worldwide, yet they remain stigmatized, especially in the Middle East. While mHealth has the potential to circumvent traditional barriers, research on its application remains scarce in Arab countries. To address this gap, we conducted a mixed-methods study of mental health apps availability, adoption, and perceptions in the Kingdom of Saudi Arabia (KSA) where digital health transformation is rapidly progressing. We interviewed twelve psychiatrists and psychologists to elicit their views on local barriers and opportunities for digital mental health support. We further systematically reviewed the Saudi app market, analysing 110 Arabic mental health apps. Our findings indicate that whilst fear of stigma and cultural factors hindered help-seeking, the privacy and anonymity enabled by technology created new opportunities for accessing mental support in the KSA. We revealed tensions between experts' professional and practical perspectives, explored technology-exacerbated challenges and provided considerations for improving Saudi digital mental healthcare experience.

CCS CONCEPTS

• **Human-centered computing → Empirical studies in HCI**.

KEYWORDS

mental health, well-being, mobile apps, mHealth, psychologist, psychiatrist, qualitative study, interview, content analysis, app review

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1 INTRODUCTION

Over the past few decades, technology has played an increasingly important role in mental health practice. Advances in technology continue to reshape clinical care, support patient-centred care and mitigate socio-economic barriers [60, 76, 89]. Given the continuously rising prevalence of mental health disorders [31, 46, 129] paired with a relative scarcity of medical resources [9, 100], mobile devices and apps get increasingly adopted to facilitate remote mental health counselling and monitoring, engage individuals actively in their self-care plan, and encourage patients to self-track their condition at home. Beyond reducing costs, mobile devices help decrease temporal and spatial barriers, especially in situations where access to clinicians is limited. In addition, mobile apps provide means of support that mitigate stigma and deliver self-help tools to assist individuals who prefer to handle their issues on their own [60, 76, 89, 134].

Research on mental health and well-being is rapidly expanding in the field of Human-Computer Interaction (HCI) [107]. The majority of past research on the use and acceptance of technology in mental healthcare has focused on Western contexts (e.g., North America, Europe and Australia) [28, 34, 68, 72, 88, 93, 96, 115, 135, 137]. As this technology becomes more prevalent, more efforts are needed to understand technology use within the challenges and opportunities of other countries and cultures [11, 73]. Considering culture in designing health interventions was associated with increased intervention acceptability, increased participant engagement, and improved treatment outcomes [64, 93, 123, 132]. Recent HCI research is addressing this by exploring technology's role in promoting the mental health of migrants [125], and East and South Asians

[97, 99, 114], contributing to a more comprehensive understanding across diverse cultural contexts. The Middle East has a large and technologically well-equipped population [11]. Yet, Middle Eastern perspectives on digital mental health remain under-researched and require more investigation to better meet the needs of diverse cultural backgrounds.

In the Kingdom of Saudi Arabia (KSA), there is a growing interest in adopting digital health tools. The Saudi Ministry of Health (MoH) recently launched the world's largest virtual hospital (SEHA Virtual Hospital) with 130 connected hospitals as part of healthcare digitalization [84]. The MoH has also released various mobile health (mHealth) apps to support the *Saudi Vision 2030* of digital health transformation [26, 59]. The adoption was accelerated by the KSA's existing technical infrastructure, as it has one of the highest rates of adoption of smartphone and Internet technologies among its population in the Middle East [3, 59, 117]. Despite the rising interest in mobile mental health from the healthcare ecosystem and stakeholders in the KSA, there is a scarcity of research on the adoption and use of mobile apps in mental health settings in the KSA [29]. As far as we can ascertain, no study has yet reviewed available mental health apps in Saudi app markets or sought to understand mental health professionals' perspectives on using mental health apps in Saudi practice. To address this gap, this paper explores the following research questions:

- RQ1: What are the main challenges and opportunities for using mental health apps in the KSA from the perspective of psychologists and psychiatrists practicing in the KSA?
- RQ2: What are available mental health mobile apps in Saudi markets (Apple App and Google Play stores), and what are their characteristics and the type of support they offer?

To address this gap, this paper seeks to explore the availability, adoption, and perspectives on mental health mobile apps in the KSA, where the rapid digital transformation of healthcare services is in progress [59], and the influence of religious and cultural factors could be observed [8, 29]. We conducted twelve semi-structured expert interviews with psychologists and psychiatrists who are practicing in the KSA to understand the adoption of mHealth in practice, and identify the main opportunities and challenges to the use of technology in the local mental health context. To better understand our clinicians' mental model of the current state of Arabic mental health mobile apps in the KSA and further understand in detail available apps and their characteristics, we conducted a review and content analysis of mental health iOS and Android apps available from the Saudi app stores.

Our interviews shed light on the opportunities stemming from technology-enabled privacy and anonymity in mitigating stigma and facilitating the pursuit of mental health support in the KSA. Additionally, they unveiled challenges that are exacerbated when incorporating mHealth into mental healthcare, such as doctor shopping behaviour and expectations of instantaneous responses and immediate diagnosis. Except for teleconsultation apps, our interviewees reported a lack of mental health apps supporting Arabic. On the other hand, our app review shows that, when the research was undertaken, 110 mental health apps met our criteria and existed in Arabic on the Saudi Apple App and Google Play stores, and most (81%) targeted Arab users. They offered a range of strategies, including mental health education, counselling and mindfulness/meditation. The paper concludes with some recommendations to fill existing gaps and improve the experience of mental mHealth in the KSA and similar contexts.

The outcomes of our study will hopefully promote research in mental health by informing an understanding of both barriers and new opportunities besides design theories for supporting the development of health technology for promoting mental health. Hence, it aims to encourage researchers to address the existing challenges in Saudi mental health practice and develop practical solutions tailored to the population's needs.

2 BACKGROUND

2.1 Culture in Health Interventions

Understanding the cultural context and influences in the application of health interventions has received attention in health research. Cultural tailoring within the health context includes employing the native language, incorporating cultural preferences, promoting family engagement and support, and adjusting existing interventions to become culturally aligned with the clients' meanings and values [36, 43]. Several studies have addressed culturally tailored health interventions for a broad range of health domains, including diabetes prevention in black Africans [132], diabetes education in Lebanon [123], insomnia in Black women [141], mHealth interventions for US Latinx communities [56], and for chronic illnesses among ethnic minorities [64]. Cultural tailoring extends beyond simply linguistic translation and demands a deep comprehension of the cultural nuances and incorporating contextual considerations specific to the target population. For instance, among British South Asian patients, empirical findings [101] indicated that delivering short digital health interventions in English is more acceptable where multiple dialects within a language hinder a clear and coherent direct translation. On the other hand, patients expressed a preference for other cultural adaptations, such as family involvement.

In the mental health context, there is a growing interest in understanding digital mental health across diverse cultural contexts, including migrants [125], Black women [93], native American [130], and East and South Asians [97, 99, 114]. Studies [64, 93, 123, 132] demonstrated that culturally tailored interventions were linked to increased disease awareness, increased intervention acceptability, increased participant engagement, improved treatment outcomes, and increased patient satisfaction. In Arab populations, cultural and religious factors play a significant role in the acceptance and adoption of digital health interventions [8]. However, studies [10, 11, 73, 86] highlighted the under-representation of Arab and Muslim populations in HCI research. They emphasised the importance of adapting research and applications developed in a Western context for Arab and Muslim communities.

2.2 Mental Health in Saudi Arabia

2.2.1 The Kingdom of Saudi Arabia (KSA). KSA is the largest sovereign nation in the Middle East [9]. Among the Saudi population, 51% are men and 49% are women. Children and young adults represent more than two-thirds of the Saudi population [52]. Arabic is the official language, the primary ethnic group is Arab, and the

official religion is Islam. The holy book of Islam, the 'Quran', and 'Hadith' (sayings of the Prophet Muhammad) are the source of the laws, daily life, and spiritual experiences of Saudis [105]. The family is a significant unit in Saudi culture. It is typical for adult children to live with their family or near them even after marriage.

2.2.2 Prevalence of Mental Disorders in the KSA. Mental health disorders are considered a growing problem in the KSA, where around 34% of Saudis have experienced a mental disorder during their life [31]. According to the Saudi National Mental Health Survey (SNMHS) [31], mental health conditions are highly prevalent in recent generations of the Saudi population. In particular, 40% of young adults (15-34) meet the criteria for a mental disorder, a rate that is almost double compared to the older population (50-65). Anxiety disorders (i.e., separation anxiety disorder, social phobia, obsessive-compulsive disorder (OCD) and generalized anxiety disorder) are the most common mental conditions among the KSA population (23%), followed by disruptive behaviour disorders (11%) and mood disorders (9%) (i.e., major depressive disorder (MDD), bipolar I–II disorders (BD)). With regard to gender differences, Saudi women have a significantly higher risk of MDDs and anxiety disorders than men [31].

2.2.3 Mental Healthcare System in the KSA. Mental healthcare services are provided freely to citizens via the MoH hospitals and other governmental sectors such as military and university hospitals [4, 16, 20]. In addition to public sectors, mental health services can be accessed via private healthcare providers [9]. The number of mental health professionals practicing in the KSA, including psychiatrists, psychologists, social workers, and nurses, is 19.4 per 100,000 population. Specifically, there are 1.3 psychiatrists per 100,000 people, accounting for just 7% of mental health professionals in the KSA, a lower proportion compared to the global average (20%) and high-income countries (20%). The number of psychologists is 2 per 100,000 people, making up 10% of mental health professionals in the KSA, in contrast to the global and high-income country averages of 14% [9]. According to a survey of 63 mental health professionals practicing in the KSA, the most common approach used was pharmacotherapy, followed by supportive therapy, cognitive behaviour therapy (CBT), a combined approach, psychodynamic and family therapies, and group therapy, respectively [20].

2.2.4 Barriers to Seeking Mental Health Care in the KSA. According to the SNMHS, 86% of surveyed Saudis who met the criteria for a mental disorder do not seek any treatment [16]. Barriers to seeking mental health services were primarily the lack of perceived need for treatment and attitudinal barriers (e.g., wanting to solve their problem by themselves and fear of stigma). This is followed by structural barriers (e.g., service availability and financial constraints) [16] where governmental services are linked with long waiting times, and financial constraints limit some individuals from seeking private services [7, 15]. This suggests that barriers to seeking mental health services in the KSA may be related more to individual beliefs and perceptions than the availability and accessibility of the services [16]. The stigma surrounding mental health disorders, psychiatric patients, mental health facilities, and their services still prevails in Saudi society [17, 19, 25, 95]. Difficulties related to mental health or personality development may stigmatize the family as stigma-by-association ('courtesy stigma'), leading to social disapproval and devaluation by others [19, 20]. Therefore, explaining psychological and psychiatric symptoms as magic, evil eye, and possession by "Jinn" [5] and thus seeking help from faith healers is more socially acceptable in Saudi society than seeking psychiatric or psychological help [20, 27]. While these supernatural beliefs also carry some stigma, they are viewed as treatable through faith healing, thereby posing less harm to the family's reputation than mental illness, which can adversely affect marriage, employment, and the social image of individuals and their families [2, 20]. Consequently, these cultural factors significantly shape individuals' attitudes towards seeking mental health care [20].

2.3 mHealth in the KSA

2.3.1 Digital transformation and KSA's Vision 2030. In 2016, the government of the KSA launched "Saudi Vision 2030" [1] with the ambition of shifting from an oil-based to a knowledge-based economy [90, 106]. It aims to reduce reliance on oil and endorse economic diversification and investing in improving the healthcare system, well-being, infrastructure construction, tourism and other economic domains [90, 102, 106]. Following the Vision's launch, the KSA has witnessed an unprecedented shift in economic, digital, and sociocultural aspects [53, 59, 106]. The Vision has notably accelerated digital transformation in various domains, including the healthcare sector, with a particular focus on mHealth [14, 26, 112]. This high interest in mHealth from healthcare providers was also paired with notable interest from Saudi citizens in accessing services through their smartphones [22, 32, 57]. COVID-19 further supported and tested this digital transition, and the KSA's digital response to it was noteworthy [59].

2.3.2 Mobile Mental Health Apps in the KSA. The Saudi MoH has launched various mHealth apps to support the Saudi Vision 2030 of digital health transformation [26]. For instance, Seha ("Health") [91] enables individuals to receive online audio–video medical consultations in all medical specialities [109, 112] and Anat platform [83] allows licensed healthcare providers to issue e-prescriptions to their patients to facilitate telemedicine [70]. In addition to governmental services, the private sector has released mHealth apps for online medical consultations, including mental health care, such as Cura, Maya Clinic, and Nala [59].

Despite the rising interest in mHealth from the healthcare ecosystem and stakeholders in the KSA[23], we lack significant research on the availability, adoption and acceptance of mobile apps in mental health practice in Saudi Arabia [29]. Atallah et al. [32] have studied the prevalence of using mHealth apps for mental health in Saudi Arabia, where 376 participants with self-reported symptoms of depression, anxiety or stress were surveyed. Results showed that approximately half of the participants used one or two healthcare apps, and most of them accessed their health information using mobile phones. Most participants were willing to use a mobile app daily to track their mental health. Furthermore, 82% of surveyed Saudis in the SNMHS who perceived the need for mental health treatment decided to handle their problem on their own outside the healthcare settings [16]. While Saudi individuals are interested in using mobile apps to maintain their mental health, less is known

about the state of apps in the Saudi marketplace and their characteristics and also professionals' viewpoints around them.

3 METHODS

In this study, we seek to understand the current state of mobile app adoption in mental health practice in the KSA and identify the main opportunities and barriers to the use of technology from the perspective of mental healthcare professionals. To achieve this, we took a mixed-methods approach. We ran a series of semi-structured interviews with mental health clinicians designed to draw upon their experiences and expertise in order to understand their perspectives, which are crucial to understanding how technology is used in Saudi mental health settings. We further systematically reviewed publicly available mental health and mental well-being mobile apps on the Saudi Apple App and Google Play stores in order to form a basis for understanding what KSA users have available and verify our clinicians' mental model of the state of Arabic mental health apps. To facilitate comparison with the abundance of literature on digital health in Western contexts, we also provide a direct comparison of this app market to Western app stores (namely, the US and UK).

3.1 Interviews

We conducted IRB-approved semi-structured interviews, which included open-ended questions to encourage two-way communication, allowing for a comprehensive discussion with mental health clinicians. Interviews were designed to capture current practices, opportunities and challenges to adopting mobile apps in mental healthcare.

3.1.1 Recruitment and Sampling. We recruited participants through snowball sampling, with an initial sample of four clinicians from the researchers' professional network. Participants were recruited according to the following inclusion criteria: (i) they were certified clinicians (psychiatrists or psychologists), (ii) they regularly worked with patients with mental illness in Saudi Arabia, and (iii) they were fluent in either English or Arabic. After receiving initial responses from the potential participants, we asked them to provide their contact details. We sent them a participant information sheet and consent form and contacted them to check the accuracy of the collected data if necessary. A total of twelve clinicians (5 men and 7 women) with time in practice ranging from one year to 10+ years were interviewed as a final sample. We managed to recruit and interview five psychiatrists and seven psychologists. This was despite the fact that the number of psychiatrists and psychologists in the KSA is only 1.3 and 2 per 100,000 population, respectively [9]. Participants were not compensated for taking part in the interview. Table 2 and Figure 2 present participants' demographics and practice characteristics. Information like gender and age have been excluded to preserve their anonymity. In this paper, we refer to the psychiatrists and psychologists as PR and PL, respectively.

3.1.2 Procedures. All interviews were conducted remotely over Microsoft Teams between January and February of 2022, and participants consented to be audio recorded using a standalone recording device. Interviews lasted between 30 and 90 minutes, with an average of about 60 minutes. Participants were initially asked to provide information about their clinical background and prior experience with technology in practice. Next were questions about clinicians' current practices in delivering mental healthcare in Saudi clinical settings; the main challenges they and their patients face in current mental health practice; the main benefits and opportunities that exist in the application of mobile health in the current Saudi mental health context; perception, experience and perspectives around existing mental health apps (based on clinicians' perception and previous experience with existing apps in their practice); the main barriers to adopting mental health mobile apps in the current mental health practice; the main challenges that exist in the application of mobile health in the current Saudi mental health practice; and their perspectives and considerations to support adopting mental health apps in Saudi mental healthcare. The first and second authors conducted the interviews in Arabic to encourage effective communication since all participants were native Arabic speakers and some of them were not able to speak English fluently. The audio recordings were manually transcribed by the first author after redacting and anonymizing all personally identifiable information. Transcripts were initially analyzed by the first and second authors (who are bilingual) in the main source language to accurately capture the full meaning. Then, excerpts and codes were translated into English by the first author for the purpose of both the team discussion (that included English-speaking authors) and research reporting. Improving mental health support accessibility in diverse populations is part of all authors' interests. The research team comprises Saudi authors, including a psychiatrist and a developer of an Arabic mental health self-help mobile app, currently living in both the KSA and a Western country, and it also includes Western authors with psychology and computer science backgrounds. Regarding the background and experience of the primary researchers in this study, the first author, with a computer science background and HCI research work focused on digital mental health, received an intensive training course in qualitative research methods in health care research. The second author, a consultant psychiatrist with research work in the KSA focused on mental disorders and their associated stigma, had prior qualitative research experience.

3.1.3 Analysis. The anonymized transcripts were analyzed using 'codebook' thematic analysis (TA) [41]. Thematic analysis is widely used in qualitative research regarding perspectives on digital health and well-being interventions, facilitators and barriers to adopting them [35, 78, 131, 138] . According to Braun and Clarke [39–41], the 'codebook' TA sits between 'reflexive' TA and 'coding reliability' TA, adopting a structured coding approach similar to 'coding reliability' (without using coding reliability measures) with the broadly qualitative philosophy of 'reflexive' TA. The codebook was used to map and document the analysis in this exploratory study with some flexibility, allowing new codes to be added for new data and interpretations [40]. Two authors (first and second) from different backgrounds, computer science and psychiatry, separately reviewed a subset of the interviews ($n = 4$). They inductively coded these transcripts and independently generated initial codes and identified candidate categories by grouping related codes. Generated codes and categories were discussed, merged and collapsed through team discussions to derive a common codebook. Then,

using this initial codebook, the next 4 transcripts were independently coded by the two authors and new codes were discussed and added to the codebook as the analysis progressed, and previously coded transcripts were reviewed. Generated codes and categories and analysed data were discussed through regular team discussions. Then, the remaining interviews ($n = 4$) were coded by the first author using the adjusted codebook. Themes were collaboratively developed through team discussions of the data and the codebook.

Coding was performed using the qualitative analysis software package ATLAS.ti Version 22, which better supports Arabic transcripts analysis.

3.1.4 Ethical Considerations. This study has received ethics approval from the University of Oxford Central University Research Ethics Committee (CUREC) (Ethics reference: 576-21). For national ethical review, the Institutional Review Board (IRB) of Princess Nourah bint Abdulrahman University (PNU) Research Ethics Committee has determined that this study poses no more than minimal risk to participants; therefore, it has been deemed EXEMPT from local IRB review (IRB log number:21-0474E).

3.2 Apps Review

Currently, little is known about the state and content of the available apps that are marketed to address mental health and mental well-being for Arabic speakers in the KSA. Our interviewees highlighted the lack of Arabic mental health apps supporting some strategies such as psychoeducation and meditation. Considering our experience in promoting digital mental health locally, we were aware of some existing certified apps for the strategies that clinicians identified as lacking. Thus, we conducted a rigorous review to understand in detail what mental health apps are available and what apps are lacking in the Saudi app market in order to verify our clinicians' mental model on existing Arabic apps and explain the local context clearly.

To establish the scope of analysis, we adopt the definition of what we mean by a "mental health app" by Borghouts et al. [38] as "an application on your mobile phone or tablet device that helps you manage your mental, emotional, or psychological health or get access to resources to support your mental, emotional, or psychological health." Following this definition and other exploratory app reviews [28, 115, 118, 134], our study includes a range of apps that aim to address well-being, stress, mood, emotions, and mental health issues. Particularly anxiety and depression, informed by our interviews where these disorders were the common conditions seen by our interviewees in practice (Table 2) besides being the most common mental disorders within the KSA population [31].

To explore mental health-related apps in Saudi app stores, we conducted a review and analysis of iOS and Android apps on the Saudi Apple App Store and Google Play Store, the two most widely used platforms for smartphone apps in Saudi Arabia [116]. We identified apps that targeted mental health and mental well-being and supported the Arabic language, downloaded them, analyzed the content and coded their features. A flowchart of the search and inclusion/exclusion process of the app review is illustrated in Figure 1.

Table 1: Arabic Keywords used for searching apps in Apple App Store and Google Play.

English Translations	Arabic Keywords
Mental Health	الصحة النفسية
Mental Well-being	الرفاهية العقلية
Depression	الاكتئاب
Anxiety	القلق
Psychological stress	ضغط نفسي
Mood Disorders	اضطرابات المزاج
Mood	المزاج
Emotions	المشاعر
Stress	إجهاد، توتر

3.2.1 Initial Keyword Search and Data Clean Up. To retrieve relevant mental health and mental well-being apps from the Saudi Apple App Store and Google Play, we used available scripts—namely SerpApi [111] and google-play-scraper [94]—to automatically retrieve search results for the Arabic keywords found in Table 1. Our search terms included technical mental well-being and mental health-related terms with a particular focus on depression and anxiety (i.e., mental health, anxiety, depression, mood disorders, psychological stress and mental well-being) as well as related common layperson synonyms (i.e., stress, mood, emotions). Keywords were identified based on search terms used in previous related app reviews [28, 118, 134]. We separately scraped apps on the Saudi stores (Apple App Store and Google Play Store). The scraper function was set to retrieve the first 200 app results for each keyword in both app stores (similar to previous related app reviews [24, 72]). It is worth noting that only one term, namely "mental health" on the Apple App Store, hit this limit. Recorded information included each app's name, description, price, rating, date of last update, developer's details, app's link, and app store category. For each app store, we wrote a custom script to combine the search results for all keywords. In total, 2411 records were retrieved through multiple search keywords on both the Apple App Store and Google Play stores. After removing duplicates, 1492 apps were resulted for manual screening.

3.2.2 App Description Review. Following similar reviews [28, 118, 121], for each app, we manually screened the titles, app store descriptions and screenshots. To be included in our analysis, apps had to fulfil the following inclusion criteria: (1) explicitly focused on mental health or mental well-being (app name or description included one of our keywords), and (2) support the Arabic language. We excluded apps if they fell into any of the following categories: not focused on mental health or mental well-being (e.g., the Arabic word for "Stress", has multiple meanings in Arabic, such as psychological stress and data compression), did not support the Arabic language, targeted clinicians only, or were e-books (consistent with previous methodologies [104, 121]). This yielded 141 potentially relevant apps.

3.2.3 Full App Review. We downloaded each app and reviewed them in detail to ensure that apps are functional and accessible to

the Saudi population. Apps that were non-functional or inaccessible (e.g., required a mobile number for registration and did not accept Saudi phone numbers) were excluded. In addition, we double-checked that the downloaded apps provided what they claimed in their store descriptions to validate that they meet the inclusion criteria and did not fall into any of the exclusion categories described above in 3.2.2. After this process, 121 apps satisfied all the inclusion/exclusion criteria. Subsequently, in cases where an app was present in both the Apple App Store and Google Play, we maintained a single record for subsequent feature analysis, as our primary objective is to analyze apps' content and the employed strategies rather than the distinctions between iOS and Android versions of the same app. Upon completion of this process, we identified 110 apps for analysis.

3.2.4 Feature Analysis. In this paper, the Mobile App Rating Scale (MARS) tool was used to collect descriptive information about the collected apps and code their features. The MARS is the most commonly used tool for analyzing mental health mobile apps [24, 28, 77]. We coded the following variables for each included app according to the app classification in MARS [120]: app name, focus (i.e., what the app targets), theoretical background/strategies (defined in Appendix A), supported platforms, category of the app on app stores, average rating, date of last update, affiliations, supported languages, price. In detail, the first author and a collaborating researcher (with a research background in Natural Language Processing for mental health topics, with a particular focus on mood disorders) independently reviewed and classified features (theoretical background/strategies, focus, affiliations) in 75 apps based on the MARS tool [120] (see Appendix A). We tested for inter-rater reliability using Cohen's kappa [44] and obtained 0.85. Cohen's kappa values over 0.80 indicate almost perfect agreement [79]. Any disagreement was discussed until an agreement was reached. The first author then coded the remaining 35 apps. Other variables were coded automatically from the scraped results. Lastly, apps were analysed by each variable using descriptive statistics performed by Python.

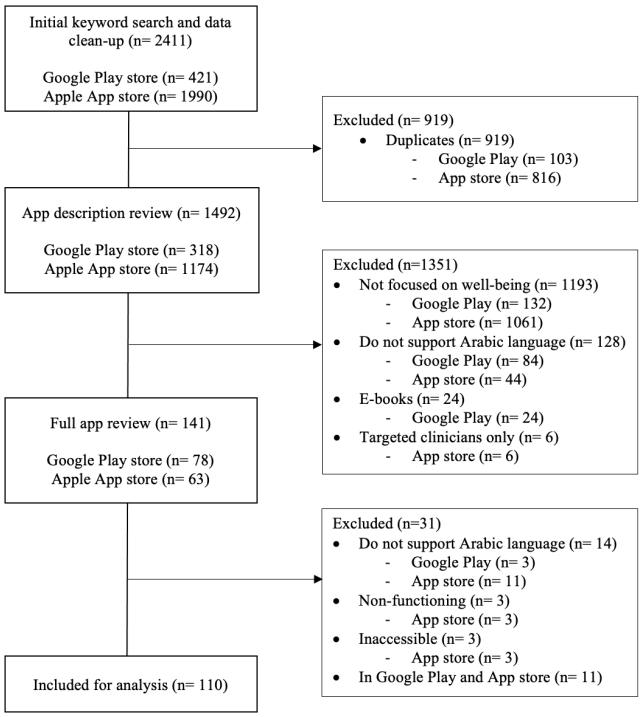

Figure 1: Flowchart of the search and inclusion/exclusion process of the app review

4 RESULTS

4.1 Interviews

In this section, we report our qualitative results from the perspectives of our interviewees, who are psychologists and psychiatrists practicing in the KSA. Participants' demographics are illustrated in Table 2 and Figure 2. We identified five themes: *(i) Current practices in adopting technology in Saudi mental healthcare*, where we found that despite the high interest in digitalization in the KSA, therapeutic tools and procedures for screening, assessment, and treatment remain paper-based in practice and present privacy and stigma-related challenges, on the other hand, there is a growing support of virtual clinics; *(ii) Clinicians' perception of publicly available mental health mobile apps*, where we revealed limited awareness of these apps among our interviewees and weak adoption in practice, except for remote consultation apps; *(iii) Perspectives around technology-facilitated privacy and anonymity in remote consultation apps*, where we found that these features enhanced service accessibility, especially among those who have been discouraged by family or experienced fear of stigma of seeking mental health services in person or through the healthcare system, and we further unveiled tensions between practical and professional perspectives around turning off the camera, seeing anonymous patients and mitigating stigma; *(iv) Concerns about possible challenges exacerbated by adopting technology in mental health care*, such as doctor shopping behaviour, and clients' expectation of instantaneous responses and immediate diagnosis; *(v) Design considerations for supporting integrating mobile apps into Saudi mental health care.*

4.1.1 Current Practices in Adopting Technology in Saudi Mental Healthcare.

Therapeutic tools remain paper-based. Despite the high penetration of smartphones in the general population, clinicians reported that therapeutic tools for screening, assessment, and treatment (e.g., assessment scales, CBT worksheets and exercises, etc.) remained paper-based in clinics. This extended to when these tools were given to patients for home self-report; for example, PR24 said: *"We print papers for patients, that we want them to fill out at home, to record their thoughts, feelings, behaviours, etc., as homework, and we ask them to bring these papers to the next session."* PR16 also mentioned that *"Patients filled out the printed assessment scales and submitted them to clinicians during visits."*

However, **paper-based tools present privacy challenges.** For instance, some patients expressed concern that, as their written notes were easily left exposed, they could be easily read by others. These concerns included privacy concerns about family members;

Table 2: Participants Demographics

ID	Clinical Role	Years in Practice	Common Disorders Seen in Practice	Avg. Age of Patients	Common Gender Seen in Practice	Experience in Online Services
PL9	Psychologist	1-5	Anxiety disorders, MDD	Adults	Women	Yes
PL10	Psychologist	1-5	Anxiety disorders, MDD	Adults	All	Yes
PL11	Psychologist	6-10	Anxiety disorders, MDD	Adults	Women	Yes
PL18	Psychologist	6-10	Anxiety disorders, MDD	Adults	Women	Yes
PL23	Psychologist	6-10	Not specified	Adults	Women	Yes
PL15	Psychologist	6-10	Anxiety disorders, MDD	Adults	Women	Yes
PL21	Psychologist	11-15	Not specified	Adults	All	Yes
PR24	Psychiatrist	1-5	Anxiety disorders, MDD, Developmental disorders	Children, Adolescents	All	No
PR16	Psychiatrist	6–10	MDD, BD, Disruptive behavior disorders	Children, Adolescents, Adults	Women	Yes
PR20	Psychiatrist	6-10	Anxiety disorders, MDD	Adults	All	Yes
PR22	Psychiatrist	6-10	Anxiety disorders, MDD	Adults	All	Yes
PR19	Psychiatrist	11-15	Anxiety disorders, MDD	Adults	Women	Yes

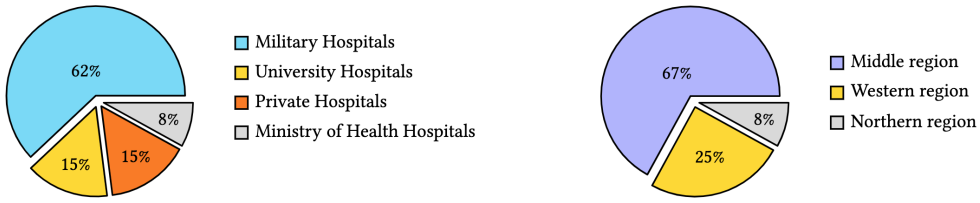

Figure 2: Participants demographics by organization and region of practice in the KSA

PL11 said: *"Many clients share their room with other family members and were afraid that someone may read their papers."* PL11 also discussed stigma as a common barrier associated with using paper tools and mentioned *"Part of the effective treatment is that clients record their thoughts or events immediately, capturing their intensity accurately. However, clients experienced the embarrassment of writing on paper in public or in front of others, if something happened."* Fear of social stigma was also relevant within clinical settings, where patients were concerned about who might access or read their papers. PR16 described that *"Some clients ask about who will scan their filled scales and ask me to do it myself. Sometimes, they resist the scanning if a nurse will do it."* This concern was often rooted in a fear of social stigma where they might be recognised by any member of the clinic staff.

To mitigate reported issues with the paper-based approach, professionals noticed that many clients are using built-in smartphone apps, namely the Notes app, to record their thoughts and symptoms or document their CBT homework. The Notes app was seen to provide better confidentiality by being under their control. Specialists also mentioned using email for transferring documents and communicating with their clients. Overall, professionals appreciated digital capabilities in managing data privacy compared to paper-based approaches.

Adoption of technology to support virtual clinics. As a response to the COVID-19 pandemic, most healthcare facilities in the KSA were obliged to adopt technology to provide their services. Therefore, almost all of our clinicians have experience in virtual clinics to provide mental health teleconsultations. For instance, PL10 said: *"Within the government facility where I work, we provide 3 types of sessions: face-to-face, audio consultations, and virtual video-based sessions through a mobile app founded by the facility."* Interviewees reported that most of the provided teleconsultations were audio, based on clients' requests.

4.1.2 *Clinicians' Perception of Publicly Available Mental Health Mobile Apps.*

Nearly all clinicians were aware of available commercial apps providing online psychological consultations. For example, PL15 said *"Labayh is the most well-known platform in the Arab world, followed by Famcare and Estenarh,"* (see Section 4.2.3 for apps' description). Furthermore, half of our participants reported providing their services via existing commercial apps. Except for online consultation apps, most clinicians reported a weak awareness of available mobile apps supporting their therapeutic practice with clients, such as assessment, tracking and meditation. For instance, PR19 said: *"Ummm.... I do not know what kind of apps are available to support mental health."* Moreover, they lack knowledge about what

kind of mental health apps their clients used themselves to manage their condition. PL9 said: *"I have never heard from my clients about apps they use."*

Most clinicians reported a lack of Arabic mental health apps for education, meditation and tracking. For instance, PL18 said: *"The available online Arabic mental health information is very dry [scarce]!"* For meditation, some interviewees discussed their practices if a client does not speak English. PL11 said: *"I advise them to record our meditation session via their mobiles and use it later to practice meditation at home"* and PL18 said: *"I do not mention any meditation apps. I know it is a limitation!"* Otherwise, if the client speaks English, a few clinicians reported recommending some popular English meditation/mindfulness apps. PL10 said: *"I usually recommend my clients, who speak English well, use Headspace for meditation."* For the CBT tasks, only one psychologist (PL11) mentioned adopting a CBT-based mobile app specifically created in Arabic. This psychologist was actively involved in the app's development and used it as a tool to enhance their clinical practice with clients. For self-tracking tasks, some professionals discussed their reluctance towards digital self-tracking apps. They debated that digital tracking may increase the risk of anxiety, stress and obsession or trigger negative emotions such as guilt, disappointment, and frustration. For example, PL10 said: *"It may increase anxiety among clients with perfectionism, paranoia or OCD symptoms due to feeling observed."* Clinicians further criticise the perceived objectiveness of passive digital tracking since contextual information and personal interpretations were not captured. PL18 mentioned that *"Individuals want objectivity; [but] actually you do not need objectiveness! For example, if you are tired, the last thing you need is a smart tracker telling you that you are ready to face your day!"* Such subjective data is crucial to understanding the context behind the numbers and reducing the possibility of misinterpretation. For example, when assessing a client's sleep, specialists wanted to know any sleep-related data highlighting the effect of circumstantial causes and sleep hygiene on sleep quality. On the other hand, other clinicians believe that self-tracking apps could be adopted to increase client self-awareness and adherence and encourage them to perform activities.

4.1.3 *Perspectives around Technology-Facilitated Privacy and Anonymity in Remote Consultation Apps.*

Maintaining privacy. Clinicians discussed the advantage of privacy facilitated by technology in supporting seeking mental health help in Saudi society. For instance, PR20 said *"Individuals, especially women, who experience family resistance to therapy benefited from remote services as they can receive mental care privately at home, without anyone knowing about it."* PL15 further mentioned that *"I receive many online appointments from clients at night when their families are asleep, as they don't want them to know about seeing a therapist,"* and *"Some women clients told me if someone walks in on us talking, pretend to be my friend, not my therapist."* Professionals also reported that most of their clients maintained a degree of privacy by keeping their cameras off during online sessions. For instance, PL11 mentioned that *"Almost all of my women clients do not turn on their cameras."* Professionals' attitudes regarding clients' behaviour of keeping their cameras off varied. Some professionals perceived this as a challenge to the effective examination and building a therapeutic alliance with clients. For instance, PR20 said: *"It is supposed to be visual, but most clients refuse to turn on the camera. Non-visual consultation affects the examination process."* PL23 also mentioned that *"Keeping the camera off is related somehow to Saudi social norms, and it is a common behaviour online, but it could hinder the therapeutic alliance."* Accordingly, some professionals limited their services to visual sessions only. PR16 said *"If clients insist on keeping their cameras off, I usually apologize, refund and ask them to see another clinician instead. Even though some of the women clients, wear the Niqab* [1] *before turning on the camera, at least I can see who is behind the screen and notice their reactions."* A clinician (PL11) further suggested that *"Turning on the camera during the session should be mandatory."* On the other hand, some professionals prioritized the importance of supporting service accessibility in the current time over service quality. PR19 discussed *"Stigma still exists; We are keen to improve the situation gradually. At the current time, we should be careful not to add more obstacles like obligating clients to turn on their cameras for better service. We hardly reached them and adding more obstacles may take us a step back."* The clinicians' attitudes toward keeping their cameras on from their sides were also discussed. Most clinicians mention that they usually keep their cameras on and encourage their clients to do the same, while others reported that they themselves prefer to provide non-visual sessions. For instance, PR19 said *"It is more convenient, you know I do not have to wear a hijab* [2] *when my camera is off."* To maintain service quality, a psychologist (PL23) further suggested that *"Clinicians should be obligated to turn on their cameras while making it optional for clients. This is not charity; this is a paid service and should be professional!"*

Maintaining anonymity. Clinicians also discussed the remarkable role of implementing anonymity within commercial apps in supporting seeking psychological help within Saudi society. PL15 said *"I was not expecting that, but I have seen a massive turnout for such apps."* PR20 also mentioned that *"It helped a lot of individuals to seek mental healthcare as a lot of them have concerns about visiting psychiatric clinics."* PL15 also discussed the advantage of anonymity for some Saudi individuals as *"It helps some people to talk freely about sensitive or highly stigmatized problems that are not aligned with the religion or culture."* Professionals had diverse perceptions regarding seeing anonymous clients. Some clinicians discussed the possible adverse effects of anonymity on the treatment process, therapeutic alliance and stigma. They expressed their concerns about seeing anonymized clients as they tend to hide basic information to protect their identities, such as marital status, education level, occupation, etc. Professionals think this behaviour could negatively affect the treatment process, and therefore, they do not prefer to see anonymized clients. PR22 said *"an anonymous client was talking for 45 mins. about her case and hiding every identifiable information to protect her identity. At the end of the session, she provided some essential basic information that I usually find in the patient's file in a different scenario."* PR20 further expressed concerns about anonymity hindering building therapeutic alliance: *"Transparency, starting from the client's real name and background, usually helps*

[1] Niqab: Face veil, that leaves the area around the eyes clear, worn in public by some Muslim women

[2] Hijab: Head covering worn in public by Muslim women

in breaking the boundaries." Moreover, a psychiatrist (PR16) stated that they do not accept anonymous clients due to ethical concerns. On the other hand, some clinicians acknowledged the challenges introduced by anonymity but prioritized responding to the current mental health crises by supporting service accessibility at the current time. PR20 said *"Currently, we have a documented problem in the KSA where 86% of people who are in need of psychological care do not seek treatment. Would we think about the consequence of anonymity in the long term?! We should now focus on supporting people to seek treatment. We can address the consequence of anonymity on the therapeutic alliance and stigma after a while after things are resolved.."*

Views on Stigma. Clinicians argued about the impact of anonymity, facilitated by commercial apps, on mitigating the stigma associated with mental disorders. Some professionals noticed that the ability to be anonymous considerably encouraged Saudi individuals to seek help as such apps helped to mitigate internal or self-stigma. However, they expressed their concerns about anonymity inadvertently reinforcing the stigma around mental illness in general. PR22 mentioned that *"Based on my observation, such apps helped to reduce self-stigma. However, they may have a negative impact on the public and structured stigma."* For instance, PR22 further explained that *"By marketing such apps reduce stigma is in itself reinforcing stigma. They claim to provide a less stigmatizing platform, which in turn indicates that other means such as clinics have a higher level of stigma."* PR16 also said *"Anonymity implies that there is an actual big issue around mental illness and you should hide it. It exacerbates the stigma!"* On the other hand, some professionals believed that by supporting service accessibility, the stigma would be mitigated over time, as they noticed that clients who perceived the benefit of treatment via these commercial apps encouraged their family and friends to seek help.

4.1.4 *Concerns about Possible Challenges Exacerbated by Adopting Technology in Mental Health Care*.

Doctor shopping behaviour. Some professionals expressed concerns exacerbated by technology as some clients on online private platforms simultaneously see several professionals during the same period, sometimes on the same day, for the treatment of the same problem without any communication between these specialists. Clinicians commented that while this phenomenon of visiting multiple doctors for the same complaint is seen in practice and could be a part of clients' symptoms or personalities, it is easier to be noticed and controlled in traditional clinics and harder for clients to continue doing it. However, in technology, it is only one click to see another clinician, especially in online commercial platforms. For instance, PR22 said *"Clients were trying many specialists as if they were wandering between shops and stores; they were happy to hear about this and did not like that, to the extent that there was a client who called me after seeing another therapist just an hour before me in the same app."* Professionals stated that this notable technology-facilitated pattern of frequent changes in clinicians without a professional referral adversely affects both sides, clients and clinicians. It hinders therapeutic alliance and clients' adherence to the treatment plan resulting in poor outcomes. Moreover, the practice of seeing clients mostly for one time and losing connection with them has negatively affected some professionals' experience and their service quality with existing commercial platforms. PR22 said *"Even for me as a clinician, I was concerned during the session as I have limited time, around 30 mins., and probably I will not see these clients again based on my previous experience. So, sessions turn on providing them with as much as possible of general one-size advice before the end of our first and last session! This could adversely affect the psychotherapy outcomes and thus its image in society."*

Expectation of instantaneous responses and immediate diagnosis. Professionals noticed that clients on online platforms expect instantaneous services and immediate responses. Clinicians also discussed common expectations from their online clients that one session is sufficient for a diagnosis and treatment plan. PL18 said *"Maybe when we say e-consultation compared to consultation, we lost the human in between. I mean, when we see e (for electronic), we assume that there is an instantaneous service. Clients when seeking online services expect that everything will be provided instantaneously including the diagnosis!"* PL23 also mentioned that *"I have noticed that if I am late even for some minutes, they easily get upset and start texting me! I have not noticed this in the traditional clinic, and I do not know why this occurs online. Do they assume that I am available since the services are provided on mobiles?"*

4.1.5 *Design Considerations for Supporting Integrating Mobile Apps into Saudi Mental Health Care*.

Supporting access control, data confidentiality and interoperability. Empowering clients to control access to their collected data and support sharing them confidentially with their clinicians was highlighted by clinicians. PL9 said: *"Suppose there is a shared platform that my clients and I could access, based on clients' access permissions, to review their documentation. In other words, from the client's perspective, I do choose what I share with clinicians for the period I want."* Interoperability requirement was also emphasized to overcome the challenges of data accessibility and integration into clinical systems. PL15 said *"Having the needed tools in one app will improve the effectiveness of our online experience."* A psychiatrist (PR19) further suggested adding caregivers and family members to the app where they can provide their recorded data and insights related to the client's case directly and confidentially to the clinician. PR19 said: *"In my clinic, sometimes families who did not want to talk in front of clients wrote their notes on paper and handled them to me during the session. So, I think supporting the ability to involve a family member in monitoring apps is helpful."*

Personalization and considering individuals' preferences and professionals' recommendations. Professionals valued considering individuals' preferences, supporting customization and providing a variety of features and options. For example, PL18 said: *"No matter which tool they use. If it works for them, it works for me."* In addition, some specialists highlighted leveraging smart devices' capabilities such as notifications and reminders to provide tailored services and support clients' engagement. They stated that such alerts could help clients maintain their daily routines and increase adherence to treatment practices. Clinicians also explained the importance of taking into account individuals' differences and clinicians' expertise while designing mental health mobile apps to maximize effectiveness and reduce potential harm to clients. For instance, professionals advised supporting flexibility while determining individuals' goals and avoiding fixed numeric targets (e.g.,

a specified number of daily steps) to mitigate potential negative consequences on clients when they fail to meet these goals exactly.

4.2 Apps Review

4.2.1 ***Descriptive of Included Apps.*** Most of the reviewed apps (81 apps, or 74%) were categorized under Health and Fitness, Medical purposes, and Lifestyle in the app stores' categories. They targeted a number of mental health-related goals as named by app descriptions, mostly improving overall mental health (45 apps or 41%), overcoming depression (43 apps or 39%), reducing anxiety (42 apps or 38%), and relieving stress (36 apps or 33%). Regarding the cost, all apps could be downloaded for free, and 28 apps (25%) had in-app purchases. We found during the analysis that apps that provided a connection with professionals (i.e., counselling) (n = 18) did not specify that they had in-app purchases on their store page; however, these services are fee-based. Moving to other attached costs, 56 apps (51%) had in-app ads. Regarding the employed native language, 89 apps (81%) were primarily in Arabic, while 21 apps (19%) were primarily in English and supported other languages, including Arabic. More descriptive details about the reviewed apps including average star rating, last update and source and affiliations are illustrated in Table 3.

4.2.2 ***Type of Support and Resources Offered by Included Apps.*** The analyzed apps employed a variety of theoretical backgrounds/strategies as detailed in Figure 3. Around 43% (47 apps) of the examined apps employed more than one strategy/theoretical background with a maximum of 11 strategies and an average of 3 strategies. The most commonly offered strategy was information/education in 61 apps (55%). Relaxation is offered by 24 apps (22%). Out of these relaxation strategies, 18 apps offered music and natural sounds, 14 apps provided written or recorded (audio or video) instructions for breathing exercises, and 2 apps provided suggestions for physical exercise or yoga. These were followed by the feedback strategy provided by 20 apps (18%) and counselling services with 18 apps (16%) offered sessions with mental health professionals. Strategies employed in the evaluated apps further included mindfulness/meditation in 16 apps (15%) and assessment in 16 apps (15%). Other strategies used in the analyzed apps were monitoring/tracking in 15 apps (14%), including mood tracking (n = 13), thought tracking (n = 10), behaviour tracking (n = 2), sleep tracking (n = 2), physical exercise tracking (n = 2), symptom monitoring (n = 1), medication tracking (n = 1), body measurements and vital signs recording (n = 1). Spiritual/religious-based strategies, such as providing audio recordings of the Holy Quran and religious-based advice, emerged during our coding process and were offered by 12 apps (11%). Positive psychology principles such as practicing optimistic thinking and expressing gratitude were provided by 11 apps (10%). Notably, the number of apps that provided therapeutic intervention, such as CBT, is rather low (8 apps, or 7%). Peer support (i.e., the ability to join online forums, ask questions, and talk to others) was the least employed feature in the reviewed apps (2 apps, or 2%). Looking at the employed strategies based on the apps' native language, among the translated apps (n = 21), 10 provided mindfulness/meditation, 4 offered mood tracking, 3 provided gratitude/affirmations, 2 were based on CBT, and 2 offered translated educational content.

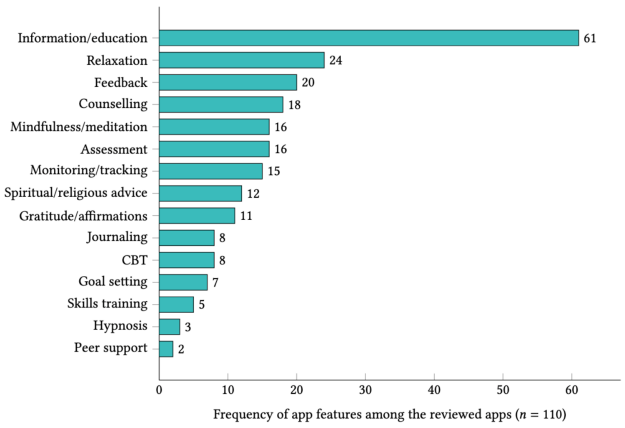

Figure 3: Theoretical background/strategies employed by the 110 reviewed apps.

4.2.3 ***Accredited Apps by the Saudi MoH*** . Five apps (5%) of the reviewed apps stated that they were accredited by the Saudi MoH. Three of them were commercial apps that offered fee-based teleconsultations mainly such as "Labayh", "Famcare", and "Estenarh". Labayh [71] is the leading commercial mobile app for psychological, family and personal online consultations in the KSA. It is a KSA-based platform founded in 2017 by a Saudi young man. It aimed to tackle the stigma around mental health issues in Saudi society. Accordingly, Labayh was designed to anonymously connect individuals looking for therapeutic and well-being services with licensed mental health specialists to mitigate stigma. In detail, individuals can explore a wide range of consultants, including psychiatrists and psychologists and book their appointments with the ability to be an anonymous client tailored to the Saudi population's needs. In addition to teleconsultation, Labayh provided other features, including assessments, mood tracking and support groups. In 2022, Labayh had more than one million users and more than 300 licensed specialists [92]. Likewise, Famcare [49] and Estenarh [48] were released after the notable acceptance of Labayh within Saudi society to offer psychological, family and social teleconsultation with the ability for users to receive services while being anonymous. The other two apps were "Qareboon" and "E-Directory for Psychological Health," both were released by the National Committee for Mental Health Promotion (NCMHP). Qareboon [82] provided mental health educational materials in various forms, such as text, infographics, and video content, along with free psychological text consultations. E-Directory for Psychological Health [51] provided comprehensive information about the hospitals, private clinics, rehabilitation centers, associations and committees located in the KSA, including the services provided and contact details. It aimed to support individuals in need in recognizing available mental health healthcare providers in the KSA and obtaining relevant information.

Table 3: Descriptive information of the reviewed 110 mental health-related apps. "A" refers to the primary categories for Apple App Store, "G" refers to the categories for Google Play and "A,G" refers to the categories that existed in both stores (Apple and Google).

Variable	Variable modalities	All apps, *n*	All apps, %
Category	Health and Fitness (A,G)	47	43%
	Medical (A,G)	18	16%
	Lifestyle (A,G)	16	15%
	Books and Reference (G)	7	6%
	Personalization (G)	5	5%
	Education (A,G)	5	5%
	Social (G)	4	4%
	Entertainment (A,G)	4	4%
	Music and Audio (G)	2	2%
	Utilities (A)	1	1%
	Productivity (A,G)	1	1%
Focus of Included Apps	Improve overall mental health	45	41%
	Overcome depression	43	39%
	Reduce anxiety	42	38%
	Relieve stress	36	33%
	Increase happiness/well-being	22	20%
	Improve sleep	21	19%
	Help to relax	19	17%
	Reduce negative emotions	16	15%
	Improve focus and concentration	13	12%
	Change behaviour	11	10%
	Improve relationships	10	9%
	Improve self-esteem and self-acceptance	8	7%
	Manage anger	7	6%
Supported Platforms	iOS	22	20%
	Android	62	56%
	Both (Android and iOS)	26	24 %
App's Source and Affiliation	Unknown parties (individuals)	79	72%
	Commercial parties (e.g., LLC, LTD, Inc.)	27	25%
	Government sectors (e.g., NCMHP)	3	3%
	Non-governmental organization (NGO)	1	1 %
Rating	No rating	62	56%
	4-5 star rating	35	32%
	3-3.9 star rating	7	6 %
	2-2.9 star rating	5	5 %
	1-1.9 star rating	1	1 %
Last Update	2022	69	63%
	2021	28	25%
	2020	3	3%
	2019	4	4%
	2018	2	2%
	2017	4	4%
In-app Purchases	Unlock more content	15	14%
	Support customization	7	6%
	Remove ads	6	5 %
	Create unlimited entries	1	1 %
	Offer entries password protection	1	1 %

5 DISCUSSION

5.1 Gap between the Ambition of the Saudi Vision 2030 and the Actual Practice

Saudi Vision 2030 highlighted the importance of digitalization across healthcare sectors. While, on one hand, there was a remarkable effort in implementing virtual clinics and supporting teleconsultation–resulting in them becoming vital avenues for care access–surprisingly, our findings showed that clinical procedures and therapeutic tools remained paper-based, such as assessment scales and CBT worksheets. This was a surprise to us, given the prominence of the issue of stigma as an obstacle to care (according to both our findings and those confirmed from the SNMHS survey [16]), and the perceived lack of confidentiality afforded by paper compared to digital tools. Our interim conclusion based on our analysis is that the current mental healthcare system may not be keeping pace with users' needs nor making the progress necessary for achieving Saudi Vision 2030. As a result, we believe that key stakeholders involved in the Saudi healthcare system may benefit from identifying where there is currently an underutilization of technology, potentially leading to missed opportunities for improving patient care and healthcare processes. It is worth noting that while there is significant enthusiasm for health digitalization from both the Saudi MoH and our clinicians, informed by their clinical experiences, the perspectives of patients on this matter haven't been explored yet, which may lead to other recommendations. Further investigations are needed to compare digital tools to paper-based tools in achieving therapeutic goals in Saudi mental health practice.

5.2 Disconnect between Clinicians' Perception of the Publicly Available Mental Health Apps and the Actual State of Affairs

The evolution of Arabic mental health mobile apps. Our findings suggest that the ecosystem of Arabic mental health apps has evolved significantly compared to the last app review in 2018 [24], which reported that only 23 Arabic mental health apps existed, limited to educational content, spiritual or religious guidance, and alternative treatments. Our review showed that publicly available Arabic mental health mobile apps now exceeded 100 in the Saudi market alone. This significant increase in Arabic apps could be credited to the recent focus on digitalization within the healthcare sector, as outlined in Saudi Vision 2030. These apps included an expanded set of therapeutic strategies, including mindfulness/meditation, assessment, feedback, counselling, self-tracking, gratitude and affirmation, etc. Unexpectedly, most of these apps (81%) were designed primarily in Arabic and targeted Arab users. Furthermore, five of the reviewed apps were certified by the Saudi MoH. This demonstrates the high interest in mHealth from the MoH particularly and the Saudi app market in general.

Saudi vs. English App Ecosystems. There were some notable commonalities and differences between the Saudi and Western app ecosystems (specifically the US and UK). For commonalities, psychoeducation was the most implemented feature across both Saudi and Western app stores according to recent reviews [42, 135]. Likewise, therapeutic interventions, such as CBT, were rarely employed in both the Saudi and Western English mental health apps [42, 72, 119, 121, 134, 135]. Recently, several studies [42, 72, 121, 134, 135] have systematically evaluated mental health apps available in English that mainly targeted anxiety and mood disorders and reported that CBT was one of the least implemented strategies among reviewed apps. Considering the efficacy and commonality of CBT treatment in clinical mental healthcare practices especially for anxiety [45, 61], and depression [126], we expected that apps would employ the same techniques; however, this was not the case. A Potential explanation may be that most of the apps were developed without involving clinicians [69]. We encourage developers targeting the Arab app market to support employing CBT strategies, knowing that CBT is currently provided in the Saudi clinical settings [20]. In addition, CBT's basic theoretical concepts are aligned with the Islamic beliefs of Saudis, such as the principle that changing behaviour is a requirement for a positive outcome and the promotion of positive thinking and optimism [18, 20, 21]. This alignment is believed to support the acceptance of such apps by Saudi individuals.

On the other hand, while self-tracking and monitoring strategies were very common in English apps [28, 42, 72], this received less attention in Arabic apps. Finally, English apps [28, 42, 72] featured more social support, including peer support; this was, meanwhile the least common feature identified in our reviewed Arabic apps. This was unexpected for us, as seeking support from others, especially friends and family members outside healthcare settings, is very common in Saudi society [16, 20]. This can be compared to studies of Asian cultures–that share being collectivist–which have also found the importance of peer and social support for supporting individuals with stress coping and mental health [50, 98, 114], and, has, in general, been discussed as an emerging area of evidence-based digital interventions [54, 87, 103]. Contributing to this literature, our interviews confirmed the potential of employing social support by involving family members in Arabic mental health apps and it should be explored in future studies. This reflects the Saudi social norms where families are involved in patient mental health care in traditional clinics [17].

Unique to the Muslim context, our review further illustrated that 11% of the apps offered spiritual/religious-based strategies, such as providing audio recordings of the Holy Quran and religious-based advice. This result shows a digital adoption of the traditional practices in Muslim communities where some people with mental health issues tend to read or listen to the Holy Quran or seek help from a faith healer who performs religious-based practices such as Ruqyah (incantation) as a source of healing [27]. The Saudi MoH considered the local context and clients' preferences. It has formally recognized the regulated involvement of Raqis (faith healers) in clinical healthcare under the supervision of mental health professionals as one of the patients' rights, as long as they are not interfering with the treatment plan [20, 81].

Clinicians' poor awareness of available apps except for the teleconsultation apps. Similar to other global studies [47, 80, 110], most mental health professionals in our study were not familiar with, and had no experience using, Arabic mental health apps in supporting care, except for the teleconsultation apps. Despite that, they expressed positive attitudes towards adopting them. In our interviews, professionals largely reported the lack of support for the

Arabic language in mobile apps, specifically for educational materials and meditation. However, our app review revealed the opposite picture that educational mental health apps were very common, including "Qareboon", which was MoH-accredited [82]. Meanwhile, 16 others offered meditation and mindfulness features in Arabic, and 6 of them (e.g., "Nafas" [75], "Tuhoon" [55]) were designed primarily in Arabic. Clinicians also reported a lack of awareness about what kind of apps their clients used to manage their conditions. These findings indicate the gap in professionals' awareness of existing mental health apps available in the app marketplaces. We posit that the lack of app awareness and adoption could be due to a number of factors which include the current state of the Saudi app ecosystem. Unlike Western app markets, which are dominated by well-known platform companies and healthcare networks, making it easier for users to trust them, the Saudi app ecosystem is relatively flat. Apart from a handful of widely recognized apps like Labayh, little is known about the numerous reviewed apps released by independent parties. This lack of visibility extends to the underlying treatment validity and the background or expertise of the individuals behind them, limiting their credibility [127].

Developers' and policymakers' roles to support app adoption. Developers should provide information about their background, dates and sources of the app's content, and reduce ads to enhance app adoption and user engagement [124, 136]. Developers should consider professionals' expertise and recommendations and involve them early while designing mental health apps to maximize app effectiveness and reduce potential harm to clients [37]. Developers may consider enhancing social support functionalities in future as they are closely aligned with the values of collectivist societies but rarely utilized in mental health apps targeting Arabic-speaking users. Healthcare policymakers should consider evaluating existing apps thoroughly to certify their content validity and conformance with improving clients' mental health without harm. In addition, it is recommended to provide an accessible framework/list of the certified mental health apps that clients and clinicians can access to explore existing certified apps or verify developers' claims.

5.3 The Role of Technology-Facilitated Privacy and Anonymity in Seeking Help and Mitigating Stigma

In highly stigmatizing societies like Saudi, where mental health clinics are perceived as for 'crazy' or 'spiritually weak' people [13, 19, 20, 63], our findings support the view that technology-mediated care presents a significant opportunity to improve healthcare accessibility [97, 99, 114]. In particular, tools that were particularly well-received included features like the ability to remain completely anonymous while receiving care, and the ability to choose between video, audio, or text communication as the medium of treatment. Our results showed that these technology-facilitated features help individuals in the KSA to overcome several stigma-related barriers [13, 19, 20, 63]. The first is the fear of the public stigma associated with mental illness when seen or known by others while visiting mental clinics. The second is the fear of judgement and/or social consequences of having or discussing issues that do not align with cultural and religious norms in the KSA. This includes fear of judgement by everyone, including potentially healthcare professionals. The third is fear of damaging their family's social image when seeking mental health treatment (stigma by association). Thus, our results argue that barriers to seeking mental healthcare in the KSA could be less tied to individuals' willingness and more connected to the medium used for healthcare delivery, manifested by the substantial demand for mental health apps that maintain a degree of privacy and anonymity over face-to-face visits.

In some sense, it should not be surprising that providing tools that provide protection of clients' privacy, such as by concealing their appearance or identity, would be seen as beneficial in the KSA. For instance, it has been reported that, in mental health in-person clinics, Saudi women are more comfortable discussing embarrassing issues while wearing the Niqab to maintain their facial identity [29]. This also happens in spite of seeing women clinicians (i.e., covering up their faces is not part of Islamic religious beliefs when they are in the company of women). Although wearing the Niqab limits recognizing facial expressions, clinicians respect clients' religious values and preferences by avoiding asking them to reveal their faces in clinics [29, 30]. Moreover, aside from stigma, clients' behaviours of maintaining privacy and anonymity could also be due to local cultural and religious contexts. It was reported previously within mobile teledermatology in the KSA that patients, mainly women, refused photography [67] and were uncomfortable with video consultations or sharing images for teleconsultations due to social and religious reasons as women typically cover their faces in public [66]. These reservations may stem from concerns about sharing their media with man clinical staff for further consultations, as well as fears of data loss or unauthorized access, all of which raise religious and cultural concerns [8, 12]. A third reason for the unwillingness to interact visually could be part of the client's symptoms of social anxiety [33], which is considered the fourth most common individual disorder in the KSA, especially among Saudi women [31]. Another possible explanation for avoiding video sessions may be simply that clients may feel uncomfortable viewing their own emotional reactions on camera [139]. Video feedback, however, may actually help those with social anxiety, as recent work by Miller et al. [65] found. More work will be needed to examine whether this is true in the KSA as well.

From care providers' perspectives, however, maintaining anonymity and turning off the camera were seen by our participants as potentially detrimental to effectively building a therapeutic alliance between patients and providers [3] and effective examination. Similar to our findings, difficulties in building this relationship and concerns around the absence of nonverbal cues were raised in online services by therapists in previous studies [6, 74]. Accordingly, some professionals in our study chose to exclusively offer visual sessions. The Saudi Health Council (SHC)'s recently released telemedicine regulations state that "Telehealth should be delivered through video, and/or audio, and/or picture, and/or text, and/or data.", which essentially leaves it up to clinicians to offer counselling via the channels they see fit. Given that further guidance remains lacking, there remains a potential conflict between clinicians who prefer video consultations (for therapeutic efficacy) and patient preferences for privacy-preserving and stigma-avoiding channels.

[3]Therapeutic alliance is the relationship between a mental health professional and a client, that involves goals, bonds, and warmth [62], which is essential for achieving successful treatment [128, 133, 140]

We suggest policymakers in Arab countries may wish to address this gap by creating further mental telehealth guidelines that take the unique cultural factors affecting adoption suggested by our research and others [8] into account.

As a brief side note, in our expert interviews, mobile apps were perceived by both participants and clients as privacy-supporting. Although it is true that the discussed app features may mitigate certain types of physical-world privacy threats (such as from snooping by friends and family), mental health apps have been known to share data invisibly behind the scenes. For instance, the Mozilla Foundation reported in 2022 [85] that "The vast majority of mental health and prayer apps are exceptionally creepy. They track, share, and capitalize on users' most intimate personal thoughts and feelings," while Lagan et al. [72] found that over 40% of mental health apps in Western app stores shared personal health data to third parties. Hence, we feel that caution should be taken when marketing mobile apps as secure and private, and healthcare providers should gain an awareness of the actual privacy and security properties of the apps they recommend to clients. Future work should also examine the technical privacy properties of KSA apps.

5.4 Doctor Shopping in the Commercial App Market

While the commercial app market has significantly facilitated service accessibility–to the extent that one click is enough to see a doctor—clinicians expressed their concerns about the growing phenomenon of "doctor shopping", defined as "consulting multiple doctors during the same illness period" [58, 108]. This could be attributed to clinician factors (e.g., long waiting lists and personal characteristics such as being strict), and also to patient-related factors (e.g., illness persistence, lack of understanding or nonacceptance of the diagnosis or treatment, and prescription drug-seeking) [108]. Regarding doctor shopping for drug prescription abuse, the Saudi MoH instituted the use of a unified e-prescription platform, "Anat" [83], which mitigated the problem across apps and platforms. However, in the context of psychotherapy, the adverse effects of this growing phenomenon remain formidable, and our participants viewed this as a potential obstacle to the therapeutic alliance.

6 LIMITATIONS AND FUTURE WORK

With respect to the interviews, while our final sample involved clinicians from different areas and institutions in the KSA with diverse time in practice, they were recruited using snowball sampling (similar to related expert interview studies [96, 97, 137]). This sampling strategy has the tendency to make the final sample more homogeneous in perspective, limiting the representativeness of the entire population. Our findings were based on the perspectives of our twelve clinicians (in common with other qualitative studies [96, 97, 137]) who mostly see adult patients with anxiety and depression disorders in the KSA. Perspectives on adopting technology to support mental health for other populations with different disorders or age groups (elderly patients and children) need to be explored. In addition, while we did not target clinicians based on their experience in digital mental health to support the diversity of clinicians' experiences and perspectives (similar to related studies [96, 137]), almost all of our participants in the final sample, except for one psychiatrist, have experience in online mental health services and all of them have an interest in using mHealth. It is important to note that clients (patients themselves) were not interviewed, and thus, findings around them were derived exclusively from professionals' perspectives and experience. Perspectives of Saudi individuals, especially women, on digital mental health tools need to be investigated further in future.

With respect to the app review, our app analysis was conducted in August 2022, and thus may not include newer apps introduced after that time. Moreover, our search was restricted to that of the KSA, so our findings are not generalised to the app ecosystems of other MENA/Arab nations. Moreover, the search function used to identify apps was limited to a maximum of 200 apps per search term (similar to other reviews [24, 72]). While only the term "mental health" on the Apple App Store hit this limit, it is still possible that some apps may have been missed as a result.

7 CONCLUSION

Much like the rest of the world, mobile health apps are widely used in the Kingdom of Saudi Arabia (KSA). Unlike in the US and Europe, as of yet, there has been a scarcity of research examining their use in the KSA. In this paper, we sought to understand whether the social and cultural context of the KSA presented unique opportunities and challenges for mental mHealth, and whether these apps served the particular needs of the Saudi population. Through interviews with 12 psychiatrists and psychologists in the KSA, we explored how religion, stigma, and social norms served as both barriers and opportunities for technology to support mental health help-seeking. Our app review discovered an abundance of Arabic mental health apps (n = 110), many of which were locally developed, and which employed a wide range of therapeutic strategies. This contradicted the views of our professionals, who expressed a lack of availability of apps as a barrier to progress. Among these apps, there was a notable absence of social support features, which was surprising given the importance of social and family-based support within the collectivist nature of Saudi society. Based on these findings, we feel that key stakeholders in the KSA, including app developers and healthcare decision-makers, should invest more effort to embrace technology's potential to overcome issues of stigma around mental health and preserve individuals' privacy and anonymity during consultations. Moreover, while this study focuses on Saudi Arabia, we believe that the findings and recommendations may be relevant to other countries, especially highly-connected nations that share similar cultural and religious beliefs, such as other Gulf Cooperation Council (GCC) countries. Future research is needed to explore other GCC regions to either validate the findings of this study or uncover new insights.

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A THEORETICAL BACKGROUND/STRATEGIES AND AFFILIATIONS DEFINITIONS

Table 4: Categories and definitions used to analyze theoretical background/strategies and affiliations of the reviewed mental health apps (n = 110).

Theoretical background/Strategies	Definitions
Assessment	Tests and scales to assess one's mental health and well-being [118]
Feedback	Collected data are presented to users numerically and visually in a graph and chart formats [28]
Information/Education	Mental health educational content (text, images, audio, video) [118]
Monitoring/Tracking	Tracking of mood, thoughts, behaviours, sleep, physical exercise, symptoms, medication, or body measurements/vital signs [72]
Goal setting	Setting up specific goals to work toward [118]
Skills training	Advice /Tips /Strategies/ Skills training [28]
Cognitive behavioural therapy (CBT)	Resources and exercises on CBT, e.g., cognitive (thought challenging), behavioural (positive events) [118]
Acceptance commitment therapy (ACT)	Resources and exercises on ACT [72]
Mindfulness/Meditation	Mindfulness/meditation tracks and written exercise instructions [118]
Relaxation	Deep breathing, music, natural sounds, physical exercise, and yoga [28, 118, 135]
Gratitude	Gratitude diary, affirmations examples and entries [118]
Counselling	The app has a built-in feature to connect with a mental health provider [72]
Journaling	Diaries, free writing and journals [72]
Hypnosis	Hypnosis audio tracks and written scripts [28, 122]
Peer support	The ability to join online forums, ask questions, and talk to others [118]
Other	Other employed strategies that do not fall into any of the categories described above
Affiliations	**Definitions**
Unknown	The affiliation cannot be verified by available information (e.g., individuals) [113]
Commercial	The app was affiliated with a business organization (e.g., LLC, LTD, Inc.) [28]
Government	The app was affiliated with a government institution [113]
NGO	The app was affiliated with a non-governmental organization (NGO) [113]
University	The app was affiliated with a university or academic institution [113]