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Original Paper

Developing a Suicide Prevention Social Media Campaign With Young People (The #Chatsafe Project): Co-Design Approach

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Abstract

Background: Young people commonly use social media platforms to communicate about suicide. Although research indicates that this communication may be helpful, the potential for harm still exists. To facilitate safe communication about suicide on social media, we developed the #chatsafe guidelines, which we sought to implement via a national social media campaign in Australia. Population-wide suicide prevention campaigns have been shown to improve knowledge, awareness, and attitudes toward suicide. However, suicide prevention campaigns will be ineffective if they do not reach and resonate with their target audience. Co-designing suicide prevention campaigns with young people can increase the engagement and usefulness of these youth interventions.

Objective: This study aimed to document key elements of the co-design process; to evaluate young people's experiences of the co-design process; and to capture young people's recommendations for the #chatsafe suicide prevention social media campaign.

Methods: In total, 11 co-design workshops were conducted, with a total of 134 young people aged between 17 and 25 years. The workshops employed commonly used co-design strategies; however, modifications were made to create a safe and comfortable environment, given the population and complexity and sensitivity of the subject matter. Young people's experiences of the workshops were evaluated through a short survey at the end of each workshop. Recommendations for the campaign strategy were captured through a thematic analysis of the postworkshop discussions with facilitators.

Results: The majority of young people reported that the workshops were both safe (116/131, 88.5%) and enjoyable (126/131, 96.2%). They reported feeling better equipped to communicate safely about suicide on the web and feeling better able to identify and support others who may be at risk of suicide. Key recommendations for the campaign strategy were that young people wanted to see bite-sized sections of the guidelines come to life via shareable content such as short videos, animations, photographs, and images. They wanted to feel visible in campaign materials and wanted all materials to be fully inclusive and linked to resources and support services.

Conclusions: This is the first study internationally to co-design a suicide prevention social media campaign in partnership with young people. The study demonstrates that it is feasible to safely engage young people in co-designing a suicide prevention intervention and that this process produces recommendations, which can usefully inform suicide prevention campaigns aimed at youth. The fact that young people felt better able to safely communicate about suicide on the web as a result of participation in

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the study augurs well for youth engagement with the national campaign, which was rolled out across Australia. If effective, the campaign has the potential to better prepare many young people to communicate safely about suicide on the web.

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KEYWORDS

suicide; social media; health promotion; co-design; adolescent; young adult; #chatsafe

Introduction

Background

Rates of youth suicide are increasing both in Australia [1] and internationally [2,3]. Although young people are often reluctant to seek professional help [4], social media can provide an accepted and accessible platform for them to talk about suicide ideation and can often act as a soft entry point into services [5]. The benefits attributed to social media by young people include the ability to seek help and express feelings in a potentially nonstigmatizing and nonjudgmental environment at any time of the day or night, the capacity to help others, and the sense of community and connection provided [6]. Additional benefits associated with social media include its ability to transcend geographical boundaries, to reach large numbers of often marginalized and hard-to-reach young people, and to deliver preventative interventions quickly and at relatively little cost [6-8].

However, the potential for harm also exists. For example, certain types of content (eg, graphic information or images) can cause distress or may lead to imitative suicidal behavior in others [9]. Furthermore, young people may also be exposed to expressions of suicide risk posted by others but feel ill-equipped to respond. Nonetheless, when it comes to suicide prevention, evidence suggests that social media needs to be viewed as part of the solution, not just part of the problem because of its reach, accessibility, and acceptability [10]. Therefore, interventions that have the capacity to harness the benefits associated with social media, yet can mitigate the potential risks, are required.

Guidelines, which advocate for responsible and sensitive reporting and portrayal of suicide, have improved the safety and quality of communication about suicide in mainstream media [11]. However, although overall suicide reporting guidelines have had good uptake with journalists and appear to be linked to reductions in suicide rates [12], uptake and adherence to guidelines by journalists is not universal [13-15]. Media guidelines also provide little specific advice on using the web-based environment and are unlikely to impact young people as producers of their own content. These limitations highlight that careful consideration needs to be given to implementation strategies and how traditional media guidelines can be adapted for their application to the interactive nature of social media, and so that they reflect the ways young people use these platforms to talk about suicide [16].

In response to this, we have developed the #chatsafe guidelines [17], which were designed to support young people to communicate safely about suicide on social media. To promote awareness, implementation, and dissemination of the guidelines [12], a national suicide prevention social media campaign was developed.

The delivery of population-wide suicide prevention campaigns has gained attention as a potentially effective suicide prevention strategy, and although evidence suggests that they can improve outcomes such as knowledge, awareness, and attitudes toward help-seeking [18-24], evidence supporting their capacity to change behavior is inconsistent, particularly among young people. One explanation for this may be that public health campaigns are rarely co-designed in partnership with the target audience.

The importance of consumer participation, often termed as patient engagement or involvement, user-centered or human-centered design, co-creation, or co-design in health research is becoming increasingly recognized around the world. There has been a significant shift from passive participation, where consumers are merely subjects of the research, toward active participation, where participants have the opportunity to make transformative contributions from the outset. In other industries, user-centered approaches to solving complex problems are widely used [25]. Although studies that actively involve consumers do exist in mental health research, very few involve young people, and fewer still exist in the field of suicide prevention. A recent systematic review identified that out of 99 studies testing suicide prevention interventions among young people, none reported actively engaging young people in the design of the intervention or the research itself [26]. Yet, it stands to reason that an intervention is more likely to achieve its aims if it is co-designed with the people it seeks to assist [25]. However, additional thought needs to be given to the settings, techniques, and materials used in the co-design process when engaging young people and addressing complex and sensitive issues such as suicide [27].

Objectives

Therefore, to improve dissemination of and engagement with the #chatsafe guidelines, we partnered with young people in the design and development of a social media campaign that aimed to promote safe web-based communication about suicide. The aims of this paper were to (1) describe the co-design process used to develop the #chatsafe campaign strategy; (2) report on young people's experiences of participating in the co-design workshops; and (3) report on campaign strategy recommendations and describe the final #chatsafe campaign strategy.

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Methods

Design

A participatory co-design process was employed to generate recommendations for the social media suicide campaign strategy. A total of 11 co-design workshops across 4 Australian states (New South Wales, South Australia, Victoria, and Western Australia) were conducted. Workshops were facilitated by at least two researchers from Orygen and the University of Melbourne (PT, JR, and ML) and two designers or producers from Portable (RB, LS, AW, AC, JS, and SG). The Aboriginal and Torres Strait Islander workshop was led by our Aboriginal researcher (SF) and an Aboriginal consultant. Youth advisors (ZT or RBC) attended 5 of the workshops in a peer capacity. The number of young people participating in each workshop ranged from 6 to 16. Workshops were between 2.5 to 6 hours in duration. The structure and process of these workshops is described in detail as follows.

At the end of each workshop, all young people were invited to complete a specifically designed pen-and-paper quantitative evaluation survey, which was based on one used in an earlier study [10]. The survey included 3 sections: (1) demographics, (2) perceived benefits gained from participation, and (3) workshop acceptability and safety. The survey comprised a combination of dichotomous responses and Likert-type scales and took approximately 10 min to complete.

Given the large number of participants, with multiple small group discussions occurring simultaneously and background music, it was not feasible to audio-record and transcribe workshops. However, a comprehensive postworkshop discussion session, attended by all of the workshop facilitators, occurred within a few days after each workshop to distill key recommendations generated in each workshop. The semistructured discussion involved summarizing the main points that had arisen in the group activities and discussions. These were recorded in detailed notes by RB and were reviewed by all of the relevant facilitators. A total of 11 discussions were held, with 4 to 6 facilitators in each discussion.

Participants and Setting

The study was conducted by researchers at Orygen and The University of Melbourne, Melbourne, Australia, between December 2017 and May 2019, in partnership with Portable, a digital design and technology company.

Young people aged between 16 and 25 years inclusive, who lived in Australia and were proficient in English, were eligible to participate in the workshops. Lived experience of suicidal ideation or behavior was not an inclusion criterion nor was it an exclusion criterion. Young people were recruited from 7 Australian youth advocacy organizations. Youth program coordinators (or equivalent) distributed advertisements via email lists and Facebook. The advertisement included background information about the #chatsafe project, co-design procedures, reimbursement, and inclusion and exclusion criteria. Interested young people were either referred to PT by program coordinators or contacted PT directly themselves via email to register for a workshop.

One tailored workshop was conducted with Aboriginal and Torres Strait Islander young people at the Second National Aboriginal and Torres Strait Islander Suicide Prevention Conference. Young people who participated in this workshop were recruited via a national bursary award program, which supported travel to and from the conference, accommodation, and conference registration. Young people who were aged between 18 and 25 years inclusive, were an Aboriginal or Torres Strait Islander person, lived in Australia or the Torres Strait, and were proficient in English were eligible to take part.

Data Analysis

Evaluation data were analyzed using descriptive statistics. Notes from the postworkshop discussions with facilitators were analyzed using a thematic analysis, following a process recommended by Braun and Clarke [28]. We identified a clear analytic question to guide the analysis (ie, how do young people want the #chatsafe guidelines to be implemented via social media?). The written notes from the discussions were then read by PT several times and sorted into initial codes that reflected the diversity of ideas that were generated in the workshops. These codes were then organized into recommendation themes. The notes, codes, and themes were then discussed within the research team to improve the fidelity of the final themes through consensual discussion [29]. The trustworthiness of findings derived from the analysis was established by these discussions. Data trustworthiness was also reached through reflection upon the first author's biases (PT), through the iterative nature of the co-design workshops and evaluation processes, and by being checked by one of our project youth advisors (ZT) and the designers and producers from Portable (LS, AW, AC, JS, and SG).

Safety and Ethics

This study received approval from The University of Melbourne Human Ethics Sub-Committee (ID: 1749618) and Western Australian Aboriginal Health Ethics Committee (ID: 887). Written informed consent was obtained in person at the start of each workshop. Parental consent was obtained for young people under 18 years of age. Young people were required to read a *Plain Language Statement* and complete a *Wellness Plan* (see the following paragraph) before the workshop. In line with best practices [30,31], young people were reimbursed for their time.

The *Wellness Plan* represented a collaborative approach to ensuring safety during each workshop. It included personal and emergency contact details, relevant medical details, key contacts (including professional service providers), and self-care and coping strategies for each young person. In instances that a young person became distressed, a researcher accompanied the young person to a private space and enacted their *Wellness Plan*, while the facilitators continued the activity. In addition, a *Risk Management Protocol* was developed, and young people had access to either telephone-based or on-site support from a psychologist during and after each workshop. At the Aboriginal and Torres Strait Islander workshop, there was an on-site Aboriginal psychologist available during and after the workshop.

Finally, the evaluation survey contained 2 safety items: (1) "Did you find participating in this workshop distressing?" and (2)

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"Would you like to speak about your experiences with a member of the research team?" Young people who responded "yes" to both safety items were asked to provide their contact details. Young people who responded "no" to the second safety item were encouraged to contact youth-friendly telephone and web-based support services. Web and telephone contact details of these services were provided in the survey. Surveys were examined immediately after workshops to identify young people who indicated they wanted support. On-call psychological support was available to the research team via telephone or in-person at all times.

Structure and Process of Co-Design Workshops

Preworkshop Planning Meeting

Approximately 1 week before each workshop, the facilitation team met to clarify roles and review the *Facilitator Resource*. During the meeting, the designers were notified of relevant information from the *Wellness Plans*. Risk mitigation strategies were discussed where appropriate.

Workshop Procedure

Warm-Up

Each workshop began with a basic introduction activity, during which everyone shared their names, preferred personal pronouns, and one *fun fact* about themselves. This was followed by a warm-up activity and the development of *room agreements*, which involved collaboratively developing some guidelines to ensure everyone felt safe and comfortable during the workshop. In the Aboriginal and Torres Strait Islander workshop, a yarning circle was conducted to open the workshop, and the aforementioned activities were incorporated into this.

Co-Design Activities

The co-design process was iterative whereby the learnings from each workshop informed the schedule of the next one. Although each workshop was unique, they concentrated on the elements of *define*, *design*, and/or *user-testing* (see Textbox 1). Young people were divided into small groups of approximately 4 participants. These smaller groups were facilitated by at least one researcher and one Portable designer. Tools to facilitate design activities were used, such as Scenes (physical and digital illustrations used to develop storyboards; Play Doh; Post-it notes, butcher's paper, pencils, and colored markers; Lego; stickers; and iPads. At the conclusion of the idea generation segment, the smaller groups presented their ideas to the larger group for discussion. Feedback during user-testing was obtained via group discussions and score cards (Figure 1). Of the 11 workshops, 3 had a *define* focus, 9 had a *design* focus, and 4 had a *user-testing* focus.

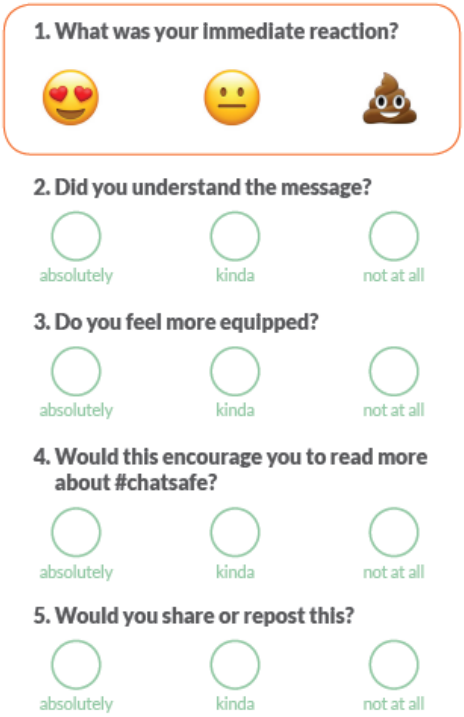
During workshops, sensory toys and mindfulness materials were provided, a private break-out area was available, and background music was played to help create a positive environment. Open plan venues were selected to ensure the young people's safety as they allowed researchers to quickly detect shifts in affect. These types of venues also promoted inclusivity as everyone remained in the same space.

Textbox 1. Co-design element definitions.

- Define: To map the ways in which young people used social media platforms to communicate about suicide and to determine how young people wanted and needed to see the #chatsafe guidelines implemented via the campaign.
- Design: To develop a social media campaign strategy that incorporated young people's perspectives and addressed their wants and needs. This included identifying campaign directions (ie, the campaign themes and messages based on the #chatsafe guidelines) and selecting content types (ie, message delivery methods such as video).
- User-Testing: To test and obtain feedback on design prototypes for inclusion in the final campaign.

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Figure 1. User-testing score card.



Evaluation and Cooldown

To conclude each workshop, a debrief session was conducted. This provided young people with an opportunity to share their experience, ask questions, and provide feedback. Workshops were closed with a meditation or mood-elevating activity, such as cute animal videos or compliment/appreciation games, where each person provided another person with a workshop-related compliment. In the Aboriginal and Torres Strait Islander group, didgeridoo instrumentals and Australian nature sounds were played. Facilitators remained in the room for at least 10 min after the workshop to provide young people with a private opportunity to ask questions, give feedback, or receive support.

To ensure fidelity across workshops, a *Facilitator Resource* was developed by the project team before the first workshop and updated before each workshop. This included facilitator guidelines, project updates, a workshop agenda, and detailed descriptions of co-design activities for each workshop.

Co-Design Barriers and Facilitators

The most significant challenge that we encountered was obtaining ethical approval, which we anticipated given the subject matter of suicide, novel social media component of the project, and the vulnerable populations that we intended to target [32,33]. Unsurprisingly, the Committee was concerned about the safety of participants. To address this concern, detailed and specific written safety protocols (including flowcharts considering the level of risk) were developed to support distressed young people; a clinical psychologist (SR) reviewed the workshop procedures; support from a psychologist was available during workshops; designers and producers were partnered with researchers who were responsible for observing psychological functioning during workshops; and, where possible, designers and producers completed Mental Health First Aid Training to increase mental health literacy and recognize common signs of distress. Given the iterative nature of the project, the Committee were also concerned that they were not reviewing final versions of project procedures and campaign output. To overcome this, a subgroup of the Committee was established to review subsequent project materials as they were produced and made available (eg, workshop agendas and schedules, storyboards, design prototypes, the final campaign strategy, etc). It was agreed that the subgroup would review amendments outside of scheduled meeting dates and give this information immediate attention. In addition to the original application, a total of 11 amendments were submitted and approved.

Results

The results are divided into the following 2 sections: (1) young people's demographic characteristics and experiences of the co-design workshops and (2) young people's content and format recommendations for the #chatsafe social media campaign strategy.

Participant Characteristics and Evaluation of the Co-Design Process

In total, 134 young people participated in the co-design workshops, of whom 131 (97.7%) completed a pen-and-paper evaluation survey. The characteristics of the young people are summarized in Multimedia Appendix 1.

The majority of young people indicated that they perceived participating in the workshops as a beneficial, acceptable, and safe experience. However, it is important to note that 8 young people reported that the workshop made them feel suicidal and 6 young people were unsure if participation caused them to feel

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suicidal. Young people's evaluation of the co-design workshops is reported in Multimedia Appendix 2.

Recommendations for the #chatsafe Campaign Strategy

A number of key themes were identified that related to both the content and format of the campaign, which informed the final campaign strategy. These have been described in the following sections.

Campaign Content

Agency and Self-Care

Young people wanted to play an active role in maintaining their own safety. They wanted tools and resources that would equip them to help themselves and their peers. They also wanted the agency and control to choose what content they consumed. Young people highlighted that language used in campaign content should not be too directive. Instead, they wanted prompts that encouraged them to act as *mental health champions* who looked after others as well as themselves.

Young people wanted self-care content to note the importance of checking-in with oneself before supporting others. They liked the idea of talking with a friend, taking a break or going offline, engaging in distraction techniques, and taking control of what they are exposed to on the web (eg, by amending their personal social media settings). Privacy was important to young people, who recommended that the campaign content elicited components of the guidelines that focused on this; for example, content that encouraged private messaging as opposed to public posts when discussing sensitive topics.

Stories of Hope and Recovery

Young people reported that real stories of hope and recovery were inspirational, modeled adaptive behavior, normalized and validated challenges, and provided a sense of community. The stories were particularly effective if young people could identify with the protagonist. They also wanted videos that were created by other young people with whom they could relate.

Active Support

Young people did not want to self-identify on social media that they needed support. They wanted others, in particular their friends, to be equipped with knowledge and skills to be able to offer support; similarly, they wanted to be able to support their friends. Moreover, communicating with a peer was often reported to be the first step toward receiving professional support. Young people wanted to start with low-impact, informal support options and then build on those, if required.

When discussing the utility of artificial intelligence (AI) on social media, young people wanted AI that was capable of detecting distress, sending personalized information and support, alerting prenominated people, and that was sophisticated enough to engage in natural human dialogue. Some young people from culturally and linguistically diverse (CALD) backgrounds reported that their communities did not talk about suicide, and, in these circumstances, functions such as chatbots could be extremely useful.

Additionally, young people wanted visible links to support services and resources such as web-based and telephone counseling services, as well as the #chatsafe guidelines.

Self-Awareness

In the event that a young person's social media behavior indicated risk, young people reported that they wanted their friends to reach out only if they felt those friends were able to provide support to the young person without causing distress to themselves. They acknowledged that sometimes it could feel overwhelming or beyond their capability to support a friend at risk. As such, they wanted the campaign to include components of the guidelines that promoted *checking-in* with oneself before responding to others.

Multicultural Perspectives, Diversity, and Visibility

Young people wanted to feel represented in the campaign. They emphasized that many people identify in multiple ways and had intersectional identities. As a result, they wanted to see a diverse range of young people visibly represented in all content, while simultaneously avoiding tokenism. They wanted nonhuman content to be culturally neutral and gender neutral (eg, anthropomorphic animations).

Although young people wanted the campaign content to be as inclusive as possible, they acknowledged that some ethnic groups required bespoke content, which addressed unique needs in an appropriate, respectful, and meaningful manner. Aboriginal and Torres Strait Islander young people spoke about the shame and stigma associated with suicide in their communities and indicated that they wanted culturally based and community-generated content.

Campaign Format

Real People

Young people wanted the content to feel realistic and natural. They wanted to see other young people (as opposed to professional actors or models) in videos and photographs. They wanted the content to feel genuine as opposed to staged. They reported that influencers and other brand ambassadors were not relatable in this context unless they were sharing authentic content (eg, personal lived experience).

Animation

Animations were considered a popular format for campaign delivery, partly because they were reported to offer cultural protection and prevent overidentification and partly because they were easily distinguishable from other types of content. However, young people still wanted an element of realness, for example, a human voiceover. Conversely, young people stated that mascots, animated animals, memes, and cartoon characters were too flippant in this context and should not be used.

Embedded in Existing Social Media Platforms

Young people stated the campaign content had to be available on platforms that they already used, as they did not want to download additional apps, and all tools and resources had to be platform agnostic. They wanted tools and resources to be customizable, adaptive, and interactive. The social media platforms most frequently used were Instagram, Snapchat,

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YouTube, Messenger, and Facebook. Some young people, particularly those interested in politics or academic research, used Twitter. Lesbian, gay, bisexual, transgender, intersex, queer/questioning, asexual, and other gender or sexual orientation (LGBTIQA+) young people also reported using Discord and Tumblr. They reported that they already used a number of these social platforms to share their experiences and seek support, provide help to others, and remember those who had died, particularly celebrities.

Accessibility

As noted earlier, young people wanted the campaign to be as inclusive as possible, and, as such, it was important that the content was accessible to all young people. They stated that video content should include subtitles as well as audio and should be consumable with and without audio. They noted that where voices were used, there should not be more than 2 narrators, so as to prevent confusion. Text-based content should be clear and concise. Many young people, in particular, those with CALD backgrounds, suggested that the content be translated into other languages so that they could share it with their families.

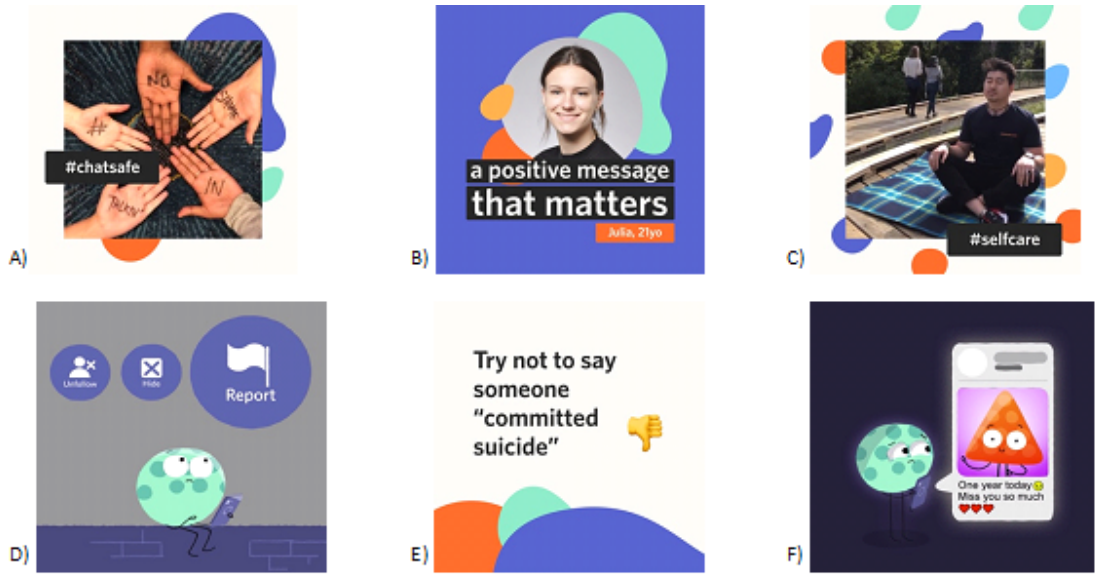
Translation of Recommendations Into the Final Campaign

On the basis of the abovementioned findings, a 12-week social media campaign strategy was developed. This comprised 7 campaign directions based on the #chatsafe guidelines: (1) general tips and introduction to #chatsafe; (2) self-care; (3) responding to someone who might be suicidal; (4) what does a safe post look like?; (5) before you post, pause and reflect; (6) remembering someone who has died by suicide; and (7) dealing with harmful content. To avoid overexposure to suicide-related content, every second week, the messaging was focused on self-care. Content relating to suicide of a celebrity was developed but not scheduled for deployment unless a celebrity died by suicide during the #chatsafe campaign (October 2019-January 2020).

Three content types were selected for the campaign: (1) animated videos featuring culturally neutral characters with human voiceovers; (2) photographs or images with text overlay; and (3) videos and photographs featuring real young people as well as pictures, images, and *Boomerangs* produced by young people. A Boomerang video "takes a burse of photos, then speeds them up, and plays them forward and backward to create a looping Boomerang video" [34].

The content was housed on an interactive website (www.orygen.org.au/chatsafe), and the campaign was delivered via Facebook, Instagram, Snapchat, Tumblr, Twitter, and YouTube. Content was deployed 3 times per week over a 12-week period. Each week of the campaign was focused on one of the campaign directions listed earlier. Examples of the campaign content can be seen in Figure 2.

Figure 2. Examples of #chatsafe campaign content. A) General tips and introduction to #chatsafe; B) General tips and introduction to #chatsafe; C) Self-care; D) Dealing with harmful content; E) What does a safe post look like? F) Remembering someone who has died by suicide.



Discussion

Principal Findings

This study reported on a participatory approach to co-designing a social media campaign that aimed to help young people communicate safely about suicide on social media. The information contained in the campaign was based on evidence-informed guidelines [17], and campaign information delivery methods were based on the valuable recommendations of the young people involved in the co-design process. The campaign was rolled out across Australia between October 2019 and January 2020. To the best of our knowledge, the #chatsafe campaign was the first of its kind worldwide.

In addition to demonstrating that it was both safe and acceptable to conduct co-design workshops in the field of suicide prevention, young people developed a number of key skills as a result of taking part in the workshops. These included feeling

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better equipped to communicate safely on the web about suicide and feeling better able to identify others who may be at risk, both of which augur well for the potential impact of the national campaign. Key implications from these findings are discussed as follows.

Co-Design in Youth Suicide Prevention

Although participatory approaches are becoming increasingly common in mental health [35-43], to the best of our knowledge, they have rarely been applied to the development of youth suicide prevention interventions. One likely explanation for this is fear of iatrogenic effects [44,45], despite the increasing body of literature that suggests that it is both safe and acceptable to conduct suicide research with young people [46-50]. However, there are a few notable exceptions that engage young people in participatory approaches for suicide prevention interventions. Robinson et al [10] engaged secondary school students to develop suicide prevention social media messages. Hetrick et al [51] engaged young people who had experienced depression, suicidal ideation, and self-harm to co-design a mood monitoring app. Neither study reported adverse events, and key benefits identified included improved web-based suicide literacy.

#chatsafe Co-Design Process

In this study, to mitigate potential risks and to make the activities less intimidating, best practice frameworks for youth participation in mental health and co-design were followed [27,52-58], but a number of modifications to commonly used co-design methods were also made. First, facilitators played a supportive/guiding role rather than a didactic role during design activities [59]. Second, design sprint methods were modified, by adding simple definitions for design terms, providing demonstrations or examples, and removing strict time limits. Finally, detached design personas (ie, stick figures without names, gender, ethnicities, or detailed stories) were used instead of common personas, which may be perceived as too familiar to participants and thereby trigger distress [60].

A multidisciplinary facilitation team comprising mental health researchers and designers and producers conducted the workshops. Designers led the creative activities and the researchers were responsible for the content and well-being of young people. Additionally, 2 project youth advisors attended several workshops in a peer support capacity. Nondiscriminatory language was used at all times [61]. For example, nouns such as *guys* were replaced with gender-neutral alternatives such as *folks*. Finally, open plan venues were used, which not only fostered interactivity but also provided good visibility that allowed the well-being of the young people to be monitored closely.

Safety

Although we considered and employed robust safety protocols and safety-monitoring techniques, importantly, 8 young people did feel suicidal as a result of the workshops and 6 young people indicated that they were unsure if taking part in the workshop made them feel suicidal. We did not conduct a pre- and postassessment; therefore, we do not know if these young people felt this way before participation. Indeed, the majority of young people who participated in the workshops reported current or previous history of suicidal ideation. Consequently, young people may have been vulnerable to suicidal ideation or may have already experienced suicidal ideation and may have been unsure if the workshop precipitated or perpetuated their thoughts. This illustrates that it may be beneficial for future work to conduct qualitative research on the impacts of participating in the co-design process.

#chatsafe Campaign Strategy

The co-design activities described earlier led to the development of a suicide prevention social media campaign strategy, in which young people wanted to see specific information on how to help others, positive stories of hope and recovery, and information on youth-friendly sources of support. They wanted to consume this information on the social media platforms that they already used via short and simple shareable and linkable content. Mass media campaigns are becoming increasingly common in suicide prevention [18,62], and social media presents new dissemination opportunities, in particular, for young people who are avid users of social media platforms [63,64]. Despite this, to date, no suicide prevention campaigns exist that specifically target young people, and none have been co-designed with end users.

Suicide and Social Media

Sharing suicide-related content on social media is often perceived as a double-edged sword [65]. On the one hand, concerns include increased risk of pro-suicide behavior, access to information about suicide methods, fears around contagion, as well as the normalization of suicide behavior [7]. In this study, young people also expressed that exposure to suicidal content can sometimes unwittingly cause distress and that exposure to web-based expressions of suicidal intent can leave them feeling ill-equipped to respond. However, on the other hand, social media can be used to deliver suicide prevention messages to large audiences quickly, to detect intervention opportunities, and to provide users with both formal and informal support [6,9,66]. In this study, young people reported using social media platforms to communicate about suicide in a number of different ways: (1) to share their own experiences of suicidal thoughts and behavior; (2) to support others, in particular their friends; and (3) to discuss and commemorate those who had died by suicide, including friends and family as well as public figures. Thus, given the potential for harm, educating and empowering young people to have these conversations safely about suicide is critical.

Suicide Literacy

There have been few studies that provide suicide literacy education to young people directly, either on the web or offline. The few offline studies that have been conducted largely focused on relatively small school samples and reported benefits such as improved knowledge, confidence, and capacity to help others [26,67-69]. However, given the proliferation of suicide-related communication on social media platforms, in particular Instagram [70-72], larger scale web-focused studies are required. One recent study by Cheng et al [73] in Hong Kong has attempted this. These investigators cocreated a short suicide prevention video with a YouTube influencer. The video was deployed on both YouTube and Facebook with results showing

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a promising shift in consumers' suicide prevention knowledge, attitudes, and willingness to talk about suicide-related feelings [73]. Increasing web-based suicide literacy at the population level in this manner is an important step forward.

Support Pathways

In this study, young people reported wanting to be actively supported by their friends without having to explicitly state that they needed help. These results are perhaps unsurprising. Young people's reluctance to actively seek help, and their preference to receive support from their friends as opposed to professionals, is widely documented [4,74-77]. Instead of overtly requesting help, young people will often hint at distress and hope that their peers are equipped to recognize this and respond appropriately [78]; however, this is often not the case. There have been a number of suicide awareness campaigns, but as noted earlier, these appear to have limited capacity to shift behavior [18,19]. This study highlighted young people's need for interventions that not only increase knowledge and awareness but better equip them to help themselves and each other and they specifically expressed the need for the #chatsafe campaign to provide specific content that would facilitate this. Importantly, young people also identified that talking to their friends on the web about this topic is often a first step toward accessing professional help, hence the need for the campaign to include direct links to professional services.

Stories of Hope and Recovery

Along with educational content on how to help others, information on where to seek help, and characters whom they could identify with, young people wanted the campaign to contain personal experience narratives that conveyed the stories of other young people who had coped with, or gained mastery over, suicidal ideation. Interestingly, these findings align with the theoretical literature. Resilience-focused content has been shown to have protective effects in studies of mainstream media and has been coined the *Papageno Effect*. The name comes from a character in Mozart's opera, The Magic Flute, in which Papageno experienced suicidal ideation because he feared he had lost his beloved; however, he refrained from acting on his thoughts because his friends helped him learn alternative coping strategies [79]. Subsequent studies have supported that portrayals of coping with suicidal ideation have protective effects [80-83]. The opposite of the *Papageno Effect* is the *Werther Effect*, which refers to imitative suicides triggered by sensationalist and repetitive communication on suicide. This comes from Goethe's novel, The Sorrows of Young Werther, which ended with the protagonist's suicide. The novel was allegedly associated with a number of young men's copycat suicides after its publication [84,85]. Studies suggest that vulnerability (eg, history of suicidal ideation or suicide attempt) and identification (eg, similar demographic backgrounds) with the featured character of a suicide story may contribute to this *contagion* effect [85]. Although there is a body of evidence on both the *Papageno* and *Werther* effects [86], to the best of our knowledge, this is the first study to consider how these may also apply to young people's web-based communication about suicide with their peers. Despite interest from young people in consuming stories of lived experience for logical and privacy reasons, we opted not to include direct personal stories in the first iteration of our public campaign. However, all content still sought to instill hope and reinforce recovery.

Campaign Format

Finally, in terms of campaign format, and akin to other health promotion research [87], young people in this study wanted the campaign to be delivered via short videos, animations, photographs, and images with text overlay. Animations, in particular, were popular among young people and have previously been described as "non-threatening, familiar, and accessible across age groups, cultures, and literacy levels" [88].

Limitations

There are limitations to this study. The first relates to the representativeness of the sample. Most young people were recruited through youth advocacy programs in metropolitan Australia and, therefore, were a self-selected sample who had high levels of mental health literacy and ready access to health services. Thus, #chatsafe campaign materials may not necessarily be relevant or acceptable to all young people. Youth advocacy programs were selected as recruitment sources primarily for safety reasons, as we wanted to ensure that young people were engaged with mental health services that could provide ongoing support if necessary. The generalizability of the campaign may be further limited by the demographic characteristics of our sample, which do not reflect the general population. For example, almost one-half of our sample identified as nonheterosexual. As a result, the campaign might address specific, rather than general, needs. Despite this, the groups represented in our sample included young people who are frequently overrepresented in the suicide statistics (those experiencing mental ill-health, Aboriginal and Torres Strait Islander, LGBTIQA+, and/or CALD); hence, it was considered important to target them [89-92]. Second, a robust evaluation of the co-design process or campaign materials was not conducted, so as to prevent overburdening of the young people involved.

To improve generalizability and explore the reach and impact of the social media campaign, a trial targeting all Australian young people aged between 18 and 25 years is currently underway, and these results will be reported separately. Moreover, we are currently working with people from other diverse communities on adapting the guidelines and campaign materials for different cultural groups across the globe. The #chatsafe guidelines are also currently being translated into a number of additional languages.

Conclusions

Despite significant government investment and a recent increase in research efforts [26,93,94], youth suicide rates continue to rise [1-3]; therefore, new approaches to youth suicide prevention are required. Mass media campaigns are gaining traction as a suicide prevention strategy [65], yet, to date, none focus specifically on young people or address the multiple ways in which they use social media to communicate about suicide. This study was the first internationally to co-design a social media campaign that aimed to facilitate safe peer-to-peer communication about suicide on the web. The co-design process

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led to the generation of valuable recommendations for the format and content of the campaign to boost its acceptability to young people. The adapted co-design process was found to be feasible, safe, and acceptable and highlights the importance of modifying methodology when undertaking a co-design process with young people in the suicide prevention arena. Finally, participating in the co-design process led to increased suicide literacy among young people. The #chatsafe social media campaign was rolled out across Australia. If effective, the campaign has the potential to better equip many young people worldwide to talk safely on the web about suicide.

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Conflicts of Interest

None declared.

Multimedia Appendix 1
Demographic characteristics of young people who participated in the co-design workshops (N=131).
[DOCX File , 14 KB - mental_v7i5e17520_app1.docx]

Multimedia Appendix 2
Workshop evaluation results (N=131).
[DOCX File , 14 KB - mental_v7i5e17520_app2.docx]

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Abbreviations

AI: artificial intelligence
CALD: culturally and linguistically diverse
LGBTIQA+: lesbian, gay, bisexual, transgender, intersex, queer/questioning, asexual, and other gender or sexual orientation

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Original Paper

Augmenting Safety Planning With Text Messaging Support for Adolescents at Elevated Suicide Risk: Development and Acceptability Study

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Abstract

Background: Suicide is the second leading cause of death among adolescents. A critical need exists for developing promising interventions for adolescents after psychiatric hospitalization who are at a high risk of experiencing repeated suicidal behaviors and related crises. The high-risk period following psychiatric hospitalization calls for cost-effective and scalable continuity of care approaches to support adolescents' transition from inpatient care. Text messages have been used to improve a wide range of behavioral and health outcomes and may hold promise as an accessible continuity of care strategy for youth at risk of suicide.

Objective: In this study of 40 adolescents at elevated suicide risk, we report on the iterative development and acceptability of a text-based intervention designed to encourage adaptive coping and safety plan adherence in the high-risk period following psychiatric hospitalization.

Methods: Adolescents (aged 13-17 years) who were hospitalized because of last-month suicide attempts or last-week suicidal ideation took part in either study phase 1 (n=25; 19/25, 76% female), wherein message content was developed and revised on the basis of feedback obtained during hospitalization, or study phase 2 (n=15; 11/15, 73% female), wherein text messages informed by phase 1 were further tested and refined based on feedback obtained daily over the course of a month after discharge (n=256 observations) and during an end-of-study phone interview.

Results: Quantitative and qualitative feedback across the 2 study phases pointed to the acceptability of text-based support. Messages were seen as having the potential to be helpful with the transition after hospitalization, with adolescents indicating that texts may serve as reminders to use coping strategies, contribute to improvement in mood, and provide them with a sense of encouragement and hope. At the same time, some adolescents expressed concerns that messages may be insufficient for all teens or circumstances. In phase 2, the passage of time did not influence adolescents' perception of messages in the month after discharge (P=.74); however, there were notable daily level associations between the perception of messages and adolescents' affect. Specifically, higher within-person (relative to adolescents' own average) anger was negatively related to liking text messages (P=.005), whereas within-person positive affect was associated with the perception of messages as more helpful (P=.04).

Conclusions: Text-based support appears to be an acceptable continuity of care strategy to support adolescents' transition after hospitalization. The implications of study findings are discussed. Future work is needed to evaluate the impact of text-based interventions on suicide-related outcomes.

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KEYWORDS

adolescents; suicide; text messaging; safety planning

Introduction

Background

As the second leading cause of death among adolescents in the United States [1], youth suicide is a major public health concern. At the same time, there are currently few effective interventions for suicidal adolescents and even fewer that have shown replicated efficacy [2-4]. Adolescents hospitalized because of severe suicidal ideation or suicide attempts are especially vulnerable to experiencing repeated suicidal crises in the postdischarge period [5-7], and there is a critical need to develop promising interventions to support adolescents' transition from inpatient to outpatient care. Within the context of improving postdischarge outcomes for adolescents at elevated suicide risk, we describe the development of a technology-augmented (text-based) intervention focusing on strengthening adolescents' motivation and self-efficacy to engage in adaptive coping after discharge.

Technology-Augmented Interventions

Technological advances, particularly with respect to mobile phones, have increasingly allowed for the development of inexpensive and relatively accessible interventions with the potential to influence health outcomes and supplement established treatment and extend existing care services [8]. Moreover, the nearly ubiquitous mobile phone ownership among adolescents in the United States [9] has paved the way for mobile interventions to have wide reach and scalability. Mobile-based interventions, including text messaging, have been used to support a range of physical, behavioral, and mental health outcomes [8,10], with recent meta-analytic work indicating that text-based interventions have the potential to impact health behaviors in the short term and produce more lasting behavior change [11]. Although the majority of text-based interventions have targeted adult populations, there is emerging support for their promise in influencing youth outcomes [12,13]. For example, text-based interventions with youth have been associated with decreases in anxiety and depression [14], reductions in binge drinking [15], and decreases in smoking behaviors [16]. Further, text-based interventions for youth have shown acceptability and feasibility in the delivery of sensitive content, such as sexual health information [17] and violence prevention [18].

Mobile-based approaches may be well-suited to aid suicide prevention efforts, especially as previous research has pointed to caring contacts as being effective in reducing suicide deaths among high-risk populations [19,20]. Text-based interventions for individuals at increased suicide risk have incorporated a range of components, including caring contacts, resource information, self-help strategies, self-monitoring prompts, and links to additional psychoeducational tools [21-23]. Notably, text-based interventions specific to suicide prevention have been shown to be feasible and acceptable following acute crisis periods [24]. More recently, Berrouiguet et al [25] presented a case series from an ongoing trial of a brief contact text-based intervention for adults with a suicide attempt history and found that the intervention may have the potential to help connect individuals to crisis support services. Moreover, results from a randomized clinical trial indicated that veterans who received caring contacts via text messages were less likely to experience suicidal ideation and had fewer suicide attempts throughout the 1-year follow-up period [22]. Despite these promising findings, to our knowledge, text-based interventions aimed at reducing suicide risk have not been developed for or evaluated in high-risk adolescent samples.

Text-Based Intervention for Adolescents Discharged From Psychiatric Hospitalization

Text-based interventions delivered after psychiatric hospitalization may hold promise as an accessible continuity of care strategy in the high-risk postdischarge period. Indeed, text messages have previously shown promise in supporting treatment maintenance or continuity of care during the transition from more intensive services for other health outcomes [26-29]. Here, our goal was to develop text-based support to reach adolescents at risk for suicide in the postdischarge period to explicitly encourage the use of adaptive coping strategies and safety plan adherence. Considered a best-practice approach for intervening with an individual at risk for suicide, a safety plan incorporates personalized coping strategies and resources for contacting social and personal support to mitigate a suicidal crisis. The clinical basis for safety plans is consistent with previous research showing that suicidal youth may engage in suicidal behaviors as a way of coping with distress [30] and tend to use less adaptive coping [31,32]. Empirical evidence for this suicide-specific intervention suggests that safety planning, combined with follow-up phone calls, was associated with a lower risk of suicidal behavior and improved treatment attendance among veterans [33]. A related crisis response planning intervention was similarly associated with a reduction in suicide attempts in an active duty military sample [34].

Despite the clinical value of safety planning, sustaining its use after psychiatric hospitalization, or using adaptive coping generally, may be challenging. Previous research on suicidal adolescents has shown that nearly 60% of discharged adolescents do not look at their safety plans in the 6 weeks after discharge, and more than half do not try to use coping strategies to manage self-harm thoughts (according to a presentation by Klaus N, PhD, October 27, 2011). In a pilot study of a safety planning intervention enhanced with motivational interviewing (MI), adolescents who received an MI-enhanced safety plan were more likely to use their safety plan when experiencing thoughts of suicide in the month after discharge compared to those who received standard safety planning [35], although safety plan use declined after discharge for both groups. Moreover, youth at risk for suicide report low confidence in their ability to use coping strategies recommended as part of safety planning [36]. As such, augmenting safety planning delivered during hospitalization with accessible follow-up strategies may promote its use, and thus increase its impact in

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the high-risk postdischarge period. This notion is consistent with the idea that mobile approaches may increase the salience and generalize the impact of interventions [37,38].

Study Purpose

Guided by the overarching goal of improving postdischarge outcomes for adolescents at risk for suicide, the purpose of this study was to describe 2 initial phases in the development of a text-based intervention designed to encourage adolescents' use of adaptive coping after psychiatric hospitalization and to sustain adherence to in-person safety planning. Thus, the intended goal of the text-based intervention was to encourage the use of individualized coping strategies identified as part of safety planning delivered during hospitalization, accessing different types of support, and using additional coping tools and resources. Given the value of youth feedback in developing text-based interventions [39-41], we iteratively sought the perspective of adolescents in the development and refinement process to maximize the saliency of text messages. In addition to describing the process of development, we report on the feasibility and acceptability of the text-based intervention as a continuity of care strategy promoting coping and safety plan use following discharge. The findings of this study are intended to inform the optimization of technology-augmented interventions for adolescents at elevated suicide risk.

Methods

Recruitment

Participants were 40 adolescents (aged 13-17 years) who were psychiatrically hospitalized because of last-month suicide attempts and/or last-week suicidal ideation and who took part in either phase 1 (n=25) or phase 2 (n=15) of the study (description in procedures). Exclusion criteria included severe cognitive impairment or altered mental status (eg, active psychosis or mania), transfer to residential placement, or unavailability of a legal guardian (ward of the state). Adolescents were also excluded from participation if they did not own a mobile phone with text messaging capability. Admitted eligible adolescents were approached for parental consent and adolescent assent. The study was approved by the participating university's Institutional Review Board.

Phase 1

In Phase 1, 79% (27/34) eligible participants provided parental consent and adolescent assent. Of those, 25 adolescents completed all study procedures before discharge. The final phase 1 sample had a mean age of 15.24 (SD 1.36) years, with 76% (19/25) of the sample being female. The racial distribution was as follows: white (21/25, 84%), African American/black (1/25, 4%), and multiracial (3/25, 12%).

Phase 2

In phase 2, 83% (20/24) eligible adolescents provided assent and parental consent. Of those, 4 adolescents were discharged before completing baseline procedures, and 1 was not reached at follow-up, resulting in a sample of 15 adolescents. The final phase 2 sample had a mean age of 15.07 (SD 1.16) years. The sample was 73% (11/15) female with the following racial distribution: white (9/15, 60%), African American/black (3/15, 20%), and multiracial (3/15, 20%).

Procedures

Initial Development

The development of text messages was guided by content area expertise in youth suicide prevention, theory, specifically self-determination theory (SDT) [42] and self-efficacy theory [43], and MI principles [44]. To promote behavior change, SDT places emphasis on encouraging intrinsic, rather than extrinsic, motivation by supporting individuals' needs of autonomy, competence, and relatedness. Self-efficacy theory emphasizes that belief in one's capability to succeed in a situation will ultimately shape behavior. Consistent with SDT and self-efficacy theory, MI uses a communication style that explicitly seeks to elicit and strengthen intrinsic motivation for change and support self-efficacy to achieve the change [44]. As such, we incorporated the principles and strategies of MI to support adolescents' motivation and self-efficacy in using coping strategies after discharge. For example, messages incorporated autonomy-supportive language (eg, *if you want and it's up to you*), affirming statements, and open-ended questions (eg, *what else do you find helpful?*) to encourage the reflection and generation of own ideas.

The bank of text messages was initially developed by coauthors (EC, NH, and CK) and included the following broad content areas: (1) self-efficacy to cope and keep self from suicidal action, (2) motivation to maintain safety, (3) tailored messages with personal coping strategies generated by the adolescent during safety planning (Phase 2 Procedures section), (4) suggestions for additional coping tips and strategies, (5) crisis resources, (6) encouragement to use personal safety plans, (7) affirmations, and (8) strengthening social connectedness. The messages included a combination of text, images, and/or links to Web-based resources or short videos. Table 1 includes example messages for each content area. In addition, supplemental (*extras*) messages were included to instill hope and facilitate engagement; these messages included inspirational quotes and humor. As described below, the process of refining the bank of messages occurred in 2 phases.

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Table 1. Text message content and examples.

Content	Example messages
Self-efficacy	"Something to consider trying when you're overwhelmed or down. Stop...Breathe...And think about how you got through difficult times before. You got this!"
Motivation	"You shared [individualized list of reasons for living] are some of your reasons for living. Reminding yourself of those can help when you need a boost. "
Personal (tailored) coping strategies	"You shared [individualized list of 3 strategies from adolescent's safety plan] help you take a break from a problem or strong feelings. What else do you find helpful? You know yourself!"
Coping tips	"Paced breathing (deep breathing) can help with anxiety and stress. Practicing it when feeling calm can make it easier to use paced breathing in times of distress. If you want, see this video showing how to do paced breathing: [link to video]"
Crisis resources reminders	"It can be hard to do it alone. Consider reaching out to friends or family for support. Or think about calling confidential 24/7 hotline 800-273-8255."
Affirmations	"We all have times our problems seem unbearable. And times we feel really alone. Even then, remember you got through it before. And that you matter!"
Support seeking; connectedness	"No man is an island." Take a moment to reflect on people & places that comfort or lift you up. Try spending time with them or connect in your own way."
Safety plan reminders	"When things get tough or painful, remember you have what it takes to cope! Remind yourself of your safety plan. It represents how strong you are. If you want, text PLAN to get an email with a copy of your safety plan you came up with when we first met."
Extras[a] (instilling hope)	Inspirational quotes were included with images representing the sentiment of the quote.

[a]Extras originally included humorous messages; however, these messages were considerably reduced following feedback (Results section).

Phase 1 Procedures

A total of 25 adolescents participated in phase 1 between April and June 2018. Participants completed the study procedures during hospitalization, which included completing a questionnaire using a tablet computer, wherein adolescents provided feedback on approximately 58 messages and responded to open-ended questions. The purpose of this phase was to revise the content and language of specific messages iteratively. Participants were compensated US $30 for their time and effort.

Phase 2 Procedures

In phase 2, 15 adolescents took part in the study between September 2018 and March 2019. The purpose of this phase was to test the bank of text messages after discharge and obtain participants' feedback about their experience receiving the messages. Adolescents filled out an initial survey during hospitalization and subsequently participated in a safety planning session with a study counselor. The purpose of the safety planning meeting was to obtain information about adolescents' individual coping strategies to personalize some of the text messages delivered after discharge. Starting on the first day after discharge, participants received 2 support text messages each day for 4 weeks. Text messages were sent using a digital platform, TextIt, which enables delivery of automated text messages in a predetermined sequence drawn from the message library, which also included personalized content. The information stored in the TextIt system included the phone number provided by the participant, contact preferences (eg, times of text messages), and specific message content scheduled to be delivered each day. The first message of the day was sent automatically (*push* message) in the morning at a preferred time previously identified by the participant. For the second message of the day, participants were prompted each afternoon, also at a time chosen by the participant, providing an option to request a message using a prespecified keyword (*pull* message). Thus, the second message of the day was sent only if requested by the participant.

Phase 2 participants were additionally asked to complete a brief survey each evening for 28 days after discharge, inquiring about their perception of the 2 support messages from the same day. A link to the survey, developed using a Qualtrics survey tool (SAP), was texted to participants' phones each evening using the TextIt platform. Finally, phase 2 participants were asked to complete a 1-month follow-up survey over the phone, inquiring about adolescents' overall perception about their experience receiving the support text messages. Participants were compensated US $10 for completing the baseline survey, US $4 for completing each of the daily surveys, and US $40 for the 1-month follow-up survey.

Measures

Phase 1 Measures

Perception of Individual Messages

For each message, participants rated the extent to which they perceived a message positively (*How much did you like or dislike this message*?) using a 5-point scale ranging from *dislikeda lot* to *liked a lot*. For each message, additional open-ended feedback was solicited by asking, *If you did not like something about the message or did not understand what we are trying to say, please give us feedback*.

Overall Feedback

After rating all messages, participants were asked to provide overall feedback using 5-point scales about their perception of the messages with regard to (1) adolescents' interest in receiving

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text messages (from *not at all interested* to *very interested*), (2) extent to which receiving text messages like these might be helpful after leaving the hospital (from *very unhelpful* to *very helpful*), and (3) the extent to which a text-messaging program like this could help teens keep themselves safe, particularly if they have thoughts of suicide (from *no, definitely not* to *yes, definitely*). Additional open-ended feedback was sought regarding adolescents' perception of why these messages might be helpful after hospitalization. Finally, adolescents were asked about their feedback regarding the type of message content they would prefer, the structure of the text-based intervention (eg, frequency of messages and duration of receiving the intervention), and possible concerns about privacy.

Phase 2 Measures

Perception of Individual Messages (Daily Survey)

Participants rated the extent to which they liked each message received daily using the same 5-point question as in Phase 1, ranging from *disliked a lot* to *liked a lot*. In addition, participants rated the extent to which each message was perceived as helpful using a 5-point scale from ranging from *very unhelpful* to *very helpful*.

Positive and Negative Affect (Daily Survey)

Positive and negative affect was rated on a 5-point scale, from *very slightly or not at all* to *extremely*. Items were adapted from the 10-item Positive and Negative Affect Schedule for Children (PANAS-C). The PANAS-C has good psychometric properties [45].

Hopelessness (Daily Survey)

Using a 4-point scale, from *strongly disagree* to *strongly agree*, hopelessness was measured with an item (*I see only bad things ahead of me, not good things*) derived from the 6-item brief Hopelessness Scale [46], which was adapted from the Hopelessness Scale for Children [47]. This item was selected because it had strong factor loading and an item-total scale correlation [47].

Overall Feedback (1-Month Follow-Up)

Using the same items as in phase 1, participants provided overall feedback pertaining to (1) adolescents' interest in receiving text messages (from *not at all interested* to *very interested*), (2) the extent to which receiving text messages might be helpful to teens after leaving the hospital (from *very unhelpful* to *very helpful*), and (3) the extent to which the text-messaging program could help teens keep themselves safe (from *no, definitely not* to *yes, definitely*). Participants were provided with an opportunity to provide additional open-ended feedback.

In addition, participants were asked about their overall perception of text messages (*Overall, how much did you like or dislike the support text messages*?) using a 5-point scale ranging from *disliked a lot* to *liked a lot*. We also assessed the extent to which adolescents liked or disliked three broad types of messages: texts with coping tips or links to resources, texts with images that included affirmations or quotes, and texts with humorous content or memes.

Finally, adolescents were asked to provide open-ended feedback about their experience receiving messages with regard to logistics, including (1) what they thought about the timing (or time of day) they received messages, (2) what they thought about the number of support text messages, and (3) how long they thought the text-based intervention should last.

Statistical Analysis

To obtain information about acceptability, frequencies, means, and SDs of feedback measures were summarized. Open-ended feedback was reviewed and coded. Specifically, a coding system was developed based on an initial review of the responses. The coding system summarized commonly mentioned responses for why text-based support may or may not be helpful. Participants' responses were then coded by 2 independent coders, and any discrepancies were resolved by a third study team member. For daily data collected in phase 2, to explore the possible influence of daily affect and hopelessness on the perception of text messages in daily life, we utilized a series of linear mixed effects models. In each of these models, predictors were group mean-centered (score minus each participant's own mean) to examine within-person effects, and each model also included the predictor's corresponding group mean to simultaneously examine between-person effects. Descriptive statistics were obtained using SPSS (version 24) [48], whereas mixed effects models were conducted using SAS (version 9.4) [49].

Results

Phase 1 Results

Sample Characteristics

Over half of the adolescents (14/25, 56%) had at least 1 lifetime suicide attempt, with 40% (10/25) of the sample reporting a suicide attempt in the last month. All 25 adolescents experienced thoughts of suicide in the week before admission. Approximately one-third (9/25, 36%) of the phase 1 sample had at least 1 previous psychiatric hospitalization.

Phase 1 Feedback

Across the 58 messages that received individual ratings, participants perceived the majority of the messages positively (mean 4.26, SD 0.28). Consistently, as shown in Table 2, adolescents expressed that support text messages could be helpful after hospitalization (mean 4.67, SD 0.57), and most (17/24, 71%) indicated that receiving support text messages could probably or definitely help in preventing a postdischarge suicidal crisis.

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Table 2. Overall feedback about text messages from phase 1 and phase 2.

Adolescent feedback	Phase 1 (n=24)	Phase 2 (n=13)
Extent to which text messages were perceived positively (1-5), mean (SD)	N/A[a]	4.31 (0.48)
Interest in receiving text messages (1-5), mean (SD)	4.33 (0.48)	4.08 (1.19)
Perception of text messages being helpful after hospitalization (1-5), mean (SD)	4.67 (0.57)	4.38 (0.65)
Perception of text messages being helpful in preventing suicidal crises, n (%)		
No, definitely not	0 (0)	0 (0)
Probably not	0 (0)	1 (8)
Maybe	7 (29)	6 (46)
Probably	9 (38)	5 (38)
Yes, definitely	8 (33)	1 (8)

[a]N/A: not applicable.

The three most commonly mentioned reasons for why text-based support may be helpful after discharge were the following: text messages serving as reminders to engage in coping behavior (n=9), for example,

> *teens would find this helpful because it would remind them of the tools they have and what they've learned;*

messages providing encouragement (n=10), for example,

> *it helps remind yourself you can be safe even when it's hard*
>
> *it can help remind teens that they matter;*

and messages contributing to an improvement in mood (n=10), for example,

> *something to lift their spirits even when they don't really want to put effort into doing so*
>
> *it may make someone's day.*

The most commonly cited reasons for why text messages could contribute to maintaining safety after discharge included providing ideas for coping (n=13), for example,

> *having resources to cope isn't always easy to find and not everyone has the energy to look for them*
>
> *there were numbers [to get] support and ideas to stay safe,*

and encouragement and reminders of reasons for living (n=7), for example,

> *they would know they're not the only ones going through this and there is hope and life is worth being here for*
>
> *makes them think about the good things to look forward to...just the motivation to keep going, something to live for.*

Some teens (n=5) cautioned that text messages may not be sufficient after discharge, for example,

> *it would be nice for [teens] to have support but if they are having suicidal thoughts they would probably need much more than [texts] to help them.*

With regard to structuring the text-based intervention, most adolescents felt that messages should be sent at least once a day (n=12), with a notable number of youths expressing a preference for receiving messages twice a day (n=8). Approximately half (n=13) indicated that providing adolescents the ability to change the frequency of messages over time or offering the choice to request more messages should be incorporated. In terms of duration, most adolescents (n=10) felt that text messages should be provided for at least 1 month, with others suggesting 2 to 3 months (n=6) or even a year (n=2). As with frequency, many participants (n=11) felt that adolescents should have the option to personalize the duration of receiving the messages. None of the teens expressed privacy concerns about receiving support text messages postdischarge.

Changes and Considerations Following Phase 1

As part of reviewing each message, participants provided both ratings of individual messages and comments and suggestions for changes. We used this feedback to make changes to the initial bank of messages. We replaced lowest-rated messages with the content that adolescents indicated as being preferred. Specifically, the two most preferred content areas identified by adolescents were coping skills (n=14), with approximately half of the teens requesting links to additional information and encouraging and hopeful messages (n=9). Thus, we supplemented the message bank with these types of messages. In addition, as shown in Table 3, we used adolescents' feedback to revise specific messages.

Consistent with the most common recommendation for the duration of text messages, we retained the initial idea to provide text messages in phase 2 for 1 month. We also structured the frequency of messages such that all adolescents received 1 message per day at the minimum. However, given that teens expressed the desire for autonomy and choice in receiving text messages, we provided an option in phase 2 to request an additional message each day and the ability to stop or restart receiving messages if desired.

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Table 3. Examples of text message revisions.

Original message	Feedback	Revised message
(1) Think about people who supported you in the past. What did they say or do that you value? Consider saying *thanks* in your own way. Or see if you'd like to Pay It Forward: [website link added]	• This could make someone upset if the people who supported them in the past are no longer with them. • It could help, but because of my past and loss of everyone who cared, it makes me think bad thoughts.	• "What *small* things have people said or done that brightened your day or helped you feel supported? See if you'd like to pay it forward: [website link added]"
(2) Everyone has triggers...situations, thoughts, emotions...that can signal a crisis. Knowing your triggers and how you'll cope can help you stay in control.	• Some people prefer not to use the word "trigger." • I'd try not to think of triggers.	• "What helps you feel taken care of...physically, emotionally, or spiritually? You are worth taking the time and space to nurture yourself. Self-care can also help you stay in control of strong emotions or triggers. See if you like any of these self-care tips [website link added]"
(3) What are some things you care most about in life? Consider keeping reminders of what matters to you where you might see them (phone, wallet, room?).	• The phrasing is a little off, it took me a minute to realize that you meant keep important things in your room wallet and phone and not the important things are the room, wallet and phone.	• "When you need a boost, try re-focusing on what's important to you...people, places, goals, things you value. Think about keeping reminders of what matters to you where you might see them. [image added expressing sentiment]"
(4) Sometimes we feel supported by being around certain people. Take a moment to think about people or places that comfort or lift you up.	• I think you should encourage them to hang out with the person or people that are helpful.	• "*No man is an island.* Take a moment to reflect on people & places that comfort or lift you up. Try spending time with them or connect in your own way."
(5) How are you feeling today? Text back: GOOD, SOSO, or LOW [if LOW] Stay strong! Consider trying one of your coping tools that helps you feel better or reach out to someone. You have what it takes to get through this!	• If low, give more direct instructions to feel better. • Maybe give an example of a coping skill.	• "[if LOW] Stay strong! Consider trying one of your coping tools, reach out to someone or see [link to website] for tips. You have what it takes to get through this!"

Phase 2 Results

Sample Characteristics

About 60% (9/15) of adolescents in Phase 2 experienced at least one lifetime suicide attempt; 53% (8/15) of adolescents attempted suicide in the month before admission. All 15 adolescents reported suicidal ideation within the week of admission.

Daily Receptivity to Messages

Over the course of the 1-month follow-up (28 days), 15 participants responded to 61% (256/420) of daily surveys, and on average, participants completed 17.07 (SD 5.78) surveys. As part of these daily surveys, between 6 and 12 adolescents provided feedback on support text messages received on that day. The results indicate that the passage of time was not associated with the extent to which adolescents rated the messages favorably (B=.002, SE 0.01; *P*=.74) or as helpful (B=−.005, SE 0.01; *P*=.35). However, as shown in Table 4, positive and negative affect were associated with adolescents' receptivity to messages. In particular, when adolescents reported higher levels of anger, relative to their own typical levels, support texts were rated less favorably; at the same time, perception of helpfulness was not associated with anger. When adolescents reported feeling happier, relative to their usual levels, they perceived messages as being more helpful, as did adolescents who generally reported feeling happier over the course of the 4 weeks as compared with those with less positive affect.

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Table 4. Relationship between support text ratings and daily affect.

Variables[a]	Extent liked				Extent helpful			
	Within-person		Between-person		Within-person		Between-person	
	B (SE)	*P* value	B (SE)	*P* value	B (SE)	*P* value	B (SE)	*P* value
Happy	.03 (0.05)	.51	.27 (0.16)	.10	.09 (0.04)	.04	.27 (0.14)	.05
Angry	−.13 (0.05)	.01	−.06 (0.12)	.61	−.04 (0.04)	.37	−.08 (0.10)	.42
Miserable	−.02 (0.04)	.70	−.16 (0.13)	.20	−.07 (0.04)	.11	−.10 (0.11)	.35
Scared or anxious	.03 (0.04)	.48	.001 (0.10)	.99	−.04 (0.04)	.31	−.05 (0.09)	.56
Sad	−.03 (0.04)	.45	−.11 (0.13)	.37	−.06 (0.04)	.12	−.12 (0.11)	.26
Hopelessness	−.09 (0.08)	.24	−.23 (0.14)	.11	−.13 (0.07)	.08	−.20 (0.13)	.11

[a]All mixed effects models include random intercept; n=252 observations provided by 15 participants.

Phase 2 Feedback

Overall, 87% (13/15) adolescents completed the end-of-study assessment. As shown in Table 2, the perception of text messages was generally positive (mean 4.31, SD 0.48), and the messages tended to be perceived as helpful (mean 4.38, SD 0.65). Using open-ended responses, about half (n=7) of participants expressed that texts could be helpful by providing coping reminders and supporting adolescents' transition from hospitalization (n=6), as illustrated by the following:

> *[you're] transitioning back into the real world. And it's good to have a reminder of the skills you learned while you were there. And it's...like a cushion to help you with your transition back home.*
>
> *...when you leave the hospital, a lot of the stuff that you learn there kind of goes out the window. And so, you know, to be reminded about your safety plan and things you might have learned there and things that make you happy is a really good way to kick-start recovery.*

Some adolescents (n=6) also indicated that support text messages may be helpful in the postdischarge period by contributing to the improvement in mood and providing a sense of hope:

> *Because after you leave the hospital, you will feel most likely bad. So it's nice to have that little cheer-up every day.*
>
> *Getting those texts kind of made me feel better...on a day that was going rough, and I would look at it and do what it said...it just kind of made me feel better. Knowing that I can do this, and that people are there wanting to help me and get me better.*

At the same time, 2 participants indicated that support delivered via an automated text messaging system may be limited:

> *[some people] could definitely benefit a lot from it, just some people don't like automated text messages. So, like, texts from real people.*

In terms of messages being helpful in preventing a suicidal crisis (see Table 2), nearly half (n=6) of adolescents indicated text messages could definitely or probably aid in the reduction of crises, for example,

> *definitely...just getting those tips and coping strategies, like little nudges, to remind myself of things I need to do to stay healthy and happy.*

At the same time, some (n=5) cautioned that the influence of messages may vary based on individual circumstances, for example,

> *Even though it's helpful, I'm not sure if for some people it would be enough.*

Others (n=5) cautioned that the influence of messages may be limited because of the interaction being automated, for example,

> *it's not someone actually talking to you twice a day.*

Feedback About Logistics

The majority (n=10) of adolescents felt that at least 2 messages per day would be preferred. Specifically, whereas most (n=7) indicated that 2 messages per day were desired, for example,

> *two per day was the sweet spot.*

Three teens suggested that additional messages per day may be helpful, for example,

> *I think it was a good amount [two per day], but there could be more. I mean, there's room for more.*

In terms of timing, the majority (n=7) felt that the timing of messages used in phase 2 (1 in the morning and 1 in the afternoon) was acceptable. Nevertheless, 3 adolescents suggested that changing the morning message timing on the weekends might make it more likely that teens will see those messages.

> *I was never up that early [on weekends]...I would have other notifications on my phone and I just wouldn't notice it because I just wasn't up.*

Finally, with regard to the duration of text-based support following discharge, the majority (n=11) of adolescents indicated that messages should be sent for at least 1 month. Of those, 2 suggested that the duration could be extended to 2 or 3 months; 2 teens suggested that messages could be available indefinitely as long as there is an option to request stopping them.

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Changes and Considerations Following Phase 2

We eliminated the majority of messages that included humor or memes. Adolescents tended to rate messages with humor as being more neutral (mean 3.69, SD 1.11), which was consistent with mixed open-ended feedback. In this context, 4 participants perceived these messages positively, for example,

> *It was nice to just get a laugh...Cause sometimes if I was having a bad time and something like that would pop up, you know it was kind of funny and I was just happy for a second. And just, like, realize that it's not all bad.*

On the other hand, 4 participants perceived these messages negatively, for example,

> *The one that looks like a meme...I found it more annoying than anything,*

and 4 were neutral.

On the basis of participants' overall acceptability of messages that included coping tips and resources (mean 4.08, SD 0.95) and messages with images that included affirmations or quotes (mean 4.38, SD 0.77), these messages were retained. Given the positive perception of messages with images and the possibility that visual representation of content could facilitate engagement, for example, one participant expressed the following:

> *[the images] were useful because they had coping mechanisms but they also weren't boring to look at,*

We supplemented some of the messages, including coping tips, with an image representing the sentiment of the message.

Finally, we considered whether or not to retain the function of requesting the second message of the day (ie, *pull* messages). On average, adolescents requested a *pull* message on half the days (mean 14.73, SD 7.93), and as might be expected, the likelihood of requesting messages decreased over time (odds ratio 0.88, 95% CI 0.85-0.91; *P*<.001). This may have been because of habituation or boredom, which was noted by 2 participants, for example,

> *When I first started...I did it every day. But toward the end, it started to fall off. I just hadn't looked at my phone...And then I didn't bother because I wasn't sure if it was going to let me see the message anyway.*

In addition, at least 4 out of 13 adolescents interviewed at the end of the study indicated that they had inconsistent or limited phone access during the study. In the end, we elected to retain the *pull* function because it is consistent with providing adolescents with autonomy and because of the fact that, whereas 3 adolescents noted they would have preferred to receive the second message without requesting it, the majority (n=8) expressed that they liked this function, for example,

> *I liked the interaction,*

and

> *I liked that it was kind of a surprise message and that it was optional.*

Discussion

Principal Findings

The high-risk period following psychiatric hospitalization calls for continuity of care strategies that can support suicidal adolescents' transition after acute services. Moreover, identifying cost-effective and scalable approaches with the potential to enhance existing suicide-specific interventions is imperative. Text messages have been used to improve a wide range of behavioral and health outcomes [8,10] and have been integrated into interventions targeting suicide prevention among adults [21-23]. This study examined the feasibility and acceptability of a text-based follow-up intervention for adolescents discharged from psychiatric hospitalization with a focus on encouraging coping behavior and safety plan adherence. To our knowledge, this is the first study to explore adolescents' perception of text messages as a follow-up strategy to support youth at elevated suicide risk.

Consistent with previous studies [39-41], our findings support the importance of obtaining adolescents' input in the development of text message content. Using a two-phase participatory process, we tested and refined the messages across eight primary domains. Overall, our results provide support for the acceptability of a text-based postdischarge intervention for teens at risk of suicide. A majority of eligible adolescents in phase 2 who were approached about receiving messages after discharge agreed to participate in the study, and during the course of the month-long intervention, none of these participants requested that messages be stopped being sent to them. Adolescents' feedback indicated that, overall, messages were perceived positively, with the exception of messages incorporating humor. Adolescents expressed a preference for messages with coping tips and those with encouraging or hopeful content, particularly if they incorporated links and images. On the basis of this feedback, we adjusted the content of text messages and incorporated specific suggestions for changing the wording of specific messages. Moreover, messages were seen as having the potential to be helpful with the transition after hospitalization, with adolescents indicating that texts may serve as reminders to use coping strategies, contribute to improvement in mood, and provide teens with a sense of comfort and hope. At the same time, some adolescents expressed practical concerns that messages may not be sufficient or effective for some teens or circumstances. This underscores the fact that text-based interventions, even if perceived as acceptable and helpful, should be conceptualized as being adjunctive.

Another contribution of this study pertains to its exploration of factors impacting adolescents' perception of messages in daily life. We observed that adolescents' daily affect may influence their perceptions of messages on a given day. Adolescents rated messages less favorably, but not as less helpful on days they reported feeling more angry than usual. Increases in positive affect, on the other hand, were associated with messages being seen as more helpful. Over the month-long intervention, the passage of time did not influence messages being liked less or liked more, or the extent to which messages were seen as helpful. However, the passage of time was associated with a

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decreasing likelihood of adolescents requesting *pull* messages. Consistent with previous literature (see review [50]), engagement tends to decline over time and is a common challenge with mobile-based interventions. In this study, intervention engagement or *pulling* messages did not appear to be because of adolescents perceiving messages as being less helpful or less likable, as indicated by no time trend for these ratings. It is possible that, given the routine nature of message delivery (eg, sent at the same time of day), adolescents may have become desensitized to text notifications, subsequently impacting their motivation to request additional messages. Sending intermittent and more random prompts reminding adolescents that they can request additional messages and including a *teaser* in the prompt about the sort of message that could be requested on a given day, may increase engagement and add to the surprise element that some adolescents noted being important.

Related to the issue of timing, it will also be critical for future work to identify the optimal window of time to provide intervention prompts, which may be achieved with the application of real-time data (derived from ecological momentary assessments and passive sensing) that can help identify states of receptivity to mobile interventions to provide more personalized support [51,52]. Future interventions could also consider adding more elements of choice with regard to individualizing both the message content adolescents may find the most useful and the number of messages. Indeed, many adolescents in the study suggested that the frequency and duration of messages could be personalized. Lastly, it is important to highlight that, unlike in adults, there may be additional reasons that may impact adolescents' ability to engage with mobile interventions, such as inconsistent phone access because of disciplinary reasons, and in the case of high-risk youth, loss of access because of hospitalization.

Implications for Future Research

Although this study highlights the benefit of formative work with the target population in developing a text-based intervention and pretesting this intervention in the real world, our study did not explore the impact of receiving text messages on suicide risk-related outcomes. Text messages have shown promise in reducing suicidal behavior among adults [22]. However, the efficacy of text-based interventions has not been tested in adolescents. Even though adolescents in this study believed that these messages could be helpful after discharge, randomized controlled trials are needed to determine the extent to which text messages have an impact on actual outcomes. Although most adolescents in this study felt that receiving at least 1 message per day for at least 1 month would be adequate, another consideration for future research is whether or not different intensity or *doses* of messages may influence outcomes.

Finally, it will be important for future research to delineate the comparative benefits of different types of follow-up modalities in the postdischarge period. Among adults, integrating follow-up phone calls with a safety planning intervention after emergency department discharge was related to both decreases in suicidal behavior and treatment engagement across a 6-month follow-up period [33]. Additionally, previous research with adolescents has shown that receiving multiple phone contacts in the 90 days following psychiatric hospitalization was associated with reductions in suicidal behaviors and perceptions of improved confidence in the safety plan [53]. In the same study, 72% of adolescents engaged with at least one phone contact, but only 40% engaged with 3 or more phone contacts, which highlights some challenges in sustaining the intended dose of the intervention (6 phone contacts). Although not without its own challenges, as described previously, there nevertheless may be unique benefits inherent to text messages as a continuity of care approach. For example, text messages can be accessed at a later time and may be revisited repeatedly in the future, which could amplify their impact. Text messages can also be viewed discretely (eg, while surrounded by others) and at the discretion of the reader (eg, when it may be needed the most). Engagement with text messages may also require less effort and motivation, perhaps impacting utility when other methods are not being accessed. Finally, tools that allow text messages to be delivered automatically afford greater feasibility and scalability of text-based contact, particularly in low-resource settings.

However, there may be circumstances under which phone contacts are preferred or indicated. As raised by the adolescents in this study, the automated aspect of text-based interventions may be insufficient in some situations and for some adolescents at risk for suicide. There may also be circumstances under which the combination of both approaches may be most efficacious for some youth. For example, adjunctive text-based approaches may prove ideal as a low-cost, low-burden intervention that may, for some youth (eg, severe clinical presentations, not engaging or appearing to not sufficiently respond to a text-based intervention), benefit from being augmented by follow-up calls. To this end, our group is conducting a pilot intervention study examining different follow-up intervention strategies for youth discharged from psychiatric hospitalization that integrate text-based support and telephone contact.

Limitations and Conclusions

Findings should be considered in the context of study limitations. Notably, although consistent with the demographics of the region and the inpatient adolescent population, our sample was primarily white and female, which limits the generalizability of the study results. Incorporating the perspective of more diverse adolescent samples will be imperative in future work to maximize the acceptability of text-based interventions for youth at risk of suicide. The sample size was consistent with similar studies [40,41]; nevertheless, the sample size limited our ability to carry out additional analyses examining text message feedback by subgroups (eg, age and sex). It is also important to note that the sample comprised help-seeking youth who consented to take part in the study, which may speak to their readiness to receive and engage with the intervention. Moreover, this study considered the acceptability of messages received for 1 month after discharge; whether the relatively positive perception of the text-based intervention would be sustained for a longer period is not known. Additional studies are thus needed to examine different approaches to augmenting suicide-specific interventions using text-based methods and examine text-based interventions in larger and more diverse adolescent samples. Despite these limitations, our findings

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provide useful information regarding text messages being seen as an acceptable approach for delivering follow-up support among adolescents at elevated suicide risk. The results suggest that adolescents were open to receiving text messages after discharge and perceived the messages as helpful in supporting their transition from psychiatric hospitalization. Future work is needed to evaluate the impact of text-based interventions, including different *doses* of text messages on suicide-related outcomes in the postdischarge period.

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Conflicts of Interest

None declared.

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Abbreviations

MI: motivational interviewing
PANAS-C: Positive and Negative Affect Schedule for Children
SDT: self-determination theory

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Original Paper

Combining Web-Based Attentional Bias Modification and Approach Bias Modification as a Self-Help Smoking Intervention for Adult Smokers Seeking Online Help: Double-Blind Randomized Controlled Trial

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Abstract

Background: Automatically activated cognitive motivational processes such as the tendency to attend to or approach smoking-related stimuli (ie, attentional and approach bias) have been related to smoking behaviors. Therefore, these cognitive biases are thought to play a role in maintaining smoking behaviors. Cognitive biases can be modified with cognitive bias modification (CBM), which holds promise as an easy-access and low-cost online intervention. However, little is known about the effectiveness of online interventions combining two varieties of CBM. Targeting multiple cognitive biases may improve treatment outcomes because these biases have been shown to be relatively independent.

Objective: This study aimed to test the individual and combined effects of two web-based CBM varieties—attentional bias modification (AtBM) and approach bias modification (ApBM)—in a double-blind randomized controlled trial (RCT) with a 2 (AtBM: active versus sham) × 2 (ApBM: active versus sham) factorial design.

Methods: A total of 504 adult smokers seeking online help to quit smoking were randomly assigned to 1 of 4 experimental conditions to receive 11 fully automated CBM training sessions. To increase participants' intrinsic motivation to change their smoking behaviors, all participants first received brief, automated, tailored feedback. The primary outcome was point prevalence abstinence during the study period. Secondary outcomes included daily cigarette use and attentional and approach bias. All outcomes were repeatedly self-assessed online from baseline to the 3-month follow-up. For the examination of training effects on outcome changes, an intention-to-treat analysis with a multilevel modeling (MLM) approach was adopted.

Results: Only 10.7% (54/504) of the participants completed all 11 training sessions, and 8.3% (42/504) of the participants reached the 3-month follow-up assessment. MLM showed that over time, neither AtBM or ApBM nor a combination of both differed from their respective sham training in point prevalence abstinence rates (P=.17, P=.56, and P=.14, respectively), and in changes in daily cigarette use (P=.26, P=.08, and P=.13, respectively), attentional bias (P=.07, P=.81, and P=.15, respectively), and approach bias (P=.57, P=.22, and P=.40, respectively), while daily cigarette use decreased over time across conditions for all participants (P<.001).

Conclusions: This RCT provides no support for the effectiveness of combining AtBM and ApBM in a self-help web-based smoking cessation intervention. However, this study had a very high dropout rate and a very low frequency of training usage, indicating an overall low acceptability of the intervention, which precludes any definite conclusion on its efficacy. We discuss how this study can inform future designs and settings of online CBM interventions.

Trial Registration: Netherlands Trial Register NTR4678; https://www.trialregister.nl/trial/4678

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KEYWORDS

cognitive bias modification; attentional bias modification; approach bias modification; Web-based intervention; smoking addiction; smoking cessation; eHealth; randomized controlled trial

Introduction

Background

Smoking is one of the major risk factors for preventable diseases and premature deaths [1]. Although most smokers are aware of the health risks of smoking and desire to quit, almost 80% of those who attempt to quit relapse within 3 months [2]. An important factor in addictive behaviors concerns automatically activated cognitive motivational processes, which are difficult to inhibit via reflective processes aimed at long-term health outcomes [3-5]. As a result, addictive behaviors might interact with substance-related cue-driven reactions, such as relatively automatic cognitive biases.

Smokers have been found to selectively pay more attention to smoking-related cues in the environment (ie, smoking-related attentional bias) and to impulsively reach out to these smoking-related cues (ie, smoking-related approach bias [6-9]). These biases have been related to the urge to smoke, the severity of nicotine dependence, and relapse rates [8-11]. Therefore, smoking-related cognitive biases are thought to be one of the mechanisms underlying smoking behaviors, highlighting the importance of targeting them in smoking cessation interventions.

Varieties of cognitive bias modification (CBM) have been developed to directly target the cognitive biases [12], such as attentional bias modification (AtBM, usually delivered with a modified visual probe task, VPT [13]) and approach bias modification (ApBM, usually delivered with a modified approach-avoidance task, AAT [14]). In the addiction field, the clinical effects of CBM as a behavior change intervention (as opposed to proof-of-principle studies [15]) were first tested in the alcohol domain. Several pioneering randomized controlled trials (RCTs) in clinical samples showed that multiple sessions of AtBM [16] or ApBM [17,18] were more effective than the respective sham training in reducing the targeted alcohol-related cognitive bias and relapse rates, when provided as an add-on to the regular cognitive behavioral therapy (CBT). Furthermore, ApBM training had effects on the reduced relapse rates that were mediated by changes in alcohol-related approach bias [17,19]. Therefore, based on both theory and the available evidence, CBM has shown the potential to be an effective novel intervention in the alcohol addiction domain.

A key advantage of CBM interventions is that they are delivered as computerized tasks, which are easily administered online, featuring CBM as a potential easy-access and low-cost online intervention, particularly for the smoker population. Instead of attending formal smoking cessation programs [20], smokers often search for online help to quit smoking [21,22]. Therefore, we designed a web-based CBM intervention specifically for smokers seeking help online. In the pioneering studies referenced above, the interventions only targeted 1 cognitive bias. However, addictive behaviors are characterized by multiple relatively independent cognitive biases [23]. Thus, combining multiple CBM varieties that target different cognitive biases may enhance the treatment outcomes by combining their effects, as well as through potential synergistic effects. Note that, at the time we set up this study (ie, in 2013), there was only 1 protocol study combining different web-based CBM varieties in an intervention targeting alcohol use disorder [24], and no studies had yet investigated the effectiveness of a combined web-based CBM intervention for smokers.

Since 2013, some studies have explored the clinical effects of CBM as a behavior change intervention for smoking problems, although the evidence is still limited (see Mühlig et al [25] for a narrative review and Boffo et al [26] for a Bayesian meta-analysis). In total, 3 RCTs delivered CBM in an online setting and 5 in a clinical or laboratory setting. Regarding the CBM studies in online settings, 1 RCT showed that web-based ApBM alone could produce specific effects on reducing smoking in adult smokers [27], while 2 other RCTs did not support that multiple sessions of web-based ApBM alone [28] or web-based AtBM alone [11] were effective in promoting smoking cessation in adult smokers, although in the latter study, AtBM positively affected continued abstinence at the 6-month follow-up in a subgroup of heavy smokers [11]. Regarding the CBM studies in clinical or laboratory settings, 1 RCT showed that multiple sessions of ApBM plus CBT led to larger reductions in daily cigarette consumption in inpatient psychiatric smokers than sham training [29], while 4 other RCTs reported that multiple sessions of ApBM plus CBT [30,31], AtBM alone [32], or plus nicotine patches and behavioral support [33] did not result in better smoking treatment outcomes than sham training in smokers who intended to quit. In sum, evidence for the effectiveness of AtBM and ApBM in the smoking addiction domain is mixed. Therefore, more research is needed to investigate whether AtBM together with ApBM can benefit smoking cessation interventions.

Study Design, Objectives, and Hypotheses

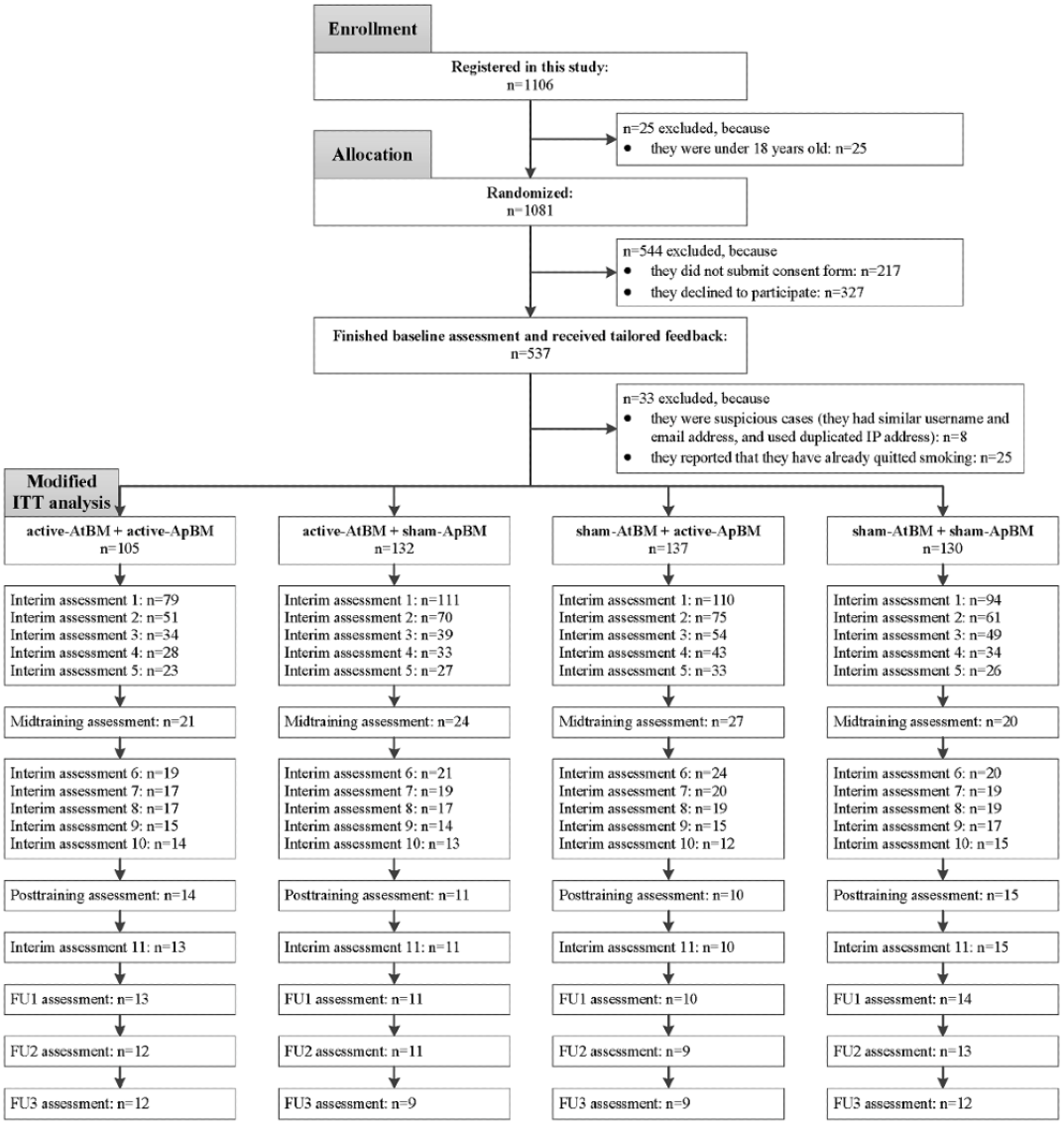
This study aimed at investigating the individual and combined effects of 2 varieties of web-based CBM, AtBM and ApBM, in adult smokers who were seeking online help for quitting smoking. A double-blind RCT was conducted with a 2 × 2 factorial design, in which participants received 11 fully automated sessions of either an active or a sham version of both types of CBM training, resulting in 4 experimental conditions (active-AtBM + active-ApBM; active-AtBM + sham-ApBM; sham-AtBM + active-ApBM; sham-AtBM + sham-ApBM; Figure 1). To increase participants' intrinsic motivation to change their smoking behaviors before the CBM training, all participants first received brief, automated, tailored feedback, irrespective of their CBM condition. The primary outcome was point prevalence abstinence (PPA), while the secondary outcome included changes in daily cigarette use (DCU). Progressive changes in attentional bias and approach bias were also included

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as secondary cognitive outcomes to verify that the CBM trainings actually changed the targeted cognitive process. All outcomes were repeatedly assessed from baseline to the 3-month follow-up. We hypothesized that, compared with its respective sham training, each type of active CBM training would (1) be more effective in fostering PPA and in decreasing DCU and (2) lead to larger decreases in the specific cognitive bias it targeted. Given that AtBM and ApBM may tap into a separate process [23], we also hypothesized that (3) the condition with double active CBM trainings would be the most effective in changing smoking-related outcomes.

Since craving, depression severity, and motivation to quit smoking have been found to be related to cognitive biases or smoking behaviors [34-36], these variables were also included in this study as additional secondary outcomes. Furthermore, we explored whether participants were aware of which version of each CBM training they received (ie, the active or the sham version) and whether this moderated training effects. The methods and results for the additional secondary outcomes and the exploratory moderation analyses are reported in Multimedia Appendices 1 and 2.

Figure 1. Consolidated Standards of Reporting Trials flow diagram. The number of participants reported here is based on timeline follow back data for our primary outcome. A similar dropout pattern is observed for all other outcomes. AtBM: attentional bias modification; ApBM: approach bias modification; Interim assessment: brief assessment before each training session; FU1, FU2, FU3: follow-up assessment at 1, 2, and 3 months; ITT: intention-to-treat; IP: internet protocol.



Methods

Participants and Procedure

Participant Enrollment

Adult smokers were recruited across the Netherlands through our lab website (Addiction Development and Psychopathology Lab of the University of Amsterdam, ADAPT [37]), press releases (eg, TV interviews, newspapers, and scientific books [38]), and word-of-mouth communication. The ADAPT website is open-access and provides a series of cognitive training targeting a variety of addiction and affective-related problems such as smoking, alcohol, gambling, anxiety, and depression. We started to recruit participants from June 2013. Since this was the first study to test the effectiveness of 2 combined

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web-based CBM trainings as a behavior change intervention for smoking cessation, no effective knowledge (eg, CBM training effect sizes and dropout rates) was available for us to calculate the sample size at the time we set up the study. Therefore, our aim was to recruit as many participants as possible with the minimum of at least 75 participants per training condition. We stopped the recruitment in December 2018.

Interested participants were directed to the study website [39]. The website explained the scientific rationale of CBM training, training to overcome mental habits and automatic responses to smoking, and explained that the current intervention program combined 2 types of CBM freely available for people who would like to quit smoking. As the study concerned a self-help intervention open to everybody, there were no specific inclusion criteria, except for being aged 18 years and older and able to understand Dutch (the intervention was only provided in Dutch).

Upon registration, participants created their own user account by providing their username, password, and email address, were screened regarding their age, and were then randomized (see the Randomization and Blinding section). Participants were notified of their eligibility via email. Eligible participants who clicked on their emailed link were returned to the study website where they submitted a consent form. Through the consent form, participants were fully informed about the whole study procedure, that the effectiveness of the 2 CBM trainings was being tested (compared with 2 training types where no or smaller effects were expected, ie, sham training), and that they had a 25% chance to be assigned to the condition with 2 sham trainings. Afterward, participants completed the baseline assessment, at the beginning of which they received brief, automated, tailored feedback.

Since the enrollment occurred online, additional actions were taken to check multiple identities. Participants who used similar usernames, email addresses, and internet protocol addresses were excluded in the data analysis stage (n=8). In addition, participants who self-reported that they already quit smoking before the training were also excluded in the data analysis stage (n=25; Figure 1).

Training Procedure

After the baseline assessment, participants were invited to complete 11 CBM training sessions and assessments at midtraining, posttraining, and follow-ups at 1, 2, and 3 months, respectively. The midtraining assessment took place between training sessions 5 and 6; and the posttraining assessment took place between sessions 10 and 11. The 11th training session was a *mask* session to minimize self-presentation biases during the posttraining assessment. All training sessions were web-based, and all assessment sessions were self-assessed via web-based questionnaires and computerized tasks. Each training or assessment session automatically opened 24 hours after the previous session was completed and stayed open for 30 days. When each session opened, an automated notification was sent to the participants. If participants did not complete the session, they received an automated reminder email after 3 days, 7 days, 11 days, and 3 weeks until the session closed (including the baseline session). They were not allowed to skip sessions, were excluded from the study if they missed any of the sessions, and were advised to complete the 11 training sessions within 4 weeks (eg, 3 sessions per week). Participants were allowed to train on a daily basis and could arrange their own training schedule. They could contact the responsible researcher (the second author) by email in case they had questions or technical problems.

Debriefing and Compensation

After completing the 3-month follow-up assessment, participants were debriefed about their condition allocation via email. They were not compensated for participation. However, all participants had the opportunity to receive 11 booster training sessions if they completed the whole study procedure, consisting of the same 11 training sessions of double active CBM training without practice and mini-assessment blocks (see the Cognitive Bias Modification section).

Randomization and Blinding

The study was as a double-blind trial. Upon creation of a study account, participants were automatically randomized to 1 of the 4 training conditions by a computer randomization algorithm. The randomization was stratified by gender with a 1:1:1:1 ratio; therefore, participants were randomly assigned to one of the conditions to which the fewest participants of their gender had been allocated so far. Since the randomization was fully automated and conducted by a computer algorithm, allocation concealment was ensured. In addition, the automated study procedure ensured that participants were blinded to the training condition they were assigned to. The second author could access the database during the data collection to monitor the data collection process and was responsible to reply to participants in case they had questions or technical problems. The first author could access the database after data collection completion to download and analyze the data. No authors provided any treatment to the participants nor assessed any of the outcomes during the trial.

The study was approved by the Ethics Committee of Psychology at the University of Amsterdam (reference number: 2013-DP-3047) and registered in the Netherlands Trial Register (NTR4678).

Intervention

Cognitive Bias Modification

In total, there were 11 CBM training sessions. Each training session consisted of 2 tasks used to both assess and retrain the cognitive biases, and each training session lasted about 20 to 25 min. Task settings of the assessment and the training version were the same, except for an additional built-in stimulus response contingency recasting the assessment task into training (see below). The order of task presentation was counterbalanced between participants and fixed within participants across all sessions. Task parameters (eg, stimulus onset, response time window, intertrial interval, etc) for both tasks were designed as in previous studies [24,40]. Two kinds of stimuli were used for both tasks: smoking-related (eg, somebody smoking or a package of cigarettes) and visually matched neutral pictures (eg, somebody holding pencils or a box of pencils; see Multimedia Appendix 3 for task stimuli).

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Attentional Bias Assessment

To assess attentional bias (AtB), we used an online version of the VPT [13,24,40]. In each trial, participants had to respond to a probe (a small arrow pointing upward or downward) presented at the location of one of 2 stimuli (ie, a smoking-related and a neutral picture) displayed next to each other on the computer screen. In half of the trials, the probe appeared immediately after the 2 pictures disappeared (*after* format), measuring the early detection of smoking-related pictures (attention engagement). In the other half, the probe appeared on top of one of the 2 pictures, which stayed on screen (*top* format), measuring the relative difficulty to disengage from smoking-related pictures (attention disengagement) [40]. Participants were required to respond to the direction of the probe as fast as possible by pressing the corresponding keys on the keyboard (U and N). The probe direction was set randomly upward or downward with the restriction that up and down appeared equally often. To assess AtB, the probe followed smoking-related pictures (smoking trials) and neutral pictures (nonsmoking trials) equally often. It is assumed that discrimination of the probe direction will be quicker when probes appear in the locus that participants are already attending to, that is, in the case of smokers, on the smoking-related stimuli. The VPT included a practice block with 8 trials and an assessment block with 320 trials.

Attentional Bias Modification

To retrain AtB, we used a modified version of the VPT [24,40]. Participants in the active training condition were trained to shift their attention from smoking-related pictures to neutral pictures by exposing them only to nonsmoking trials (ie, the probe only followed the neutral pictures), whereas participants in the sham training condition were presented with 50% of smoking trials and 50% of nonsmoking trials (ie, continued assessment). Each AtBM session started with a practice block (8 trials) and a mini-assessment block (128 trials), after which, participants received the active or sham version of the AtBM (192 trials).

Approach Bias Assessment

To assess approach bias (ApB), we used an online version of the AAT [14,24,40]. In each trial, a smoking-related or a neutral picture rotated 3° to the right (right-format) or left (left-format) was presented in the middle of the computer screen. Participants were required to respond (pull or push away) to the format rather than the content of the picture as fast as possible by pressing the corresponding keys on the keyboard (U and N). The pull and push responses were accompanied by a zooming feature: pulled pictures enlarged in size and pushed pictures shrunk, generating the sense of approach and avoidance, respectively. The contingency between the picture format and the response (ie, rotation direction and pull or push response) was counterbalanced across participants. To assess ApB, smoking-related and neutral pictures were pushed and pulled equally often. It is assumed that (faster) approach rather than avoid responses would be triggered by appetitive or affective stimuli, that is, in the case of smokers, by the smoking-related stimuli. The AAT included a practice block with 12 trials and an assessment block with 160 trials.

Approach Bias Modification

To retrain ApB, we used a modified version of the AAT [24,40]. Participants in the active training condition were trained to avoid smoking-related pictures by exposing them only to smoking/push and neutral/pull trials, whereas participants in the sham training condition were presented with 50% pull and 50% push trials for both smoking-related and neutral pictures (ie, continues assessment). Each ApBM session started with a practice block (12 trials) and a mini-assessment block (64 trials), after which, participants received the active or sham version of the ApBM (192 trials).

Automated Tailored Feedback

All participants received brief automated tailored feedback at the beginning of the baseline assessment. This session provided feedback based on participants' current smoking behaviors, attitudes toward smoking, perceived importance, confidence, motivation to quit, and goals and plans to change smoking behaviors [41,42]. The tailored feedback consisted of (1) summarizing the information participants provided, (2) comparing their smoking behaviors and attitudes toward smoking with current smokers and ex-smokers, (3) challenging and modifying their positive attitudes toward smoking by providing health risk information, and (4) providing tips and support for their further changing progress.

Assessment Measures

Outcomes

Primary Outcome

The primary outcome PPA was determined by using the timeline follow-back method (TLFB [43]) and was assessed at 6 main assessment time points (eg, baseline, midtraining, posttraining, and follow-ups at 1, 2, and 3 months) and 11 interim assessment time points (eg, a brief assessment before each training session). When TLFB was administrated at baseline and the follow-up assessments, participants reported the number of cigarettes they smoked per day in the past 7 days. When TLFB was administrated at midtraining, posttraining, and before each training session, participants reported the number of cigarettes they smoked per day since the last training or assessment session for a maximum of 7 days.

PPA was defined as not smoking at all over the period of reported days at each assessment time point and was coded as 1 (quit: the sum score of DCU=0) or 0 (not quit: the sum score of DCU >0). Note that the primary outcome preregistered was 7-day PPA at the follow-up assessments. That is, in the original plan, we focused on the medium-term training effects on the smoking status. However, because of the huge dropout rates (Figure 1), we decided to include all available data at all assessments. As a result, in the current report, we focused on the changes in the PPA over time.

Secondary Behavioral Outcome

The secondary behavioral outcome DCU was also derived from the TLFB data. DCU was calculated at each assessment time point by summing the number of cigarettes reported each day divided by the number of reported days. The internal consistency (Cronbach α) for the TLFB at baseline was .98.

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Secondary Cognitive Outcomes

Secondary cognitive outcomes included AtB and ApB assessed with the online version of the VPT and AAT, respectively, described above (see the Cognitive Bias Modification section). Both biases were assessed at 4 main assessment time points (eg, baseline, midtraining, posttraining, and 3-month follow-up) and 11 interim assessment time points (eg, a mini-assessment block in each training session). By doing this, progressive changes in the cognitive biases over the study could be detected.

An AtB score for smoking was computed for both *after* and *top* trial formats by subtracting the median response time in smoking trials from that in nonsmoking trials. A positive score reflected an attentional bias toward smoking-related pictures, whereas a negative score reflected an attentional bias away from the smoking-related pictures and toward the neutral pictures.

An ApB score for each stimulus category was computed by subtracting the median response time in pull trials from that in push trials. A smoking-specific ApB score was defined as the difference between ApB scores for smoking-related pictures and neutral pictures. A positive score reflected an action tendency toward smoking-related pictures, whereas a negative score reflected an avoidance tendency for smoking-related pictures.

Bootstrapped split-half reliability estimates [44] for both VPT and AAT at baseline were obtained by using the *splithalf* package in R (version 0.3.1 [45]), which performed 5000 random splits. The reliability of VPT was r=0.25, 95% CI 0.19 to 0.31 (Spearman-Brown corrected r_{sb}=0.40, 95% CI 0.32 to 0.48), and the reliability of AAT was r=0.02, 95% CI −0.10 to 0.13 (Spearman-Brown corrected r_{sb}=0.03, 95% CI −0.18 to 0.23).

Other Measures

Baseline Measures

At baseline, demographics and smoking history information was collected, including age, gender, highest education level, marital status, household income/month, DCU in general, duration in terms of years of smoking, and previous quit attempts. Nicotine dependence was assessed with the Modified Fagerström Tolerance Questionnaire (mFTQ [46]). The internal consistency (Cronbach α) for the mFTQ was .71 in this study. Motivation to changing smoking behaviors was assessed with the Readiness to Change Questionnaire (RCQ [47,48]). The internal consistency (Cronbach α) for the RCQ was .64 in this study.

Training Evaluation and Reasons to Leave the Intervention

The training evaluation questions (TEQs) were administrated at the posttraining assessment, where participants evaluated both the CBM training as a whole and the AtBM and ApBM training. In addition, participants also indicated if they were aware of the training condition they were assigned to. For participants dropping out of the study before completing the posttraining assessment, TEQs could be triggered by the participants themselves when requiring to stop the study, by clicking on a web link included in the reminder emails they received. In this case, participants provided reasons for leaving the intervention, in addition to the training evaluation and their awareness of the training condition they were assigned to.

Data Analysis

Task Data Preparation

Preparation of both VPT and AAT data can be found in Multimedia Appendix 4. For the VPT, there was no indication of a difference in AtB scores between *after* and *top* trials in the whole sample (see Multimedia Appendix 4 for details). Thus, we combined the 2 AtB scores (ie, engagement and disengagement AtB) into a single AtB index.

Preliminary Analyses

To check for baseline differences and differences in training compliance and retention across the 4 conditions, and to check for any differences in training evaluation between training dropouts and training completers, chi-square tests and one-way analysis of variance (ANOVA) were conducted. To verify if participants showed smoking-related AtB and ApB at baseline, one-sample t tests were conducted. To determine if AtB and ApB were correlated with smoking-related variables at baseline, zero-order Pearson correlations were computed.

Hypotheses Testing

To test the training effects, a multilevel modeling (MLM) approach was adopted, which allows for an intention-to-treat (ITT) analysis including all available data and takes the clustering of data by participants into account [49]. In our analyses, all models incorporated a random intercept for participants, used the maximum likelihood estimator, and were conducted in R with the *lme4* (version 1.1.17 [50]) and *lmerTest* packages (version 3.0.1 [51]). An alpha of .05 (two-sided) was applied to all hypotheses testing.

We used a piecewise step-function growth curve model [52] to track outcome changes over time. For PPA, the training effects were evaluated over 3 time phases: first half intervention phase (TP1: from baseline to midtraining assessment), second half intervention phase (TP2: from interim assessment 6 to posttraining assessment), and follow-up phase (TP3: from interim assessment 11 to the 3-month follow-up). Although all participants were coded as 0 (not quit) for PPA at baseline, modeling the growth curve starting at baseline is necessary for ITT analyses. Therefore, baseline was included into TP1. For DCU, AtB, and ApB, the training effects were evaluated over 4 time phases: baseline (TP1), first half intervention phase (TP2: from interim assessment 1 to midtraining assessment), and, similar to PPA, second intervention phase (TP3) and follow-up phase (TP4).

To test the training effects on PPA, a multilevel logistic regression analysis was conducted, whereas for DCU, AtB, and ApB, a series of multilevel linear regression analyses was conducted. Predictors included time phase, AtBM (active vs sham), ApBM (active vs sham), and their interactions. Our hypotheses testing focused on the two-way interaction effects of time phase × AtBM and time phase × ApBM, and the three-way interaction effects of time phase × AtBM × ApBM.

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Results

Preliminary Analyses

Sample Description

The Consolidated Standards of Reporting Trials flow diagram is reported in Figure 1. The final sample comprised 504 adult smokers who were seeking online help for quitting smoking. Overall, the final sample had a mean age of 45.10 (SD 13.36) years. Of these, 66.9% (337/504) were female, 74.8% (377/504) were highly educated (bachelor's degree or above), 72.8% (367/504) were unmarried, and 42.5% (214/504) had a monthly household income above the national modal income of about €3000 (US $3329). On average, participants had smoked for 27.55 (SD 13.60) years, used to smoke 17.01 cigarettes per day (SD 8.83), had a medium level of nicotine dependence (mFTQ: mean 3.21, SD 1.62, range 0-6). In addition, on average, participants had made 5.70 previous quit attempts (SD 5.22) and were highly motivated to quit before training (RCQ: mean 12.10, SD 5.41, range −24 to 24).

Baseline characteristics of the final sample per condition can be found in Table 1. Overall, participants' baseline characteristics did not differ among the training conditions, with the exception of gender (Table 1). Adding gender as a covariate to the models did not affect the relative model fit or the significance of any relevant parameters.

Adherence and Retention

On average, participants completed 2.75 (SD 3.45) out of the 11 training sessions, which did not differ between conditions ($F_{3,500}$=0.11; P=.95). Of the final sample, 67.1% (338/504) completed at least one training session, 21.4% (108/504) completed at least five training sessions, and 10.7% (54/504) completed all 11 training sessions, all of which did not differ between conditions (χ^2_3=2.5, P=.48; χ^2_3=0.9, P=.83;χ^2_3=1.5, P=.68). On average, the training interval was 5.57 (SD 4.64) days, which did not differ between conditions ($F_{3,332}$=1.32; P=.27).

Regarding the evaluation of retention, 2 measures were considered (Figure 1). First, only 61.8% (529/856) of the eligible participants completed the baseline assessment, which did not differ between conditions (χ^2_3=7.4; P=.06). Second, for the final sample, only 18.3% (92/504), 9.9% (50/504), and 8.3% (42/504) of the participants completed the primary outcome measure (ie, TLFB) at midtraining, posttraining, and follow-ups, respectively. All retention rates did not differ between conditions (χ^2_3=1.1, P=.77; χ^2_3=3.2, P=.37; χ^2_3=2.4, P=.49).

Training Evaluation and Quitting the Intervention

In total, 19.6% (99/504) of the final sample provided the training evaluation. This subsample was older ($F_{1,502}$=15.67; P<.001) and smoked for more years ($F_{1,502}$=13.97; P<.001) than the participants who did not provide the training evaluation (age: mean 49.80, SD 11.76 years vs mean 43.95, SD 13.49 years; duration of years of smoking: mean 32.07, SD 12.54 vs mean 26.44, SD 13.64). Since there were no differences in TEQ responses between training versions for both AtBM and ApBM (results are reported in Multimedia Appendix 5), the overall responses to TEQs are summarized in Table 2. Among the 99 TEQ respondents, 49 quit the project during the training (ie, training dropouts) and 50 completed all 11 training sessions (ie, training completers). That is, 10.9% (49/450) of the training dropouts and 93% (50/54) of the training completers of this study evaluated the training. The TEQ responses for training dropouts and training completers are also separately summarized in Table 2. Compared with training completers, training dropouts were more negative on all the evaluation questions, thought the instructions of both training paradigms were less clear, and perceived both training interventions as less fun to do. Moreover, the 49 training dropouts also directly reported the reasons for their dropout. The top 4 reasons were as follows: 39% (19/49) of dropouts indicated that they were not satisfied with the training, 33% (16/49) of dropouts indicated that the training was too time consuming and they did not have time to do the training any more, 12% (6/49) of dropouts indicated that the training was boring, and 8% (4/49) of dropouts indicated that they thought they were in the sham training condition, which decreased their motivation to continue.

Hypotheses Testing

The summary statistics of all outcomes by condition, time phase, and assessment time points are reported in Table 3. None of the outcome measures differed significantly across conditions at baseline (DCU: $F_{3,500}$=0.79, P=.50; AtB: $F_{3,490}$=0.33, P=.81; ApB: $F_{3,490}$=1.26, P=.29). The results of the MLM analyses to test the training effects (omnibus effects) on all outcomes are reported in Table 4. The full MLM models for all outcomes can be found in Multimedia Appendix 6.

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Table 1. Baseline characteristics of the final sample per condition.

Characteristics	Active-AtBM[a] + active-ApBM[b] (n=105)	Active-AtBM + sham-ApBM (n=132)	Sham-AtBM + active-ApBM (n=137)	Sham-AtBM + sham-ApBM (n=130)	*F* value (df_1,df_2)[c] or chi-square value (df)[d]	*P* value
Age (years)					1.76 (3,500)[c]	.15
Mean (SD)	44.98 (13.34)	46.86 (12.39)	45.38 (14.13)	43.10 (13.37)		
Gender, n (%)					7.9 (3)[d]	.048
Male	30 (28.6)	34 (25.8)	54 (39.4)	49 (37.7)		
Female	75 (71.4)	98 (74.2)	83 (60.6)	81 (62.3)		
Highest education, n (%)					5.7 (3)[d]	.13
≥Bachelor's degree	76 (72.4)	91 (68.9)	111 (81.0)	99 (76.2)		
<Bachelor's degree	29 (27.6)	41 (31.1)	26 (19.0)	31 (23.8)		
Marital status, n (%)					3.0 (3)[d]	.40
Married	23 (21.9)	41 (31.1)	40 (29.2)	33 (25.4)		
Other	82 (78.1)	91 (68.9)	97 (70.8)	97 (74.6)		
Household income/month (€), n (%)					0.8 (3)[d]	.86
>3000	46 (43.8)	58 (43.9)	59 (43.1)	51 (39.2)		
≤3000	59 (56.2)	74 (56.1)	78 (56.9)	79 (60.8)		
Daily cigarette use in general						
Mean (SD)	16.15 (9.84)	18.32 (8.95)	17.23 (8.08)	16.12 (8.53)	1.77 (3,500)[c]	.15
Duration of smoking (years)						
Mean (SD)	27.54 (13.16)	29.83 (12.77)	27.40 (14.31)	25.38 (13.81)	2.36 (3,500)[c]	.07
mFTQ[e] (0 to 6)						
Mean (SD)	2.89 (1.73)	3.44 (1.53)	3.18 (1.58)	3.25 (1.63)	2.30 (3,500)[c]	.08
Previous quit attempts						
Mean (SD)	5.82 (5.35)	5.54 (5.29)	5.89 (5.07)	5.55 (5.24)	0.16 (3,500)[c]	.93
RCQ[f] (−24 to 24)						
Mean (SD)	12.62 (5.85)	11.85 (5.19)	11.80 (5.22)	12.26 (5.50)	0.59 (3,500)[c]	.62

[a]AtBM: attentional bias modification.

[b]ApBM: approach bias modification.

[c]One-way analyses of variance were conducted to test the baseline differences on continuous variables across the 4 conditions.

[d]Chi-square tests were conducted to test the baseline differences on categorical variables across the 4 conditions.

[e]mFTQ: Modified Fagerström Tolerance Questionnaire.

[f]RCQ: Readiness to Change Questionnaire.

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Table 2. Summary of training evaluation responses.

Training evaluation questions	TEQ[a] respondents (n=99)	Training dropouts (n=49)	Training completers (n=50)	*F* value (df_1,df_2)[b] or chi-square value (df)[c]	*P* value
Training evaluation for CBM[d] as a whole					
1. What do you think of the quality of this CBM training?[e], n (%)	47 (47.5)	15 (30.6)	32 (64.0)	11.1 (1)[c]	.001
2. How satisfied are you overall with this CBM training?[f], n (%)	47 (47.5)	16 (32.7)	31 (62.0)	8.6 (1)[c]	.003
3. I think the CBM training helped me with my problems[g], mean (SD)	3.43 (1.99)	2.73 (1.63)	4.12 (2.08)	13.60 (1,97)[b]	<.001
4. Would you recommend this CBM training to others?[h], n (%)	48 (48.5)	16 (32.7)	32 (64.0)	9.7 (1)[c]	.002
5. Will you use the CBM training in the further?[h], n (%)	65 (65.7)	23 (46.9)	42 (84.0)	15.1 (1)[c]	<.001
Training evaluation for AtBM[i]					
1. The goal of the AtBM training was clear before I started it[g], mean (SD)	4.98 (1.84)	4.69 (2.06)	5.26 (1.56)	2.37 (1,97)[b]	.13
2. The instructions on what I should do during the AtBM training was clear[g], mean (SD)	6.05 (1.55)	5.73 (1.80)	6.36 (1.21)	4.13 (1,97)[b]	.045
3. The AtBM training was difficult to do[g], mean (SD)	3.25 (1.83)	3.53 (1.89)	2.98 (1.74)	2.27 (1,97)[b]	.14
4. The AtBM training was fun to do[g], mean (SD)	3.29 (1.93)	2.61 (1.74)	3.96 (1.88)	13.65 (1,97)[b]	<.001
Training evaluation for ApBM[j]					
1. The goal of the ApBM training was clear before I started it[g], mean (SD)	5.11 (1.88)	4.80 (2.04)	5.42 (1.67)	2.78 (1,97)[b]	.10
2. The instructions on what I should do during the ApBM training was clear[g], mean (SD)	5.98 (1.48)	5.65 (1.79)	6.30 (1.02)	4.94 (1,97)[b]	.03
3. The ApBM training was difficult to do[g], mean (SD)	2.89 (1.80)	3.18 (1.83)	2.60 (1.73)	2.66 (1,97)[b]	.11
4. The ApBM training was fun to do[g], mean (SD)	3.81 (2.07)	3.02 (1.96)	4.58 (1.89)	16.26 (1,97)[b]	<.001

[a]TEQ: training evaluation question.

[b]One-way analyses of variance were conducted to test the differences in modal responses of the training evaluation between training dropouts and training completers.

[c]Chi-square tests were conducted to test the differences in average responses of the training evaluation between training dropouts and training completers.

[d]CBM: cognitive bias modification.

[e]Poor, fair, good, excellent; percentage of “good” and “excellent” responses.

[f]Very dissatisfied, fairly dissatisfied, fairly satisfied, very satisfied; percentage of “fairly satisfied” and “very satisfied” responses.

[g]Participants indicated the extent to which they agreed with this statement on a scale from 1 (completely disagree) to 7 (completely agree).

[h]No, definitely not; No, I do not think so; Yes, I think so; Yes, definitely; percentage of “Yes, I think so” and “Yes, definitely” responses.

[i]AtBM: attentional bias modification.

[j]ApBM: approach bias modification.

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Table 3. Summary statistics on outcomes by condition, time phase, and assessment time points.

Outcomes, time phase, and assessment time points	Active-AtBM[a] + active-ApBM[b]	Active-AtBM + sham-ApBM	Sham-AtBM + active-ApBM	Sham-AtBM + sham-ApBM
PPA[c], n_1/n_2 (%)[d]				
Baseline	0/105 (0)	0/132 (0)	0/137 (0)	0/130 (0)
IA[e]1	11/79 (14)	16/111 (14.4)	5/110 (4.5)	8/94 (9)
IA2	7/51 (14)	9/70 (13)	5/75 (7)	11/61 (18)
IA3	7/34 (21)	6/39 (15)	6/54 (11)	9/49 (18)
IA4	5/28 (18)	6/33 (18)	7/43 (16)	5/34 (15)
IA5	8/23 (35)	4/27 (15)	8/33 (24)	3/26 (12)
Mid[f]	7/21 (33)	2/24 (8)	6/27 (22)	3/20 (15)
TP1[g]	*45/341 (13.2)*	*43/436 (9.9)*	*37/479 (7.7)*	*39/414 (9.4)*
IA6	8/19 (42)	4/21 (19)	5/24 (21)	2/20 (10)
IA7	7/17 (41)	2/19 (11)	4/20 (20)	3/19 (16)
IA8	6/17 (35)	3/17 (18)	2/19 (11)	3/19 (16)
IA9	5/15 (33)	2/14 (14)	3/15 (20)	3/17 (18)
IA10	5/14 (36)	2/13 (15)	3/12 (25)	2/15 (13)
Post[h]	5/14 (36)	2/11 (18)	3/10 (30)	4/15 (27)
TP2[i]	*36/96 (38)*	*15/95 (16)*	*20/100 (20.0)*	*17/105 (16.2)*
IA11	5/13 (38)	2/11 (18)	3/10 (30)	4/15 (27)
FU1[j]	5/13 (39)	3/11 (27)	3/10 (30)	1/14 (7)
FU2[k]	3/12 (25)	3/11 (27)	3/9 (33)	1/13 (8)
FU3[l]	4/12 (33)	2/9 (22)	3/9 (33)	2/12 (17)
TP3[m]	*17/50 (34)*	*10/42 (24)*	*12/38 (32)*	*8/54 (15)*
DCU[n], mean (SD)[o]				
TP1 (baseline)	*15.25 (9.70)*	*16.71 (9.97)*	*15.43 (8.48)*	*15.20 (8.44)*
IA1	11.23 (8.60)	12.96 (10.58)	12.89 (8.22)	13.48 (8.98)
IA2	11.07 (9.11)	13.07 (10.12)	12.48 (8.63)	10.97 (9.76)
IA3	10.41 (9.99)	13.30 (10.48)	11.96 (9.23)	9.74 (8.46)
IA4	10.06 (10.71)	13.15 (11.09)	11.39 (9.93)	11.36 (8.93)
IA5	9.26 (9.54)	14.15 (11.30)	11.58 (10.73)	9.24 (8.28)
Mid	7.77 (10.25)	15.14 (9.94)	12.52 (10.94)	11.55 (11.36)
TP2	*10.44 (9.38)*	*13.33 (10.47)*	*12.31 (9.13)*	*11.52 (9.23)*
IA6	6.79 (9.27)	14.71 (10.37)	13.15 (11.74)	10.33 (9.68)
IA7	7.84 (10.36)	15.13 (9.60)	13.70 (11.71)	10.62 (9.94)
IA8	8.49 (10.37)	15.15 (10.74)	13.15 (12.25)	10.19 (10.22)
IA9	8.56 (10.21)	15.24 (11.53)	12.10 (11.63)	8.68 (7.59)
IA10	10.16 (10.65)	14.53 (10.03)	11.48 (10.75)	7.14 (6.99)
Post	8.67 (10.45)	14.63 (10.79)	9.22 (8.93)	7.48 (7.72)
TP3	*8.32 (9.97)*	*14.92 (10.19)*	*12.51 (11.25)*	*9.22 (8.81)*
IA11	10.56 (12.26)	14.07 (10.98)	9.15 (8.10)	7.00 (7.25)
FU1	11.70 (16.09)	15.77 (14.69)	7.99 (8.53)	6.55 (6.19)

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Outcomes, time phase, and assessment time points	Active-AtBM[a] + active-ApBM[b]	Active-AtBM + sham-ApBM	Sham-AtBM + active-ApBM	Sham-AtBM + sham-ApBM
FU2	12.21 (14.00)	13.42 (14.98)	8.27 (9.78)	8.23 (6.20)
FU3	12.29 (13.19)	15.68 (18.99)	8.83 (9.05)	8.70 (7.23)
TP4[p]	*11.67 (13.55)*	*14.69 (14.43)*	*8.56 (8.50)*	*7.56 (6.60)*
AtB[q], mean (SD)[o]				
TP1 (baseline)	*24.15 (30.69)*	*27.42 (27.65)*	*24.84 (27.36)*	*24.56 (29.79)*
IA1	23.06 (37.74)	16.36 (36.17)	27.27 (40.80)	23.95 (28.87)
IA2	15.32 (42.95)	15.92 (32.99)	18.10 (35.52)	15.85 (31.78)
IA3	15.42 (32.93)	5.62 (46.13)	19.84 (37.84)	21.73 (39.93)
IA4	6.89 (33.65)	−2.38 (32.61)	20.40 (43.01)	23.65 (35.33)
IA5	−0.88 (20.32)	−1.86 (32.68)	8.92 (53.41)	14.02 (30.31)
Mid	3.40 (33.38)	8.35 (25.93)	3.29 (25.17)	16.45 (18.61)
TP2	*14.05 (36.44)*	*10.00 (36.04)*	*19.39 (40.38)*	*20.20 (31.98)*
IA6	15.21 (29.28)	9.78 (34.79)	12.41 (40.02)	14.28 (24.70)
IA7	11.24 (26.26)	0.92 (28.94)	4.65 (31.91)	16.16 (28.66)
IA8	14.24 (32.64)	5.44 (31.32)	5.64 (34.85)	9.17 (29.67)
IA9	4.33 (43.25)	4.89 (27.51)	5.50 (31.64)	8.32 (30.34)
IA10	4.71 (33.25)	−2.00 (32.02)	−4.42 (42.26)	8.50 (17.07)
Post	−4.08 (12.82)	−2.46 (28.18)	10.70 (25.76)	2.47 (26.12)
TP3	*8.42 (30.96)*	*3.35 (30.33)*	*6.23 (34.72)*	*10.23 (26.39)*
IA11	1.19 (32.46)	−16.59 (23.64)	−2.15 (25.38)	5.67 (33.41)
FU3	7.36 (14.38)	2.28 (16.09)	4.25 (23.70)	8.96 (17.65)
TP4	*4.02 (25.49)*	*−8.10 (22.27)*	*0.69 (24.14)*	*7.13 (27.12)*
ApB[r], mean (SD)[o]				
TP1 (baseline)	*−7.84 (65.28)*	*8.82 (84.61)*	*4.52 (67.04)*	*9.70 (77.34)*
IA1	4.88 (77.67)	−11.23 (114.00)	11.25 (113.95)	4.66 (98.25)
IA2	7.10 (76.98)	−7.74 (71.96)	−0.17 (78.86)	9.56 (82.04)
IA3	1.15 (73.75)	−4.47 (46.16)	−1.83 (82.75)	12.24 (59.45)
IA4	−35.76 (42.72)	12.82 (70.46)	10.87 (75.61)	9.80 (71.82)
IA5	−2.50 (73.86)	−13.05 (53.32)	0.79 (62.30)	−7.06 (68.51)
Mid	7.85 (47.22)	−6.87 (27.64)	−10.35 (91.38)	11.30 (48.89)
TP2	*−0.50 (71.27)*	*−6.47 (81.99)*	*3.72 (90.65)*	*7.04 (79.30)*
IA6	−12.18 (56.42)	8.10 (54.18)	−26.52 (99.34)	4.58 (41.78)
IA7	−10.68 (44.52)	18.58 (47.19)	−3.10 (67.67)	3.97 (99.19)
IA8	6.94 (49.90)	−2.09 (49.79)	26.66 (82.69)	8.47 (47.50)
IA9	−7.70 (78.92)	−1.46 (42.34)	−5.10 (31.09)	−3.12 (62.89)
IA10	−22.75 (38.49)	20.50 (45.27)	−21.67 (39.40)	−9.87 (53.18)
Post	−17.96 (35.54)	26.58 (32.70)	−5.60 (36.41)	−13.10 (29.10)
TP3	*−10.13 (52.45)*	*10.99 (46.77)*	*−5.42 (71.26)*	*−0.75 (59.90)*
IA11	−14.96 (52.63)	20.36 (51.52)	−15.70 (22.51)	34.20 (66.24)
FU3	2.27 (41.97)	−4.39 (41.06)	2.06 (54.69)	−12.04 (59.54)

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Outcomes, time phase, and assessment time points	Active-AtBM[a] + active-ApBM[b]	Active-AtBM + sham-ApBM	Sham-AtBM + active-ApBM	Sham-AtBM + sham-ApBM
TP4	*−7.06 (47.83)*	*9.22 (47.61)*	*−7.81 (39.78)*	*13.65 (66.41)*

[a]AtBM: attentional bias modification.

[b]ApBM: approach bias modification.

[c]PPA: point prevalence abstinence.

[d]For PPA at each assessment time point, n_1/n_2= number of participants coded as 1 (that is, quit) at that assessment time point divided by the total number of participants who reported their smoking status at that assessment time point; at each time phase, n_1/n_2= sum of observations coded as 1 (that is, quit) at that time phase divided by sum of all reported observations at that time phase.

[e]IA: interim assessment.

[f]Mid: midtraining assessment.

[g]TP1: time phase 1, first half intervention phase for PPA; baseline for DCU, AtB, and ApB.

[h]Post: posttraining assessment.

[i]TP2: time phase 2, second half intervention phase for PPA, first half intervention phase for DCU, AtB, and ApB.

[j]FU1: follow-up assessment at 1 month.

[k]FU2: follow-up assessment at 2 months.

[l]FU3: follow-up assessment at 3 months.

[m]TP3: time phase 3, follow-up phase for PPA; second half intervention phase for DCU, AtB, and ApB.

[n]DCU: daily cigarette use.

[o]For DCU, AtB, and ApB, at each assessment time point, average score at the assessment time point is reported; at each time phase, time average score at that time phase is reported.

[p]TP4: time phase 4, follow-up phase for DCU, AtB, and ApB.

[q]AtB: attentional bias for smoking stimuli.

[r]ApB: approach bias for smoking stimuli.

Table 4. Results of multilevel modeling analyses.

Omnibus effects	PPA[a]		DCU[b]		AtB[c]		ApB[d]	
	Chi-square value (*df*)	*P* value	*F* value (df_1,df_2)	*P* value	*F* value (df_1,df_2)	*P* value	*F* value (df_1,df_2)	*P* value
TP[e]	3.7 (2)	.15	111.98 (3,1835.75)	<.001	17.62 (3, 1930.01)	<.001	0.34 (3,2049)	.80
AtBM[f]	0.0 (1)	.90	0.04 (1,620.77)	.84	0.31 (1,766.99)	.58	0.48 (1,2049)	.49
ApBM[g]	0.5 (1)	.49	2.64 (1,620.77)	.11	0.01 (1,766.99)	.91	4.43 (1,2049)	.04
TP × AtBM	3.6 (2)	.17	1.34 (3,1835.75)	.26	2.35 (3,1930.01)	.07	0.67 (3,2049)	.57
TP × ApBM	1.2 (2)	.56	2.23 (3,1835.75)	.08	0.32 (3,1930.01)	.81	1.47 (3,2049)	.22
AtBM × ApBM	0.4 (1)	.50	1.82 (1,620.77)	.18	3.62 (1,766.99)	.06	0.13 (1,2049)	.73
TP × AtBM × ApBM	4.0 (2)	.14	1.86 (3,1835.75)	.13	1.78 (3,1930.01)	.15	0.99 (3,2049)	.40

[a]PPA: point prevalence abstinence.

[b]DCU: daily cigarette use.

[c]AtB: attentional bias for smoking stimuli.

[d]ApB: approach bias for smoking stimuli.

[e]TP: Time phase.

[f]AtBM: attentional bias modification.

[g]ApBM: approach bias modification.

Primary Outcome

With respect to PPA, no significant effects emerged from the MLM analysis (Table 4), indicating that neither training versions nor their combination had a significant impact on PPA over time. However, note that descriptively, the double active training condition showed the highest PPA rate at each time phase of the study (Table 3).

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Secondary Behavioral Outcome

With respect to DCU, the MLM analysis only indicated a significant main effect of time phase (Table 4). From baseline to the first half of the intervention, all participants had a significant reduction in DCU (*B*=−3.89, 95% CI −4.96 to −2.83; *P*<.001; *d*=0.43), regardless of training condition. This effect persisted to the second half of the intervention (*B*=-5.46, 95% CI −6.91 to −4.00; *P*<.001; *d*=0.60) and to the follow-ups (*B*=-4.61, 95% CI −6.32 to −2.90; *P*<.001; *d*=0.50). Contrary to our hypotheses, no significant two- or three-way interaction effects between training version and time phase emerged, suggesting that neither training versions nor their combination had a significant impact on DCU over time.

Secondary Cognitive Outcomes

At baseline, overall, participants demonstrated an AtB toward smoking-related stimuli (mean 25.30, SD 28.73; t_{493}=19.57; *P*<.001), but demonstrated neither an approach nor an avoidance bias (mean 4.43, SD 74.43; t_{492}=1.32; *P*=.18). Baseline AtB was positively correlated with the duration of years of smoking (*r*=0.21, *P*<.001), while baseline ApB was positively correlated to nicotine dependence (*r*=0.11, *P*=.01) and DCU in general (*r*=0.12, *P*=.01). The two biases were not correlated with each other at baseline (*r*=0.06, *P*=.20).

The MLM analysis only indicated a main effect of time phase on AtB (Table 4). All participants showed a significant reduction in AtB from baseline to the second half of the intervention (*B*=−10.28, 95% CI −18.98 to −1.58; *P*=.02; *d*=0.36), but this reduction did not maintain up to the 3-month follow-up (*B*=−11.03, 95% CI −24.05 to 1.99; *P*=.10, *d*=0.38). Although there was also a main effect of ApBM on ApB (Table 4), follow-up analyses showed that none of the regression coefficients involving ApBM was significant (Multimedia Appendix 6). Contrary to our hypotheses, there were no significant interaction effects between training version and time phase on both AtB and ApB. This suggests that both the AtBM and ApBM did not affect the respective cognitive bias it targeted over time.

Summary of Additional Analyses

The methods and results for testing training effects on the additional secondary outcomes (ie, craving, depression severity, and motivation to quit smoking) and for the exploratory moderation analysis on participants' awareness of CBM condition are reported in Multimedia Appendices 1 and 2. The main findings were (1) all participants showed a significant reduction in craving over time, and no training effects on depression severity and motivation to quit smoking were observed; (2) 19.6% (99/504) of the final sample (ie, TEQ respondents) indicated their awareness of training condition, the majority of whom thought they completed the sham training, while they actually completed the active one, for both training types; and (3) participants' awareness of CBM condition moderated training effects in DCU: participants who correctly thought that they were in the active training condition (for either training type) showed larger decreases in DCU over time compared with those who thought they were in the sham training condition but actually completed the active training.

Discussion

Principal Findings

This double-blind RCT tested the individual and combined effects of web-based AtBM and ApBM in adult smokers seeking online help for quitting smoking. Against our expectations, we did not find evidence for the effectiveness of neither CBM trainings nor their combination, compared with their respective sham version, in improving any of the smoking-related outcomes. In addition, neither did any of the CBM training conditions change the targeted cognitive biases. Compliance to the intervention was very low as only 10.7% (54/504) of participants completed all training sessions, and 8.3% (42/504) of the participants completed the follow-up assessments, suggesting that the web-based intervention was not well accepted.

The results indicated a general improvement in smoking-related behaviors irrespective of condition. That is, participants in all conditions may have tried to quit smoking and reduced their DCU over time. The enrollment in the intervention is a sign for motivation to change, which may suggest that the training did not have an effect larger than the mere motivation for participants to do something about their behavior and enroll in a self-help web-based program. This general improvement might also be attributable to features of the intervention that were common to all participants, including exposure to automated tailored feedback and self-monitoring of smoking behaviors. In addition, the general improvement is also likely to be driven by the high dropout rates. That is, those who stayed in the intervention longer may have produced a floor effect because of a greater self-confidence and motivation to change their smoking behaviors or a better ability to master their smoking behaviors.

The null findings on the smoking-related outcomes are consistent with recent studies examining web-based CBM in smokers [11,28] and in problem drinkers [15,53,54], except for one study using a waitlist (passive control) instead of the sham training (active control) as a comparator condition [27]. However, our findings are at odds with the studies examining CBM effects in the clinical setting with inpatient psychiatric smokers [29] and alcohol-dependent inpatients [17,18,55,56], except for 2 studies with a much smaller sample size [31,32]. Therefore, differences between the 2 types of studies, online and in the clinic, may explain the inconsistent findings [15].

A major difference is that CBM is normally administrated as an add-on intervention to the standard treatment in the clinical setting (eg, CBT [17,18,28,29]), whereas as a stand-alone or primary intervention in the online setting (as in this study). Although automated tailored feedback was included as a cointervention in this study, it was minimal and its effectiveness might have been threatened by its static feature. It is possible that CBM interventions only produce effects when blended with other standard treatments targeting more controlled cognitive processes aimed at long-term health outcomes. A related difference is that, in a clinical setting, CBM is administrated in a guided environment (ie, with the support of the therapists), while an unguided environment online fully relies on

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participants' autonomy, self-reliance, and self-discipline [57]. The lack of personal contact or therapist-client interaction in an online setting may increase the feelings of lack of support. Indeed, effects of web-based interventions can be enhanced when brief face-to-face communication with therapists [58] or various forms of remote support from therapists (eg, emails or telephone calls [59]) are included. However, accessing in-person standard treatment and support from therapists in a blended format would cost time and money, thereby limiting the feasibility of the widespread implementation and cost-effectiveness of online CBM. Thus, future online CBM studies may benefit by incorporating online CBM training with online standard treatment and additional remote support from therapists as a treatment package. This new design, building on the previous studies in a clinical context may also increase the credibility of online CBM training (a topic further discussed below).

In addition, compared with clinical settings, participants recruited online are more heterogeneous in terms of severity of symptoms. In this study, the CBM training program was open to any adult smoker seeking online help to quit smoking. As a result, our sample was very diverse in terms of severity of tobacco dependence resulting in mild smoking problems on average. Considering that CBM overall has shown small effects as an adjunct intervention in clinical settings with severely addicted patients [15,26], to find a similar effect size in such a heterogeneous population of interest, the sample size would need to be much larger [60], especially to also account for the higher number of dropouts typical of unguided online interventions.

Aside from a nonspecific improvement in smoking-related outcomes, none of the targeted cognitive biases were influenced by the 2 variants of CBM. This is in line with few previous studies evaluating CBM as a smoking behavior change intervention, which hardly found any evidence of specific reductions in the targeted cognitive bias online [11,28] and in clinical or laboratory settings [29-32]. There is one exception [33], although its interpretation is complicated by a very different experimental design (3 sessions of active AtBM training compared with 1 session of sham training). Presumably, CBM interventions would show substantial effects on behaviors once the targeted mechanism of change (changing the targeted bias) is successfully engaged, which so far has not been the case. Furthermore, at baseline, we only found a moderate AtB toward smoking-related stimuli, and no ApB, suggesting little room for CBM training effects.

Recently, there has been a debate about the optimal comparison condition in CBM studies [61,62]. In the standard sham training condition (as in this study), participants learn to shift attention away or avoid smoking stimuli in half of the trials, which is very similar to the active training condition and may leave no room for the active training to produce specific effects. A recent Bayesian meta-analysis of clinical CBM studies in addiction found larger training effects in the control condition involving mostly sham training, relative to the active training condition, with an increased dosage of training [26]. This might point to a slower learning mechanism (perhaps exposure) in addition to a quicker and short-lasting change in bias in the active condition. Therefore, we may need to make larger differences between the active and sham versions of the training to detect specific effects of CBM. To specifically evaluate clinical effects of CBM, one solution could be to carefully choose a more appropriate control condition, and another solution could be to make active training more meaningful to participants, for example, by training participants to approach (personalized) meaningful stimuli rather than neutral stimuli in addition to training them to avoid smoking stimuli [63] or by providing positive or relevant rewards to reinforce newly learned behaviors (eg, avoid smoking stimuli) during training [64].

Limitations and Future Research

The most notable limitation of this study is the low training adherence and the high dropout rates. Although high dropout rates are similar to the few published web-based CBM studies [54,65] and are very common in online interventions [60,66,67], this issue may have limited the validity of the results and caused power issues in this study.

A second important limitation that may have affected the low degree of engagement and adherence with the intention concerns the *top-down* approach we used to design this intervention. We developed this intervention by using a *theory and evidence-based* approach; therefore, we moved the typical CBM trainings delivered in the clinical setting to the online setting, by considering the online environment as a mere *delivery box* to a larger public and not as a new component of the intervention likely affecting its reception. Furthermore, since we did not incorporate any potential users' perspective or feedback into the intervention design, the intervention may not have met the users' needs and preferences (ie, the program was not user-friendly and engaging enough [57,68]). These hypotheses were supported by the training evaluation provided by a minority of participants (ie, the TEQ respondents: 19.6% (99/504) of the final sample). It should be noted that the TEQ respondents were older and smoked for more years than those who did not provide the training evaluation; therefore, they are not representative of the whole sample. For this reason, these findings should be interpreted with some caution. In addition, to obtain a more representative sample, especially those who left the intervention without providing an evaluation of the intervention should be approached. Future research could adopt the strategy of monetary incentives to increase these response rates [69] or make more effort to interview the dropouts to understand their needs and thoughts to improve the intervention.

Although the TEQ respondents in this study are not representatives of the whole sample, their feedback can be very valuable in pinpointing factors contributing to the lack of success of the study. For example, as a reason to leave the intervention, some training dropouts reported that the training was too time consuming. Indeed, this study included a lot of assessments before and during the intervention, which may have increased the burden on the participants. Although repeatedly measuring the cognitive biases during the training allows to study progressive changes, this setting may have taxed participants' motivation to train and may also have interfered with the training effects [17,18]. Therefore, a recommendation for future research is to keep the amount of measurements to a sufficient minimum.

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In addition, compared with training completers, training dropouts indicated the training was less fun to do, and some of them explicitly reported that it was boring. Indeed, the CBM tasks had an intrinsic repetitive nature. To improve the motivation to train and compliance, future research is recommended to make the CBM task more interesting and engaging by, for example, gamifying it [24,70]. Besides the dullness of the CBM tasks, the intervention website had a very simple layout and only provided text-based information to the participants. Participants were required to read and process much information to understand the study and its procedure, without an alternative source of information, such as video or graphics. The amount and length of the text may have challenged participants' literacy level and attention span and led participants to become overwhelmed or bored (compare Atkinson et al [71]).

Moreover, compared with training completers, training dropouts indicated that the training instructions were less clear, and some of them also explicitly reported that they perceived that they received the sham training and were therefore likely demotivated to continue. In this study, we used an indirect version of CBM training, where participants are required to respond to an irrelevant feature of the stimuli (eg, orientation of the probe in AtBM and tilted format of the stimuli in ApBM) rather than the content of the stimuli (ie, smoking-related or neutral stimuli). As a result, we have replicated the results of previous research that a majority of the participants in both training conditions believed that they were in the sham training condition [72]. This is positive from a blinding to conditions perspective, but suboptimal from a motivational clinical perspective. In general, with indirect instructions, participants often have difficulties understanding how the training is relevant to their problem, which may threaten the credibility of the training [72] and may have led them to feel disappointed when perceiving that they were assigned to a sham treatment [73]. In addition, our exploratory moderation analyses of awareness of training version (Multimedia Appendix 2) showed that participants who correctly thought that they were in the active training condition for either training type, showed a larger decrease in DCU over time compared with those who thought they were in the sham training condition but they actually completed the active training. It should be noted that these results need to be interpreted with caution given that the exploratory moderation analyses were conducted on a minority of participants and the mechanism of the moderation effects was unclear, since participants were only asked about what training version they perceived they received rather than the exact contingencies between stimuli and their responses. Yet, this information may also point to the importance of providing explicit and clear task instructions to improve the intervention credibility (see also Van Dessel et al [74,75]). Furthermore, the credibility of the online CBM training may also have been threatened since participants were informed that they had a 25% chance to be assigned to a condition combining two sham trainings (where smaller or no effects were expected), likely affecting their compliance to and acceptance of the intervention. This limitation is inevitable since this information should be provided to meet ethical standards [76].

A last notable limitation refers to the unsatisfactory reliabilities for both the VPT and AAT in this study, consistently with most implicit tasks [77]. As a result, it still remains unsolved whether the CBM intervention did not change the cognitive biases or whether we were merely not able to assess any changes in the biases reliably. Therefore, it is necessary to develop more reliable experimental tasks for measuring cognitive biases in further research.

Conclusions

This was the first study to evaluate whether combining 2 CBM paradigms was effective as a self-help web-based intervention for smoking cessation. Contrary to our hypotheses, the results only revealed a general reduction in DCU across time in all conditions, suggesting no beneficial effects that can be directly attributed to any of the web-based CBM training or their combination. The study had very high dropout rates and a very low frequency of training usage, indicating an overall low acceptability of the intervention, which precludes any definite conclusion on its effectiveness. Before drawing firm conclusions regarding the effectiveness of online CBM training in smokers, a fully powered study with a more engaging version of smoking CBM in a large sample is needed. Therefore, further studies on online CBM should improve the intervention compliance and prevent dropouts as a first step, whereas the overall design of the next online CBM intervention would benefit greatly from being not only *theory and evidence-based* but also *user-centered* to ensure engagement and retainment by its users. In addition, to translate findings on CBM in clinical settings into a viable and effective behavior change intervention in the real world, substantial modification of the training procedure and core design is needed.

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Conflicts of Interest

None declared.

Multimedia Appendix 1
Additional secondary outcomes.

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[DOC File , 127 KB - mental_v7i5e16342_app1.doc]

Multimedia Appendix 2
Exploratory moderation analysis.
[DOC File , 77 KB - mental_v7i5e16342_app2.doc]

Multimedia Appendix 3
Task stimuli.
[DOC File , 32 KB - mental_v7i5e16342_app3.doc]

Multimedia Appendix 4
Task data preparation.
[DOC File , 34 KB - mental_v7i5e16342_app4.doc]

Multimedia Appendix 5
Summary of training evaluation responses in the training condition of attentional bias modification and approach bias modification, respectively.
[DOC File , 85 KB - mental_v7i5e16342_app5.doc]

Multimedia Appendix 6
Full multilevel models for primary and secondary outcomes.
[DOC File , 88 KB - mental_v7i5e16342_app6.doc]

Multimedia Appendix 7
CONSORT EHEALTH checklist (V1.6.1).
[PDF File (Adobe PDF File), 2574 KB - mental_v7i5e16342_app7.pdf]

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Abbreviations

AAT: approach-avoidance task
ADAPT: Addiction Development and Psychopathology Lab of the University of Amsterdam
ApB: approach bias
ApBM: approach bias modification
AtB: attentional bias
AtBM: attentional bias modification
CBM: cognitive bias modification
CBT: cognitive behavioral therapy
DCU: daily cigarette use
ITT: intention-to-treat
mFTQ: Modified Fagerström Tolerance Questionnaire
MLM: multilevel modeling
PPA: point prevalence abstinence
RCQ: Readiness to Change Questionnaire
RCT: randomized controlled trial
TEQ: training evaluation question
TP: time phase
VPT: visual probe task

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Original Paper

Mental Health Problems and Internet Access: Results From an Australian National Household Survey

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Abstract

Background: Mental health support and interventions are increasingly delivered on the web, and stepped care systems of mental health services are embracing the notion of a digital gateway through which individuals can have access to information, assessment, and services and can be connected with more intensive services if needed. Although concerns have been raised over whether people with mental health problems are disadvantaged in terms of their access to the internet, there is a lack of representative data on this topic.

Objective: This study aimed to examine the relationship between mental health and internet access, particularly lack of access because of affordability issues.

Methods: Data from wave 14 of the *Household, Income, and Labour Dynamics in Australia* survey were used (n=15,596) in the analyses. Sample weights available in the survey were used to calculate the proportion of those with or without internet access for those with and without mental health problems and more severe long-term mental health conditions. These proportions were also calculated for those with and without internet access due, specifically, to affordability issues. Multinomial logistic regression analyses assessed the relationship between mental health status and internet access/affordability issues, adjusting for a range of covariates.

Results: Access to the internet was poorer for those with mental health problems (87.8%) than those without mental health problems (92.2%), and the difference was greater when a measure of more severe mental health conditions was used (81.3% vs 92.2%). The regression models showed that even after adjusting for a broad range of covariates, people with mental ill health were significantly more likely to have no internet access because of unaffordability than those without mental ill health (mental health problems: relative risk ratio [RRR] 1.68; 95% CI 1.11-2.53 and severe mental health conditions: RRR 1.92; 95% CI 1.16-3.19).

Conclusions: As Australia and other nations increasingly deliver mental health services on the web, issues of equity and affordability need to be considered to ensure that those who most need support and assistance are not further disadvantaged.

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KEYWORDS

internet access; mental health; affordability, mobile phone

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Introduction

Background

In Australia, as in many other countries, access to and use of the internet has become commonplace [1-3]. In 2016-2017, a regular national survey conducted by the Australian Bureau of Statistics (ABS) found that 86.5% of Australians aged 15 years or older had accessed the internet for personal use in the previous 3 months [2], with their most frequent web-based activities being entertainment (80.0%), social networking (79.9%), banking (79.5%), and shopping (72.6%). In addition, 46.1% had accessed web-based health-related services. The use of the internet (or broader digital platforms) for the delivery of mental health services, information, and support (electronic mental health) is seen as a mechanism to address the barriers associated with traditional mental health services (eg, cost and accessibility).

A large number of web-based interventions have been developed and delivered for treating mental illness. There is evidence supporting the efficacy of some of these interventions [4-8]. For example, a recent meta-analysis included 13 studies comparing internet-delivered cognitive behavioral therapy (ICBT) and face-to-face cognitive behavioral therapy (CBT), and the results showed that ICBT was as equally effective as face-to-face CBT in treating depression and anxiety disorders [6]. A meta-analysis of 12 randomized controlled trials comparing ICBT and control groups (eg, treatment as usual, waiting list, and attention placebo) showed that ICBT had a large effect in treating anxiety disorders and a small effect in treating depression [7]. This study also showed that ICBT with minimal therapist support had a large effect size and ICBT without such support had a small effect size. Apart from ICBT, web-based psychoeducational programs and self-management interventions have also been shown to be effective in improving psychiatric symptoms [5]. However, it must also be acknowledged that some research have raised concerns that although various web-based interventions appear to be effective in research trials, their real-world efficacy may be limited by low adherence [9], the severity of patients' illness, lack of support, and inadequate personalization of program content [10,11].

In response to a recent review of mental health programs and services [12], the Australian government announced the introduction of a stepped care approach to service delivery, encompassing a hierarchy of services of increasing intensity [13]. A digital gateway is the entry point for services, providing a greater focus on early intervention. This digital mental health gateway, *Head to Health*, offers information about mental health services and resources delivered by mental health service providers on the web, including free/low-cost apps (both self-help and clinician-moderated options), online support communities, web-based courses, and phone services. Although *Head to Health* may assist many Australians seeking mental health care (particularly those who prefer anonymity or who live far from face-to-face services), it cannot be considered a universal platform, when a digital divide remains in Australia. Engagement by some sociodemographic groups will be lower because the accessibility and use of the internet remain, to some extent, socioeconomically determined [14]. Those with low levels of educational attainment, who are unemployed, in low-income households, and/or live in rural or remote areas are less likely to have access to the internet and are more likely to have low internet literacy [2,15-18]. According to the ABS, although the proportion of households with access to the internet at home has steadily increased since 2004-2005, it has plateaued at 86% between 2014-2015 and 2016-2017 [2]. The ABS survey did not explicitly ask why people did not use the internet, but their report shows that affordability is likely a major factor, given that internet use was much less prevalent among households in the lowest quintile of household income (68.8%) compared with those in the high-income quintile (97.4%). Unfortunately, people with less education and fewer financial resources are also particularly vulnerable to mental health problems [19,20], and thus, those most in need of low-cost web-based mental health interventions are likely to be those least likely to be able to access this resource.

Several studies have examined internet use by people experiencing mental illness. In a recent study, Robotham et al [21] surveyed 241 people with psychosis or depression in London about their use of the internet and internet-enabled technologies. They found that only 10% of their sample was digitally excluded, with limited internet access. For people with psychosis, the most commonly reported barriers to using the internet were security concerns, lack of credit/money, lack of knowledge, lack of places to access the internet, and lack of availability. For people with depression, the most common barriers were security concerns and a lack of credit/money. They also found that for people with psychosis, those digitally excluded tended to be older and have been in contact with mental health services for a longer period. In contrast, Tobitt and Percival [22] interviewed 97 users of community mental health rehabilitation services in London and found high levels of digital exclusion. Only 14.4% of their sample used the internet, 17.5% used computers, and 40.2% used mobile phones. Those who used these technologies were younger than those who did not. Those who used mobiles and computers were more likely to reside in low-support/high-independence placements. Although these recent studies suggest there may be accessibility issues for people experiencing mental illness, their conclusions are limited by small sample sizes and no comparison with people without mental illness. Overall, although evidence about accessibility/engagement is critical to the success of web-based interventions for people experiencing mental illness, knowledge remains scarce. Thus, additional research on this issue is urgently needed.

Objective

This study sought to address the lack of population-based research examining the relationship between mental health and internet access. We used data from a large, nationally representative Australian survey. We hypothesized that people with mental health problems would be more likely to have no access to the internet compared with those without mental health problems, mainly because of affordability issues. We also hypothesized that this relationship would be more evident for those who had a severe mental health condition.

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Methods

Participants

This study used data from the *Household, Income, and Labour Dynamics in Australia* (HILDA) survey. HILDA is a longitudinal study of a nationally representative sample of Australian households, randomly selected through a multistage approach [23]. It has been conducted annually since 2001 and collects household and individual information across a wide range of domains (eg, demographic, social, health, and financial) through face-to-face interviews and self-completion questionnaires. Information at the individual level is collected from all household members aged 15 years or older in each survey wave.

In wave 1, 13,969 individuals from 7682 households responded to the survey (66% response rate) [24]. Retention of these individuals in wave 2 was 87% and more than 90% for each wave thereafter. The total number of respondents in subsequent waves was greater than those in wave 1 for several reasons, including (1) nonrespondents from participating households in wave 1 were successfully interviewed in later waves, (2) individuals in sample households turned 15 years old, and (3) individuals were added to the sample following changes in household composition (eg, marriage of a household member). In addition, to retain the cross-sectional representativeness of the HILDA sample, the sample was topped up by including an additional 3652 people from 2153 households in wave 11. Each wave of the HILDA survey comprises a household survey with a key informant from each household and a personal interview and a (paper) self-complete questionnaire with all household members aged 15 years or older. The self-complete questionnaire is either completed during the interview process or left with respondents to complete at a later time. As a result, the response rate to the self-complete questionnaire is lower than that of the interview, with an average return rate of 90%.

This study primarily used data from wave 14 (collected in 2014) when a measure of material deprivation was included. This module of questions examined which resources, activities, and services were considered essential and if each household had access to them (total number of responding households at wave 14=8327, 87.3% of all invited households). The measure of mental health problems was drawn from the self-complete questionnaire, meaning there was a maximum of 15,596 respondents (75.8% of all invited persons) included in the analyses.

Ethics Approval

The HILDA survey was approved by the Human Research Ethics Committee of the University of Melbourne.

Measures

Outcome Variable

The key household respondent answered the material deprivation module on behalf of the household. The module considered 26 different resources, activities, and services (eg, *access to the internet at home, a decent and secure home,* and *medical treatment when needed*) [23] and asked respondents (1) if they considered this essential (response options: *yes* and *no*); (2) if the household had this item (response options: *yes* and *no*); and (3) if not, whether this was because they could not afford it (response options: *yes* and *no*). On the basis of the latter 2 questions, we created a variable regarding internet access: (1) yes, the household had internet; (2) no, the household did not have internet because of unaffordability; and (3) no, household did not have internet for reasons other than unaffordability.

Exposure Variables

Each household member aged 15 years or older was invited to complete a personal interview and the self-completion questionnaire, which included mental health questions. Mental health was assessed using the 5-item Mental Health Inventory (MHI-5), a subscale of the Medical Outcomes Study 36-item short-form health survey. This survey is administered annually in HILDA (ie, at every wave) and is one of the most widely used self-completion measures of health status [25,26]. The MHI-5 has been widely recognized as an effective screening instrument for depression/common mental disorders in both the general population and clinical settings [27,28]. The MHI-5 score (ranging from 0 to 100) was dichotomized at an established cutoff point, with below 50 indicating mental health problems [29].

Mental health was also assessed using mental health items from a module of questions assessing the presence of any long-term health condition that restricted activity. This mental health measure was based on 2 questions assessing *any mental illness that requires help or supervision* and a *nervous or emotional condition that requires treatment*. The need for help, supervision or treatment indicated greater adverse functional effects and thus a more severe form of mental health condition. Those who responded *yes* to either of these questions were classified as having a severe mental health condition, whereas everyone else was classified as not having a severe mental health condition.

Covariates

Variables that are known to be associated with mental health and that might potentially confound the relationship between mental health and internet access were adjusted in the analysis [21,22]. These include sex, age, partner status, any children under 15 years old in the household, employment status, annual household gross income, financial hardship, and residential remoteness. In terms of partner status, those who were legally married or in a de facto relationship were grouped as *having a partner*, whereas those who were separated, divorced, widowed, or never married/not in a de facto relationship were grouped as *not having a partner*. Employment status included the categories of employed, unemployed, and not participating in the labor force. Annual household gross income was the sum across all household members of financial year market income, private transfers, Australian and foreign pensions and benefits, and irregular income (described in detail elsewhere [30]). Household income was classified into 5 groups. Financial hardship was based on 7 items: (1) *could not pay electricity, gas, or telephone bills on time*; (2) *could not pay the mortgage or rent on time*; (3) *pawned or sold something*; (4) *went without meals*; (5) *was unable to heat home*; (6) *asked for financial help from friends or family*; and (7) *asked for help from welfare/community*

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organizations. Respondents were classified as experiencing financial hardship if they responded *yes* to any of these items. Residential remoteness was classified into 5 categories based on the 2011 Australian Statistical Geography Standard: major cities, inner regional, outer regional, remote, and very remote.

Statistical Analysis

All analyses applied the sample weights (ie, household population weight for items from the household survey and responding person sample weight for items from the self-complete questionnaire, details of the weighting methodology described elsewhere [31]) provided in the HILDA dataset to reflect the overall Australian population. We used descriptive statistics to report the sample characteristics and the proportion of those with or without internet access for those with and without mental health problems and more severe long-term mental health conditions. For each weighted percentage, we reported the unweighted number which may differ from the weighted estimate. Multinomial logistic regression models were then used to assess the relationship between mental health status (assessed separately by MHI-5 cutoff point and questions on any long-term health condition) and internet access. The first model was a simple bivariate model, and the subsequent models adjusted for age and sex (model 2), partner status and any children aged under 15 years (model 3), residential remoteness (model 4), and socioeconomic circumstances (employment status, household income, and financial hardship; model 5). Finally, we tested the interaction effect of mental health with age by comparing a model that comprised only the main effects with a model that also incorporated their interaction effect using the likelihood ratio test.

The proportion of observations with missing data on all variables was low, ranging from 0% to 3.2% (financial hardship). Our analyses were based on observations with no missing data (complete analyses). All analyses were performed using the Stata/SE version 14 (StataCorp LLC).

Sensitivity Analyses

We performed a sensitivity analysis using HILDA data from the following year (wave 15, collected in 2015). This wave did not include the deprivation module and did not assess if respondents considered internet access to be essential but asked each participant if they had access to the internet at home (response categories: *yes* or *no*). Wave 15 also included the Kessler Psychological Distress Scale (K10) [32], a widely used and validated scale used to assess nonspecific psychological distress and screen for mental disorders in the population. The validity of K10 as an indicator of distress is comparable with that of the MHI-5 [29]. For this analysis, we used recommended cutoff points to identify those with very high psychological distress as an indicator of mental health problems [33]. Sample weights were used to estimate the proportion of those with or without internet access for those with and without very high psychological distress and in logistic regression models to examine the relationship between mental health and internet access, controlling for the same covariates as the main analyses.

Results

Sample Characteristics

Of the respondents in wave 14, there were approximately equal-weighted proportions of males (49.2%) and females (50.8%) as well as respondents who were aged less than 35 years (34.8%), between 35 and 54 years (33.5%), and more than 54 years (31.7%; Table 1). Approximately 60% of respondents had a partner, 31.0% had children under 15 years old, 3.9% were unemployed, about half lived in a household with an annual gross income of more than Aus $100,000 (US $63,868), 21.7% experienced financial hardship, and 71.4% resided in major cities.

The cutoff point of 50 on the MHI-5 defined approximately 11% of HILDA survey respondents with mental health problems. For comparison, in the analysis of the 2014-2015 National Health Survey, the ABS identified 11.7% of Australian adults with high or very high levels of psychological distress assessed using K10, a measure that is comparable with MHI-5 [34]. Approximately 5% of the HILDA survey respondents were identified with long-term mental health conditions that required help/supervision or treatment.

Just less than half of the households (46%, as represented by the key respondent) indicated that internet access at home was essential. This was somewhat greater than the percentage of households where it was considered essential to have a television (44.1%) but less than a motor vehicle (55.1%). It is estimated that 88.5% of Australian households had access to the internet (consistent with the ABS estimate of 86.1%). At the person level, approximately 91.6% of respondents resided in households that had access to the internet, whereas 1.5% were in households with no internet access because of not being able to afford it, and 6.8% were in households with no internet access due to other reasons.

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Table 1. Weighted proportion of sample characteristics at wave 14 (persons: n=15,596 and households: n=8327).

Characteristics	Weighted percentage	
	n (%)	95% CI
Sex		
Male	7308 (49.21)	48.14-50.28
Female	8288 (50.79)	49.72-51.86
Age group (years)		
<35	5355 (34.78)	33.72-35.86
35-54	5037 (33.48)	32.47-34.50
>54	5204 (31.74)	30.82-32.67
Partner status		
No partner	5734 (39.41)	38.36-40.47
Have a partner	9861 (60.59)	59.53-61.64
Children <15 years old		
No	10,939 (69.05)	68.05-70.03
Yes	4657 (30.95)	29.97-31.95
Employment status		
Employed	9771 (62.13)	61.09-63.17
Unemployed	634 (3.94)	3.46-4.47
Not in the labor force	5191 (33.93)	32.94-34.93
Annual household gross income Aus $ (US $)		
<34,000 (21,715)	1978 (10.33)	9.83-10.86
34,000-59,999 (21,715-38,320)	2509 (15.41)	14.68-16.18
60,000-99,999 (38,321-63,867)	3361 (21.43)	20.57-22.31
100,000-159,999 (63,868-102,187)	3995 (26.48)	25.61-27.38
>160,000 (102,188)	3753 (26.34)	25.46-27.25
Financial hardship		
No	11,723 (78.34)	77.44-79.22
Yes	3372 (21.66)	20.78-22.56
Remoteness		
Major cities	10,452 (71.43)	70.59-72.26
Inner regional	3374 (18.85)	18.16-19.55
Outer regional	1570 (8.48)	8.00-8.99
Remote/very remote	200 (1.24)	1.03-1.49
Mental health problems (5-item Mental Health Inventory)		
No	13,888 (89.19)	88.53-89.81
Yes	1662 (10.81)	10.19-11.47
Severe mental health conditions		
No	14,768 (94.99)	94.56-95.39
Yes	825 (5.01)	4.61-5.44
Internet access is essential (household respondent)		
No	4677 (53.98)	52.58-55.38
Yes	3617 (46.02)	44.62-47.42
Households with internet access		

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Characteristics	Weighted percentage	
	n (%)	95% CI
No	1020 (11.55)	10.73-12.42
Yes	7301 (88.45)	87.58-89.27
Persons with internet access at home		
Yes	14,185 (91.62)	91.08-92.13
No, cannot afford	259 (1.53)	1.26-1.86
No, other reasons	1143 (6.85)	6.42-7.31

Weighted Proportion of Internet Access by Mental Health Variables

Table 2 shows that similar weighted proportions of respondents with and without mental health problems (MHI-5) were from households in which having internet access at home was considered essential (44.9% vs 46.2%). However, a lower weighted proportion of respondents with mental health problems had access to the internet compared with those without mental health problems (87.8% vs 92.2%). In addition, the weighted proportion of respondents with mental health problems who did not have internet access because they could not afford it was more than three times greater than it was for respondents without mental health problems (4.0% vs 1.3%). The difference in the weighted proportion of those with and without mental health problems who had no internet access at home because of other reasons was minor, 8.3% and 6.5%, respectively.

Table 2. Weighted proportion of internet access by mental health problems (5-item Mental Health Inventory) and severe mental health conditions.

Internet access	Mental health problems (5-item Mental Health Inventory)				Severe mental health conditions			
	No		Yes		No		Yes	
	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI
Internet access is essential (household respondent)								
No	4153 (53.82)	52.32-55.31	508 (55.10)	51.06-59.07	4425 (53.84)	52.39-55.29	250 (56.56)	51.26-61.71
Yes	3242 (46.18)	44.69-47.68	367 (44.90)	40.93-48.94	3421 (46.16)	44.71-47.61	195 (43.44)	38.29-48.74
Persons with internet access at home								
Yes	12,718 (92.17)	91.59-92.72	1437 (87.77)	85.66-89.60	13,504 (92.20)	91.64-92.73	678 (81.27)	77.38-84.62
No, cannot afford	188 (1.29)	1.03-1.63	66 (3.97)	2.91-5.39	210 (1.41)	1.14-1.75	49 (5.17)	3.60-7.37
No, other reasons	974 (6.53)	6.06-7.04	159 (8.27)	6.79-10.02	1045 (6.38)	5.94-6.86	98 (13.56)	10.58-17.23

A similar pattern was observed for the measure of severe mental health conditions, but the difference was greater in magnitude. Specifically, the difference in the weighted proportion of persons with internet access at home between those with and without severe mental health conditions was 10.9% (81.3% vs 92.2%). The weighted proportion of those with severe mental health conditions who had no internet because they could not afford it was 4 times greater than it was for those without this condition (5.2% vs 1.4%). The difference in the weighted proportion of those with and without mental health problems who had no internet access at home because of other reasons was 7.2% (6.4% vs 13.6%).

Relationship Between Mental Health and Internet Access

A series of models examining the relationship between mental health and internet access at home are presented in the Multimedia Appendix 1. The simple model shows that the relative risk that people with mental health problems did not have access to the internet at home because they could not afford it was 3 times greater than for those without mental health problems (relative risk ratio [RRR] 3.22; 95% CI 2.16-4.80). People with mental health problems were also more likely to have no access to the internet at home for *other reasons* than those without mental health problems, although the relative risk was lower (RRR 1.33; 95% CI 1.06-1.67). These results remained significant in the subsequent models adjusted for sex, age, partner status, young children, and remoteness (no internet access because of unaffordability; RRR 2.60; 95% CI 1.73-3.93 and no internet access because of *other reasons*: RRR 1.39; 95% CI 1.08-1.80). The greater risk of those with mental health problems having no internet access because of unaffordability was attenuated but remained significant after adjusting for the comprehensive block of financial measures (employment status, household income, and financial hardship; RRR 1.68; 95% CI 1.11-2.53), but the difference associated with mental health in having no access to the internet for *other reasons* was no longer significant in this final model.

In the final model (Multimedia Appendix 1), other covariates that were related to no internet access because of unaffordability included did not have a partner, had children aged under 15 years, from a low-income household, experienced financial hardship, and lived in the outer regional area. Those aged older than 34 years, who did not have a partner, did not have children

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aged under 15 years, were not in the labor force, from a low-income household, and lived in regional/remote areas were more likely to report no internet access for *other reasons*.

As shown in Multimedia Appendix 2, individuals with a severe mental health condition were more likely to report no internet access because they could not afford it (model adjusted for sociodemographic variables and remoteness: RRR 3.46; 95% CI 2.20-5.45 and fully adjusted model: RRR 1.92; 95% CI 1.16-3.19) compared with those without a severe mental health condition. Those with a severe mental health condition were also more likely to report no internet access because of *other reasons* (model adjusted for sociodemographic variables and remoteness: RRR 2.06; 95% CI 1.46.2.91 and fully adjusted model: RRR 1.43; 95% CI 1.01-2.01). The covariates that were significant in the final model (Multimedia Appendix 2) were the same as those in Multimedia Appendix 1.

The likelihood ratio test showed that there was no significant interaction between mental health (assessed by MHI-5 and questions on any long-term health condition) and age, indicating no significant difference in the relationship between mental health and internet access at home across age groups.

Findings From Sensitivity Analyses

When using wave 15 data, we found 91.3% (consistent with 91.7% in 2014) of respondents reported that they had access to the internet, which included 87.4% of those with very high psychological distress (based on the K10) and 91.9% without very high distress (Multimedia Appendix 3). The weighted logistic regression models confirmed that those with very high distress were significantly more likely to report having no internet access at home than those without distress (model adjusted for sociodemographic variables and remoteness: odds ratio [OR] 2.14, 95% CI 1.61-2.84 and full model incorporating socioeconomic measures: OR 1.46, 95% CI 1.08-1.97; Multimedia Appendix 4).

Discussion

Principal Findings

This study aimed to examine the relationship between mental health and internet access using a large representative Australian sample. The findings show that in 2014, 91.7% of respondents had internet access at home. However, the proportion was lower among those identified with mental health problems (87.8%) compared with those without (92.2%) mental health problems. This difference was greater for those with than those without severe mental health conditions (81.3% vs 92.2%). The findings also show that individuals with mental health problems were less likely to have internet access at home because they could not afford it compared with those without mental health problems: an effect that remained even after controlling for an extensive range of sociodemographic, geographical, and socioeconomic factors. After controlling for these factors, mental health problems were no longer associated with not having internet access because of reasons other than unaffordability. The same pattern of results on not having internet access because of affordability issues (with a greater RRR) was observed when using severe mental health conditions as the exposure variable. However, severe mental health conditions remained significantly associated with lack of internet access because of reasons other than unaffordability in the fully adjusted model.

Comparison With Prior Work

Our study analyzed data from the HILDA survey, a large, high-quality, nationally representative household panel survey. The weighted estimate derived from the data of the proportion of Australian households with internet access (88.5%) was consistent with the published figures from the ABS for the same years (2014-2015, 85.9%) [2], further enhancing our confidence in the robustness of the findings. The measure of mental health problems used in the main models, based on the MHI-5, assesses symptoms associated with common mental disorders such as depression and generalized anxiety. Using this measure, we found a difference of 4.4% in internet access at home between those with and those without mental health problems in 2014. Other analyses included the alternative marker of mental health conditions that identified those who reported having a long-term mental illness that required help or supervision or required treatment. We hypothesize that this measure may identify a cohort with more severe mental health conditions. Accordingly, we found a much greater difference (10.9%) in the rate of internet access at home among those with and without such a mental health condition and evidence of a much stronger association between this form of mental health condition and lack of internet access at home for financial reasons (RRR 1.92 vs MHI-5's RRR 1.68). This provides evidence of an inverse relationship between the severity of mental health conditions and likelihood of internet access and further strengthens the importance of understanding the nature of, and how to potentially address, this digital exclusion of those with poor mental health before the design and implementation of digital-centric mental health service systems.

Consistent with our hypothesis, we found that individuals with mental health problems are more likely to not have access to the internet because of affordability issues. This finding echoes previous research with nonrepresentative samples that have reported inadequate financial resources as a barrier to internet use for people with mental illness [21]. The same issue has also been emphasized in the 2017 Australian Digital Inclusion Index [35], where affordability remained a key challenge for some excluded groups. In addition, we found that not having internet access because of reasons other than unaffordability was not related to mental health measured by the MHI-5 but was marginally related to more severe mental health conditions in the fully adjusted models. This finding indicates the likelihood that people with more severe mental health conditions have no internet access primarily because of unaffordability and secondarily because of other potential reasons, such as lack of internet literacy, low acceptability of internet use, and concerns related to cybersecurity and privacy [21,36].

The findings of this study have important implications in terms of ensuring equity in the planning, delivery, and provision of web-based mental health interventions and their role in broader mental service systems. Although digital platforms provide a low-cost option for the delivery of effective mental health services and treatments and can have a key role as a central

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gateway directing individuals with mental health problems to appropriate services, our findings suggest that the key target for these services (potentially both those likely to benefit from web-based self-help and more intensive assistance) will be disproportionally less able to access these treatments from home. As affordability is a key factor for lack of internet access in people with mental illness, making internet access more affordable to this vulnerable group of people may be one way to address these inequalities. This study raises questions about the use of web-based mental health service delivery as the gateway to services and support. It points to the need for alternative and flexible pathways to care, and that it is essential to continually monitor service accessibility and engagement with the most disadvantaged in our community. Although the evolution of web-based service delivery will continue, it is critical to note that the digital divide remains.

The ongoing inequality in internet access documented in this paper also has implications for those who undertake mental health research via web-based platforms or who develop and evaluate web-based mental health interventions. The results of this study suggest that, if not explicitly targeted, those with mental health problems (and more so, those with more severe mental conditions) will be underrepresented in this research and that caution is needed in the interpretation and generalizability of the findings.

Strengths and Limitations

The key strengths of this study include the large nationally representative sample and the multiple and robust assessments of mental health problems. However, there are some limitations that should be considered in the interpretation of the findings. First, although our analysis produced estimates of household internet access consistent with published figures from the ABS, as in all longitudinal surveys, the HILDA sample may be influenced by selection and attrition bias, which, over time, may limit the generalizability of the findings. To overcome such potential bias, cross-sectional and longitudinal weights are generated for each wave in the HILDA. The application of these weights to adjust for differences between the characteristics of the HILDA sample and the characteristics of the Australian population corrects for the under- or over-representativeness in the sample of certain characteristics. The application of the population weights included in the HILDA allows us to make stronger inferences about the Australian population from the HILDA survey data. The inclusion of new household members and the addition of a top-up sample in 2011 also increased the representativeness of the HILDA sample (eg, providing an opportunity to recruit newly arrived Australian residents). Second, the HILDA study only includes self-report data on mental health and internet access, and thus, the observed relationship may be understated or overstated because of under- or over-reporting resulting from recall bias. Nonetheless, the consistency of findings from the 2014 (in which a single key household respondent reported on household internet access) and the 2015 HILDA survey (where each individual respondent provided data on household internet access and their own mental health using a different measure) may suggest such effects were not substantial. Third, the HILDA survey only asks about internet access at home in a general manner and, therefore, could be interpreted by respondents narrowly to imply that only fixed-line access was being accessed. However, the correspondence of the HILDA survey estimates of household internet access with the estimate from the ABS, in which connection to the internet at home via a mobile phone or smartphone is explicitly described, suggests that the approach in the HILDA survey did not significantly underestimate the levels of household internet access. Fourth, we have no detailed information about the other reasons people did not have internet access at home (other than unaffordability), so we do not know if this reflects a personal choice, broader geographic access difficulties, or other reasons. Finally, the HILDA survey does not contain questions about internet use related to accessing web-based mental health services. Thus, although we assume that those with internet access have less opportunity to engage with web-based services, this topic could be included in future questionnaires.

Conclusions

In summary, the findings provide direct evidence that people with mental health problems are more likely to not have access to the internet because of affordability issues than those without mental health problems (particularly those with more severe mental health conditions). This means people who need web-based medical treatments the most are less able to access them. Translating our findings to the context of Australia's new digital mental health gateway, we suggest that there are inequity issues and that everyone with a mental health problem cannot currently access what is intended to be a universal platform. The problem of internet affordability needs to be addressed to increase the accessibility of web-based treatments for everyone.

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Authors' Contributions

PB designed and oversaw the study. LST analyzed the data and interpreted the findings with PB. LST wrote the first draft, and all authors contributed to and approved the final draft of the manuscript.

Conflicts of Interest

None declared.

Multimedia Appendix 1
Relative risk ratio and 95% CIs from multinomial logistic regression models assessing the relationship between mental health problems (5-item Mental Health Inventory) and internet access at home.
[DOCX File , 30 KB - mental_v7i5e14825_app1.docx]

Multimedia Appendix 2
Relative risk ratio and 95% CIs from multinomial logistic regression models assessing the relationship between severe long-term mental health conditions and internet access at home.
[DOCX File , 29 KB - mental_v7i5e14825_app2.docx]

Multimedia Appendix 3
Weighted proportion of internet access by mental health condition in wave 15.
[DOCX File , 22 KB - mental_v7i5e14825_app3.docx]

Multimedia Appendix 4
Odds ratio and 95% confidence intervals from logistic regression models assessing the relationship between psychological distress and no internet access at home (wave 15).
[DOCX File , 28 KB - mental_v7i5e14825_app4.docx]

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Abbreviations

ABS: Australian Bureau of Statistics
CBT: cognitive behavioral therapy
DSS: Department of Social Services
HILDA: Household, Income, and Labour Dynamics in Australia
ICBT: internet-delivered cognitive behavioral therapy
K10: Kessler Psychological Distress Scale
MHI-5: 5-item Mental Health Inventory
OR: odds ratio
RRR: relative risk ratio

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Original Paper

Evaluation of Electronic Mental Health Implementation in Northern Territory Services Using the Integrated "Promoting Action on Research Implementation in Health Services" Framework: Qualitative Study

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Abstract

Background: Electronic mental health is a promising strategy to bridge the treatment gap in mental health care. Training workshops have been delivered to service providers working with Aboriginal and Torres Strait Islander people at a primary health care level to raise awareness and knowledge of electronic mental health approaches.

Objective: This study aimed to understand service providers' perspectives and experiences of electronic mental health adoption. More specifically, it aimed to use the integrated Promoting Action on Research Implementation in Health Services (i-PARIHS) framework to further identify and understand how different factors facilitate or impede electronic mental health uptake within primary health care settings providing services to Aboriginal and Torres Strait Islander people.

Methods: Qualitative interviews were conducted with 57 service providers working with Aboriginal and Torres Strait Islander people, who had undergone electronic mental health training workshops.

Results: Several factors related to innovation (electronic mental health approach), recipients (service providers as an individual and as a team), and context (local, organizational, and external contexts) were found to influence electronic mental health uptake. Particularly, organizational readiness, in terms of information technology resources and infrastructure, policies, workforce and culture, and processes to mandate electronic mental health use, were found to be significant impediments to electronic mental health utilization. These findings led to the development of a three-phase implementation strategy that aims to enhance electronic mental health adoption by addressing organizational readiness before and post electronic mental health training.

Conclusions: The i-PARIHS provides a useful determinant framework that deepens our understanding of how different factors impede or facilitate electronic mental health adoption in this setting. This insight was used to develop a practical and comprehensive implementation strategy to enhance the utilization of electronic mental health approaches within primary health care settings, involving three phases: pretraining consultations, training workshops, and post-training follow-up support.

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KEYWORDS

eHealth; implementation science; health care delivery

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Introduction

Electronic Mental Health Background

It is estimated that 450 million people worldwide are affected by mental illness, that is, at least one in four people are burdened by mental health conditions. This places mental illness as one of the leading causes of ill health and disability worldwide [1]. Despite the high prevalence of mental illness, a significant proportion of burdened individuals are not receiving treatment [2-4]. The treatment gap is a global challenge involving a complex interplay between multiple factors from policy to individual elements and thus requires an innovative and feasible solution.

With the omnipresence of the internet and technology in today's society, many scholars recognize the potential of digital media as a promising strategy to bridge the treatment gap in mental health care. This surge of interest led to the emergence of the electronic mental health field in 1999 [5]. An electronic mental health approach has been defined as "the use of information and communication technology... to support and improve mental health conditions and mental health care" [6]. Typically, the approach involves the use of a variety of digital platforms such as telephone, mobile, computer, and Web-based apps.

One of the attractions of the electronic mental health approach is flexibility. Electronic mental health can be applied at different levels of health care, such as promotion, prevention, early intervention, active treatment, maintenance, and relapse intervention. Its mode of utilization can also vary. Some tools are designed to be self-directed and used without professional support, whereas others are practitioner-guided [7,8]. Other strengths of electronic mental health include improved accessibility, cost-efficiency, interactivity, and consumer engagement [8,9].

Evidence for the effectiveness of electronic mental health in addressing mental health concerns has begun to emerge in the last couple of decades. Several systematic reviews and meta-analyses have shown that the approach is effective in reducing symptoms for a range of mental illnesses, for example, depression, anxiety, eating disorders, and substance misuse [10-12].

Researchers and clinicians have, however, raised some concerns about the approach. In particular, issues around cybersecurity, confidentiality, data storage, and management have been highlighted [13]. Other concerns include the level of responsivity to crises, the lack of guidelines, and the limited number of evidence-based tools and resources [14]. Nonetheless, efforts are underway to address these concerns. Several professional organizations have issued ethical guidelines for Web-based counseling [15,16] as well as for risk management of crises [17]. In Australia, electronic portals (ePortals) have been developed to direct individuals to electronic mental health tools and resources that have been filtered by experts, for example, HeadtoHealth and Beacon [18]. The Australian government has also launched a project to develop a certification framework to ensure the quality of electronic mental health resources and their safe application [19].

Electronic Mental Health in Australia

In line with global statistics, the disparity between demand and supply of mental health services in Australia is significant [20]. To reduce the burden and treatment gap of mental illness in Australia, the Australian government released the National eMental Health Strategy, which aims to raise awareness and utilization of electronic mental health approaches by all Australians [21]. The initiative encompasses three components: the head to health website (ePortal), Mindspot (electronic clinic]), and nationwide electronic mental health training and implementation support (electronic mental health in practice [eMHPrac]).

Menzies School of Health Research (Menzies) is a partner in the eMHPrac project. In collaboration with the University Centre for Rural Health (UCRH) and Queensland University of Technology (QUT), we focus on raising awareness and promoting electronic mental health resources along with providing training and support to service providers working with Aboriginal and Torres Strait Islander people (First Nations hereafter) at the primary health care level, for example, nurse, peer support worker, Indigenous health worker, psychologist, and alcohol and other drug workers. In our use of the term First Nations, we acknowledge the diversity of Australian Aboriginal and Torres Strait Islander languages and traditions. The training package aims to educate service providers on available evidence-based electronic mental health resources and tools. The Menzies Aboriginal and Islander Mental Health Initiative (AIMhi) Stay Strong app is one of the relatively few available apps responsive to First Nations cultures.

Electronic Mental Health Within Australia's First Nations Context

For First Nations, positive identities, extensive social networks, connectivity with languages, and traditions can act as protective factors for well-being; nevertheless, there is a much higher prevalence of mental health concerns in comparison to other Australian communities [22]. The multiple underlying factors include consequences of colonization, marginalization, intergenerational trauma, and enduring inequality and racism [23,24]. Despite the high need for support, access to appropriate services is poor, particularly for those who live in remote areas [25]. With the rising presence of digital media in First Nations communities, particularly for youth [26,27], an electronic mental health approach has the potential to bridge the treatment gap and overcome the barriers to services such as stigma and geography.

Research on the application of electronic mental health in Australia First Nations contexts is still in its infancy; however, the approach is perceived to be feasible, acceptable, and appropriate [28]. From the service providers' perspective, the approach is deemed useful for rapport building and engagement with First Nations clients. Its applicability across a range of clients, services, and settings is perceived to be broad and viable [28]. Enthusiasm for electronic mental health is also expressed by community members. Povey et al [29] conducted focus groups exploring the response of First Nations community members to their experience of two culturally adapted apps. Overall, the community members were optimistic about

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electronic mental health and its potential for improving well-being for First Nations. The three key factors identified as influencing the acceptability of electronic mental health approaches within indigenous settings were as follows: personal factors (eg, motivation and information technology [IT] literacy), environmental factors (eg, availability of resources), and app characteristics (eg, graphics and content).

Implementation of Electronic Mental Health

It takes approximately 17 years for research to be translated into clinical practice [30]. The time lag is referred to as the translation gap, and it is a forefront issue in health research [31]. Minimizing this gap optimizes patient benefits and the use of scarce resources. It is therefore imperative to gain an understanding of the factors influencing translation to inform robust implementation strategies.

To date, little is known regarding effective strategies for implementing electronic mental health resources in primary health care services working with Australia's First Nations. Findings from the very few studies in this field report common themes essential to electronic mental health uptake relating to three key domains: organizational factors, characteristics of the adopters (ie, practitioners and clients), and the innovation itself. For example, factors that impose challenges to adoption are the lack of organizational policy and procedural support for electronic mental health utilization, and IT infrastructure and resources. Poor IT literacy and knowledge of electronic mental health also impedes the uptake of the electronic mental health approach. Utilization is also dependent on the characteristics of the innovation, that is, user-friendliness and cultural responsiveness [32,33].

This Study

This study aimed to further the current knowledge of electronic mental health implementation in primary care services working with Australia's First Nations. A conceptual framework, the integrated Promoting Action on Research Implementation in Health Services (i-PARIHS), was used to deepen the understanding of factors influencing adoption. The framework applied here is a revised version of the Promoting Action on Research Implementation in Health Services (PARIHS) [34,35].

The *i*-PARIHS framework conceptualizes successful implementation as "achievement of agreed implementation/project goals, the uptake and embedding of the innovation in practice, individuals, teams and stakeholders are engaged, motivated, and 'own' the innovation, variation related to context is minimized across implementation settings" [34]. The framework posits that factors relating to innovation (*innovation*, I), the individuals involved in the implementation process (*recipients*, R), and the settings in which evidence-based practice is to be implemented (*context*, C) are key considerations for *facilitation* (Fac^n), which drives successful implementation. In other words, *facilitation* is an active ingredient that assesses and draws knowledge from I, R, and C to inform strategies and processes to enable successful implementation.

The *i*-PARIHS is deemed useful as a determinant framework for our analysis, as it resonates with findings from our earlier work [33]. That is, factors related to the context, individuals, and innovation were used to inform implementation efforts. This study, therefore, used the *i*-PARIHS to retrospectively evaluate factors influencing electronic mental health adoption, with a focus on the core constructs, *context*, *innovation*, and *recipients*. By gaining a greater understanding of these three constructs in relation to electronic mental health implementation within primary health care services working with First Nations, we will be able to develop a tailored facilitation strategy for future electronic mental health implementation programs within this context.

For the purpose of this study, *innovation* is defined as the integration of external evidence (knowledge of research, clinical, and patients' experience relating to electronic mental health approaches) with local priorities and practices to impact electronic mental health uptake*; recipients* refers to the actors involved in, affected by, and influencing implementation; *context* is the setting in which the proposed change is to be implemented and is considered across different levels from local organizational to the external health system [34].

The specific objectives of this study were threefold. First, to continue identifying important factors in the adoption of electronic mental health from the service providers' perspective. Second, to further understand how they influence (ie, impede or facilitate) electronic mental health adoption by service providers working with First Nations, with reference to the *i*-PARIHS framework. Third, to evaluate the usefulness of the *i*-PARIHS framework in this specific context by determining which elements are helpful as theoretical guides and how they are operationalized in practice. From our findings, we aimed to further the current understanding of electronic mental health implementation and to provide practical guidance for future implementation strategies for services and researchers working with Australia's First Nations.

Methods

The Role of Menzies School of Health Research

The eMHPrac project is a joint venture involving multiple organizations across Australia to support electronic mental health uptake using a number of dissemination and translation strategies, including Web-based campaigning, promotions at community activities and conferences, and provision of electronic mental health training. Menzies have extensive experience in developing and training service providers in culturally grounded mental health interventions through the AIMhi research program [36]. Therefore, our primary role in the project is to provide electronic mental health training workshops for service providers working with First Nations at the primary care level.

The training aims to raise awareness of validated electronic mental health tools and resources, specifically those that are responsive to First Nations cultures as well as to build service providers' skills and confidence in applying them in their practice. The training workshops, adapted from the AIMhi training program *Yarning about Indigenous Mental Health* [37], are delivered by Indigenous and non-Indigenous trainers. An

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in-depth description of the training workshop is reported elsewhere [38].

Participants and Settings

From October 2013 to December 2015, 261 participants received training, and 21 training workshops were held in Darwin, Alice Springs, and remote Northern Territory communities. The training workshops were advertised through professional networks, newsletters, and the Menzies website. Participants either self-selected or were selected by their organizations to attend the training. The participants were service providers working with First Nations at the primary care level, such as nurses, support workers, Indigenous health workers, psychologists, and alcohol and other drug workers.

Between June 2015 and November 2015, service providers who had completed the training program were approached for a follow-up interview via email and telephone. The aim was to interview as many trainees as possible; however, the final sample, 57, only represents a proportion of those trained. The main reason for nonparticipation was staff movement into different roles and organizations. The demographic information of the trainees who participated in the interview, that is, ethnicity, primary role, profession, and service type, is reported in Table 1. Professions reported in the *Other* category included support/administrative and managerial staff, nutritionists, and dieticians.

Table 1. Participants' primary role, profession, and service type (N=57).

Participants	Values, n (%)
Primary role (n=53)	
Family well-being	2 (4)
Social and emotional well-being	15 (28)
Chronic disease	7 (13)
Youth	12 (23)
Alcohol and other drugs	4 (8)
Primary care	1 (2)
Other	12 (23)
Profession (n=54)	
Aboriginal community worker	3 (6)
Alcohol and other drug worker	3 (6)
General nurse	5 (9)
Mental health nurse	1 (2)
Other nurse	2 (4)
Psychologist	3 (6)
Social worker	11 (20)
Peer support worker	2 (4)
Trainer/educator	1 (2)
Manager/coordinator/chief executive officer	6 (11)
Other	17 (32)
Service type (n=53)	
Aboriginal community−controlled health service	8 (13)
Nongovernment community	30 (57)
Government community	13 (25)
Other	2 (4)

Research Design

A qualitative approach, embedded in a contextualist paradigm, was used to deepen our understanding of factors that influence, that is, impede or facilitate, uptake of electronic mental health approaches by primary care service working with First Nations. As explained by Braun and Clarke, contextualism is an epistemological position that sits between positivism and constructionism. This epistemology recognizes that knowledge is shaped by and acquires meaning in particular contexts, which may be physical, cultural, or temporal. Through a contextualist paradigm, we understand electronic mental health implementation as a process that is inalienable from local service provision contexts [39]. A semistructured interview was selected

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as the method to explore participants' perceptions and experiences of using electronic mental health resources.

The research team was involved in the development of the Stay Strong app (which is included in the training workshops), delivery of the training workshops, follow-up support, and conducting the interviews. This limitation is emphasized in the Discussion section.

Data Collection

The one-on-one, face-to-face, semistructured interviews conducted in Alice Springs were carried out by MS; those in Darwin were conducted by Katrina Kawaljenllo and SP. MS and SP are female researchers who conducted the training workshops and provided follow-up support. The interviews were held at the researchers' or participants' workplaces, except for three that were conducted over the phone as the participants worked in remote communities, that is, Groote Eylandt and Borroloola. The semistructured interview guide was developed by the research team based on the team's knowledge of the implementation literature and experience researching and working with service providers in electronic mental health implementation. It was designed to explore participants' attitudes and experiences with electronic mental health approaches, and the perceived real or potential implementation issues.

The interviews took approximately 45 min to an hour to complete. The interviews were recorded, and the audio was transcribed verbatim by a professional transcription service and then entered into the NVivo[2] software program. The transcribed data were not returned to participants for comments. Participants' confidentiality was assured by the assignment of ID codes. The extracts reported here are deidentified. All participants provided written consent to interviews and audio recordings, and ethics approval was granted by all relevant ethics committees (reference number HREC 12-1881 and CAHREC 12-100).

Data Analysis

A thematic analysis was used to analyze the data. The analysis oscillated between deductive and inductive approaches and was carried out in two phases. The first phase involved familiarization with the data by multiple readings, and the preliminary coding of the data was conducted independently by 2 authors, MS and MW. At this stage, the codes were formed inductively, and common perspectives were grouped together with an assigned descriptive code name. The comparison revealed consistency across categories and broad agreement on codes and key themes. Data saturation was reached. Through collaboration, 3 members of the research team (MS, MW, and TN) reinterpreted participants' experiences by using the original PARIHS framework to retrospectively evaluate key elements influencing electronic mental health implementation. The coded extracts were categorized into themes in reference to the elements and subelements of the framework through extensive discussion between the authors.

Post analysis, the *i*-PARIHS framework was discovered, and thus another phase of analysis took place to ensure that the most up-to-date conceptual framework was used. The key differences between the original PARIHS and the revised *i*-PARIHS framework is the addition of the *recipient* construct, expansion of the *context* element to encapsulate inner (local and organizational context) and outer context (the wider health system), and reconceptualization of *facilitation* to be an overarching active factor that assesses and responds to the other core constructs. The second phase of analysis involved recategorization of the preidentified data extracts from the first phase to the revised *i*-PARIHS framework elements and subelements (BR). Therefore, the final themes were established deductively based on the relevant principles of the *i*-PARIHS framework. The remapping of data extracts to the *i*-PARIHS elements and interpretation of the data were consulted with TN and MS to ensure rigor and validity. Owing to the time lag between the interviews and the final stages of analyses, the final findings were not reviewed by the participants. However, our findings will be disseminated through the newsletter, which will be sent to participants on the distribution list.

Results

Aims of the Analysis

The analysis aimed to identify factors and to form an understanding of how they impede or facilitate electronic mental health utilization. The *i*-PARIHS was used as a determinant framework, that is, as a descriptive purpose for identifying factors that influence implementation outcomes. Therefore, the core elements and subelements that are supported by data are presented according to the framework's conceptualization. In addition, as previously discussed, the *facilitation* construct is not presented in the results, as it is considered to be the next phase of the implementation process.

The aim of the study was to explore the utilization of an electronic mental health approach in general; however, many of the responses were related to the use of the Stay Strong app. The app, developed as part of the AIMhi research program, is a strength-based brief intervention designed to incorporate both Indigenous and Western perspectives of mental health and well-being [36]. The target audience for the training workshops was service providers working with Indigenous Australians, and so a portion of the training was focused on electronic mental health apps that are culturally responsive to indigenous cultures. The Stay Strong app is one of the very few culturally adapted tools, and thus attracted a lot of interest from the trainees.

Innovation

Definition: The integration of external evidence (knowledge of research, clinical, and patients' experience relating to electronic mental health approaches) with local priorities and practice impact on electronic mental health uptake.

Underlying Knowledge Sources

The three key areas of knowledge relating to electronic mental health approaches identified as essential in the decision-making process to use a particular resource include the context in which the resource was developed, the population it was developed for, and whether it has been validated. Utilization was dependent on whether the user was confident that the information embedded in the resource aligned with the local settings and

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target populations. Some of the participants expressed a lack of knowledge and confusion regarding the context and the population for which the innovation was developed and validated. Therefore, they were uncertain about the suitability of the resources for their clients:

> *A lot of the time there are resources listed but then you are not really sure where they were developed, in what context, and then if they would be useful in the Central Australian context. Sometimes it could be more tailored towards Top End, or somewhere else completely.* [P81, social worker, nongovernment community]

Degree of Fit With Existing Practice and Values

The degree of change required to incorporate electronic mental health into current practice was perceived by a minority of the participants to influence the speed of adoption. For example, a participant said:

> *It just required us all to change practice a bit slightly too. So we dragged the ball a bit.* [P129, peer support worker, government community]

This, however, appears to vary across organizations as another participant reported that minimal change in practice was needed:

> *No change to clinical practice... we just incorporate into our framework of how we work with young people.* [P32, social worker, nongovernment community]

Uptake of electronic mental health approaches was dependent upon the perceived fit of the innovation to the organization's priorities. Specific to the Stay Strong app, some participants reported that conducting brief interventions was not an immediate priority; hence, the app was not fully integrated into practice. Utilization was also dependent on the perceived fit with service providers' roles and responsibilities. For example, a participant commented that alcohol and other drug workers perceived their primary responsibility to include the following but not providing brief interventions:

> *taking people to appointments for different social needs* [P89, psychologist, Aboriginal community-controlled health service]

Thus, the Stay Strong app was not incorporated into their practice. In addition, participants in a managerial role explained the nonutilization of eMental Health due to its irrelevance to the role (eg, acting manager).

Characteristics of the target population (age, culture, and IT literacy) were also important considerations. With regard to age, some participants expressed concerns over electronic mental health incompatibility with the older population:

> *the older people don't really relate to the animation and to the touching of the screen. They don't really feel comfortable.* [P58, general nurse, Aboriginal community−controlled health service]

The majority of the participants perceived electronic mental health to be applicable and suitable for young people, and so those who worked with youth were more receptive to the innovation.

> *I work with young people between twelve and eighteen and technology is their bible, you know the things they go to most. So I find that the use of electronic mental health is like a good resource that young people feel comfortable using.* [P205, youth and family worker, nongovernment community]

Electronic mental health was also perceived to be potentially beneficial and useful for First Nations communities:

> *A lot of the work we do is based on community needs and a very traditional way of doing things…but even they want more different ways of doing things as well and capturing information on film and photographs and applications like this... So I think there is a real need for communities to use applications and things like this.* [P81, social worker, nongovernment community]

However, utilization was dependent on the apps' cultural responsivity to First Nations cultures. This was expressed by 1 participant:

> *e-health in general, some of them are not [developed for First Nations clients] so we wouldn't be using it.* [P89, psychologist, Aboriginal community−controlled health service]

Challenges to electronic mental health utilization in communities, particularly those living in remote areas, were limited availability and accessibility to resources such as IT and the internet as well as low IT literacy levels:

> *It depends on the situation or the context…a lot of stuff can be difficult in remote communities because of access to internet or things like that.* [P98, social worker, Aboriginal nongovernmental organization)]

Usability and Relative Advantages

Overall, most participants perceived electronic mental health resources to be more interactive, engaging, and useful for bridging literacy gaps as well as enabling clients to exert ownership over their well-being journey:

> *It was far better than having a therapist really because they could do it at their speed, and it was often someone with anxiety and a bit of OCD and things like that. They have to get things just right and having a computer to deal with is really very, very good for them.* [P41, occupation, and organization not reported]

One participant also commented that electronic mental health is flexible, easily accessible, and a useful resource:

> *I do like that you can call a phone number for mental health and you can get advice whether you're a patient or whether you're a professional. I like the way you can go online and you can do little tests and go, "Okay. I'm not suicidal" or "Okay. My child's not depressed."* [P108, general nurse, government community]

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Specific to the Stay Strong app, some participants expressed that the app has relative advantages over a traditional paper format in terms of data recording and management. They also voiced that it helped streamline their approach and communication between staff:

> *You can fill out all the information you need on an app and then email your information straight across so it makes life a little bit easier for us.* [P124, social worker, nongovernment community]

However, the technological requirements of electronic mental health approaches were perceived to impede implementation by most participants. Specifically, participants reported difficulties accessing the appropriate technology, that is, iPads or the internet as well as having trouble with various aspects of the technology such as charging, passwords, and connectivity requirements:

> *We have challenges with our apps and our iPad because the communities I go to don't have WIFI hotspots so I can't access internet.* [P108, general nurse, government community]

Moreover, for the participants who worked across multiple sites, having to remember to take the technology with them was a challenge:

> *We didn't even think to grab the i-Pad when we were heading out, or even ask for it.* [P85, alcohol and other drug worker, Aboriginal community−controlled health service]

Trialability

Having a good understanding of how electronic mental health resources are effectively used in a real-life context was identified to be important in the training and implementation process.

> *So it's all good and well to role play or simulate using it, but until you have the client there – especially with a young person whose vocabulary isn't the same as an adult, you know, that's where more of the training would happen.* [P205, youth and family worker, nongovernment community]

One participant reported having undergone a trial of electronic mental health resources with their clients to assess suitability:

> *We trial them on a small group of people to see if it's suitable for our population and see where we go from there.* [P124, social worker, nongovernment community]

This suggests that, at least for this organization, electronic mental health approaches can be implemented in a step-by-step process.

Recipient

The definition of recipient is as follows: "Actors involved in, affected by, and influencing implementation. Characteristics of the individuals, eg, motivation, values, beliefs, skills and knowledge, and factors relating to the team's culture influence individuals and teams in supporting or resisting an innovation."

Motivation

In general, most participants expressed enthusiasm toward electronic mental health approaches; however, some participants commented that having the motivation to incorporate it into practice was a challenge. The lack of motivation was partly due to high workload:

> *People are already feeling overwhelmed by their work and then all of a sudden, "Oh, I've got to do it this way", because you have to put more thought and effort into it and that turns people off.* [P133, other nurse, government community]

Nevertheless, motivation was acknowledged to be intrinsic, which could overcome the challenges of circumstance. As one participant said:

> *Your barrier is yourself... when you've got a hundred other things that you're focusing on with a young person, adding another one in often seems like a barrier but it isn't.* [P193, youth and family worker, nongovernment community]

Values and Beliefs

Electronic mental health approaches were perceived by the majority of the participants to fit with the times and future directions and to be particularly applicable for young people:

> *More relevant in peoples' modern lives. It's using technology these days, and if we can keep using paper based and forms that are wordy, that sort of thing, we are not going to be effective so yes, I think it's good. It's simple language and it's digital which is where we need to be.* [P129, peer support worker, government community]

It was also considered to be a good and valuable option for therapeutic practice. However, 1 participant was concerned that the utilization of electronic mental health resources without professional supervision would negatively impact the face-to-face treatment process:

> *Some of these e-Health resources adopt psychological procedures [that may not be] appropriate for the client, [so] the client's attribution is, "Oh, it doesn't work". So when they eventually are referred to see a psychologist... it spoils their chances of benefitting from psychological therapy because they come in with a negative attitude already.* [P84, psychologist, organization not reported]

Successful implementation of electronic mental health was also perceived to be dependent on the organization's appraisal of the approach. One participant expressed that integration of electronic mental health into the general orientation is dependent on whether the organization saw the value of the approach.

Goals

Specific to the Stay Strong app, some participants reported having trouble remembering using it in their day-to-day practice. An explicit goal setting of where, when, and with whom the electronic mental health resource will be used was suggested

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by 1 participant as a potentially useful technique to combat this issue:

> *I had these big ideas. I was like, "Oh, I'm going to use it. It's going to be great. I'm going to get all these really good results" [but]when I do home visits, I…forget to take it with me … – you've almost got to allocate a scheduled time of who you want to do it with and say, "Okay. So I'm going to do it on this time."* [P95, mental health support worker, nongovernment community]

Skills and Knowledge

The lack of knowledge around electronic mental health approaches poses a barrier to utilization. This includes uncertainty around the effectiveness, accessibility, and applicability of the tools and resources. Having the ability to efficiently sort out information and select the right tools and resources for target clients was perceived by 1 participant to be an important skill in electronic mental health adoption:

> *There is some great resources out there but I need to know where to access them, how to access them, and what to do with them once I have them... Because there is so much out there as well. It's a bit overwhelming at the same time. So to try and pick the right resource for the right setting, for the right people and finding that online, can be a daunting experience as a practitioner in trying to work out where to start with that.* [P81, social worker, nongovernment community]

Low levels of IT literacy pose a challenge to electronic mental health adoption. Unfamiliarity with different ways of using technologies impedes the utilization of the approach by both service providers and community members. Poor IT literacy within communities was attributed to limited access to technology:

> *… so many of the patients we work with don't use technology in that way. A lot of people use mobile phones … not necessarily Smart Phones. Some might enjoy the i-Pad and being able to play games on it, but … accessing computers and the internet within the mob that we work with is not so much.* [P91, administration support, Aboriginal community−controlled health service]

Finally, the lack of confidence and skills to conduct therapeutic interventions was perceived to impede service providers' use of electronic mental health resources. For example, specific to the Stay Strong app, 1 participant reported that alcohol and other drug workers were reluctant to use the app as they were not:

> *comfortable about intervening in a more therapeutic way.* [P89, psychologist, Aboriginal community–controlled health service]

Time, Resources, and Support

Finding the time to explore and learn more about electronic mental health resources was a challenge for many participants. High workload was reported to also delay senior staff, who was perceived to be an important driver, to action implementation:

> *You need to have will coming from the top…It starts there. Why is there no will? Partly because that person may have so many things… so many battles from the front that something like this falls behind.* [P84, psychologist, organization not reported]

The lack of IT resources prevented both service providers and community members from using an electronic mental health approach. Many participants reported limited resources such as iPads within their workplace:

> *I tried to get our iPad – a single iPad that we have here – and it was lost or someone had it and it was just difficult* [P122, general nurse, government community]

And a lack of IT infrastructure within communities:

> *Places that young people and older people can go and get online, that is actually going to make a bit of a difference.* [P60, Aboriginal community worker, Aboriginal community−controlled health service]

Lack of supervision due to skilled staff shortage served as a barrier for incorporating electronic mental health into the general practice:

> *It was a time when we had very few therapists and so the AOD workers were mostly left to their own devices to interact with clients as they saw fit and we weren't able to provide closer supervision and so while we did roll out the app, it was seeds not going into fertile ground at that time.* [P89, psychologist, Aboriginal community−controlled health service]

Insufficient support and training within the organization were also perceived to hinder utility and negatively impact fidelity of use:

> *The staff, they are not getting enough support, or they might need more training or support, or workshops internally to use it adequately.* [P94, manager/coordinator/chief executive officer nongovernment community]

Collaboration and Teamwork

Some participants expressed the view that staff encouraging, teaching, and holding each other accountable with regard to the use of electronic mental health may facilitate adoption. For instance, 1 participant commented that collaboration and encouragement could prompt utilization.

Power and Authority

Staff in an authoritative role were considered important in driving successful implementation. This was highlighted by 1 participant who attributed nonutilization of electronic mental health to the absence of clear directions from those in power:

> *If the co-ordinator sat down and said, "Okay. We're going to apply this [the app]…", then obviously we would follow it through–that would be something that we could focus on - but that was never forwarded to us in any way.* [P20, social support worker and well-being, nongovernment community]

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Local Context

Formal and Informal Leadership Support

Having leaders within the organization showing interest and providing direct support was perceived to facilitate uptake. It created incentives and provided opportunities for service providers to reflect and evaluate the utility of the electronic mental health approach.

> *The manager was supportive of the app… she would ask how we were going with the application and we would sit down and show her that it is really working and purchasing some results.* [P224, manager/coordinator/chief executive officer, Aboriginal community−controlled health service]

However, 1 participant reported that too much advocacy could create pressure instead of being supportive:

> *Definitely supported to use it... There was a lot of – I don't know. I would say a lot of pressure. Like, "Have you used your Stay Strong yet?"* [P121, occupation, and organization not reported]

Evaluation and Feedback Processes

As illustrated above, evaluation of the effectiveness of electronic mental health approaches may incentivize practitioners to continue using the approach and support fidelity.

Organization Context

Organizational Priorities

Delays in the implementation process were reported to be partly due to resource constraints, that is, technology, workforce, and structures to support electronic mental health approaches. Prioritization of financial and training investment was also perceived to impact implementation. Decisions on which aspects within the organization are worth investing in may render insufficient resources for some programs.

> *Whether our program has the financial resources to invest in that, I'm not sure. And also whether we are going to have sort of an iPad available for all programs to use which would make it more accessible for my program. And that is still undecided yet.* [P149, trainer/educator, government community]

Strategic investment in training may potentially assist organizations in sustaining implementation efforts in the long term. For example, one participant reported:

> *We thought training the local Aboriginal staff was a better option... they are the more appropriate people to talk to their own community... and they are going to be there longer. So in that way, we tried to overcome some of the turnover and issues.* [P135, manager/coordinator/chief executive officer, government community]

Culture

A work culture that values on-going staff development was identified as important for successful implementation. The commitment to upskilling staff may render organizations more receptive to innovations and more inclined to invest effort into the implementation process.

> *We're quite keen on the AOD workers up-skilling in their abilities to at least do brief interventions. So when it comes time to concentrate on that, that will be where the app comes into its own and having had it introduced into the team and then some follow-up recently, it will make implementation quite easy.* [P89, psychologist, Aboriginal community-controlled health service]

A culture of accountability was expressed by one participant to be potentially useful for enhancing adoption:

> *We have very little accountability generally in our workplace which I would like more of... accountability from management would be good... And perhaps even the peer accountability between the dietitians.* [P157, nutritionist, government community]

Structure and Systems

Two main aspects of the organizational structure and systems were identified as influential in electronic mental health adoption. One aspect relates to the adequacy of the existing (or the lack thereof) structure and systems to support electronic mental health utilization, and the other involves the effectiveness of the integration process in the existing system.

The three key areas identified to be lacking in the organizational structure and systems were resources, policies, and procedures to support the use of the electronic mental health approach. Insufficient IT resources were highlighted as an impediment to utilization. Many participants expressed difficulties in obtaining iPads in a timely manner and gaining access to the internet, particularly in remote settings. In addition, shortage of skilled staff and high staff turnover meant difficulties retaining knowledge and expertise within the workplace, and thus limited support and supervision for the general staff. One participant attributed these issues to inadequate funding, particularly for First Nations organizations:

> *What's happening is that we are living in an economic environment where we get funding for six months or twelve months and we're not attracting staff to stay here or people who can help with the training and the knowledge base of the team…there are a lot of indigenous organisations who are constrained by those very factors.* [P89, psychologist, Aboriginal community−controlled health service]

Policy was another structural issue identified to influence the utilization of the electronic mental health approach. Inadequate policies regarding the use and access of the technology and the client's confidentiality were reported to delay the implementation process:

> *So the policy and procedure needed to be created to get around our usage and downloading apps; and how the staff could access it; and who they need to go to if they found an app that they would like to use.* [P149, trainer/educator, nongovernment community]

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Organizational processes to streamline the integration of electronic mental health into the existing system were identified to be essential for successful implementation. Inadequate integration may increase workload or render the innovation lost within the system, and thus impede staff from incorporating the approach into their practice. In addition, insufficient processes at the higher management level was reported to delay the implementation process and constrained utilization:

> *We've just been held up by, you know … at the Director level … somewhere in the corporate communications area…it's getting approval for these things.* [P134, public health nutritionist, government community]

Many participants reported difficulties obtaining iPads in a timely manner due to reasons such as unavailability and empty battery as well as remembering to use it as part of their practice. To address some of these difficulties, one participant suggested developing on the ground processes to systemize the utilization of IT resources:

> *[the] process could be streamlined…say, "Here – here's an iPad"– or whatever the process is.* [P122, general nurse, government community]

Finally, having a procedure to train new staff and disseminate new resources among existing staff was perceived to be important for effective use of electronic mental health in the long term.

> *I think there should be a process for it so if something new comes out, you tend to go around and show people how they use it and practise it. So you'll teach someone your bad habits... I think better processes and having some evaluation of it. "We use this because it's been shown to …" you know, "do this or do that" – not just "Isn't this pretty and here's another thing to use".* [P138, general nurse, government community]

History of Innovation and Change

The history of introducing technology to the workplace may ease the integration of the electronic mental health approach into the system. For example, 1 participant reported:

> *IT policies are pretty up to date with regards to using iPads and stuff like that, which all happened when we did start getting the iPads in to do – 'cause we used them for Survey Monkey to do feedback.* [P188, case manager, nongovernment community]

External Context

Policy Drivers and Priorities

The importance of the external health system in the successful implementation of electronic mental health approaches was foreshadowed throughout. As described in the previous elements, participants expressed the importance of electronic mental health approaches to be validated for the First Nations, IT infrastructure within community and organization, and human resources in electronic mental health uptake. This suggests a perceived need for policies to cover a range of areas, that is, the accreditation process of resources and tools, investment in technology in remote areas, and funding to First Nations organizations.

Interorganizational Networks and Relationships

Communication across services working with the same client may help to ensure nonoverlapping of interventions and resources. The issue of repetition posing a negative impact on the clients' experience of electronic mental health approaches was expressed by 1 participant:

> *Everybody is coming on board with these apps, and often we all service the same clients…How often do these clients get asked to do this because the clients that we work with often… it's passive resistance…I wonder if it's [us] asking them to do the same thing.* [P106, occupation and organization not reported]

Discussion

The Integrated Promoting Action on Research Implementation in Health Services as a Determinant Framework

To further understand the conditions for successful implementation of electronic mental health approaches, this study aimed to provide insights into factors that impede or facilitate electronic mental health uptake within primary health care services for Australia's First Nations in the Northern Territory. The *i*-PARIHS was used as a determinant framework to deepen our understanding and interpretation of service providers' experiences and perspectives on electronic mental health adoption.

The framework had been previously used in a similar manner—as a retrospective analysis by Laycock et al [40], who found it to enhance their understanding of factors that influenced the interactive dissemination process. Similarly, we found that the framework helped us to understand service providers' experiences systematically. It also deepened our understanding of how the *innovation*, *recipient*, and *context*, relating to electronic mental health adoption, operationalized in a real-life context. However, we also found that some of the *i*-PARIHS elements could not be analyzed as separate constructs due to their interdependencies. This is due to both the complex nature of implementation, that is, the inter-relations and flow-on effects among factors in determining implementation outcomes as well as the difficulty in teasing out conceptual differences among some of the *i*-PARIHS subelements.

For example, the lack of human resources and IT infrastructure at the organizational level (*context*) impacted the availability of supervision and technological devices for individual practitioners (*recipients*). Therefore, when discussing the negative impact of the lack of resources and support on electronic mental health uptake, it is difficult to categorize if its related to *context* or *recipients* when there is an interdependency, that is, the lack in the organizational structure has a flow-on effect on the individual practitioner.

Another example is the issue of knowledge related to electronic mental health approaches. Participants expressed a lack of

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knowledge and confusion regarding the context and the population for which electronic mental health approaches were developed and validated. Thus, they were uncertain about the suitability of the resources for their clients. This important issue is related to *recipients* as it highlights that, practitioners themselves lack the knowledge; however, it is also related to *innovation* as it demonstrates the importance of information from research, clinical, patient, and local experience in electronic mental health uptake. Moreover, there were no definitions for the subelements within each of the core elements, and thus we had to rely on our understanding.

With regard to the conceptualization of *facilitation* (an active ingredient that assesses and aligns *innovation*, *recipients*, and *context*), we found it to provide greater depth to our implementation strategy. We viewed ourselves as an external facilitator aiming to empower internal facilitators and service providers to incorporate electronic mental health as part of their practice. We intend to use our findings relating to the *innovation* (electronic mental health approach), *recipients* (service providers as an individual and as a team), and *context* (local, organizational, and external contexts) to inform future facilitation strategies and catalyze electronic mental health uptake.

The key findings, as discussed below, were therefore used to develop a structured approach or framework for implementing electronic mental health approaches within First Nations primary health care services.

Principal Findings

Similar to previous studies, service providers showed optimism and enthusiasm for electronic mental health approaches and viewed them as valuable and potentially useful resources, particularly for young people [32,33]. In addition, the approach was perceived to be suitable and useful for First Nations communities, resonating with previous findings from other health organizations and community members [29,33]. With the omnipresence of information and communication technology in today's society, digital media such as smartphones and computers are inevitably becoming part of and shaping First Nations' lives [26,27]. Although still in its infancy, the literature suggests promising potential for electronic mental health to enhance First Nations well-being and culture [41,42].

However, limited availability and access to IT resources in some areas impeded electronic mental health utilization and contributed to community members' low levels of IT literacy. The lack of resources, particularly in remote areas, is recognized by the Australian Government. Efforts are being made under the Mobile Black Spot Program and the National Broadband Network as part of the government *Closing the Gap 2016* initiative to ensure the availability of IT across Australia [43].

In line with findings from systematic reviews on factors essential to the successful implementation of electronic mental health approaches [44,45], the present findings demonstrate the importance of service providers' knowledge, skills, and perception in electronic mental health adoption. Particularly, service providers' low levels of IT literacy pose a challenge to electronic mental health utilization. The importance of IT proficiency in electronic mental health adoption was highlighted in previous studies in primary health care for First Nations. This suggests the potential usefulness of basic IT skills training for service providers [32,33]. In addition, service providers had limited knowledge of electronic mental health approaches, particularly of the context in which the resources were developed, the population they were developed for, and whether they have been validated. This resonates with the general lack of electronic mental health awareness and knowledge exhibited by the wider population [24,46,47].

This lack of knowledge impeded utilization, as confidence that the resources are appropriate for First Nations and the local settings was essential to uptake. The need for electronic mental health resources to be culturally responsive to First Nations has been previously highlighted [29,33]. As part of the electronic mental health training program provided by Menzies, culturally responsive tools and resources such as the Stay Strong app are promoted. The training program also promotes directories, such as Head to Health and Beacon, which provide links to other relevant resources. Nonetheless, future adaptation of the training program will develop service providers' skills in obtaining and evaluating relevant information on electronic mental health approaches to facilitate independent selection of suitable tools for their clients.

The adoption of electronic mental health was also dependent on the perceived fit of the approach to the organizational ethos as well as on the practitioners' role and responsibilities, which is in accordance with previous findings [32,33,44,45]. More specifically, service providers who held managerial roles, and those who did not work with clients in a therapeutic way did not use the approach. However, it was recognized that leaders within the organization, who may not work with clients directly, can have a positive impact by championing the approach and influencing others to use it as part of their practice. This resonates with the literature that identifies internal facilitators as important figures in successful implementation [48,49].

Similar to the systematic reviews' findings, we found that organizational factors played a major role in electronic mental health uptake [44,45]. In particular, the lack of IT resources and infrastructure posed a significant barrier to utilization. Insufficient workforce due to staff shortage and high staff turnover was an impediment as it meant high workload and difficulties retaining knowledge and expertise within the workplace. Uptake was hindered by inadequate policies to guide the appropriate use of technology and confidentiality, and insufficient processes to streamline the integration of electronic mental health approaches into existing systems. Direction and support from leaders in the organization were also important for providing incentives and may enhance fidelity in electronic mental health use. These barriers were previously noted by Bennet et al [32].

A scoping review found that organizational drivers (decision support, administration, and system intervention) and leadership drivers received significantly less attention than competency drivers (staff and user selection, training, and supervision) in the electronic mental health implementation literature [50]. The importance of organizational structure, systems, and leadership

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support in electronic mental health adoption highlighted in the present findings as well as in the previous findings [32,33] suggest that much more attention to these elements is needed.

It is important to note that Puszka et al [33] reported on chief executive officers', mangers', and directors' perspectives on potential barriers and enablers of electronic mental health implementation, whereas this study provided the experiences of service providers who have undergone electronic mental health training and had some time to apply what they have learned into their practice. Nonetheless, similar issues around organizational readiness have been raised by both cohorts, thus emphasizing the need for organizational readiness to be addressed in implementation strategies.

Organizational readiness is conceptualized to comprise *both individual difference and structural factors, reflecting the extent to which the organization and its members are inclined to accept, embrace and adopt a particular plan to purposefully alter the status quo*. Individual difference refers to the *characteristics of those being asked to change* (eg, skills, knowledge, attitude, perception), and structural factors refer to *the circumstances under which the change is occurring* (eg, infrastructure, policies, resources availability) [51].

The importance of organizational readiness in successful implementation is well recognized in the literature. Multifaceted approaches to implementation are considered an optimal strategy for influencing change [52]. In the literature, implementation frameworks such as the four-stage implementation model developed by the National Implementation Research Network [53] and the Quality Implementation Framework [54], propose multiple stages to implement with the initial stages, focusing on need analysis and development of strategies addressing organizational readiness.

Reflecting on our electronic mental health implementation strategy, we recognize the limitations of one-off trainings and the need for a more comprehensive facilitation strategy that addresses organizational readiness. Taken together, the present findings and the literature, we propose a multistaged implementation strategy aimed at enhancing electronic mental health uptake by addressing the different aspects of organizational readiness relating to electronic mental health implementation at both the individual and structural levels.

Given the importance of preparatory stages as outlined in other existing implementation frameworks, for example, the National Implementation Research Network and The Quality Implementation Framework [53,54], we propose a three-phase implementation strategy for electronic mental health implementation in health care, involving: (1) pretraining consultations to address organizational readiness, (2) training workshops to increase awareness, knowledge, and skills relevant to electronic mental health utilization, and to train internal facilitators to supervise, support, and conduct trainings within the organization, and (3) follow-up support to boost the trainees' motivation and the organizations' efforts to incorporate electronic mental health into practice and the existing system, and to provide support for internal facilitators in supervising and training other staff.

Pretraining Consultations

Our findings demonstrate the importance of organizational readiness in successful implementation. Organizational factors highlighted as essential to uptake are IT resources and infrastructure; policies around the use of technology and confidentiality; human resources; processes to streamline integration of electronic mental health into the existing system; and leadership/internal facilitators to advocate, action implementation, train, and provide support and supervision for on-going electronic mental health utilization within the organization. Thus, before training, it is pertinent for organizations to assess their level of readiness across the highlighted areas to identify aspects that require improvements. Key considerations are listed in Textbox 1. To ensure that organizations have thoroughly reflected on their readiness and improve the identified areas, we propose at least two consultation sessions. The objective of the first session is to aid organizations to assess their level of electronic mental health readiness and develop an action plan to address areas in which adaptation is required. The second session's aim is to provide an opportunity for further identification and refinement of strategies to address the areas of improvement.

This stage should also instigate reflections on who within the organization should attend training and who would be appropriate to carry the role of an internal facilitator. Moreover, information regarding organizations' local settings and target populations, as well as the service providers' levels of IT skills and literacy, should be noted. This information would be useful in informing the training sessions so that the resources and information are contextualized and more relevant and useful for trainees.

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Textbox 1. The three-phase facilitation process for electronic mental health implementation.

Phase 1: Pretraining consultations

Consultations assess the following aspects of organizational readiness:

- Information technology (IT) resources and infrastructure, that is, computers, iPads, and Wi-Fi connectivity
- Policies and procedures to guide collection, confidentiality, and security of data
- Current conducive work culture and climate (eg, accountability, on-going learning, staff turnover, and priorities)
- Staff skills and literacy in IT and electronic mental health approaches
- Suitability of client population and cultural context
- Internal facilitators to champion, train, and support on-going e utilization

Phase 2: Training

Workshops occur when suitable organizational readiness is achieved through mutual agreement and incorporate the following elements:

- IT skills training if needed (determined through consultation)
- Presentation of electronic mental health resources relevant to organizations' local and cultural needs
- Strategies to find and evaluate electronic mental health resources
- Information regarding electronic portals hosting resources that are filtered by experts
- Planning when, where, and with whom, electronic mental health resources will be used
- Training for internal facilitators to supervise and support on-going electronic mental health use

Phase 3: Follow-up support

- Face-to-face, email, and telephone follow-up to support on-going use
- Face-to-face, email, and telephone follow-up for internal facilitators to support their training, support, and supervision
- Review progress of organizational readiness and support implementation
- Guidelines for evaluating the implementation strategy
- Assessment of organizational readiness before, during, and postintervention. The assessment should cover individual characteristics as well as structural factors, as discussed in the literature [51]. The assessment should function as both a diagnostic and evaluative tool to track the trajectory of organizational readiness over the course of the intervention
- Comparison of the frequency of electronic mental health use before and after the intervention
- Frequency and quality of trainings conducted within the organization by internal trainers
- Service providers' skills, knowledge, and perception of electronic mental health approaches before, during, and postintervention
- Records of discussions during pretraining consultations and follow-up support to illuminate the progression and type of support needed throughout the intervention

Training

The training should be contextualized and involve information and activities relevant to the trainees. That is, it should include resources that are applicable to the trainees' local settings and target populations, that is, resources that are culturally relevant to local indigenous populations as well as incorporating IT training to ensure adequate levels of IT literacy for electronic mental health utilization. The training should also provide trainees with the skills to find, assess, and evaluate information to select the right electronic mental health resources for their specific clients. In addition, a time should be set aside for implementation planning, so trainees can plan where, when, and with whom they would use an electronic mental health approach.

A separate training for the selected individuals who would take on the internal facilitator role within the organization should be offered. Specifically, it should provide internal facilitators with the knowledge and skills to support, supervise, and conduct electronic mental health training with the organization.

Follow-Up Support

The literature highlights the importance of follow-up supervision post one-off workshops in influencing therapist behavior and patient outcomes [9,32]. Specific to electronic mental health implementation, Bennett-Levy et al [55] reported the positive impact of post-training consultations regarding the enhancement of skills and exploration of electronic mental health resources. Therefore, follow-up support should be provided to trainees and organizations following training workshops. It should include occasional face-to-face meetings and regular emails and phone calls to motivate on-going use and to address any issues regarding electronic mental health utilization, such as skills and confidence, technical setups, and troubleshooting. In addition, separate support should be provided to the internal facilitators

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to ensure the fidelity of electronic mental health training and implementation within the organization. Finally, organizational readiness should be reevaluated to identify any further gaps and to ensure the effectiveness of the ongoing progress in the integration of the electronic mental health approach into the wider system.

Limitations

Our position as an eMHPrac partner as well as developers of the AIMhi Stay Strong app, which is included in the training workshop, may have introduced a positive bias and influenced data collection and the analysis process. However, due to our position, we have established rapport with the participants before the interviews, which may have rendered participants more comfortable in sharing their experiences. In addition, through the delivery of our training program, we have developed an understanding of local service delivery contexts. Nonetheless, we were cognizant of the way in which our subjectivity may have influenced and shaped the different stages in the research process.

The analysis was carried out in two stages upon the discovery of the revised *i*-PARIHS framework. It is possible that starting the analysis with the *i*-PARIHS framework may have led to some nuances in the results. However, the data were initially analyzed inductively, that is, codes and themes were identified without the guidance of any particular framework. Therefore, the data extracts, the initial codes, and themes identified as relevant to electronic mental health implementation were not influenced by either the *i*-PARIHS or PARIHS framework. As this initial stage is strongly informed by data, it is unlikely that the sequence of applying the framework to the data would have majorly impacted the results.

The present findings are consistent with those in the literature regarding factors essential for successful implementation of electronic mental health approaches in health care settings. However, it is important to acknowledge the context of our participants, who are service providers working with Australia's First Nations in the Northern Territory. Certain factors, such as limited resources, IT literacy, and high staff turnover, may be more salient to this context relative to other services in urban areas working with nonindigenous populations.

Conclusions

Through the lens of the *i*-PARIHS framework, this study provides a practical understanding of how different factors impede or facilitate electronic mental health implementation within primary health care servicing Indigenous Australians. This insight laid a foundation for a comprehensive facilitation strategy, involving three stages: pretraining consultations, training workshops, and post-training follow-up support, aiming to enhance the success of electronic mental health implementation.

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Authors' Contributions

BR designed the study, analyzed the data, and wrote the manuscript. MW analyzed the data and edited the manuscript. MS, SP, KD, and TN designed the study and data collection tools, developed and conducted training, collected data, analyzed data, and edited the manuscript. TN also supervised all activities.

Conflicts of Interest

None declared.

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Abbreviations

AIMhi: Aboriginal and Islander Mental Health Initiative
eMHPrac: electronic mental health in practice
ePortal: electronic portal
i-PARIHS: integrated Promoting Action on Research Implementation in Health Services
IT: information technology
Menzies: Menzies School of Health Research
PARIHS: Promoting Action on Research Implementation in Health Services
QUT: Queensland University of Technology
UCRH: University Centre for Rural Health

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Original Paper

An Automated Mobile Mood Tracking Technology (Mood 24/7): Validation Study

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Abstract

Background: Electronic tracking has been utilized for a variety of health conditions. Previous studies have shown that there is higher adherence to electronic methods vs paper-and-pencil tracking modalities. Electronic tracking also ensures that there are no back-filled entries, where patients have—to appear compliant—entered their responses retrospectively just before their visits with their health care provider. On the basis of the recognition of an unmet need for a Web-based automated platform to track psychiatric outcomes, Johns Hopkins University partnered with Health Central (a subsidiary of Remedy Health Media LLC) to develop Mood 24/7, an electronic, mobile, automated, SMS-based mood tracker. This is a pilot study to validate the use of Mood 24/7 in anticipation of clinical trials to demonstrate the therapeutic benefit on patients' health outcomes of utilizing digital mood-tracking technology.

Objective: Mood 24/7 is an electronic mood-monitoring platform developed to accurately and efficiently track mood over time through automated daily SMS texts or emails. This study was designed to assess the accuracy and validity of Mood 24/7 in an outpatient psychiatric setting.

Methods: This pilot study involved a retrospective chart review for depressed outpatients (N=9) to compare their self-reported Mood 24/7 daily mood ratings with their psychiatrist's independent clinical mood assessment at the time of the patient's visit. Their mood ratings via Mood 24/7 were collected over 36 weeks. In addition, a mixed model analysis was applied to compare the weekly Montgomery-Åsberg Depression Rating Scale (MADRS) scores with Mood 24/7 scores over an average of 3 months.

Results: A 97.2% (315/324) digital mood reporting adherence was found over 36 weeks, and a significant correlation (r=0.86, P<.001) was observed between patients' Mood 24/7 scores and their psychiatrist's blinded clinical assessment of the patient's mood when seen in the clinic. In addition, a significant concordance (intraclass correlation of 0.69, 95% CI 0.33-0.91, P<.001) was observed in the mixed model analysis of the clinician-administered MADRS vs Mood 24/7 scores over time.

Conclusions: Our chart review and mixed model analyses demonstrate that Mood 24/7 is a valid instrument for convenient, simple, noninvasive, and accurate longitudinal mood assessment in the outpatient clinical setting.

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KEYWORDS

depression; text messaging; patient monitoring; mobile phone; short message service; ecological momentary assessment; digital health

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Introduction

Background

The virtually universal adoption and use of personally accessible technology have transformed the way patients monitor their health and medically relevant signs and symptoms over time. Electronic tracking has been utilized for a variety of health-related conditions, including pain [1], migraine [2], gastroesophageal reflux [3], and cancer [4], to name just a few. There are many benefits to electronic health tracking and reporting, as patient-reported ease of use and satisfaction are generally higher in digital tracking vs analog (eg, pen and paper) tracking [1,5]. Furthermore, the vast majority of studies conducted to compare analog vs digital health outcome tracking report higher adherence using electronic methods [6].

Low patient adherence to the temporal requirements of routine paper record entries and the possibility of patients backfilling entries to compensate for missed days pose significant problems with paper tracking methods. To measure the difference in patient-reported, handwritten diary adherence, a 2003 study embedded photosensors into paper diaries to track the opening of the diary [7]. Patient-reported paper compliance rates were 90%, but analysis of photosensor data gave an actual compliance rate of only 11%, demonstrating a high level of nonadherence and embellishment among patients. This study also included a patient group that used electronic diary tracking, where the patient was aware that all entries were time-stamped. As compared with the 11% actual adherence observed in written diary tracking, that of electronic diary tracking was dramatically higher at 94%. Taken together, these findings suggest that patients are more likely to adhere to regular recordings using digital technology compared with paper records. With this in mind, along with the recognition of an unmet need for a Web-based automated platform to track psychiatric outcomes, Johns Hopkins University partnered with Health Central (a subsidiary of Remedy Health Media LLC), who developed and maintained Mood 24/7.

Objective

Mood 24/7 is an electronic mood monitoring system that offers users the flexibility to track their mood via the technology they already own and carry around on a daily basis: their mobile phone. Users sign up on the Web [8] by registering their basic contact (name, phone, email), and specifying what time of day they would like Mood 24/7 to send them an SMS text message inquiring about their mood. No apps are needed or used as part of Mood 24/7, and instead, it is run via a Web-based secure service employing SMS texting for registration and communication. A wireless service sends the daily text message to the patient, asking the patient to rate their mood using a standard Likert scale: *On a scale of 1 (low) to 10 (high) what was your average mood today?* Daily mood ratings (and annotations of unlimited length and frequency, if entered) are compiled into a mood chart stored on a Health Insurance Portability and Accountability Act-compliant server that a patient can access by logging onto their encrypted Mood 24/7 account at any time. Moreover, the patient can choose to share their mood chart with any number of their health care providers or friends and family, making it a real-time mobile electronic health diary.

This study was designed to assess how well patient self-assessments of their mood over time on Mood 24/7 correlates with traditional methods of evaluating patients' mood and depression, including clinician ratings and the Montgomery-Åsberg Depression Rating Scale (MADRS) [9].

Methods

Subjects

A total of 9 sequentially chosen outpatients (4 women) met the inclusion criteria for the study, which consisted of (1) a diagnosis of major depressive disorder and (2) agreement and ability to use Mood 24/7 (essentially any mobile phone with SMS texting capability). Exclusion criteria included all moderate to severe substance use disorders except tobacco. These patients were followed for at least 36 weeks. All protocols were approved by the Johns Hopkins University Institutional Review Board.

Clinician Mood Rating

The clinician mood ratings were the clinical evaluations by the psychiatrist upon completion of the patient's office visit based on a 1 to 10 mood scale, with 1 corresponding to the worst mood state the patient ever had, and 10 a return to euthymia. The psychiatrist was blinded to the patient's Mood 24/7 self-ratings.

Mood 24/7

All patients signed up for Mood 24/7 at www.mood247.com. The daily mood was tracked via the patient entering their mood rating between 1 and 10 in response to the following daily prompt occurring at a flexible single daily time of their choosing: *On a scale of 1 (low) to 10 (high) what was your average mood today?*

Statistical Analyses

Mood 24/7 ratings were correlated with clinical rated scores. Statistical analyses were conducted using GraphPad Prism 5.0 (GraphPad Software LLC). Two-tailed Pearson correlation analyses were conducted between Mood 24/7 ratings and clinician mood ratings. P values <.05 were considered statistically significant. Absolute adherence of these patients to Mood 24/7 was determined by counting the number of weeks they responded without interruptions. Interruptions were considered as 7 consecutive days without a single response. Adherence was considered as at least one response per week [10]. Absolute adherence of the 9 patients over 36 weeks was calculated by taking the ratio of the number of weeks without interruption divided by the total number of weeks. To further test the validity of Mood 24/7 against a gold-standard assessment [11], a linear mixed effects model was used to compare the concordance of Mood 24/7 reports and MADRS longitudinal assessments using STATA 14 (Stata Corp). Mood 24/7 scores of 3 patients with treatment-resistant depression were used, with time and patient number as fixed effects. This method is robust against missing data, which could be the result of a patient omitting a report on a given day or a missed clinician assessment. For improved intelligibility of time-series data comparing changes in daily mood ratings vs MADRS

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assessments, scores were transformed to a common scale using the following formula in Figure 1

The effects in the mixed model were determined by the likelihood ratio test.

Figure 1. Montgomery-Åsberg Depression Rating Scale (MADRS) (a) and Mood 24/7 (b) scores were converted to a common scale (0 to 1). Note that MADRS scaling was also inverted such that improvements in mood were represented as greater values.

a) Scaled MADRS

$$= \frac{(Maximum\ Possible\ Score - Recorded\ Score)}{Maximum\ Possible\ Score}$$

$$= \frac{(60 - Recorded\ Score)}{60}$$

b) Scaled Mood 24/7

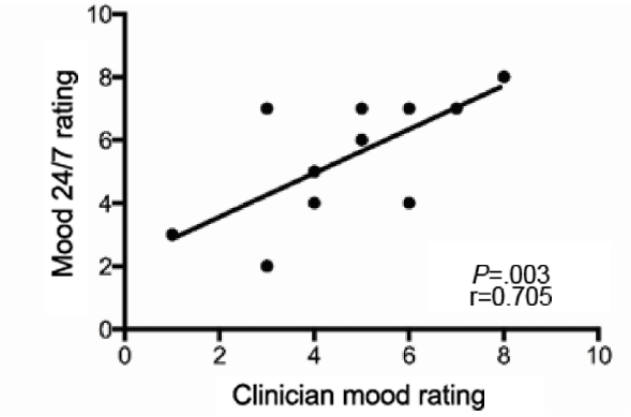
$$= \frac{Recorded\ Score}{10}$$

Results

Clinician Mood Rating Correlated with Mood 247

A clinician's assessment of their patient's mood was correlated to the patient's self-reported Mood 24/7 scores from the same day, and a significant positive correlation was observed between the clinician mood rating and Mood 24/7 rating (r=0.705, P=.003; Figure 2). To further corroborate the use of Mood 24/7 as an accurate and reliable means to track patient mood over time, clinician mood ratings were plotted against mood data collected across multiple days from 9 consecutive independent patients.

Figure 2. Validation of Mood 24/7. Both the mood ratings assigned by the clinician and mood determined by a standard mood assessment test correlate with patients' Mood 24/7 self-assessment rating. Clinician mood ratings positively correlated with Mood 24/7 rating (P=.003).

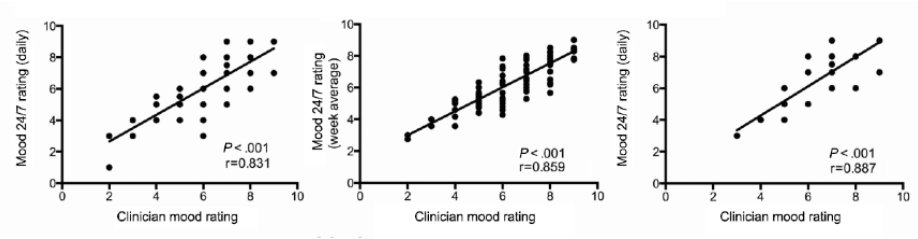


Clinician Mood Rating

Patients received a clinician mood rating (on a 1-10 scale) at every office visit (average=11 visits per patient, over an average length of follow-up of 36 weeks). Values were correlated to both the patient's Mood 24/7 self-rating given on that day (Figure 3, left graph) and the patient's Mood 24/7 weekly rating obtained by averaging the mood scores from 3 days before, the day of, and the 3 days after their clinic visit (ie, the week average, Figure 3, center graph). This was done to account for small variations potentially introduced by the effect on a patient's mood after seeing their treating psychiatrist. Significant correlations were reached for daily (r=0.83) and weekly averaged (r=0.859) Mood 24/7 ratings, after controlling for the number of office visits per patient and frequency of office visits (P<.001). Data analyzed from 1 patient who used Mood 24/7 for the longest duration (approximately 2 years, with a daily adherence rate of 84%) showed that the Clinical Mood Rating and Mood 24/7 self-rating correlation (r=0.887) was maintained over time (Figure 3, right graph; P<.001). The weekly adherence of the 9 patients to Mood 24/7 over 36 weeks was 97.2% (315/324), and daily response adherence was 60.60% (1386/2286; with the least responsive at 93/254, 36.6% and the most at 214/254, 84.3%).

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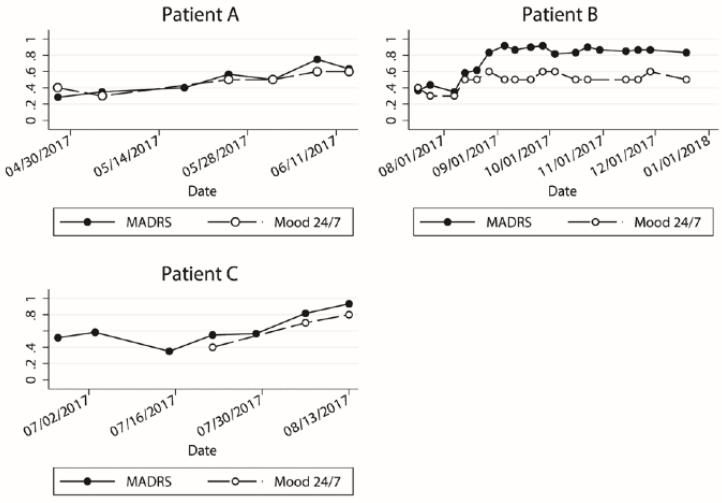
Figure 3. Long-term validation of Mood 24/7. Data from 9 patients collected over multiple office visits demonstrate lasting correlations between clinicians' mood assessment and patients' Mood 24/7 self-assessment rating. Positive correlations were found between the clinician mood rating and daily Mood 24/7 rating of 100 data points, with each point representing a unique patient and clinician assessment (P<.001; left). Similarly, positive correlations were found between the clinician mood rating and the weekly average of Mood 24/7 rating of 100 data points (P<.001; center); 44 data points collected from 1 patient over the course of 2 years demonstrated strong positive correlations between the clinician mood rating and Mood 24/7 rating (P<.001; right).



Montgomery-Asberg Depression Rating Scale

Another method we used to strengthen the validation of Mood 24/7 was to compare changes in weekly MADRS and Mood 24/7 mood scores in a group of 3 patients with treatment-resistant depression (ie, failure to respond to at least two adequate antidepressant trials, and who were newly placed on another treatment regimen). A mixed model analysis was performed on these patients' MADRS assessments by a trained mental health practitioner and the patient's Mood 24/7 ratings. MADRS is a 10-item diagnostic questionnaire administered and scored by a trained rater with mental health experience to measure the severity of depression. The patients' MADRS scores were compared with their Mood 24/7 scores over an average of 3 months (Figure 4). A mixed model analysis, with patient number and time as fixed effects, demonstrated high concordance between Mood 24/7 and MADRS scoring over time. The postestimation analysis of the mixed model demonstrated an intraclass correlation of 0.69 (CI 0.33-0.91) and P<.001 between clinician-rated MADRS and patient-selected Mood 24/7 scores.

Figure 4. Scaled Mood 24/7 and Montgomery-Åsberg Depression Rating Scale (MADRS) scores over 3 months. A mixed effects model analysis was applied to the longitudinal data shown here. Scaled MADRS and Mood 24/7 ratings are shown by the patient. Data points represent clinician or patient mood scores for that given day. Mixed model analysis indicates significant concordance between Mood 24/7 and MADRS scores within each patient (P<.001), and postestimation analysis showed an intraclass correlation of 0.69.



Discussion

Principal Findings

This study was designed to validate Mood 24/7 as a Web-based mood-tracking technology for convenient, accurate, and reproducible monitoring of patients' mood between clinic visits. This was a pilot study for validation as a mood tracking tool in anticipation of subsequent studies of therapeutic efficacy and improved patient health outcomes. Here, we demonstrated strong and significant correlations between patients' self-reported Mood 24/7 scores and their performance on the MADRS. MADRS is a well-established standardized test for mood routinely used to evaluate depression [12]; it is the second most widely used depression rating scale, has high interrater reliability, and correlates significantly with the Hamilton rating scale for depression [13]. Our findings demonstrated that patients self-ratings are on par with the sensitivity of the established and previously validated MADRS, indicating that Mood 24/7 can provide accurate mood data for the purposes of monitoring a patient's level and severity of depression over periods of time when the MADRS cannot be administered (ie, between office visits).

The mixed model analysis of Mood 24/7 scores vs MADRS assessment demonstrated that Mood 24/7 is a valid instrument for noninvasive and accurate mood assessment and depression tracking. Most notably, this preliminary analysis, based on a

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2016 meta-analysis that recommends a correlation of 0.4 to 0.7 between self-report and clinician reports on a mood rating scale, indicated that Mood 24/7 is a robust instrument for longitudinal collecting and reporting of a patient's mood [14].

Although scores were demonstrated to be concordant using the mixed model analysis, absolute scores between Mood 24/7 and MADRS were not linearly related, and there were notable ceiling and floor effects in patient self-reporting. These effects can be attributed to idiosyncratic patient preference, which is common to all subjective estimation activities. A similar phenomenon was observed in comparing the clinician's and patient's rating scores (see Figure 3, center graph): (1) when a patient is clearly depressed (eg, mood<5) or clearly euthymic (eg, mood>9), there is high concordance in the absolute scores given, but (2) what a patient considers a mood score in the middle of the range (eg, 5-7) may differ by 1 or 2 points from what the clinician estimates their mood. Thus, although patients vary in their subjective definition of their absolute mood rating, the changes over time in their Mood 24/7 are indicative of changes in their level of depression.

The results demonstrated keen mood self-awareness and sustained adherence by patients, even during periods of significant levels of depression. Mood 24/7 correlations with clinician ratings remained strong over a long period (ie, multiple years) of follow-up treatment, supporting the use of Mood 24/7 as a longitudinal outcome assessment and treatment monitoring tool. Taken together, these analyses exhibit the accuracy and reliability of Mood 24/7 in outpatients being treated for depression.

Slightly stronger correlations were observed between the clinician assessment of patient mood and the weekly patient Mood 24/7 ratings as compared with daily patient Mood 24/7 ratings. It is possible that the patients' daily Mood 24/7 rating on the day of their clinic visit was affected by their visit, thus providing more variability and accounting for the somewhat weaker correlation. For example, if a patient is very apprehensive about a psychiatric appointment and receives their Mood 24/7 text prompt before the visit, then he or she may rate their mood lower than usual. Conversely, if a patient is reassured and pleased with his or her psychiatric appointment, then the patient might rate their mood higher than usual when sending their text response to Mood 24/7. In this case, and for future studies, a weekly average mood rating might provide a more accurate representation of actual mood as compared with one mood value from the day of the clinic visit.

This study offers two findings that are of importance to the population with depression. First, changes in Mood 24/7 measurements are valid when compared with the trained clinician's evaluations. Second, this approach is associated with high patient adherence over time [15]. There are other technology platforms that offer patient self-rated mood reporting that differ along dimensions relevant to adherence. Electronic diaries such as Medicus or Actiwatch have been utilized to track mood and other psychiatric outcomes, but these diaries require a stand-alone electronic device [16,17]. Mood 24/7 allows for continuous and daily monitoring of the patient's mood by utilizing the mobile device they already possess—any phone that can receive and send an SMS text is sufficient. Between appointments with the clinician or therapist, both the patient and health care professional can, but do not have to, check the daily mood ratings on the Web and in real-time by logging in to their private account at www.mood247.com. The patient can also include family, friends, or other health care professionals into their *trusted circle*, a feature of Mood 24/7 that enables those included in the circle by the patient to log into the patient's mood chart, enter their own observations, and track the mood of the patient remotely. Thus, Mood 24/7 facilitates collaborative and potentially multidisciplinary care coordination. Family and friends can be given peace of mind by regularly checking up on an individual who has invited them into their trusted circle without having to directly contact the patient and inquire about their mood. Patient response to the daily reporting-style question utilized in Mood 24/7 is time- and date-stamped. Data cannot be entered retrospectively, which prevents any recall bias [18]. The adaptation and implementation of Mood 24/7 for use in clinical trials are straightforward. Finally, the text-based use of Mood 24/7 is for US citizens. Mood 24/7 uses text messages to reach users instead of a mobile app, so it is not limited to smartphone owners. For those living outside of the United States (or for those in the United States who prefer email over text messaging), the Mood 24/7 prompt can be sent via a daily email with a link that directs patients to a secure (eg, https) data entry site.

Mood 24/7 has the potential to improve quality of care for patients in many areas of health care beyond mood-related disciplines. For example, the Likert scale is considered to be the *gold standard* for sleep quality assessment [19]. The texting technology and Likert scale–style question employed in Mood 24/7 could be easily adapted to the longitudinal monitoring of sleep, anxiety, sexual function, memory, concentration, and pain [10].

Limitations

There are several limitations to this study. The results might have been affected by the small sample size of 9 patients in the first study and 3 patients in the second study. However, the strong correlations observed, despite the relatively small sample size, suggest that Mood 24/7 is a highly sensitive and precise tool that aligns with a traditional depression outcome measure (MADRS and clinician ratings). Moreover, with respect to the 9 subjects who were followed for 36 weeks, this amounts to a total of 2268 daily texts, 324 weeks, and over 6 patient-years of follow-up. The 3 patients who underwent weekly MADRS assessments were followed for an average of approximately 80 days or over 11 weeks. Another possible source of variability in this study could be the timing of the Mood 24/7 text message. Patients program the Mood 24/7 software to send a text at the same time every day, asking them to gauge their average daily mood, so variability in mood throughout the day, particularly in the bipolar patients, might be more difficult to capture. This needs to be tested empirically.

The mixed model analysis was limited to 3 patients undergoing intensive psychiatric assessment in the setting of severe treatment-resistant depression. In addition, all MADRS assessments were performed by the same two clinicians. The

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preliminary significance of these results warrants further study in a larger population to better understand the potential utility of Mood 24/7 across a large population of diverse patients.

Although this pilot study did show that daily Mood 24/7 scores positively correlate with clinician assessments and MADRS scores, future studies will involve a larger patient population followed over a longer period of time. Another point that will be addressed in future studies is the probable therapeutic effect of daily mood tracking on the patients' mood [20].

Conclusions

In conclusion, Mood 24/7 has been shown to be a reliable and accurate predictor of both a standardized depression scale (ie, MADRS) and the clinician's assessment of the patient's mood. This study, designed to validate the use of Mood 24/7, provides support and rationale for the use of integrated mobile phones and Web-based technology to track and monitor mood and outcome of patients being treated for depression. Mood 24/7 has the potential not only to improve the quality of clinical studies that measure mood over time but also to improve the quality of an individual's mental health care.

Conflicts of Interest

None declared.

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Abbreviations

MADRS: Montgomery-Åsberg Depression Rating Scale

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Corrigenda and Addenda

Correction: Assessment of Microstressors in Adults: Questionnaire Development and Ecological Validation of the Mainz Inventory of Microstressors

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Related Article:

Correction of: https://mental.jmir.org/2020/2/e14566/

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The authors of "Assessment of Microstressors in Adults: Questionnaire Development and Ecological Validation of the Mainz Inventory of Microstressors" (JMIR Ment Health 2020;7(2):e14566) noticed that the equal contribution footnote was missing from the author list.

This has been amended to indicate that authors Oliver Tüscher, Thomas Kubiak, and Raffael Kalisch all contributed equally.

The correction will appear in the online version of the paper on the JMIR website on May 4, together with the publication of this correction notice. Because this was made after submission to PubMed, PubMed Central, and other full-text repositories, the corrected article has also been resubmitted to those repositories.

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Letter to the Editor

Comment on "Web-Based Measure of Life Events Using Computerized Life Events and Assessment Record (CLEAR): Preliminary Cross-Sectional Study of Reliability, Validity, and Association With Depression": Validity and Methodological Issues

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Comment on: https://mental.jmir.org/2019/1/e10675/

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KEYWORDS

validity; methodological issues; diagnostic test

We were interested in the article titled, "Web-Based Measure of Life Events Using Computerized Life Events and Assessment Record (CLEAR): Preliminary Cross-Sectional Study of Reliability, Validity, and Association With Depression" published in *JMIR Mental Health* [1].

One of the aims of the abovementioned study was to assess the validity of Computerized Life Events and Assessment Record (CLEAR), considering the Life Events and Difficulties Schedule (LEDS) and the List of Threatening Experiences Questionnaire (LTE-Q) as gold standards among 328 participants (126 students; 202 matched midlife sample: 127 unaffected controls, 75 recurrent depression cases). The authors concluded that CLEAR has acceptable validity and great potential for effective use in research and clinical practice. However, there are some methodological issues in this conclusion that are mentioned below.

First, there are some measures that can be applied to the assessment of the validity of a test including sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio (LR+; ranging from 1 to infinity; the higher the LR+, the more accurate is the test), negative likelihood ratio (LR–; ranging from 0 to 1; the lower the LR–, the more accurate is the test), and odds ratio (ratio of true to false results) [2-5]. According to the results, sensitivity of CLEAR was 59.1% and 43.1% compared to LEDS and LTE-Q, respectively, as gold standards. Likewise, specificity of CLEAR was 65.4% and 78.6%, respectively, compared to the abovementioned gold standards.

It is good to know that sensitivity is an important measure in public health aspects instead of clinical fields. Likewise, the positive predictive value and negative predictive value are among measures that are more appropriate for advice about the validity of a diagnostic test for clinical purposes [3-5].

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Therefore, we suggest applying predictive values, likelihood ratios, odds ratio, and diagnostic accuracy to decide the validity of CLEAR. Moreover, according to the data of study, LR+, LR–, odds ratio, and diagnostic accuracy of CLEAR will be 1.6, 0.6, 2.6, and 62%, respectively, compared to LEDS (Tables 1 and 2) and 1.9, 0.7, 2.6, and 60%, respectively compared to LTE-Q (Tables 3 and 4). Therefore, there is a high level of uncertainty for decisions based on these values, and there is insufficient evidence to conclude that the validity of the CLEAR test is acceptable.

Table 1. Two by two table of Computerized Life Events and Assessment Record compared to Life Events and Difficulties Schedule as the gold standard.

CLEAR[a]	LEDS[b] (gold standard)		
	Positive	Negative	Total
Positive	59	35	94
Negative	41	65	106
Total	100	100	200

[a]CLEAR: Computerized Life Events and Assessment Record.

[b]LEDS: Life Events and Difficulties Schedule.

Table 2. Assessing the validity of Computerized Life Events and Assessment Record compared to Life Events and Difficulties Schedule as the gold standard.

Parameter	Estimate
Sensitivity (%)	59
Specificity (%)	65
Positive predictive value (%)	63
Negative predictive value (%)	61
Diagnostic accuracy (%)	62
Likelihood ratio of a positive test	1.6
Likelihood ratio of a negative test	0.6
Diagnostic odds	2.6

Table 3. Two by two table of Computerized Life Events and Assessment Record compared to List of Threatening Experiences Questionnaire as the gold standard.

CLEAR[a]	LTE-Q[b] (gold standard)		
	Positive	Negative	Total
Positive	43	22	65
Negative	57	78	135
Total	100	100	200

[a]CLEAR: Computerized Life Events and Assessment Record.

[b]LTE-Q: List of Threatening Experiences Questionnaire.

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Table 4. Assessing the validity of Computerized Life Events and Assessment Record compared to List of Threatening Experiences Questionnaire as the gold standard.

Parameter	Estimate
Sensitivity (%)	43
Specificity (%)	78
Positive predictive value (%)	66
Negative predictive value (%)	58
Diagnostic accuracy (%)	60
Likelihood ratio of a positive test	1.9
Likelihood ratio of a negative test	0.7
Diagnostic odds	2.6

Conflicts of Interest

None declared.

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Abbreviations

CLEAR: Computerized Life Events and Assessment Record
LEDS: Life Events and Difficulties Schedule
LR–: negative likelihood ratio
LR+: positive likelihood ratio
LTE-Q: List of Threatening Experiences Questionnaire

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Letter to the Editor

Author's Reply to: Comment on "Web-Based Measure of Life Events Using Computerized Life Events and Assessment Record (CLEAR): Preliminary Cross-Sectional Study of Reliability, Validity, and Association With Depression": Validity and Methodological Issues

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KEYWORDS

life events; validity; depression; measure

I thank the editors of *JMIR Mental Health* for the opportunity to respond to the Letter to the Editor [1] critiquing the methodology of the Computerised Online Life events Record (CLEAR) [2] published in this journal. While appreciating the critique, it expands on only one of the validity findings, comparing CLEAR with a life event interview and checklist questionnaire. There are significant points not outlined in the letter [1] and these are addressed here. Without questioning the additional statistical analyses provided by the sensitivity and specificity, the conclusion that this is unacceptable for a "diagnostic tool" is refuted. CLEAR is not a clinical diagnostic tool but owing to its high predictive validity with regard to depression and superiority to the checklist life events test (LTE-Q) [3], it retains value as a method for identifying environmental stressors related to clinical models.

The ambition of the CLEAR measure design needs to be understood. It attempts to capture similar data to those established in the intensive, contextualized, face-to-face, semistructured Life Events and Difficulties Interview (LEDS) [4] by using very detailed, interactive, time-based online self-report material. This is both complex and novel. Such conversion of the interview has never previously been undertaken despite various attempts at further structuring the interview for computerization [5]. The value of CLEAR lies in the large amount of event information and context generated, both quantitative and qualitative, and the preprogramming of data to produce both derived risk factors and partly analyzed data that are easily downloadable for analysis. CLEAR also provides a tailored feedback report for respondents. Besides identifying events, it can specify life event characteristics—not only their usual domain categorizations, but also their severity of threat/unpleasantness; focus of event; and characteristics such as loss, danger, and humiliation. It also identifies positivity of events and related characteristics (eg, relief, goal achievement). This is in addition to the timing of events and those stressors constituting longer-term problems. No checklist can provide such detailed data. Although interviews can provide such data, CLEAR provides very large savings in time and cost, expertise of investigators, and respondent convenience in large-scale data collection. Therefore, the balance of the reported lower sensitivity of the tool to interviews (ie, in missing some life events) needs to be considered in relation to the higher specificity with associated richness of event characteristics and the associated increased prediction of depression [2,4].

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Further points in response to this paper are given below:

- The authors of the letter point out that the sensitivity of CLEAR is weaker than its specificity. This is due, in large part, to the different modes of administering the tools. The results show that an interview (with the investigator asking probing questions) elicits more life events than individuals identify online without such personalized probes, thus yielding lower sensitivity. Further qualitative investigation in the study showed that this was largely because a trained investigator identified more stages in a developing event crisis in the same category—the CLEAR tool tended to combine these into single events. However, all key crisis events were reflected in CLEAR when compared qualitatively with the interview. Therefore, high predictive validity for depression was retained. This limitation is more pronounced in a checklist approach where only one event per category applies, with no differentiation of phases in a developing crisis possible. The online CLEAR is superior to the checklist with better predictive validity.
- There was higher validity found in the group studied, which included midlife clinical and case control individuals and young adult students. Midlife individuals responded more accurately than the students in interview accounts. Because of the restricted numbers in the validation exercise, due to interview time taken, both age groups were combined. We believe young people rushed through the exercise more, and even when interviewed, had a more confused reporting style. We are examining ways of further structuring the measure to avoid this in younger age groups.
- CLEAR severe events significantly differentiate the matched depression and control groups as hypothesized [2].
- The authors do not address predictive validity in their paper. CLEAR severe life events are significantly related to depression, indicating high predictive validity [6]. Further investigation showed that this increased from any severe life events (odds ratio [OR]=3.59) to those involving humiliation (OR=6.38) or trauma (OR=5.83). In comparison, the LTE-Q checklist events in this study do not predict depression [2].

However, we do take messages from the letter by Rahmani and colleagues [1] and are seeking to increase the validity of CLEAR as compared with the LEDS interview from the observations and qualitative aspects taken from the analyses. This involves providing more structured options on the menu of life events checked. We believe having an online tool such as CLEAR will enable wider investigation of life events and their role in depression for both research and clinical practice.

Conflicts of Interest

None declared.

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Abbreviations

CLEAR: Computerised Online Life events Record
LEDS: Life Events and Difficulties Interview
LTE-Q: checklist life events test

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Original Paper

Mental Health, Risk Factors, and Social Media Use During the COVID-19 Epidemic and Cordon Sanitaire Among the Community and Health Professionals in Wuhan, China: Cross-Sectional Survey

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Abstract

Background: The mental health consequences of the coronavirus disease (COVID-19) pandemic, community-wide interventions, and social media use during a pandemic are unclear. The first and most draconian interventions have been implemented in Wuhan, China, and these countermeasures have been increasingly deployed by countries around the world.

Objective: The aim of this study was to examine risk factors, including the use of social media, for probable anxiety and depression in the community and among health professionals in the epicenter, Wuhan, China.

Methods: We conducted an online survey via WeChat, the most widely used social media platform in China, which was administered to 1577 community-based adults and 214 health professionals in Wuhan. Probable anxiety and probable depression were assessed by the validated Generalized Anxiety Disorder-2 (cutoff ≥3) and Patient Health Questionnaire-2 (cutoff ≥3), respectively. A multivariable logistic regression analysis was used to examine factors associated with probable anxiety and probable depression.

Results: Of the 1577 community-based adults, about one-fifth of respondents reported probable anxiety (n=376, 23.84%, 95% CI 21.8-26.0) and probable depression (n=303, 19.21%, 95% CI 17.3-21.2). Similarly, of the 214 health professionals, about one-fifth of surveyed health professionals reported probable anxiety (n=47, 22.0%, 95% CI 16.6-28.1) or probable depression (n=41, 19.2%, 95% CI 14.1-25.1). Around one-third of community-based adults and health professionals spent ≥2 hours daily on COVID-19 news via social media. Close contact with individuals with COVID-19 and spending ≥2 hours daily on COVID-19 news via social media were associated with probable anxiety and depression in community-based adults. Social support was associated with less probable anxiety and depression in both health professionals and community-based adults.

Conclusions: The internet could be harnessed for telemedicine and restoring daily routines, yet caution is warranted toward spending excessive time searching for COVID-19 news on social media given the infodemic and emotional contagion through online social networks. Online platforms may be used to monitor the toll of the pandemic on mental health.

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KEYWORDS

COVID-19; nonpharmaceutical interventions; population mental health; depression; anxiety; community; health professionals; social media; WeChat; pandemic; outbreak; public health; mental health; intervention

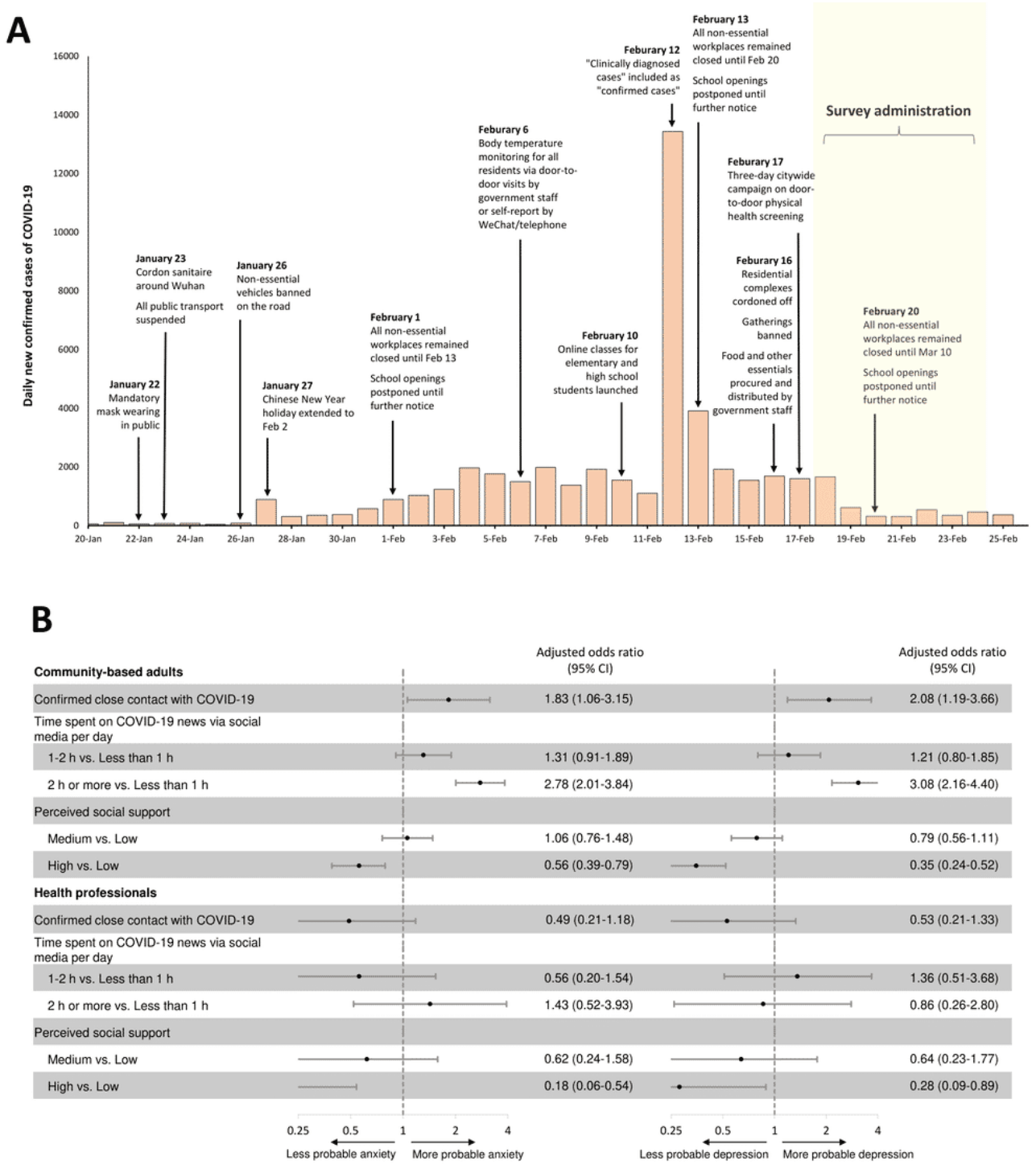
Introduction

The World Health Organization (WHO) has raised its global risk assessment of the coronavirus disease (COVID-19) to the highest level. The WHO-China Joint Mission on Coronavirus Disease 2019 has called for a worldwide response to draw on China's extensive experience of nonpharmaceutical interventions (NPIs). NPIs aim to modify behavior to reduce the spread of infectious diseases. The first and most draconian NPIs to date have been implemented in Wuhan, China [1]. Countries around the world including France, Germany, Iran, Italy, Philippines, Kenya, Spain, the United Kingdom, and the United States have since deployed stringent interventions used in Wuhan.

The widespread lockdowns and stringent measures that require or encourage people to stay at home could result in more time spent on social media, particularly on searching for news or information about the pandemic [2]. Although the psychological impact of quarantine has been documented [3], the mental health consequences of the COVID-19 pandemic, community-wide NPIs, and social media use during a pandemic are unclear. Social media could mitigate the mental health impact of COVID-19 and lockdowns by maintaining social support during physical distancing, as well as providing health information, telemedicine, and online psychological counseling [4,5]. Yet social media can also spread negative emotions, rumors, and fake news during an epidemic [6-8]. In this paper, we examined risk factors including the use of social media for probable anxiety and depression in the original epicenter, Wuhan, China, and during the first month of the cordon sanitaire (Figure 1).

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Figure 1. (A) Chronology of the cordon sanitaire and nonpharmaceutical interventions in Wuhan, China in 2020. The number of new confirmed cases of COVID-19 from the Health Commission of Hubei Province. (B) Risk factors of probable anxiety and probable depression during the COVID-19 epidemic and cordon sanitaire around Wuhan, China. Odds ratios are obtained through multivariable logistic regression. COVID-19: coronavirus disease.



Methods

Study Design and Participants

We conducted an online survey via WeChat, the most widely used social media platform with a prevalence reaching over 90% in major cities in China [9]. We selected WeChat as the lockdown and enrollment of health professionals precluded in-person surveys and random digit dialing, respectively. Adults 18 years or older in Wuhan City during the cordon sanitaire were recruited for this study. Participants who were diagnosed with COVID-19 infections were excluded. Two sociodemographic groups, community-based adults and health professionals in Wuhan, were purposively sampled. We conducted the survey shortly after the neighborhood-level lockdown on February 16, 2020, and during the first month of the cordon sanitaire (Figure 1).

During the lockdown, residential complexes in Wuhan had established WeChat groups where at least one member from each household joins the online group to facilitate communication, support, and organize bulk purchases for daily

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necessities. We recruited community-based adults from 16 WeChat groups of residential complexes located in the Jianghan, Wuchang, and Jiangxia districts of Wuhan. The recruited health professionals were from 8 WeChat groups covering four main hospitals of Wuhan. We used the Tencent questionnaire system, which can collect data via WeChat and includes a built-in function to provide incentives to participants. Participants received CNY 10 (~US $1.5) via their WeChat accounts upon completion of the survey.

Outcomes and Covariables

Probable anxiety was assessed using the validated Generalized Anxiety Disorder (GAD)-2 [10]. Total score of the GAD-2 ranges from 0 to 6 with a cut-off score ≥3, indicating probable anxiety [10].

Probable depression was assessed using the validated Patient Health Questionnaire (PHQ)-2 [11]. Total score of the PHQ-2 ranges from 0 to 6 with a cut-off score ≥3, indicating probable depression [11]. We use the term probable anxiety or probable depression as GAD-2 and PHQ-2 are brief, validated screening instruments but not diagnostic interviews.

Perceived social support was assessed using the Medical Outcomes Study Social Support Survey (MOS-SSS) [12]. The total score of the six items of the MOS-SSS ranges from 6 to 30, with a score ≤15 indicating low social support [13]. We further categorized medium and high support using a score of 16-23 and ≥24, respectively.

Demographic characteristics, exposure to COVID-19 (eg, whether they were close contacts of known cases of COVID-19 or if there were known cases of COVID-19 infections in their residential complexes), and time spent on COVID-19 news via social media and television were assessed in the survey. The study was approved by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster.

Statistical Analysis

We estimated the prevalence of probable anxiety and probable depression in the community and health professionals with the proportion and 95% CI reported. We used multivariable logistic regression analysis to examine factors associated with probable anxiety and probable depression for these two demographic groups, giving results as adjusted odds ratios. All analyses were conducted using Stata 15.1 (StataCorp LLC).

Results

A total of 1577 community-based adults and 214 health professionals in Wuhan completed the online survey. Among the total 1791 participants, 1341 (74.87%) were members of the selected WeChat groups. The remaining participants also reported that they were currently in Wuhan and enrolled via links of the survey forwarded by WeChat group members. Participants' demographics are shown in Multimedia Appendix 1. As expected, a higher proportion of health professionals (n=55, 25.7%) reported being close contacts of patients with COVID-19 compared to community-based adults (n=70, 4.44%). The majority of community-based adults (n=1110, 70.39%) and health professionals (n=131, 61.2%) reported that they live in neighborhoods with COVID-19 cases. Among community-based adults, 37.16% (n=586) and 18.64% (n=294) of them spent 2 hours or more per day on COVID-19 news via social media and television, respectively. Similarly, 33.2% (n=71) and 16.4% (n=35) of health professionals spent 2 hours or more per day on COVID-19 news via social media and television, respectively.

Of the 1577 community-based adults, around one-fifth of respondents reported probable anxiety (n=376, 23.84%, 95% CI 21.8-26.0) and probable depression (n=303, 19.21%, 95% CI 17.3-21.2). Similarly, of the 214 health professionals, about one-fifth of surveyed health professionals reported probable anxiety (n=47, 22.0%, 95% CI 16.6-28.1) or probable depression (n=41, 19.2%, 95% CI 14.1-25.1). The multivariable logistic regression analysis showed that close contact with individuals with COVID-19 and spending ≥2 hours daily on COVID-19 news via social media were associated with probable anxiety and depression in community-based adults (Figure 1). In contrast, social support was associated with less probable anxiety and depression in both health professionals and community-based adults (Figure 1). Time spent on COVID-19 news via television was not associated with either probable anxiety or probable depression (Multimedia Appendices 2 and 3).

Discussion

Our study shows that online platforms such as WeChat can be leveraged to survey community-based adults and health professionals during an epidemic and lockdown. Although our samples are not representative, in-person surveys would not be appropriate or possible during the increasingly widespread lockdowns and the COVID-19 pandemic. Random digit dialing could provide random samples in affected regions but are often associated with low response rates and would not be suitable for the enrollment of health professionals. Future studies could address these limitations by nesting follow-ups in existing random samples where available, as this could provide timely access to longitudinal population-representative data [14].

Our study showed that social support was associated with less probable anxiety and depression in both the community and health professionals. Although physical distancing is recommended to reduce the spread of COVID-19, social support should be maintained, as it is a key source of emotional support. Mitigating the mental health impact of both the pandemic and physical distancing measures is, therefore, important [15]. The internet could be harnessed for online consultation or counseling (eg, Ali Health, Ping An Good Doctor, WeChat implemented in China) and restoring daily routines (eg, online learning, telework, exercise). Yet caution is warranted toward spending excessive time searching for COVID-19 news on social media given the infodemic and emotional contagion through online social networks [8,14]. Our findings are susceptible to reverse causality, whereby anxiety or depression could lead to rumination on social media. However, the null association between time spent on television viewing and mental health suggests social media might have a specific role in adverse

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mental health during epidemics. Further, our findings are consistent with longitudinal studies on social media use and mental health during major population events [14,16,17].

Stress and psychiatric sequelae among health professionals requires urgent redress. This includes ensuring adequate personal protective equipment, allaying anxiety, and strengthening psychosocial support. Clinicians in turn need to be vigilant of psychiatric sequelae among patients given the potential for anxiety and depression during an epidemic [18]. COVID-19 will exact a substantial toll on the population's well-being beyond the acute respiratory illnesses and pneumonia hospitalizations associated with infections. To mitigate the long-term impact on the populations' physical, mental, and social well-being, monitoring the broad consequences of infections and interventions (eg, psychological, social, and economic costs), which may increasingly need to be conducted online due to widespread lockdowns and physical distancing measures, is of paramount importance. Building community resilience and, where appropriate, harnessing the social media while reducing the adverse impact should also be incorporated into global preparedness and response to pandemics.

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Conflicts of Interest

None declared.

Multimedia Appendix 1
Participants' demographic characteristics.
[PDF File (Adobe PDF File), 68 KB - mental_v7i5e19009_app1.pdf]

Multimedia Appendix 2
Risk factors of probable anxiety and probable depression among community-based adults during the coronavirus disease epidemic in Wuhan, China.
[PDF File (Adobe PDF File), 19 KB - mental_v7i5e19009_app2.pdf]

Multimedia Appendix 3
Risk factors of probable anxiety and probable depression among health professionals during the coronavirus disease epidemic in Wuhan, China.
[PDF File (Adobe PDF File), 15 KB - mental_v7i5e19009_app3.pdf]

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Abbreviations

COVID-19: coronavirus disease
GAD: Generalized Anxiety Disorder
MOS-SSS: Medical Outcomes Study Social Support Survey
NPI: nonpharmaceutical interventions
PHQ: Patient Health Questionnaire
WHO: World Health Organization

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