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The Living the Example Social Media Substance Use Prevention Program: A Pilot Evaluation

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Abstract

Background: Adolescent substance use rates in rural areas of the United States, such as upstate New York, have risen substantially in recent years, calling for new intervention approaches in response to this trend. The Mentor Foundation USA conducts the Living the Example (LTE) campaign to engage youth in prevention using an experiential approach. As part of LTE, youth create their own prevention messages following a training curriculum in techniques for effective messaging and then share them via social media. This paper reports on a pilot evaluation of the LTE program.

Objective: To conduct a pilot test of LTE in two rural high schools in upstate New York. We hypothesized that positive antidrug brand representations could be promoted using social media strategies to complement the Shattering the Myths (STM) in-person, event-based approach (hypothesis 1, H1), and that youth would respond positively and engage with prevention messages disseminated by their peers. We also hypothesized that exposure to the social media prevention messages would be associated with more positive substance use avoidance attitudes and beliefs, reductions in future use intentions, and decreased substance use at posttest (hypothesis 2, H2).

Methods: We adapted a previously published curriculum created by the authors that focuses on branding, messaging, and social media for prevention. The curriculum consisted of five, one-hour sessions. It was delivered to participating youth in five sequential weeks after school at the two high schools in late October and early November 2016. We designed a pre- and posttest pilot implementation study to evaluate the effects of LTE on student uptake of the intervention and short-term substance use and related outcomes. Working at two high schools in upstate New York, we conducted a pilot feasibility evaluation of LTE with 9th-grade students (ie, freshmen) at these high schools. We administered a 125-item questionnaire online to capture data on media use; attitudes toward social media; next 30-day personal drug use intentions; personal reasons to use drugs; reasons participants believe their peers would use drugs; self-reported exposure to the LTE program; and receptivity to the LTE program, among those reporting exposure. We constructed multivariable logistic regression models to analyze the relationship between program receptivity and outcomes. First, in a cross-sectional logistic regression model, we regressed self-reported LTE message receipt on drug use intent and actions related to LTE messaging. Then, for analysis of participants with matched pre- and posttest responses, we used multilevel generalized estimating equation (GEE) techniques to model changes in behavior from baseline to follow-up.

Results: Youth reported increased intentions to use marijuana (odds ratio [OR] 2.134, *P*=.02) between pre- and posttest. However, youth who reported exposure and receptivity to LTE reported a significant decrease in intentions (OR 0.239, *P*=.008). We observed a similar pattern for sedatives/sleeping pills—an increase in intentions overall (OR 1.886, *P*=.07), but a decrease among youth who reported exposure and receptivity to LTE (OR 0.210, *P*=.02). We saw the same pattern for use of any drug—an increase in

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reported intentions overall (OR 2.141, *P*=.02), but a decrease among youth who reported exposure and receptivity to LTE (OR 0.111, *P*=.004).

Conclusions: We observed some evidence of significant LTE program effects. Social media may be an effective strategy for peer-to-peer substance use prevention in the future. These findings point both to the potential of LTE and the social media diffusion model and to the need for more research on a larger scale with an expanded youth population in the future.

Introduction

Background

Adolescent substance use rates in rural areas of the United States, such as upstate New York, have risen substantially in recent years [1], calling for new intervention approaches in response to this trend. There is growing evidence that substance use, including marijuana and other drug use, has negative health consequences for adolescents, especially when use begins early and when multiple substances are used [2]. Recent studies suggest adolescent marijuana use may be linked to altered longer-term neurodevelopmental trajectories, compromised neural health, impaired frontal lobe function, and psychosocial effects [3-8]. Additionally, early-onset adolescent marijuana use combined with alcohol and other substance use has been linked to numerous cognitive impairments and neural health effects [9,10]. Social norms favoring many forms of substance use are increasing [11,12] and may be associated with medicalization and legalization of marijuana in some states [13,14]. According to the 2016 survey Monitoring the Future—a long-term study of the behaviors, attitudes, and values of American adolescents, college students, and young adults—38% of high school seniors living in states with medical marijuana laws reported past-year use, compared with 33% in states without these laws. Furthermore, perceptions regarding the dangers of marijuana are at the lowest point ever, with only 31% of high school seniors perceiving smoking marijuana regularly as a "great risk." Increased adolescent substance use due to changing norms and relaxed laws is a substantial public health threat.

The Mentor Foundation USA conducts the Living the Example (LTE) campaign [15], which includes an interactive youth rally event, Shattering the Myths (STM), designed to dispel myths surrounding drug abuse and engage youth in prevention messages using an experiential learning approach. LTE is a branded program that creates new mental associations with the positive attributes of avoiding substance use that may modify adolescent social norms and reduce drug use intentions [16]. The rally is a catalyst for youth to become advocates for prevention; however, the rally was originally conceived to be conducted in person, thus limiting potential reach of prevention messages. In response to the growing popularity and use of social media, we adapted LTE to include a social media component. We trained youth advocates to create LTE-branded prevention messages, disseminate them via social media platforms, and engage peers in their social networks, with the intention of increasing peer interaction around the brand's core

messaging. We conducted a pilot study in Columbia County, New York, to evaluate the efficacy of LTE with the added social media component. We also assessed the utility of this novel approach using social media strategies and branding principles to reach at-risk youth with prevention messages, engage youth in the program's brand, and monitor exposure to specific social media channels.

Potential of Social Media for Prevention

New technologies, including the Internet, social media, and mobile phones, offer tremendous potential to expand the reach and effectiveness of public health programs [17,18]. As noted, some prevention programs have used social media as delivery channels, such as Above the Influence with its large Facebook presence and efforts to create a social community of youth sharing narratives related to the avoidance of marijuana [18-20]. However, relatively little has been published demonstrating the effectiveness of social media as substance use prevention channels. The Substance Abuse and Mental Health Services Administration (SAMHSA) has funded a number of statewide media campaigns for prevention, some of which have used social media activities, including Colorado's SpeakNow! Campaign focused on teen drinking prevention [21]. However, these efforts are in their infancy, and LTE is a novel effort to design and test a systematic intervention for prevention driven by social media.

Theoretical Basis for Living the Example: Branding and Social Media

Schools are a common context for interventions, given their almost universal access to youth. School-based interventions have an established history with an emerging array of successful interventions documented on SAMHSA's National Registry of Evidence-based Programs and Practices [20]. Reviews report an average effect size for youth in school substance use prevention programs in the range of Cohen *d*=0.10 to 0.16 [22-27]. However, in a prevention environment in which marijuana use—and potentially other substance use—is normalized, a more comprehensive approach using other channels to deliver prevention messages is needed. Given its near ubiquity, one promising channel is social media.

Previous research provides a basis for adding media to school interventions. In the conceptual framework behind Slater and colleagues' intervention that combined in-school activities and community-level media, Be Under Your Own Influence, adolescent experience was embedded in school, community, and the larger social world experiences [28]. Other prevention efforts have been conducted in rural communities and school

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settings, similar to LTE, and have demonstrated effectiveness [29-31].

LTE provides an even broader community reach by offering a strong presence on social media platforms widely used by adolescents. This approach complements and extends the reach of the existing Mentor Foundation USA's in-person STM youth rally. Social media provides access to a larger social world that is inaccessible via direct experience [32]. Social media messages echo branded STM rally messages beyond school walls, reinforcing and amplifying antiuse norms [33].

Health branding represents an evolution in behavioral theory, building on social cognitive theory (SCT) and the theory of planned behavior (TPB) (see Figure 1) [34,35]. Health branding specifies the modeling component of SCT by proposing a testable process by which the benefits of healthy behaviors may be depicted through positive social role models, such as teens who remain drug-free and thereby achieve social status and respect. It also specifies the attitude component of TPB, namely that a change in attitudes targeted by health messages is

mediated by the novel theoretical construct of brand equity (see Figure 1). Health branding extends research on the mediation of health beliefs targeted in behavior change campaigns [36]. Previous research on prevention programs such as Above the Influence demonstrates that higher brand equity is associated with improved antiuse attitudes and norms [18]. This study extends that research.

Using social media strategies and branding principles, we conducted a pilot test of LTE in two rural high schools in upstate New York. We hypothesized that positive antidrug brand representations could be promoted using social media strategies to complement the STM in-person, event-based approach (hypothesis 1, H1), and that youth would respond positively and engage with prevention messages disseminated by their peers. We also hypothesized that exposure to the social media prevention messages would be associated with more positive substance use avoidance attitudes and beliefs, reductions in future use intentions, and decreased substance use at posttest (hypothesis 2, H2).

Figure 1. Living the Example (LTE) conceptual model.
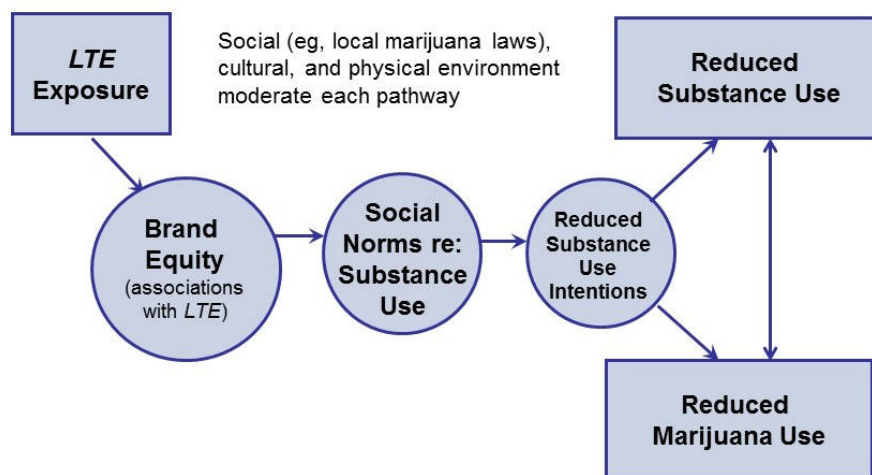
Methods

Intervention

In late September and early October 2016, we conducted a weeklong, in-person STM rally at each school based on the idea of Living the Example (ie, living drug-free as a positive alternative to drug use) at two high schools in Columbia County, New York. Following the weeklong rally, we engaged a group of youth ambassadors (n=12 per high school) in a 5-week, after-school social media and prevention-branding training activity. As part of the training, the ambassadors learned how to develop and disseminate their own prevention messages. They were trained to create social media content and share their drug use avoidance experiences, thus forming positive antidrug social norms with their friends and social networks. The training was based on a previous activity developed by the two lead authors (WE and EA) under National Institutes of Health funding. For 5 weeks after the weeklong STM rally, ambassadors at both high schools disseminated prevention messages through their social networks with the

#livingtheexample hashtag to identify posts as representing the LTE program.

Living the Example Social Media Training

The social media training consisted of five, one-hour sessions. The training was conducted five sequential weeks after school at the two high schools in late October and early November 2016. The curriculum comprised the following:

1. Session 1: What is a Brand? This session described the idea of branding; how it is used to market products, services, and companies; and how it can be applied to social causes and behavior change. The idea of branding substance use prevention was introduced.

2. Session 2: Introduction to Social Media. This session introduced youth to the basics of social media, how it can influence message recipients, and how to begin thinking about creating their own influential messages. The session included a social media message creation exercise.

3. Session 3: Boosting Online Engagement. This session covered how to connect and build engagement with social networks. It also covered the idea of social media as a conversation, knowing one's audience, techniques to create engaging posts, and how to communicate about prevention topics with peers.

4. Session 4: Using Your Voice—Introduction to Advocacy. This session focused on how youth can share their opinions about an issue in their community that they would like to change. It examined examples of how advocacy has made a difference in social causes and how to create advocacy messages.

5. Session 5: Advocacy in Action. This session focused on applying concepts from the preceding sessions to advocate for substance use prevention with peers. It included an exercise in creating a persuasive social media prevention message and post.

Once the training was completed, youth were encouraged to continue creating their own prevention messages and disseminating them to peers through their preferred social media channel for the rest of the fall 2016 semester.

Evaluation Methods

We designed a pretest-posttest pilot implementation study to evaluate the effects of LTE on student uptake of the intervention and short-term substance use and related outcomes. Working at two high schools in upstate New York, we conducted a pilot feasibility evaluation of LTE with 9th-grade students (ie, freshmen) at these high schools. The rationale for testing the program with freshmen was that they had not yet been enrolled in any previous high school-level prevention programs, including Mentor Foundation USA programs. Due to challenges in collecting posttest data at one high school, the following presentation of data and results focuses on one school for which we successfully completed both pre- and posttesting. We sought to evaluate whether branded prevention messages disseminated via social media increased intervention effects of the adolescent substance use prevention program.

Measures and Instrument

We developed a questionnaire using validated scales from previous work by the authors [37,38], as well as from other validated scales from both the SAMHSA 2014 Communities that Care survey instrument and the 2012 Monitoring the Future survey [39,40]. The 125-item instrument was programmed into SurveyMonkey software for computer-administered completion during a required freshman English class at both high schools. In addition to demographic information and last grade completed in school, other scales used included the following: Traditional and Digital Media Use (9 items); Attitudes Toward Social Media (18 items); Drug Use Risk Perceptions (12 items); Personal and Perceived Peer Reasons to Use Drugs (6 items); Drug Use Social Norms (18 items); Perceived Peer Drug Use (18 items); Reported Peer Drug Use (14 items); Self-Reported Past 30-Day Drug Use (14 items); Next 30-Day Drug Use Intentions (8 items); Drug Use/Refusal Influences (8 items); and Self-Reported Exposure to the LTE Program and Receptivity to the LTE Program (7 items), which was administered among those reporting exposure.

Data Collection

We recruited participants from the 9th-grade student bodies at the two high schools and attempted to obtain full participation from all freshmen. Active parental consent had been previously obtained for youth ambassadors to participate in the social media training activity and we sought passive parental consent for all potential freshmen participants in the questionnaire. Youth informed assent was also obtained prior to questionnaire administration. No personal contact or other identifying information was stored with the questionnaire data and a unique identifier was created and used to match pre- and postquestionnaire responses by participant. All study instruments and the protocol were approved by the George Washington University Institutional Review Board and the principals of each high school.

Pretest questionnaires were administered before the intervention launched in late September 2016 and posttest questionnaires were administered in December 2016. Students were asked to log into a password-protected site and complete the pretest and posttest questionnaires online using SurveyMonkey. A total of 129 participants were recruited at the high school included in the pre-post analysis, representing the entire eligible freshman student body at that school. The questionnaire was anonymous and confidential; no student was obligated to complete the questionnaire or penalized for nonparticipation. Students were enrolled in a contest for retail gift card prizes as an incentive upon completion.

Data Analysis

We conducted all data analysis in Stata release 14 (StataCorp LLC). For each wave of the study, we matched respondents and were able to identify matching records for 80 of the 129 (62.0%) total study participants; 49 students out of 129 (38.0%) completed the posttest only. We compared drug use intent; personal reasons why they, or general reasons why their peers, might use drugs; and agreement with actions related to LTE messaging for baseline and follow-up questionnaires. We also examined respondent exposure to both traditional and new media, social media use attitudes, and how students interacted with LTE social media posts. We created dummy variables that represented students' likelihood of using a specific or any drug in the next 30 days. We also created a dummy variable to represent whether the respondent self-reported receipt of LTE social media posts.

We then constructed multivariable logistic regression models to analyze the relationship between program receptivity and outcomes. First, in a cross-sectional logistic regression model, we regressed self-reported LTE message receipt on drug use intent and actions related to LTE messaging. Then, for analysis of participants with matched pre- and posttest responses, we used multilevel generalized estimating equation (GEE) techniques to model changes in behavior from baseline to follow-up. We estimated the odds of reductions in drug use intent from baseline to follow-up in those who interacted with LTE compared to those who did not. All models included age and gender as covariates.

Table 1. Descriptive statistics of participants (n=80).

Characteristics	n (%)
Gender	
Female	39 (49)
Male	40 (50)
Other/transgender	1 (1)
Total	80 (100)
Age at baseline (years)	
13	9 (11)
14	64 (80)
15	6 (8)
16	1 (1)
Total	80 (100)

Results

Table 1 summarizes the sample demographics of freshmen successfully surveyed at follow-up.

Figure 2 summarizes results on reasons why participants believed their peers used drugs. Nearly all of the categories of reasons scored above 50%, indicating that youth had many reasons why they believed their peers would use drugs. Peer pressure showed up as the most commonly reported reason (36/49, 73%) among participants who only responded to the wave 2 questionnaire. Among those who responded to both waves, family stress was the most common reason (67/80, 84%). The most common overall reason for drug use among all respondents was family stress (105/129, 81.4%).

Figure 2 also summarizes reasons why participants said that they personally used drugs. As personal reports of drug use are generally lower, the results for this scale were lower than perceptions of peer use. Among those who responded to both waves, boredom and academic stress were the most common reasons (32/80, 40%). The same two categories were most common among all respondents (43/129, 33.3%).
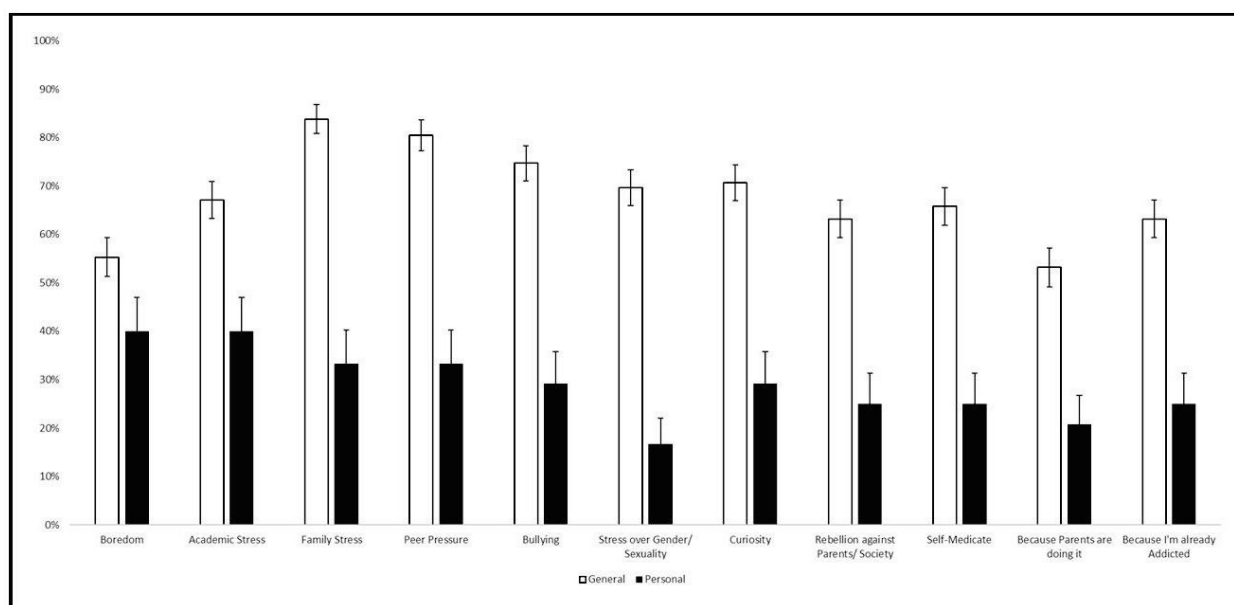
Figure 2. Reasons for peer and personal drug use among matched respondents.

Table 2. Multivariate regressions comparing self-reported drug use intent at pre- and posttest and Living the Example receptivity (matched participants, n=80).

	Self-reported drug use intent, exponentiated coefficient (*P*)													
	1[a]	2[b]	3[c]	4[d]	5[e]	6[f]	7[g]	8[h]	9[i]	10[j]	11[k]	12[l]	13[m]	14[n]
Any LTE[o] exposure	0.918 (.94)	0.565 (.61)	2.445 (.18)	0.678 (.74)	1.491 (.61)	0.972 (.96)	1.217 (.86)	2.097 (.45)	2.097 (.45)	2.097 (.45)	2.364 (.38)	2.097 (.45)	2.360 (.24)	2.121 (.19)
Change from baseline to follow-up	1.672 (.35)	1.892 (.06)	1.886 (.07)	2.261 (.08)	1.848 (.17)	2.134 (.02)	1.681 (.15)	1.066 (.90)	1.066 (.90)	1.066 (.90)	0.855 (.76)	1.066 (.90)	0.676 (.45)	2.141 (.02)
Change from baseline to follow-up among those with LTE receptivity	1.820 (.54)	1.495 (.62)	0.210 (.02)	1.409 (.72)	0.432 (.33)	0.239 (.008)	1.809 (.35)	1.000 (>.99)	1.000 (>.99)	1.000 (>.99)	1.000 (>.99)	1.000 (>.99)	0.736 (.73)	0.111 (.004)
Gender[p]	0.663 (.63)	3.027 (.12)	1.343 (.60)	0.845 (.81)	1.197 (.76)	1.698 (.40)	1.279 (.77)	1.108 (.91)	1.108 (.90)	1.108 (.91)	1.699 (.54)	1.108 (.91)	1.691 (.43)	2.006 (.12)
Age	0.467 (.28)	0.560 (.24)	0.614 (.29)	0.428 (.17)	0.508 (.22)	0.834 (.70)	0.462 (.12)	0.782 (.74)	0.782 (.74)	0.782 (.74)	0.581 (.44)	0.782 (.74)	0.740 (.60)	0.673 (.33)

[a]Will smoke cigarettes.

[b]Will use electronic cigarettes (ie, vaping).

[c]Will use sedatives such as sleeping pills.

[d]Will use tranquilizers or antianxiety drugs.

[e]Will use painkillers such as OxyContin or similar.

[f]Will use marijuana.

[g]Will use synthetic marijuana or K2/Spice.

[h]Will use cocaine.

[i]Will use crack.

[j]Will use hallucinogens.

[k]Will use any inhalant for kicks or to get high.

[l]Will use heroin.

[m]Will use any other medicines or substances.

[n]Will use at least one drug.

[o]LTE: Living the Example.

[p]Female is the reference for gender.

Table 2 summarizes results of the GEE models we developed to compare pre- and posttest results and the effect of self-reported exposure and receptivity to LTE social media messages. Youth reported increased intentions to use marijuana (odds ratio [OR] 2.134, *P*=.02) between pre- and posttest, which may be expected given the age range of 14-15 years and concomitant increase in drug use intentions observed in other research for this age group [41,42]. However, among youth who reported exposure and receptivity to LTE, they reported a significant decrease in marijuana use intentions (OR 0.239, *P*=.008). We observed a similar pattern for sedatives/sleeping pills—an increase, although only marginally significant, in intentions overall (OR 1.886, *P*=.07), but a decrease among youth who reported exposure and receptivity to LTE (OR 0.210, *P*=.02). We saw the same pattern for use of any drug—an increase in reported intentions overall (OR 2.141, *P*=.02), but a decrease among youth who reported exposure and receptivity to LTE (OR 0.111, *P*=.004). No other statistically significant results were observed, although a marginally significant increase in e-cigarette (ie, vaping) use was observed among all respondents (OR 1.892, *P*=.06) and a nonsignificant increase

was observed among those exposed and receptive to LTE (OR 1.495, *P*=.62).

Discussion

Principal Findings

With respect to H1, we found that, overall, youth responded positively and engaged with LTE messages when they were exposed to them by their peers. As shown in Table 2, message receptivity was generally high among those who self-reported exposure to LTE social media. Respondents found LTE to be engaging and convincing, and they generally liked the posts. In terms of immediate response from the target audience, the LTE peer-to-peer approach appears to be a promising way to deliver prevention messages.

We also confirmed H2 in that positive receptivity to LTE messages was associated with some evidence of reduced self-reported drug use intentions, specifically for marijuana and use of sedatives/sleeping pills, and reports of intent to use any drug. As shown in Table 2, the overall sample showed a significant increase in intent to use both marijuana,

sedatives/sleeping pills, and any drug, but there was a significant reduction in intent among those who were receptive to LTE messages. While this result could be due to other factors not measured in the study, given the pilot nature of this work and intent to establish preliminary evidence of efficacy and feasibility, these findings suggest that LTE is promising.

Additionally, we identified a number of key reasons why youth believe their peers use drugs and why they personally would use drugs. The most frequently cited reasons why youth believe their peers use drugs and why they themselves would use drugs were academic stress, family stress, and peer pressure. In an overall social environment where marijuana use laws are relaxing, perceived risk and social unacceptability of marijuana use may be decreasing [43]. These changing perceptions and risk factors should be investigated in future studies.

We observed no significant effects for a number of other drugs measured, including cigarettes, e-cigarettes, prescription drugs, inhalants, cocaine, and others. However, the LTE curriculum did not specifically focus on these drugs and in conversations with youth (see sections below), we found that youth did not post about them specifically. Thus, message recipients' attitudes toward these drugs may not have been affected.

Overall, study findings suggest that peer-to-peer substance use prevention via social media is a promising strategy. Given the low cost and low burden of social media as an intervention channel, schools, communities, and prevention programs can use this approach even in low-resource settings. However, more research is needed on how best to structure such programs. LTE used a model that combined a curriculum, training of peer leaders, and sharing of prevention messages in a social network by those trained peer leaders. The advantages, disadvantages, and alternatives to this model should be explored in future studies.

Intervention Challenges and Opportunities

In terms of the process of implementing the LTE intervention and the social media training, we observed many positive aspects of the intervention, as well as some challenges. Youth ambassadors who received the social media and peer leadership training liked the experience, were receptive to LTE overall, and reported enjoying the program. Based on our survey data, we have evidence that they participated and did indeed share sufficient social media posts with their peers to generate high LTE awareness in their social networks and produce the observed effects on substance use intentions. Additionally, we also gathered valuable information on how best to use social media platforms. Students indicated that they frequently used Snapchat Geofilters to stay connected to peers. LTE and similar programs may benefit from using this tool, including at events and within social media training/school programming. Furthermore, Instagram and Snapchat now have 24-hour *Story* features that youth encouraged us to use. These features allow more people to see the posts for a longer period of time, thus potentially facilitating diffusion of messages, enhancing reach, and increasing exposure to program messages.

We experienced some challenges with the LTE social media training. One was that our social media examples were often based on Facebook, which is a platform that many youth participants were no longer using. Alternatively, we found that Snapchat and Instagram were the most widely used platforms, with Snapchat typically being used for person-to-person contact (ie, one individual at a time, similar to texting) and Instagram being used for *posts*. Almost none of the participants used Facebook and very few had a Twitter account. Use of Snapchat and Instagram presented challenges for the program, since they were less conducive to detailed posts that tend to be best for prevention advocacy. We recognize that future versions of LTE and programs using similar engagement strategies need to be responsive to rapidly changing social media use patterns among adolescents.

In addition to the social media platform used, youth participants indicated that the intention of the social media message should match the purpose for which they usually used a particular platform. In other words, youth participants primarily used Instagram to demonstrate personal involvement or creativity, and not necessarily to send messages, including prevention messages.

However, participants were more willing to put out *motivational messages* that might deter a peer from using drugs. These messages were intended to be positive and could show "who they were." The research team faced some challenges communicating and reminding the youth ambassadors to post on social media. We attempted to use direct messaging through Instagram, but some students reacted negatively, indicating a preference for not receiving contact from school or adults through the platform, which they considered as an extension of their "personal space" reserved for socializing with peers.

Limitations

Finally, it should be noted that this was a pilot study and had the limited objective of demonstrating the potential of social media as a peer-to-peer education tool for prevention. As such, we had a relatively small sample size and, thus, limited statistical power. Therefore, our results should be interpreted with caution. The sample was limited to freshmen; while we achieved a near census of full participation among the freshman class, this did not represent the school as a whole. Additionally, results are not generalizable beyond this population or the individual school setting.

Despite these limitations, LTE did demonstrate a significant program effect. Social media may be an effective strategy for peer-to-peer substance use prevention in the future. Anecdotal information gathered during implementation revealed a number of ways the program and use of social media may be optimized in the future. These findings point both to the potential of LTE and the social media diffusion model and to the need for more research on a larger scale with an expanded youth population in the future.

Acknowledgments

Conflicts of Interest

None declared.

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Abbreviations

GEE: generalized estimating equation
H1: hypothesis 1
H2: hypothesis 2
LTE: Living the Example
OR: odds ratio
SAMHSA: Substance Abuse and Mental Health Services Administration
SCT: social cognitive theory
STM: Shattering the Myths
TPB: theory of planned behavior

<u>Original Paper</u>

Gathering Opinions on Depression Information Needs and Preferences: Samples and Opinions in Clinic Versus Web-Based Surveys

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Abstract

Background: There has been limited research on the information needs and preferences of the public concerning treatment for depression. Very little research is available comparing samples and opinions when recruitment for surveys is done over the Web as opposed to a personal invitation to complete a paper survey.

Objective: This study aimed to (1) to explore information needs and preferences among members of the public and (2) compare Clinic and Web samples on sample characteristics and survey findings.

Methods: Web survey participants were recruited with a notice on three self-help association websites (N=280). Clinic survey participants were recruited by a research assistant in the waiting rooms of a family medicine clinic and a walk-in medical clinic (N=238) and completed a paper version of the survey.

Results: The Clinic and Web samples were similar in age (39.0 years, SD 13.9 vs 40.2 years, SD 12.5, respectively), education, and proportion in full time employment. The Clinic sample was more diverse in demographic characteristics and closer to the demographic characteristics of the region (Winnipeg, Canada) with a higher proportion of males (102/238 [42.9%] vs 45/280 [16.1%]) and nonwhites (Aboriginal, Asian, and black) (69/238 [29.0%] vs 39/280 [13.9%]). The Web sample reported a higher level of emotional distress and had more previous psychological (224/280 [80.0%] vs 83/238 [34.9%]) and pharmacological (202/280 [72.1%] vs 57/238 [23.9%]) treatment. In terms of opinions, most respondents in both settings saw information on a wide range of topics around depression treatment as very important including information about treatment choices, effectiveness of treatment, how long it takes treatment to work, how long treatment continues, what happens when treatment stops, advantages and disadvantages of treatments, and potential side effects. Females, respondents with a white background, and those who had received or felt they would have benefited from therapy in the past saw more information topics as very important. Those who had received or thought they would have benefited in the past from medication treatment saw fewer topics as important. Participants in both groups expressed an interest in receiving information through discussion with a counselor or a physician, through written brochures, or through a recommended website.

Conclusions: The recruitment strategies were helpful in obtaining opinions from members of the public with different concerns and perspectives, and the results from the two methods were complementary. Persons coping with emotional distress and individuals not specifically seeking help for depression would be interested in information to answer a wide range of important questions

about depression treatment. The Clinic sample yielded more cultural diversity that is a closer match to the population. The Web sample was less costly to recruit and included persons who were most interested in receiving information.

Introduction

Importance of Health Information

Major depression is one of the most common and disabling mental health problems in the community [1]. It is important to understand how persons with depression prefer to receive information about treatment and what they want to know about treatment options. The exchange of information about treatment options is essential in shared decision-making and obtaining informed consent for treatment [2]. There are large differences among people in the amount of information they wish to receive concerning treatment options and how they prefer to receive this information [3]. In a wide range of health conditions, information needs early in the course of treatment may differ from information needs later in the course of treatment, or when considering changes in treatment [4]. Often even those who are well connected with health services have information needs that have not been addressed in the course of regular clinical contacts [5]. It is helpful to have information resources available that are flexible enough to allow for differing information needs and that are low enough in cost to be easily accessible to patients receiving health care and to those searching for health information on the Web [3,4].

Health information preferences are influenced by attitudinal and motivational factors [6]. The theory of planned behavior [7,8], for example, suggests that the approach people take to health information seeking will be influenced by anticipated benefits (attitudes), the influence of important individuals (subjective norms), confidence in one's ability to use information (perceived behavioral control), and the degree to which the person intends to actually seek information (intent) [3]. Given this context, it is helpful to explore what information people consider to be important in decision making around treatments for depression (attitudes), whom people consider turning to for help in making health decisions (subjective norms), and their views on preferred ways to receive information (perceived behavioral control).

Whereas there is a great deal of health information on the Web, and the public increasingly uses the Web to access health information [9], there are questions about the quality and the comprehensiveness of the information available [10]. Previous research suggests that currently available information does not address many of the important questions that patients have about managing health [11] and mental health problems [12]. Current information on the Web often focuses on a description of the health problem with a description of the treatment options with little evaluative information based on research evidence [13,14]. In a recent systematic review of the information and decision-making needs of people with mental disorders [15], only 12 studies were identified with 6 addressing depression.

The results suggest that much more research is needed in this area. One study [16] found that many patients received very limited information when making treatment choices and most desired more information.

Paper- and Web-Based Survey Methods

Obtaining the opinions of those who may be interested in specific types of health information is challenging in survey research. The most favorable research situation [17] is when the researchers can clearly establish the survey population (the group they wish to generalize results to—in this case people wanting information about depression and its treatment), the sampling frame (a list of possible participants from which a sample is to be drawn), and a random sample from this sampling frame. Whereas in some cases, this information is available (such as national health and social surveys which obtain a representative sample from a specific geographic area), in many situations there is not a good source of information to provide a list of potential survey participants. In these situations, it is often necessary for researchers to consider opportunity or convenience samples that may not be clearly representative of a larger population but may provide helpful information about a research question in any case. We identified two approaches to obtaining survey samples to consider the information needs of persons who are currently or may in the future be seeking information about treatments for depression. The first was to sample persons visiting a primary care medical setting for routine care. When people decide to seek treatment for depression, this is often where they first go, and many people receive treatment for depression exclusively in a primary care setting [18]. People with chronic medical conditions are also at greater risk for the development of mood disorders [19]. A second approach was to post a notice about the survey on the websites of organizations focused on informing the public about mental health problems. Members of the public frequently search for information about health problems and treatment on the Web [9].

With the increased use of the Web in the last 20 years, Web-survey research has become very prevalent. There has been limited research comparing the results when recruitment is done over the Web (responding to a mass mailing or clicking on a link in a posted invitation) as opposed to being done with a personal invitation to complete a paper survey in a community setting [20]. Much of the research in this area has focused on comparing the measurement properties of established measures administered in Web-based and paper-based formats [21-24]. The comparability of Web-based and paper-based surveys has been assessed in a variety of different situations and generally, this research has found that responses are reasonably similar between paper and Web-based questions and structured

measures, especially when demographic factors are considered [20,25].

One advantage of traditional survey administration is that it is possible to determine response rate. Whether the survey is administered via mail or email invitations to specific persons or when participants are approached in a medical clinic waiting room in person, researchers are able to determine how many persons responded out of the total number invited to participate. It is also possible to obtain more information about the representativeness of respondents as compared with nonrespondents when there is a sampling frame with detailed information about those invited to participate. In surveys carried out in public areas (such as a medical waiting room), it is possible to gather information about respondents but no information is available on the characteristic of nonrespondents. For both the medical clinic survey and the Web survey, it is possible to compare the characteristics of respondents with characteristics of persons in the region.

Web survey recruitment and administration, on the other hand, has the advantage of lower cost and of reaching a broader audience, that is, people that differ demographically and geographically [26]. Another advantage is convenience; there are few restrictions on the time and place participants can access the survey, as long as they have access to the Web. Web-based surveys can be constructed to minimize the number of missed questions and to easily branch into different questions based on earlier answers.

Aims of This Study

Professionals commonly produce resources for the public with limited knowledge of what information is of interest to consumers and the public at large. Hence, there remains a need to understand the information needs and preferences of the public concerning treatment choices for depression. The first aim was to explore the following questions using two different survey approaches: (1) What information would be important to members of the public? (2) To whom would they turn for advice? (3) How would they prefer to receive information? and (4) What treatment services would they see as most helpful if they were experiencing problems with depression?

The second aim of this study was to compare respondent characteristics and information needs and preferences between participants recruited in a clinical setting for paper surveys and those recruited on the Web through self-help organization websites.

Methods

This study was approved by the University of Manitoba Research Ethics Board (REB).

Participants

Clinic Survey

This survey was conducted in two medical clinics in Winnipeg, Canada. One was a large clinic near a teaching hospital where patients had scheduled appointments with family physicians. The second clinic, near a large shopping center, provided both

walk-in services and a limited number of scheduled appointments with family physicians. Under Canada's publicly funded health care system, there is no charge for physician visits. Of 340 patients in the waiting rooms invited to complete the survey, 241 agreed to participate and 231 were included in the analyses (67.9% of the total).

Web Survey

Persons visiting the websites of the Anxiety Disorders Association of Manitoba, the Canadian Mental Health Association (Winnipeg Region), and the Mood Disorders Association of Manitoba were invited to participate in the survey by a notice posted on each of these websites (see Multimedia Appendix 1 for recruitment notice). These websites are widely visited by members of the public searching for information about common mental health problems. We made the survey available on the Anxiety Disorders Association of Manitoba website because persons with anxiety problems have a higher rate of problems with major depression than the public in general. Website visitors who were interested in participating could click on a link to the survey, which was presented through a web-based survey tool called SurveyGizmo (SurveyGizmo, 4888 Pearl East Cir. Suite 100, Boulder, Colorado). Once the link was clicked, participants viewed the information and informed consent page.

Procedure

Clinic Survey

A research assistant invited persons waiting for appointments to participate. Those who provided consent completed the 20-min anonymous survey in the waiting room. An honorarium (a gift card, Can $5 value) was provided.

Web Survey

The same measures were used in the Web survey as in the Clinic survey. After the participants provided their consent, they were presented with the survey. Enrollment continued for approximately 2 months without providing compensation to participants. After 2 months of data collection, in order to increase participation, we provided a $10 gift card to a grocery or coffee retailer as compensation for participation. Whereas 280 participants answered the demographic questions, approximately 262 individuals answered the information needs and preferences questions. Just over half (54.3%) of this group of respondents received an honorarium for participating in the study. The survey duration was approximately 20 min.

Measurement

In developing questions, we considered what information might be important to a well-informed person making treatment decisions. The questions considered the logical sequence of events in decisions about treatment: treatment choices; the characteristics of each treatment; treatment cost, effectiveness, and duration; what happens when the treatment is stopped; and the risks of treatment. Draft questions were reviewed in a consensus meeting involving members of a self-help anxiety association, psychiatrists and psychologists specializing in the treatment of anxiety, and a family physician from a teaching clinic. There was a high degree of consensus on the final

questions. These questions have been used in previous research on information needs of young adults [27], parents of anxious children [28], and persons with inflammatory bowel disease [29] and have provided consistent findings in these different contexts. The topic areas were consistent with themes developed in focus groups with young adults (unpublished data). The complete survey is shown in Multimedia Appendix 2.

Sociodemographic Information

Participants provided information concerning their gender, age, marital status, education level, main activity (employment), and cultural or ethnic background.

Information Preferences

To set the context, respondents read a vignette describing a person with depression matching their gender. The vignette was brief (7 lines) and described a person with significant depression meeting five of the nine Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5) criteria for major depression [30] with no mention of suicidal thoughts. Next, they were asked whether or not they had used the Web to search for health care information and how familiar they are with the types of help available for depression. Then they received the instructions: "At some time in your life you, a close friend, or a close family member might be having a problem with depression. What information would be important to you in considering the kinds of help available for depression?" These instructions were followed by 27 questions focusing on content areas of information that they might consider important in making decisions.

Then participants were asked 5 questions about the medium they would prefer in receiving information. They were also asked, "How likely would you be to talk to one of the following people for advice if you were having a serious problem with depression?" and a list of options was provided. Next participants were asked: "If YOU were having difficulty with depression at some point in your life, how helpful would the following be?" and a list of service options was provided. Finally, participants were asked about past treatment experience.

Emotional Distress

Current emotional distress was assessed using the Kessler Psychological Distress Scale (K6), a validated measure of anxiety and depressive symptoms [31]. The 6-item survey asks: "During the past 30 days, about how often did you feel...nervous,...hopeless,...restless or fidgety,...so depressed that nothing could cheer you up,...that everything was an effort,...worthless." Items were rated on a 5-point rating scale from 1 (none of the time) to 5 (all of the time). This measure has been found to be both valid and reliable, with a Cronbach alpha of .92 in previous research [31], .88 in the Clinic sample, and .91 in the Web sample.

Statistical Methods

IBM SPSS statistics version 23.0 was used to conduct the data analysis. Demographic characteristics between the 2 samples were compared using independent samples t test for mean differences and chi-square comparisons for the proportions in the 2 groups. The information preferences questions' 0-8 rating scales were categorized into three categories as follows: 0-2: not important, not likely, not preferred, not helpful; 3-5: moderately important, moderately likely, moderately preferred, moderately helpful; and 6-8: very important, very likely, very preferred, very helpful. The proportions of respondents providing high ratings (ie, very important, very likely, very preferred, or very helpful) on the information preferences questions as well as mean ratings with CIs are presented in Tables 2-5. CIs are often used in survey research and have been recommended rather than pairwise significance tests for comparisons between and within groups because they help the reader understand the magnitude of differences rather than simply concluding that a difference is statistically significant [32,33]. When making comparisons between means (ie, between groups and across different question items), it should be noted that in approximately one case out of 20, the 95% CIs will be nonoverlapping even in the absence of a difference in that measure within the underlying populations.

We conducted a linear regression analysis to explore the sociodemographic predictors of the number of information topics considered to be very important by participants in the Clinic sample with different characteristics. We were particularly interested in the relationships between information needs and previous experience with depression and its treatment as predictors.

Results

Participants

In the Clinic sample, the mean age of participants was 40 years, and it was reasonably well balanced for gender with 57.1% being female (136/238; Table 1). In terms of cultural background, 71.0% (169/238) of this sample were white, whereas 17.2% (41/238) were Aboriginal. The Web sample was similar to the Clinic sample in demographic characteristics; the mean age of participants was 39 years, 86.0% were white (241/280) and 12.1% (34/280) had an Aboriginal background. However, the Web sample had a much larger proportion of females (83.9%, 235/280). On average, respondents in both samples had completed 2 years of education after high school, and more than half had been working full-time in the prior year. Although Web surveys have the potential to reach a broader audience, almost all participants responding on the Web were from Manitoba (92.9%, 260/280). In the previous 12 months, 63.0% (150/238) of respondents in the Clinic sample indicated that they had searched the Internet for health-related information compared with 92.9% (260/280) in the Web group (χ^2_1=66.9, P<.001). Respondents rated how familiar they were with types of help available for depression on a 0-8 rating scale (not at all familiar to very familiar). More of those (55.0%, 154/280) in the Web sample indicated that they were very familiar with types of help for depression (rating of 6-8; mean 5.42, 95% CI 5.16-5.68), compared with 28.2% (67/238) in the Clinic sample (mean 3.70, 95% CI 3.38-4.02).

Table 1. Sample characteristics.

Characteristics	Clinic sample (N=238)	Web sample (N=280)	Statistical comparison	P value
Mean age (SD[a])	39.0 (13.90)	40.2 (12.47)	$t_{508}=-0.98$	.33
Gender proportion, n (%)			$\chi^2_1=48.4$	<.001[b]
Female	136 (57.1)	235 (83.9)		
Male	102 (42.9)	45 (16.1)		
White, n (%)			$\chi^2_1=17.6$	<.001[b]
Yes	169 (71.0)	241 (86.1)		
No	69 (29.0)	39 (13.9)		
Married, n (%)			$\chi^2_1=5.1$	.03[b]
Yes	145 (60.9)	143 (51.1)		
No	93 (39.1)	137 (48.9)		
Working full-time proportion, n (%)	143 (60.0)	148 (52.9)	$\chi^2_1=2.7$	.10
Mean years education (SD)	13.8 (3.80)	14.1 (5.21)	$t_{516}=-0.58$	.57
Distress score (SD)	5.1 (4.57)	10.5 (6.14)	$t_{463}=10.5$	<.001[b]
Received counseling for depression, n (% yes)	83 (34.9)	224 (80.0)	$\chi^2_1=103.9$	<.001[b]
Counseling for depression would have been helpful but not received, n (% yes)	88 (37.0)	210 (75.0)	$\chi^2_1=72.9$	<.001[b]
Received medication for depression, n (% yes)	57 (24.0)	202 (72.1)	$\chi^2_1=112.6$	<.001[b]
Medication for depression would have been helpful but not received, n (% yes)	33 (13.9)	106 (37.9)	$\chi^2_1=103.9$	<.001[b]

[a]SD: standard deviation.

[b]Significantly different means or proportions between the 2 samples, where *P*<.05.

The Clinic sample was minimally distressed with an average K6 score of 5.1 (K6 sum scores range from 0 to 24). In contrast, the Web sample was significantly more distressed with a K6 score of 10.5 (*P*<.001). The recommended threshold for identifying a likely mental disorder is 13 or higher [34]. Approximately 80.0% (224/280) of the Web sample reported previously receiving counseling or therapy for depression at some time in their life, whereas 72.1% (202/280) reported receiving medication. This is compared with only 34.9% (83/238) and 24.0% (57/238) in the Clinic sample.

Important Information Content When Considering Help

Table 2 shows ratings of importance of 20 information topics concerning the depression treatment. The overall impression is that both samples of respondents viewed most of the topics as very important. In both groups, participants placed a high level of importance on information about the effectiveness of treatment, goal, or outcome of treatment, how the treatment works, what happens when the treatment stops, and the advantages and disadvantages of a treatment approach. Mean ratings of importance as well as proportions rating a topic as very important were both greater overall in the Web sample compared with the Clinic sample. We also asked about seven other administrative topics (such as timing of appointments, hours of service, location of services). As these administrative issues will differ by geographic region, they are presented in Multimedia Appendix 3.

Table 2. Treatment options: What information would be important to you if you were considering help (for yourself, a close friend, or a close family member)?

Information type	Clinic sample (N=231)		Web sample (N=262)	
	Very important n (%)	Mean rating (95% CI)	Very important n (%)	Mean rating (95% CI)
All available treatments	164 (71.0)	6.4 (6.16-6.66)	233 (88.9)	7.2 (7.09-7.40)[a]
Available medication treatments	134 (58.0)	5.7 (5.47-6.03)	183 (69.9)	6.3 (6.11-6.57)[a]
Available counseling or psychological treatments	162 (70.1)	6.3 (6.06-6.58)	233 (88.9)	7.2 (7.06-7.40)[a]
Self-help treatment	88 (38.1)	4.8 (4.46-5.06)	204 (77.9)	6.7 (6.44-6.85)[a]
Herbal remedies	81 (35.1)	4.3 (4.00-4.63)	110 (42.0)	4.7 (4.37-4.95)
Exercise	157 (68.0)	6.0 (5.76-6.30)	194 (74.1)	6.5 (6.25-6.70)
Meditation	122 (52.8)	5.4 (5.07-5.65)	_[c]	-
Bright light therapy	104 (45.0)	4.9 (4.58-5.19)	173 (66.0)	5.8 (5.59-6.09)[a]
What you have to do as part of the treatment	164 (71.0)	6.3 (6.06-6.56)	228 (87.0)	7.1 (6.92-7.29)[a]
Cost of treatment to you	139 (60.2)	5.7 (5.38-6.01)	207 (79.0)	6.8 (6.55-7.01)[a]
Cost of treatment to health care system	81 (35.1)	4.3 (3.99-4.63)	68 (26.0)	3.8 (3.48-4.06)
Effectiveness of treatment	201 (87.0)	7.1 (6.85-7.25)	236 (90.1)	7.3 (7.12-7.45)
How treatment works	199 (85.6)	6.8 (6.60-7.05)	225 (85.9)	7.0 (6.85-7.21)
Goal or outcome of treatment	201 (86.1)	7.1 (6.86-7.26)	238 (90.8)	7.3 (7.12-7.43)
How long it takes for treatment to produce results	173 (74.9)	6.4 (6.11-6.60)	218 (83.2)	6.9 (6.69-7.07)[a]
How long treatment continues	168 (72.7)	6.3 (6.09-6.57)	215 (82.1)	6.8 (6.59-6.98)[a]
What happens when treatment stops	199 (86.1)	7.0 (6.74-7.16)	233 (88.9)	7.2 (6.99-7.34)
Common side effects of treatment	194 (84.0)	6.9 (6.70-7.10)	228 (87.0)	7.1 (6.95-7.30)
Uncommon but serious side effects of treatment	194 (84.0)	6.9 (6.67-7.10)	212 (80.9)	6.8 (6.62-7.01)
Advantages and disadvantages of treatment	189 (81.8)	6.8 (6.58-7.00)	233 (88.9)	7.1 (6.95-7.30)

[a]Web sample and Clinic sample CIs do not overlap.

[b]Each source was rated on a 9-point rating scale with the anchors 0-2 (not important), 3-5 (moderately important), and 6-8 (very important).

[c]"-" indicates items in Clinic but not Web survey.

Preferred Source of Advice

In the Clinic sample, respondents reported that if they were having serious problems with depression, they would be very likely to speak with a romantic partner or spouse (63.2%, 146/231), a family doctor (60.2%, 139/231), or a counselor or therapist (58.9%, 136/231; see Table 3). Those in the Web sample showed similar preferences in general, although this group reported a higher likelihood of speaking to a counselor or therapist (80.2%, 210/262) as compared with a family doctor (69.9%, 183/262), or a romantic partner or spouse (61.1%, 160/262). Few people reported being very likely to speak with a religious leader or elder in either sample (15.2%, 35/231 and 17.2%, 45/262).

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Table 3. How likely would you be to talk to one of the following people for advice if you were having a serious problem with depression?

Source of advice	Clinic sample (N=231)		Web sample (N=262)	
	Very likely n (%)	Mean rating (95% CI)	Very likely n (%)	Mean rating (95% CI)
Romantic partner or spouse	146 (63.2)	5.8 (5.53-6.14)	160 (61.2)	5.7 (5.33-5.97)
Parent	86 (37.2)	4.1 (3.76-4.52)	68 (26.0)	3.4 (3.10-3.78)
Family member (not parent)	74 (32.0)	4.0 (3.65-4.32)	76 (29.0)	3.8 (3.48-4.12)
Friend	106 (45.9)	5.0 (4.64-5.25)	139 (53.1)	5.2 (4.92-5.49)
Phone-in counseling or health line	69 (29.9)	3.8 (3.47-4.16)	81 (30.9)	3.99 (3.69-4.29)
Counselor or therapist	136 (58.9)	5.5 (5.21-5.82)	210 (80.2)	6.7 (6.43-6.88)[a]
Religious leader or community elder	35 (15.2)	2.1 (1.74-2.45)	45 (17.2)	2.1 (1.75-2.44)
Family doctor	139 (60.2)	5.7 (5.39-6.00)	183 (69.9)	6.1 (5.81-6.34)

[a]Web sample and Clinic sample CIs do not overlap.

[b]Each source was rated on a 9-point rating scale with the anchors 0-2 (not likely), 3-5 (moderately likely), and 6-8 (very likely).

Preferred Method of Receiving Information

There are several ways to receive information about depression and its treatment. Table 4 shows that Clinic participants indicated a high level of preference for receiving information through discussion with a medical doctor (61.9%, 143/231), a counselor or therapist (61.0%, 141/231), or through a written information sheet or a website that could be accessed from home (50.2%, 116/231). The Web sample not only indicated a greater preference for a discussion with a counselor or therapist (74.1%, 194/262 very preferred) but also indicated preference for information in written form (61.8%, 162/262 very preferred) through discussion with a medical doctor (59.2%, 155/262) or a website accessed from home (56.9%, 149/262). Video information through a website had the lowest level of preference for both the Clinic and Web surveys (about 30% highly preferred).

Table 4. Preferred method of receiving information about services.

Preferred method	Clinic sample (N=231)		Web sample (N=262)	
	Very preferred n (%)	Mean rating (95% CI)	Very preferred n (%)	Mean rating (95% CI)
Written form (information sheet)	116 (50.2)	5.3 (5.02-5.59)	162 (61.8)	6.0 (5.76-6.27)[a]
Discussion with medical doctor	143 (61.9)	5.9 (5.62-6.10)	155 (59.2)	5.7 (5.43-5.91)
Discussion with counselor or therapist	141 (61.0)	5.7 (5.44-6.00)	194 (74.1)	6.2 (6.01-6.46)[a]
Video on the Web	69 (29.9)	4.0 (3.67-4.32)	81 (30.9)	4.2 (3.93-4.49)
Recommended website accessed from home	116 (50.2)	5.0 (4.70-5.35)	149 (56.9)	5.6 (5.37-5.85)[a]

[a]Web sample and Clinic sample CIs do not overlap.

[b]Each source was rated on a 9-point rating scale with the anchors 0-2 (not preferred), 3-5 (moderately preferred), and 6-8 (very preferred).

Helpfulness of Various Forms of Assistance

In considering various forms of assistance for depression, many approaches to treatment were seen as likely to be very helpful by clinic respondents including in-person meetings with a counselor (68.8%, 159/231), exercise (66.2%, 153/231), and medication recommended by a psychiatrist (51.0%, 118/231; Table 5). A similar pattern of responses was found for the Web sample, but that group provided higher ratings of the helpfulness for most forms of assistance. (Note that the Web survey did not ask about exercise, meditation, herbal medication, or bright light therapy.)

Table 5. How helpful would the following types of assistance be if you were having a problem with depression?

Type of assistance	Clinic sample (N=231)		Web sample (N=262)	
	Very helpful n (%)	Mean rating (95% CI)	Very helpful n (%)	Mean rating (95% CI)
Recommended self-help book	72 (31.2)	4.3 (3.98-4.57)	113 (43.1)	4.9 (4.65-5.20)[a]
Recommended self-help website	81 (35.1)	4.5 (4.17-4.76)	109 (41.6)	5.1 (4.87-5.39)[a]
Telephone meetings with a counselor	86 (37.2)	4.4 (4.07-4.67)	131 (50.0)	5.0 (4.72-5.29)[a]
In person meetings with a counselor	159 (68.8)	6.1 (5.81-6.36)	223 (85.1)	6.9 (6.72-7.13)[a]
Educational meeting (about 2 h with 20-30 people)	65 (28.1)	4.0 (3.62-4.29)	94 (40.5)	4.2 (3.90-4.54)
Educational workshop (about 6 h with 20-30 people)	55 (23.8)	3.6 (3.25-3.90)	102 (38.9)	4.1 (3.81-4.47)
Web-based discussion group led by professional	42 (18.2)	3.2 (2.85-3.47)	63 (24.1)	3.7 (3.42-3.99)
Web-based discussion group led by person who has coped with depression	55 (23.8)	3.5 (3.18-3.82)	79 (30.2)	3.8 (3.51-4.11)
Medication recommended by your family doctor	109 (47.2)	4.9 (4.54-5.15)	147 (56.1)	5.4 (5.15-5.71)[a,b]
Medication recommended by a specialist in psychiatry	118 (51.1)	5.0 (4.72-5.34)	170 (64.9)	5.9 (5.57-6.14)[a]
Taking herbal medication	72 (31.2)	3.9 (3.55-4.21)	_[c]	-
Doing exercise	153 (66.2)	6.0 (5.69-6.22)	-	-
Doing meditation	109 (47.2)	4.9 (4.55-5.19)	-	-
Having bright light therapy	62 (26.8)	3.7 (3.37-4.04)	-	-

[a]Web sample and Clinic sample CIs do not overlap.

[b]Upon examination of the CIs with 3 decimal places, the CIs of the two samples do not overlap.

[c]"-" indicated items were in Clinic but not Web survey.

[d]Each source was rated on a 9-point rating scale with the anchors 0-2 (*not helpful*), 3-5 (*moderately helpful*), and 6-8 (*very helpful*).

Web Respondents Who Did and Did Not Receive an Honorarium

We evaluated the impact of the introduction of an honorarium to increase recruitment for the Web sample by comparing the subsamples before and after the introduction of the honorarium. The samples that received and did not receive an honorarium were very similar in demographic characteristics (see Multimedia Appendix 4). One noteworthy difference was that a higher proportion of males responded after the introduction of the honorarium, although there continued to be a high proportion of female respondents. Similar mean ratings and pattern of responses were also found for the information needs and preferences questions for both those who received the honorarium and those who did not receive it (see Multimedia Appendices 5-8). By adding the honorarium we were able to double our participation in half the time (1 month), which is consistent with previous research on improving response to Web- and paper-based surveys [35,36].

Predictors of Information Topics Considered Very Important

Table 6 describes the regression analysis for predictors of the number of information topics considered to be very important by participants in the Clinic sample. We focused on the Clinic sample because it was more diverse in terms of gender and ethnic background. The partial correlation (*pr*) reported in the table, when squared, indicates the unique proportion of the variance in the outcome that is accounted for by each predictor variable when all other predictors and their shared variance have been accounted for in the model. Gender (beta=−1.94, *P*=.007, *pr*=−.19), ethnicity (beta=1.85, *P*=.02, *pr*=.17), therapy received or needed (beta=2.07, *P*=.03, *pr*=.16), and medication received or needed (beta=−2.78, *P*=.005, *pr*=−.20) were found to be significant predictors of number of information topics after accounting for marital status, age, education, and distress level. Overall the females indicated more information topics as important than males (13.8 information topics as very important vs 12.2), the white respondents saw more topics as important than those from other groups (13.6 vs 11.8), those who had received or needed therapy saw more topics as important than those who had not (13.6 vs 12.8), and those who received or needed medication saw fewer topics as important than those who had not (12.6 vs 13.4). The reader should note that the magnitude of the difference in amount of information desired by the different demographic groups is small and that personal preferences may play a stronger role here than demographic characteristics [3].

Table 6. Predictors of composite information topic score for topics given a very important rating for the Clinic sample.

Predictor	B [a]	SE B [b]	Beta[c]	P value	pr [d]
Gender (0=female, 1=male)	−1.94	.72	−.19	.007	−.19
Ethnicity (0=nonwhite, 1=white)	1.85	.76	.17	.02	.17
Marital status (0=not married, 1=married)	.47	.76	.05	.54	.04
Age	.004	.03	.01	.88	.01
Education sum	−.02	.09	−.02	.83	−.02
Distress score	−.11	.09	−.10	.21	−.09
Therapy received or needed[e]	2.07	.92	.21	.03	.16
Medication received or needed	−2.78	.98	−.25	.005	−.20

[a]B: unstandardized coefficients (weights).

[b]SE B: standard error of unstandardized coefficient.

[c]Beta: standardized coefficients (weights).

[d]pr: partial correlation.

[e]Therapy received or needed includes individuals who indicated that they had previously received counseling or therapy for depression in the past or there was a time that they would have benefited from counseling or therapy but did not receive it.

[f]Medication received or needed includes individuals who indicated that they had previously received medication for depression in the past or there was a time that they would have benefited from medication but did not receive it.

[g]This includes the Clinic sample (N=231) data only. Information importance composite score was calculated by summing the topics that respondents provided a rating of 6-8 (very important). The range of scores on this variable is from 0 to 20.

Discussion

Principal Findings

In considering how typical respondents in the Clinic and Web surveys were of people living in the region, we compared characteristics of survey respondents with people living in the city of Winnipeg (population of about 700,000) and to those living in the province (population of about 1.3 million). Most of the Clinic participants would live in Winnipeg, whereas persons visiting the websites could have come from anywhere in the province. The Clinic sample is primarily from white (71.0%) and Aboriginal or First Nations (16.5%) cultural groups. Manitoba has an Aboriginal population of 14% [37], whereas Winnipeg has an Aboriginal population of 11% [38]. The Clinic sample, which was much more balanced for gender compared with the Web sample, had slightly more females than the general population of Manitoba and Winnipeg, which are 50% and 51% female, respectively [39,40]. There were smaller proportions of individuals in both samples who were working full-time compared with the general population (79% in the Manitoba population are working full-time; [41]). Both samples were similarly educated compared with the population of Manitoba with an average of 2 years of postsecondary education. It was found that 88% of the Manitoba population (aged 25-64 years) has attained a high school diploma or equivalent [42]. There were slightly more individuals in the two samples that indicated that they were married or living together in a marital like relationship (common law) compared with a rate of 46% in the general population of Manitoba and Winnipeg [40,43].

The Clinic sample reported less current distress and had less experience with previous treatments for depression than the Web sample. This is understandable because the Clinic sample was recruited from people seeking general medical assessment and treatment, whereas those visiting the self-help association websites were more likely focused on getting information on depression and anxiety. Furthermore, persons who have sought help in the past are more likely to seek help in the future [44]. In considering the higher proportion of females in the Web sample than the Clinic sample, possible explanations may be the higher prevalence of depression among females [45] and the greater tendency of them to seek help [46]. In the Clinic sample, we also found that females judge information on more topics to be very important.

The Clinic sample appears to produce more cultural diversity that is a closer match to the population. Both surveys had an underrepresentation of males relative to the population. In the case of the Web survey, this was improved somewhat by the use of an honorarium to encourage participation.

We found that in both Clinic and Web samples, people are interested in information on a wide range of topics. Participants were especially interested in psychological treatments, physical exercise, and medication treatments. Characteristics of treatments such as the effectiveness of treatments, their goals, duration, side effects, and what happens when treatment stops were also considered to be important. This finding that people are interested in information on many topics is consistent with previous research on mental health information needs and preferences [47,48].

One can imagine how difficult it would be to review this amount of information in the typical primary care visit of 10-15 min and even in a specialist visit of 20-50 min. More importantly from the patient's perspective it would also be very challenging to remember this amount of information if it were presented orally, especially when struggling with depression. In these situations, it is often helpful for the clinician to provide information in some form that can be reviewed over a longer

time period by the patient and concerned family and friends. This type of written information is commonly provided in the form of patient-oriented brochures [13] or Web-based information [14]. Even in text format, it would take considerable space to address all of the topics identified as important and to put this in the context of the quality of the scientific evidence available. One way of dealing with differences in preference among individuals for more or less information is to produce information focused on each topic and allow information users to choose the areas of information that are of most interest to them.

Other researchers [47] have found that Web-based resources about depression are reasonably good, although these researchers did not present information on the specific content areas covered by these websites. Current resources tend to describe the diagnosis and some of the treatments available but they provide little or no evidence-based information to answer most of the questions identified as important in this survey. The shortcoming in Web-based information is not limited to information concerning depression, but is also seen in information concerning other mental health problems such as children's anxiety [12], and medical conditions such as inflammatory bowel disease [11]. A challenge for those developing information resources is that there is a limited amount of evidence available to answer some of these questions and some of the information is difficult for professionals to access. Whereas there is a wide range of evidence concerning the effectiveness of psychological and pharmacological treatments for depression, there is little research available on self-help approaches, herbal remedies, exercise, meditation, and bright light therapy. Members of the public would have difficulty locating and evaluating the quality of this evidence. It would be valuable to take a knowledge synthesis approach [48] to review the evidence available to answer these questions and to provide information in a form that would be clear for the public and for health professionals.

A specific example of challenges in accessing evidence to answer an important question is the topic of what happens when psychological or medication treatment stops. Many medication treatment trials are of relatively short duration (eg, 8-12 weeks), include no follow-up period, and report no data on what happens after medication is discontinued. Psychological treatment trials often report follow-up after treatment is terminated but the time period is often limited (6-12 months; [49]). Studies including longer follow-up after treatment is discontinued, suggest that return of symptoms after treatment is discontinued is a common experience [50]. These studies would be difficult for the layperson and even a reasonably well-informed professional to locate and digest. Again, a knowledge synthesis approach of reviewing information, assessing the quality of research, and summarizing the information in clear language would be very helpful.

Ratings of importance of most topics were both greater overall in the Web sample compared with the Clinic sample. This is not surprising as those in the Web survey were seeking information, whereas those attending the clinic would have been seeking care for a wide range of health problems. The Web sample also reported higher levels of psychological distress,

which could be associated with a higher interest in depression information.

In considering people to speak to for advice, respondents reported a broad range of people that were seen as important sources of advice. Counselors and family doctors were seen as important sources of advice along with romantic partners and friends. In the Web group, a counselor or therapist was rated particularly highly as a source of advice. This may have been related to the high amount of experience in this group with counseling for depression.

Participants in both samples indicated preferences for receiving information in a variety of ways including discussion with a counselor or therapist, written form (such as a brochure), and discussion with a medical doctor. Despite being Web users, receiving information in written form or brochure was highly rated in the respondents to the Web survey. These findings demonstrate the importance of having information available to be delivered via different formats or methods, which is consistent with previous research in this area [3,51]. People do not have to choose a single source of information, and brochure or Web-based information can complement discussion with a health service provider and vice versa.

Overall, the pattern of responses on the helpfulness of assistance types between the Clinic and Web samples was quite similar. However, the Web sample provided higher ratings of helpfulness of most assistance types. The Web sample was more distressed and had more treatment experience so they may have seen treatment options as more helpful for this reason. In both samples, counseling or therapy was rated highest among the different forms of assistance, which is not surprising given the literature on preference for psychological treatments [52]. Medication as a treatment for depression has also been widely studied, has been shown to be effective, and is widely available [53]. Therefore, it is reasonable that many respondents also provided high ratings for medication recommended by a family doctor or psychiatrist. Self-help approaches to treating depression were rated significantly higher by the Web sample compared with the Clinic sample. As the Web sample participated in this survey by accessing self-help association websites, it is not surprising that they would be interested in self-help methods of treatment. Self-help resources are advantageous in that they are potentially widely available and usually associated with lower cost [54].

When we considered characteristics of respondents related to the number of information topics considered to be very important, we found that females, whites, and those who had received or felt they would have benefited from therapy in the past saw more topics as very important. Those who had received or thought that they would have benefited in the past from medication treatment saw fewer topics as important. The magnitude of these differences was modest however. This finding was similar to findings by Cunningham and colleagues [3] in a large survey with more than 1000 respondents from primary care clinics. Cunningham [3] found that there were larger differences based on patterns of information preferences and suggested that the best solution is to make information available in a variety of formats (paper and Web formats) in a

variety of settings, allowing people to choose the type of information they prefer. Taken together, the results suggest that both persons coping with depression and persons seeking information about depression would be interested in information developed to answer important questions concerning depression treatment. It is likely that information needs for other common mental health problems would be quite similar but this should be the subject of future research. Guidelines about the development and evaluation of health information for the public are available from the International Patient Decision Aids Standards collaboration [55]. The wide range of information topics judged to be important by members of the public suggests that it would be very difficult to address these information needs via oral communication during health care visits or using currently available materials. A resource with Web-based information and downloadable fact sheets has the advantage that it can provide information in a format that can be accessed by the public (searching for information for themselves or family members) and by health professionals interested in information to use to supplement discussions with their patients. Our team has been developing resources to address these needs with material address each of the main topics identified as important by community members. This resource focused on information for Canadians is available on the Web [56]. This information has been evaluated favorably by service providers in primary care settings [4]. Much of this information would be suitable for the public in many countries. National and regional information would be particularly helpful around questions concerning cost of treatment and resources available to support consumers in paying for treatment. The topics concerning the administrative aspects of treatment (health care providers providing treatment, waiting periods, location of services, hours) were also considered to be very important by many respondents. It is necessary to tailor this information at the regional and local level.

Limitations

This study has a few main limitations. One major limitation is the differences in the characteristics of the samples. Therefore, some of the differences found in the results may have been a consequence of the different make-up of the two samples. Recruiting more similar samples would have allowed for more control of potential sample effects. A second limitation is that the response rate for the Web survey is unknown. Due to a link to the survey being available on a number of websites, we do not know who might have reviewed the invitation to participate in the survey, and not clicked on the link to start completing the survey. In comparison, 71% of the people approached for the paper-based survey agreed to participate. Another limitation is that most of the respondents to the Web-based survey were female (84%). This limits the generalizability of those findings. However, we compared the results reported by males and females within the Clinic survey (57% female) and the response patterns were very similar (data not shown). The final limitation is related to the Clinic survey. Participants were recruited from primary health care settings and their opinions may not be generalizable to the opinions of the general public.

Conclusions

This is one of few studies that addresses the information needs and preferences concerning treatment options for depression. The findings may help practitioners in making resources available that assist members of the public in decision making. Each survey format has its advantages. The Clinic survey includes a more broad and representative sample. The Web survey through self-help association websites captures individuals who are clearly seeking information. Web surveys are considerably lower in cost than a survey administered by a research assistant inviting participation by visitors to a primary care medical clinic. The use of an honorarium to encourage participation increases response rate and likely representativeness of the sample (compared with the population at large), although it also increases the cost. The similarities in the broad findings between the Clinic and the Web surveys is reassuring and suggests that helpful opinions may be gathered by each method as long as the limitations of the sampling approach are recognized.

Authors' Contributions

MTB participated in study design, data analysis, data interpretation, and prepared the manuscript. JRW participated in survey design, data interpretation, and manuscript preparation. KAS participated in survey design and manuscript preparation. AK participated in survey design and manuscript preparation. BEB participated in data collection. All authors read and approved the final manuscript.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Website survey notice.

[PDF File (Adobe PDF File), 24KB - mental_v4i2e13_app1.pdf]

Multimedia Appendix 2

Complete version of survey.

[PDF File (Adobe PDF File), 83KB - mental_v4i2e13_app2.pdf]

Multimedia Appendix 3

Administrative aspects of treatment.

[PDF File (Adobe PDF File), 25KB - mental_v4i2e13_app3.pdf]

Multimedia Appendix 4

Sociodemographic characteristics of respondents who received or did not receive honorarium.

[PDF File (Adobe PDF File), 61KB - mental_v4i2e13_app4.pdf]

Multimedia Appendix 5

Treatment options: what information would be important to you if you were considering help? Responses with or without honorarium.

[PDF File (Adobe PDF File), 25KB - mental_v4i2e13_app5.pdf]

Multimedia Appendix 6

How likely would you be to talk to one of the following people for advice if you were having a serious problem with depression? Responses with and without honorarium.

[PDF File (Adobe PDF File), 23KB - mental_v4i2e13_app6.pdf]

Multimedia Appendix 7

Preferred method of receiving information about services. Responses with and without honorarium.

[PDF File (Adobe PDF File), 29KB - mental_v4i2e13_app7.pdf]

Multimedia Appendix 8

How helpful would the following types of assistance be if you were having a problem with depression? Responses with and without honorarium.

[PDF File (Adobe PDF File), 23KB - mental_v4i2e13_app8.pdf]

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Abbreviations

DSM: Diagnostic and Statistical Manual of Mental Disorders
REB: Research Ethics Board
SD: standard deviation

Original Paper

Delivering Cognitive Behavior Therapy to Young Adults With Symptoms of Depression and Anxiety Using a Fully Automated Conversational Agent (Woebot): A Randomized Controlled Trial

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Abstract

Background: Web-based cognitive-behavioral therapeutic (CBT) apps have demonstrated efficacy but are characterized by poor adherence. Conversational agents may offer a convenient, engaging way of getting support at any time.

Objective: The objective of the study was to determine the feasibility, acceptability, and preliminary efficacy of a fully automated conversational agent to deliver a self-help program for college students who self-identify as having symptoms of anxiety and depression.

Methods: In an unblinded trial, 70 individuals age 18-28 years were recruited online from a university community social media site and were randomized to receive either 2 weeks (up to 20 sessions) of self-help content derived from CBT principles in a conversational format with a text-based conversational agent (Woebot) (n=34) or were directed to the National Institute of Mental Health ebook, "Depression in College Students," as an information-only control group (n=36). All participants completed Web-based versions of the 9-item Patient Health Questionnaire (PHQ-9), the 7-item Generalized Anxiety Disorder scale (GAD-7), and the Positive and Negative Affect Scale at baseline and 2-3 weeks later (T2).

Results: Participants were on average 22.2 years old (SD 2.33), 67% female (47/70), mostly non-Hispanic (93%, 54/58), and Caucasian (79%, 46/58). Participants in the Woebot group engaged with the conversational agent an average of 12.14 (SD 2.23) times over the study period. No significant differences existed between the groups at baseline, and 83% (58/70) of participants provided data at T2 (17% attrition). Intent-to-treat univariate analysis of covariance revealed a significant group difference on depression such that those in the Woebot group significantly reduced their symptoms of depression over the study period as measured by the PHQ-9 (F=6.47; P=.01) while those in the information control group did not. In an analysis of completers, participants in both groups significantly reduced anxiety as measured by the GAD-7 ($F_{1,54}$= 9.24; P=.004). Participants' comments suggest that process factors were more influential on their acceptability of the program than content factors mirroring traditional therapy.

Conclusions: Conversational agents appear to be a feasible, engaging, and effective way to deliver CBT.

KEYWORDS

Introduction

Up to 74% of mental health diagnoses have their first onset before the age of 24 [1]. Depression and anxiety symptoms are particularly common among college students, with more than half reporting symptoms of anxiety and depression in the previous year that were so severe they had difficulty functioning [2]. In addition, epidemiological data suggest that mental health

problems are both increasing in prevalence and severity [3]. However, up to 75% of the college students that need them do not access clinical services [3]. While the reasons for this are varied, the ubiquity of free or inexpensive mental health services on campuses suggests that service availability and cost are not primary barriers to care [3]. Like non-college populations, stigma is considered the primary barrier to accessing psychological health services.

Overcoming problems of stigma has been traditionally considered a major benefit of Internet-delivered and more recently mobile mental health interventions. In recent years, there has been an explosion of interest and development of such services to either supplement existing mental health treatments or expand limited access to quality mental health services [4]. This development is matched by great patient demand with about 70% showing interest in using mobile apps to self-monitor and self-manage their mental health [5]. Internet interventions for anxiety and depression have empirical support [6] with outcomes comparable to therapist-delivered cognitive behavioral therapy (CBT) [7,8]. Yet, despite demonstrated efficacy, they are characterized by relatively poor adoption and adherence. One review found a median minimal completion rate of 56% [9]. A hypothesized reason for this lack of adherence is the loss of the human interactional quality that in-person CBT retains. For example, certain therapeutic process factors such as accountability may be more salient in traditional face-to-face treatments, compared to digital health interventions.

With recent advancements in voice recognition, conversational interfaces (ie, those that use natural language as inputs and outputs) have begun to emerge. Conversational agents (such as Apple's Siri or Amazon's Alexa) may be a more natural medium through which individuals engage with technology. Humans respond and converse with nonhuman agents in ways that mirror emotional and social discourse dynamics when discussing behavioral health [10] and their capacity to act as first responders has already been evaluated [11]. Theoretically, conversational interfaces may be better positioned than visually oriented mobile apps to deliver structured, manualized therapies because in addition to delivering therapeutic content, they can mirror therapeutic process. Indeed, Bickmore et al demonstrated that a carefully designed health-related conversational agent could establish a therapeutic relationship with adults attempting to increase exercise [10]. The intervention was an embodied conversational agent, that is, it was designed with a graphical face to mirror human interactions that are typically face-to-face.

However, most consumer-facing conversational agents are not embodied. The capacity of text-based agents to deliver CBT is a question worth exploring given the ability of widely disseminated evidence-based digital apps to reduce the burden of mental illnesses in the US college population, estimated to be approximately 20 million [12]. Unfortunately, the few mobile apps that have been evaluated formally have seen substantial challenges to sustainability since they tend to be built in academic research settings and rarely have the required infrastructure to support them. One systematic review of 5464 abstracts identified just 5 apps that had supporting evidence from randomized controlled trials, though, as of January 2014, none of them were available commercially [13]. Thus, in the

interest of sustainability, this study tested the ability of a commercially developed text-based conversational agent to deliver CBT to college students.

Given the variability in quality of available mental health apps, a conversational agent was created to integrate 15 out of the 16 evidence-based recommendations for app development [4] as follows: built using a CBT framework; addressing both anxiety and low mood; designed for use by nonclinical populations; incorporating automated tailoring; reporting of thoughts, feelings, or behaviors; recommending activities; provision of mental health information; real-time engagement; activities explicitly linked to specific reported mood problems; encouraging non technology-based activities; gamification and intrinsic motivation to engage; reminders to engage; simple and intuitive interface and interactions; and including links to crisis support services. While these recommendations were created in the context of mobile phone apps, to our knowledge, their relevance in the context of a conversational interface has never been tested.

Thus, the objective of this study was to assess the feasibility of delivering CBT in a conversational interface via an automated bot in a way that facilitates engagement and reduction in symptoms. The current study compared outcomes from 2 weeks of a CBT-oriented conversational agent (Woebot), or an information control group (National Institute of Mental Health's [NIMH] ebook) in a nonclinical college population. We hypothesized that conversation with a therapeutic process-oriented conversational agent would lead to greater improvement in symptoms relative to the information control group. We also hypothesized that receiving psychoeducational material in a conversational manner would be more acceptable to those who received it.

Methods

Recruitment and Procedure

Potential participants were recruited using a flyer posted on social media websites targeting a US university community for students who self-identified as experiencing symptoms of depression and anxiety. Inclusion criteria included age 18 and over (screened at the first level via checkbox confirmation) and able to read English (implied). To guard against compromise, for example from malicious bots, all potential participants were sent an email requesting that they respond denoting their confirmation. Confirmed participants were randomized via computer algorithm that automatically generated a number between 0 and 1. Participants with numbers 0.5 were allocated to receive a direct link to begin chatting with Woebot in an instant messenger app, and participants with numbers >0.5 were sent a link to NIMH's ebook on depression among college students [14], after completion of online baseline questionnaires. Because the randomization allocation occurred algorithmically, allocation concealment was in place. However, the condition to which each participant was allocated was not masked for the service providers (Woebot Labs). After approximately 2 weeks (T2), participants were contacted again to complete a second set of questionnaires online. Participants were offered a prorated

incentive of US $10 per completed assessment (US $20 for completion of both assessments).

Since this trial involved a nonclinical population of college students, it was considered exempt from registration in a public trials registry. See Multimedia Appendix 1 for the study's CONSORT-EHEALTH checklist [15].

Interventions

Woebot

Woebot is an automated conversational agent designed to deliver CBT in the format of brief, daily conversations and mood tracking. Woebot is used within an instant messenger app that is platform agnostic and can be used either on a desktop or mobile device. Each interaction begins with a general inquiry about context (eg, "What's going on in your world right now?"), and mood (eg, "How are you feeling?") with responses provided as word or emoji images to represent affect in that moment. After gathering mood data, participants are presented with core concepts related to CBT by link to short video, or by way of short "word games" designed to facilitate teaching participants about cognitive distortions. The first day included an "onboarding" process that introduced the bot, adding that while the bot may seem like a person, it is closer to a "choose your own adventure self-help book" and therefore not fully capable of understanding what the needs of the user may be. The bot also briefly explained CBT and notified the user that while a psychologist was "keeping an eye on things" (ie, monitoring), this was not happening in real time and thus the service should not be used as a replacement for therapy. In addition, participants were encouraged to call 911 for emergencies.

The bot employed several computational methods depending on the specific section or feature. The overarching methodology was a decision tree with suggested responses that also accepted natural language inputs with discrete sections of natural language processing techniques embedded at specific points in the tree to determine routing to subsequent conversational nodes. For the duration of the study, the decision tree structure remained the same for each participant and parameters did not change depending on the participants' inputs. Weekly graphs were processed using temporal pattern recognition to provide users with weekly mood description.

The bot's conversational style was modeled on human clinical decision making and the dynamics of social discourse. Psychoeducational content was adapted from self-help for CBT [16-18]. Aside from CBT content, the bot was created to include the following therapeutic process-oriented features:

Empathic responses: The bot replied in an empathic way appropriate to the participants' inputted mood. For example, in response to endorsed loneliness, it replied "I'm so sorry you're feeling lonely. I guess we all feel a little lonely sometimes" or it showed excitement, "Yay, always good to hear that!"

Tailoring: Specific content is sent to individuals depending on mood state. For example, a participant indicating that they feel anxious is offered in-vivo assistance with the anxious event.

Goal setting: The conversational agent asked participants if they had a personal goal that they hoped to achieve over the 2-week period.

Accountability: To facilitate a sense of accountability, the bot set expectations of regular check-ins and followed up on earlier activities, for example, on the status of the stated goal.

Motivation and engagement: To engage the individual in daily monitoring, the bot sent one personalized message every day or every other day to initiate a conversation (ie, prompting). In addition, "emojis" and animated gifs with messages that provide positive reinforcement were used to encourage effort and completion of tasks.

Reflection: The bot also provided weekly charts depicting each participant's mood over time. Each graph was sent with a brief description of the data to facilitate reflection, for example, "Overall, your mood has been fairly steady, though you tend to become tired after periods of anxiety. It looks like Tuesday was your best day."

Information Control Condition

In the information control condition, participants were directed to the NIMH resources section and specifically, a free publication entitled "Depression in College Students" [14]. The ebook provides comprehensive evidence-based information on depression among college students including sections on signs and symptoms, different types of treatments, answers to frequently asked questions, and a list of resources including further reading, helpline numbers, and other resources.

Measures

The Patient Health Questionnaire-9

The Patient Health Questionnaire (PHQ-9) [19] is a 9-item, self-report questionnaire that assesses the frequency and severity of depressive symptomatology within the previous 2 weeks. It is one of the most widely used, reliable, and validated measures of depressive symptoms. Each of the 9 items is based on the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (DSM-IV) criteria for major depressive disorder and can be scored on a 0 (not at all) to 3 (nearly every day) scale. Scores ranging from 0-5 indicate no symptoms of depression, and scores of 5-9, 10-14, 15-20, and 20 representing mild, moderate, moderately severe, and severe depression, respectively.

Generalized Anxiety Disorder-7

The Generalized Anxiety Disorder 7-item scale (GAD-7) [20] is a valid, brief self-report tool to assess the frequency and severity of anxious thoughts and behaviors over the past 2 weeks. Based on the DSM-IV diagnostic criteria for GAD, the scores of all 7 items range from 0 (not at all) to 3 (nearly every day). Therefore, the total score ranges from 0-21. A score 10 is indicative of moderate anxiety, with a score greater than 15 indicating severe anxiety.

Positive and Negative Affect Schedule

The Positive and Negative Affect Schedule (PANAS) [21] is a 20-item self-report measure of current positive and negative

affect. Half the items represent positive affect (ie, interested, excited, determined), whereas half of the items are indicative of negative affect (ie, hostile, scared, ashamed). Items are scored on a 1 (very slightly or not at all) to 5 (extremely) scale, with higher scores representing higher affect. Positive and negative affect are summed independent of each other with possible scores from 10-50.

Acceptability and Usability

Mixed-format questions assessed feasibility and acceptability of both conditions. Participants from both groups were asked to rate on a 5-point Likert scale their level of overall satisfaction and satisfaction with content (0=hated it, 5=loved it, 3=neutral, 2 and 4 unlabeled); the extent to which they felt the intervention facilitated emotional awareness (0=not at all, 5=a lot, 3=neutral, 2 and 4 unlabeled); whether or not they learned anything (binary, yes/no response), and to what extent this learning was relevant to their everyday life (0=not at all, 5=a lot, 3=neutral, 2 and 4 unlabeled). In addition, participants were asked what the best and worst thing about their experience was and to provide other comments. While we were mainly interested in qualitative responses pertaining to the Woebot condition, responses to the information control allowed for an informal assessment of engagement. Finally, for those in the Woebot condition, we recorded total number of interactions (ie, conversations) with the bot over the 2-week period. An interaction was deemed to have taken place if mood and context data were recorded. Session or conversation length varied from approximately 90 seconds to 10 minutes, depending on psychoeducational content.

Statistical Analysis

Statistical power calculations using analysis of covariance (ANCOVA) revealed that a sample size of 70 would have sufficient (80%) power to detect a moderate-large effect size (Cohen d=0.4) for depression, reported by a meta-analysis of Internet-delivered treatments for adult depression and anxiety [8], with alpha at 5%.

To determine whether any significant differences between groups existed at baseline, independent t tests were conducted on continuous baseline variables (eg, age, PHQ-9, GAD-7, and PANAS), and chi-square analyses conducted on categorical or nominal variables (gender, race, ethnicity). Univariate effects of group membership on T2 outcomes were examined using between-subjects ANCOVA adjusting for baseline measures. Cohen d effect sizes were calculated to examine the magnitude of between-group differences. All subjects were included in intention-to-treat (ITT) analyses. Prior to conducting these analyses, the multiple imputation procedure in SPSS v. 23 was used to handle missing data assumed to be missing at random.

As secondary subgroup analyses, we conducted completer analyses using 2x2 repeated measures analysis of variance (ANOVA) to explore main and interaction effects.

Qualitative Analysis

Participants' responses to open-ended questions were analyzed for the Woebot group using only thematic analysis and were reported as frequencies. Data were analyzed thematically using an inductive (data-driven) approach guided by the procedure outlined by Braun and Clarke [22]. Data codes were generated systematically, then collated into "thematic maps" and applied to the entire dataset to generate frequencies.

Ethics and Informed Consent

The study was reviewed and approved by Stanford School of Medicine's Institutional Review Board. Participants indicated their consent to the terms of the study via checkbox on an information sheet. As additional safety measures, participants in the Woebot group who denoted long-standing depression, suicidality, or self-harm were automatically provided with helpline numbers and a crisis text line number, and were encouraged to call 911 in emergencies.

With the exception of data on usage, which were collected by the Life Ninja Project, all study data were collected by the academic institution. Because of deidentification of all data transmitted between the Life Ninja Project and Stanford, usage data were not linked to specific research participants and are reported as means only for the entire group of study participants.

Results

Figure 1 shows the participant flow throughout the study. A total of 204 registrations were received between January 31 and February 20, 2017, and all registrants were asked to confirm their interest by return email. A total of 115 responded to this email, though 45 of these were deemed bot-generated (eg, email addresses with unusual almost identical formats and identical responses) and were deemed ineligible. The resultant sample of N=70 were randomized via computer algorithm to receive either a direct link to begin chatting with Woebot (n=34) in an instant messenger app, or NIMH's ebook on depression among college students [14] (n=36), after completion of online questionnaires at baseline.

Attrition

Of the randomized participants, 83% (58/70) went on to provide partial or complete data at T2 representing an overall attrition rate of 17%. Attrition was not equal between the arms and was greater among the information control group (31% vs 9%; χ^2_1=5.16; P=.023). However, independent t tests and chi-square analyses failed to detect evidence of significant differences at baseline between those who dropped out of the study versus those who did not on age (t_{68}=1.18; P=.24); GAD-7 (t_{68}=1.28; P=.89); PHQ-9 (t_{68}=.63; P=.59); PANAS positive (t_{68}=.79; P=.43) and negative (t_{68}=.02; P=.98) affect scores; or on gender (χ^2_1=1.75; P=.18) or ethnicity (χ^2_1=.066; P=.79).

Participant Demographics

Table 1 shows the demographic information and baseline scores on clinical variables for those with data from the entire sample (N=58). Participants were an average of 22.2 years old (SD 2.33) and over two-thirds female. Participants were mostly non-Hispanic (93%, 54/58), 79% Caucasian (46/58), with 7% (4/58) Asian, 9% (5/58) more than one race, 2% (2/58) African American, and 2% (2/58) Native American/Alaskan Native.

In terms of baseline characteristics, nearly half (46%, 32/69) of the sample was in the moderately-severe or severe range of

depression at baseline as measured by the PHQ-9, while three-quarters (74%, 52/70) were in the severe range for anxiety as measured by the GAD-7.

Figure 1. Participant recruitment flow.
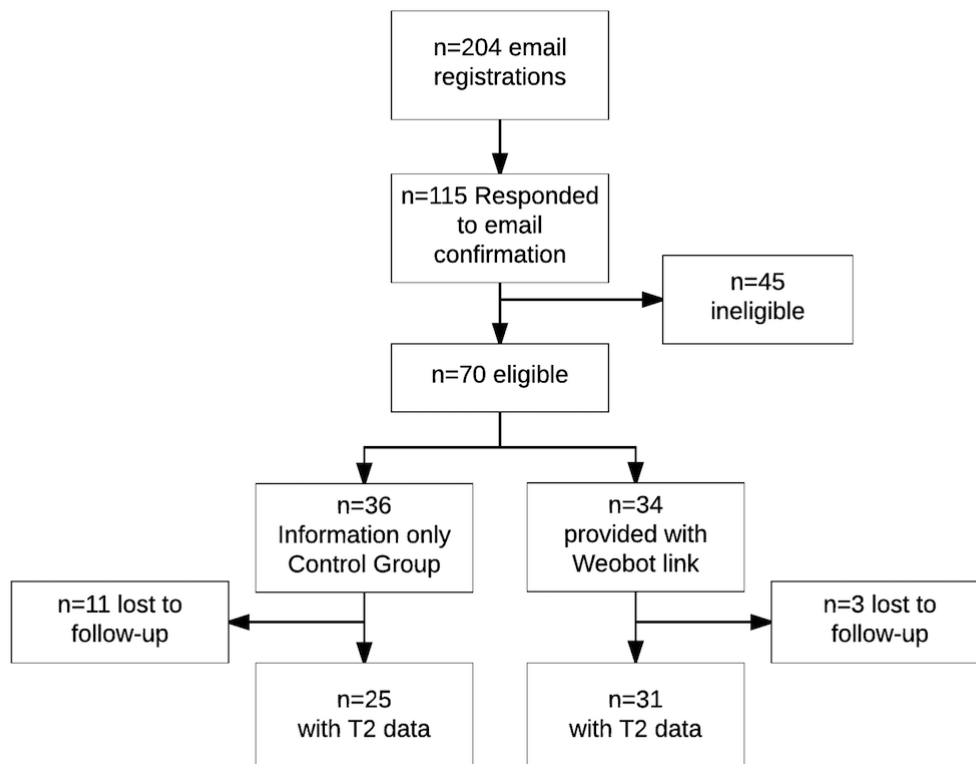
Table 1. Demographic and clinical variables of participants at baseline.

		Information control	Woebot
Scale, mean (SD)			
	Depression (PHQ-9)	13.25 (5.17)	14.30 (6.65)
	Anxiety (GAD-7)	19.02 (4.27)	18.05 (5.89)
	Positive affect	26.19 (8.37)	25.54 (9.58)
	Negative affect	28.74 (8.92)	24.87 (8.13)
Age, mean (SD)		21.83 (2.24)	22.58 (2.38)
Gender, n (%)			
	Male	4 (7)	7 (21)
	Female	20 (55)	27 (79)
Ethnicity, n (%)			
	Latino/Hispanic	2 (8)	2 (6)
	Non-Latino/Hispanic	22 (92)	32 (94)
	Caucasian	18 (75)	28 (82)
	Non-Caucasian	6 (25)	6 (18)

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Table 2. Results of ITT analysis of entire sample on primary outcomes in the study at T2.

	Information-only control		Woebot		F	P	d [c]
	T2 [a]	95% CI [b]	T2 [a]	95% CI [b]			
PHQ-9	13.67 (.81)	12.07-15.27	11.14 (0.71)	9.74-12.32	6.03	.017	0.44
GAD-7	16.84 (.67)	15.52-18.56	17.35 (0.60)	16.16-18.13	0.38	.581	0.14
PANAS positive affect	26.02 (1.45)	23.17-28.86	26.88 (1.29)	24.35-29.41	0.17	.707	0.02
PANAS negative affect	27.53 (1.42)	24.73-30.32	25.98 (1.24)	23.54-28.42	0.91	.912	0.344

[a] Baseline=pooled mean (standard error)

[b] 95% confidence interval.

[c] Cohen d shown for between-subjects effects using means and standard errors at Time 2.

Figure 2. Change in mean depression (PHQ-9) score by group over the study period. Error bars represent standard error.

Preliminary Efficacy

Table 2 shows the results of the primary ITT analyses conducted on the entire sample. Univariate ANCOVA revealed a significant treatment effect on depression revealing that those in the Woebot group significantly reduced PHQ-9 score while those in the informati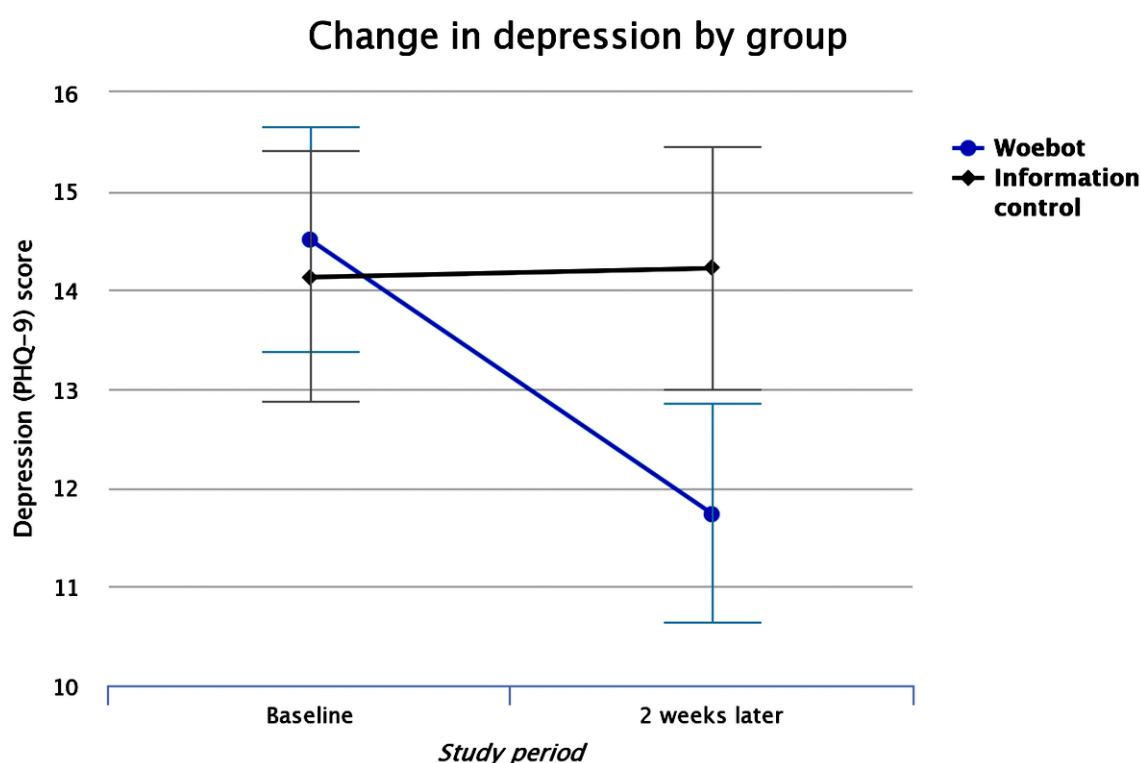on control group did not ($F_{1,48}$=6.03; P=.017) (see Figure 2). This represented a moderate between-groups effect size (d=0.44). This effect is robust after Bonferroni correction for multiple comparisons (P=.04). No other significant between-group differences were observed on anxiety or affect.

Completer Analysis

As a secondary analysis, to explore whether any main effects existed, 2x2 repeated measures ANOVAs were conducted on the primary outcome variables (with the exception of PHQ-9) among completers only. A significant main effect was observed on GAD-7 ($F_{1,54}$=9.24; P=.004) suggesting that completers experienced a significant reduction in symptoms of anxiety between baseline and T2, regardless of the group to which they were assigned with a within-subjects effect size of d=0.37. No main effects were observed for positive ($F_{1,50}$=.001; P=.951; d=0.21) or negative affect ($F_{1,50}$=.06; P=.80; d=0.003) as measured by the PANAS.

To further elucidate the source and magnitude of change in depression, repeated measures dependent t tests were conducted and Cohen d effect sizes were calculated on individual items of the PHQ-9 among those in the Woebot condition. The analysis revealed that baseline-T2 changes were observed on the following items in order of decreasing magnitude: motoric symptoms (d=2.09), appetite (d=0.65), little interest or pleasure in things (d=0.44), feeling bad about self (d=0.40), and concentration (d=0.39), and suicidal thoughts (d=0.30), feeling down (d=0.14), sleep (d=0.12), and energy (d=0.06).

Use and Acceptability

Participants in the Woebot condition checked in with the bot (defined as at least providing context and mood information) an average of 12.14 times (SD 2.23; median 12; range 8-18) over the 2-week period, with almost all check-ins occurring on unique days. Since we could not track website visits, page views, click-through rates, etc, of NIMH's website that hosted the ebook, we have no means of confirming to what extent individuals in the information control group engaged with the material. However, a total of 13 (52%) provided detailed comments suggesting they had read the ebook at least once.

While ratings indicated that both conditions were acceptable (above 3/5), participants in the Woebot condition reported significantly higher levels of satisfaction both overall (4.3 versus 3.4; t_{48}=3.99; P<.001) and with content (4.0 versus 3.4; t_{48}=2.30; P=.02), and they reported a significantly greater amount of emotional awareness as a result of using the bot (3.3 versus 2.7; $t_{47.06}$=2.38; P=.021) than the information control group. All (100%) of the participants in the Woebot group endorsed having learned something new versus three-quarters (77%) of the information control group, though numbers were too small in some cells to allow for a chi-square analysis. There was no difference between groups in how relevant participants viewed that learning to everyday life.

Qualitative Results

Figure 3 shows a thematic map of participants' responses to the question "What was the best thing about your experience using Woebot?" Two major themes emerged in respect to this question: process and content. In the process theme, the subthemes that emerged were accountability from daily check-ins (noted by 9 participants); the empathy that the bot showed, or other factors relating to his "personality" (n=7); and the learning that the bot facilitated (n=12), which in turn was divided into further subthemes of emotional insight (n=5), general insight (n=5), and insights about cognitions (n=2).

Figure 4 illustrates a thematic map of participants' responses to the question: "What was the worst thing about your experience with Woebot?" Three themes emerged: process violations (n=15), technical problems (n=8), and problems with content (n=8). By far the most common subtheme to emerge among the process violations related to the limitations in natural conversation such as the bot not being able to understand some responses or getting confused when unexpected answers were provided by participants (n=10), and 2 individuals noted that the conversations could get repetitive. Technical problems were described by 8 individuals, with technical glitches in general (n=4) and looping conversational segments (n=4) emerging as subthemes. Problems with content were described by 8 individuals, with most of these relating to emoticons and either interactions or content length.

Figure 3. Thematic map of participants' most favored features of their experience of using Woebot.
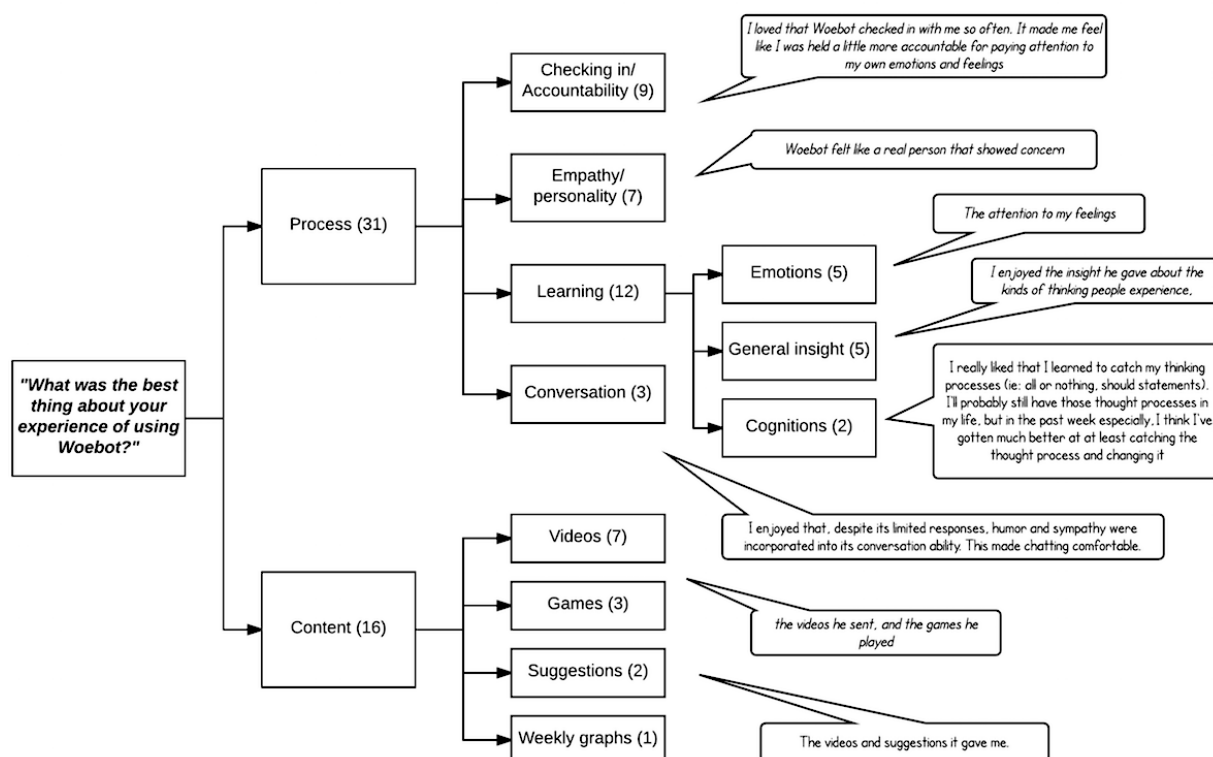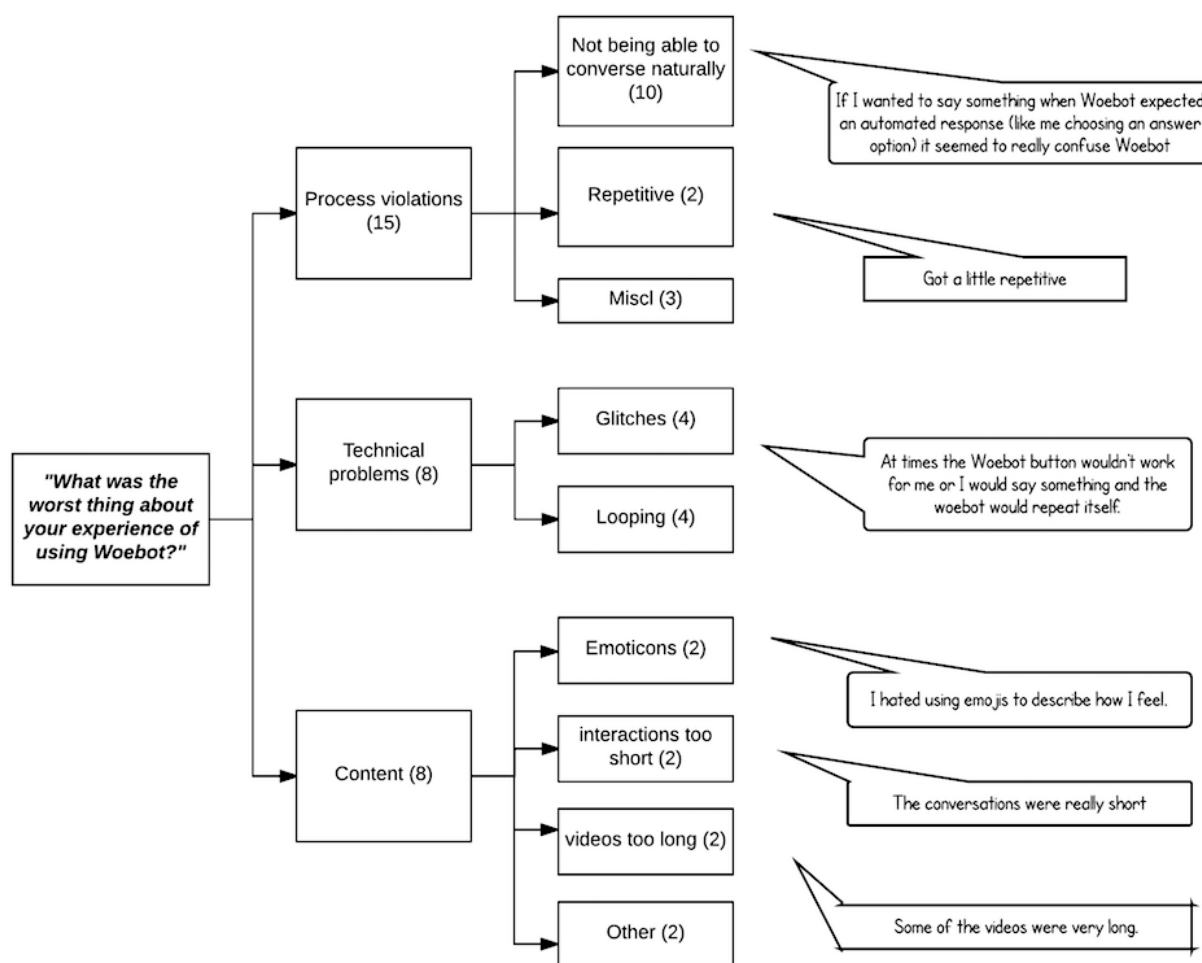
Figure 4. Thematic map of participants' least favored experiences using Woebot.

A total of 11 "other comments" were received, which were all positive, either expressing gratitude for the experience: "I love Woebot so much. I hope we can be friends forever. I actually feel super good and happy when I see that it 'remembered' to check in with me!" Statements described how helpful it was: "I really was impressed and surprised at the difference the bot made in my everyday life in terms of noticing the types of thinking I was having and changing it". Many spoke about Woebot in interpersonal terms, for example, "Woebot is a fun little dude and I hope he continues improving."

Discussion

Principal Results

To our knowledge this is the first randomized trial of a nonembodied text-based conversational agent designed for therapeutic use. The objective of the study was to explore whether a fully automated conversational agent based on CBT principals could deliver a therapeutic experience to college students over a 2-week period. We hypothesized that a conversational agent built to incorporate both evidence-based guidelines for the development of mental health apps as well as hypothesized therapeutic process variables would be highly engaging, more acceptable, and would lead to greater reductions

in symptoms of anxiety and depression relative to an information control group.

The study confirmed that after 2 weeks, those in the Woebot group experienced a significant reduction in depression, thus our hypothesis was partially supported. Woebot was associated with a high level of engagement with most individuals using the bot nearly every day and was generally viewed more favorably than the information-only comparison.

Comparisons With Prior Work

Using Woebot was associated with a significant reduction in depression as measured by the PHQ-9. The effect size for depression was moderate though smaller than the four published studies [23-26] that describe three other mobile app interventions targeting depression. For example, Burns et al [26] found a reduction in depression symptoms with a between-groups effect size of 1.9, and Watts et al also found significant reductions in PHQ-9 scores with an effect size of 1.56, both after an 8-week program. However, these interventions were much longer in duration than Woebot, which was just 2 weeks long. Indeed, our effect size for reduction in depression is in line with that observed in a randomized trial of DBT Coach [27], a mobile app for individuals with borderline personality disorder, who received a similar dose of 14 days.

The number of participants reporting that the bot felt empathic is noteworthy, and comments that referred to the bot as "he," "a friend," and a "fun little dude" suggest that the perceived source of empathy was Woebot rather than the bot's developers. This is especially noteworthy since a purposefully robotic name "Woebot" was chosen to emphasize the nonhuman nature of the agent. This is in line with other work that suggests that therapeutic relationship can be established between humans and nonhuman agents in the context of health and mental health. For example, Bickmore et al [10] have demonstrated that individuals using a bot to encourage physical activity developed a measurable therapeutic bond with the conversational agent after 30 days. This embodied bot was built on substantial design work on establishing human-computer relationships [28]. In addition, a trial that compared therapeutic engagement with a nonhuman agent between individuals randomized to think that there was a human operating the agent or not demonstrated that individuals were more willing to disclose to an artificially intelligent "virtual therapist" than when they believed it was human-operated [29]. The results of this preliminary trial suggest that this should be explored explicitly in future studies, ideally employing a standardized measure of working alliance, such as the Working Alliance Inventory [30].

The frequency of process-related comments made by participants in response to questions about their experience with Woebot suggests that conversational agents can approximate some therapeutic process factors. In addition, just as these factors are thought to convey much of the variance in positive outcomes across therapeutic approaches, this study suggests that conversational agent process factors, such as the ability to convey empathy, may be capable of both amplifying and conversely, violating, a therapeutic process. This underscores the importance of including trained and seasoned clinicians in clinical app design processes. While this point has been suggested, for example in the recent guidelines for clinical app evaluation published by the American Psychiatric Association [31], and in the United Kingdom by the National Institute for Health and Care Excellence [32], this study goes some way towards illustrating the impact that therapeutic process variables may have on user experience in the context of mental health apps.

Limitations

There are several methodological weaknesses that limit the generalizability of the findings. As a feasibility study, we recruited a limited number of participants to receive a relatively short intervention, and no follow-up data were available to assess whether gains were sustained. The small number of participants meant that a formal mediator analysis was not possible, thus we cannot formally test a theorized relationship between engagement and outcome in this context of conversational agents. The study should be replicated with more participants, a longer dose, and a follow-up period to investigate if findings persist. In addition, sufficient numbers to test for mediation effects would inform theory. Aside from indirectly inferring from comments, objective quantitative data on engagement were not available for the information-only control group, thus it was not possible to compare engagement between the two groups in a meaningful way. In addition, because data were deidentified, it was not possible to explore whether any dose-response effects existed. Nonetheless, the relatively strong comparison group can be viewed as a strength of the study. Indeed, the relative strength of the control group was illustrated by the fact that individuals providing data in that group saw a similar reduction in anxiety as those who received Woebot, which supports the literature that suggests minimal passive psychoeducation alone can reduce symptoms of psychological distress [33]. Nonetheless, the choice of control group was somewhat limiting for two main reasons. First, it may have contributed to the high attrition rate since an ebook is not designed for multiple or recurring sessions. It also did not introduce any CBT-specific material, thus it was not possible to evaluate whether the conversational delivery mediated symptom reduction, rather than the CBT content that the bot delivered. In order to answer this question adequately, future research should incorporate an interactive online CBT self-help intervention as a comparison condition.

Finally, the study was conducted in a New York area university community population and since we did not formally assess digital divide factors such as socioeconomic status, findings may be limited in their generalizability.

Conclusions

While results should be viewed with some caution and the findings need to be replicated, this study nonetheless demonstrates that a text-based conversational agent designed to mirror therapeutic process has the potential to offer an alternative and engaging method of delivering CBT for some 10 million college students in the United States who experience debilitating anxiety and depression.

Conflicts of Interest

The second author (AMD) is the founder of a commercial entity Woebot Labs Inc. (formerly, the Life Ninja Project) that created the intervention (Woebot) that is the subject of this trial and therefore has financial interest in that company. Woebot Labs Inc. covered the cost of participant incentives, though Standford made the payments.

Multimedia Appendix 1

CONSORT-EHEALTH checklist V1.6.2.

[PDF File (Adobe PDF File), 3MB - mental_v4i2e19_app1.pdf]

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Abbreviations

ANCOVA: analysis of covariance
ANOVA: analysis of variance
DSM-IV: Diagnostic and Statistical Manual of Mental Disorders, 4th edition
GAD-7: Generalized Anxiety Disorders scale
ITT: intention to treat
NIMH: National Institute of Mental Health
PANAS: Positive and Negative Affect Scale
PHQ-9: Patient Health Questionnaire scale
T2: time 2

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Original Paper

Who is More Likely to Use the Internet for Health Behavior Change? A Cross-Sectional Survey of Internet Use Among Smokers and Nonsmokers Who Are Orthopedic Trauma Patients

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Abstract

Background: eHealth presents opportunities to provide population groups with accessible health interventions, although knowledge about Internet access, peoples' interest in using the Internet for health, and users' characteristics are required prior to eHealth program development.

Objective: This study surveyed hospital patients to examine rates of Internet use, interest in using the Internet for health, and respondent characteristics related to Internet use and interest in using the Internet for health. For patients who smoke, preferences for types of smoking cessation programs for use at home and while in hospital were also examined.

Methods: An online cross-sectional survey was used to survey 819 orthopedic trauma patients (response rate: 72.61%, 819/1128) from two public hospitals in New South Wales, Australia. Logistic regressions were used to examine associations between variables.

Results: A total of 72.7% (574/790) of respondents had at least weekly Internet access and more than half (56.6%, 357/631) reported interest in using the Internet for health. Odds of at least weekly Internet usage were higher if the individual was born overseas (OR 2.21, 95% CI 1.27-3.82, P=.005), had a tertiary education (OR 3.75, 95% CI 2.41-5.84, P<.001), or was a nonsmoker (OR 3.75, 95% CI 2.41-5.84, P<.001). Interest in using the Internet for health increased with high school (OR 1.85, 95% CI 1.09-3.15, P=.02) or tertiary education (OR 2.48, 95% CI 1.66-3.70, P<.001), and if household incomes were more than AUS $100,000 (OR 2.5, 95% CI 1.25-4.97, P=.009). Older individuals were less interested in using the Internet for health (OR 0.98, 95% CI 0.97-0.99, P<.001).

Conclusions: Online interventions may be a potential tool for health care in this hospitalized population.

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Introduction

Worldwide rates of Internet access are high, with more than 3.5 billion people currently connected [1]. This reach is ever increased by mobile networks, which cover more than 90% of the globe, a reach forecasted to penetrate 71% of the global population by 2019 [2]. In Australia, 86% of households have Internet access, a rate which continues to increase with the development of the National Broadband Network [3,4]. Further, 3G and 4G networks increase this reach through mobile phone and tablet devices [5,6], making Internet-based programs more available. Using the Internet and technology for health, otherwise known as eHealth, is becoming more popular, with online programs used to deliver mental health care [7], change health behaviors [8], and deliver postsurgery rehabilitation programs [9]. eHealth programs are also attractive means of delivering interventions because they have a low cost per user [4,10], have the potential to reach people who may not have otherwise sought support [11], reduce stigma [4], and provide timely support when it is most needed [4]. Additionally, utilizing eHealth has been found to be acceptable to health care providers and patients [12,13].

Reviews on the effectiveness of eHealth interventions for health behavior change have found a mixed effect, stating that more research is needed in this area [14-17]. Potential factors contributing to this finding may include low uptake, adherence, or retention to online programs, with the format of online interventions regarded as an important factor in intervention effectiveness [18]. Therefore, consumer-based research to help understand patient-related factors likely to improve eHealth intervention use is important.

Within the hospital setting, previous research with people receiving treatment for orthopedic trauma has found that the receipt of health behavior change advice is low, despite patients' interest in receiving such care [19,20]. Reasons for low levels of behavior change support include lack of time or appropriate knowledge [21-28]. eHealth interventions may be one way to address this lack of care by providing behavior change support with minimal staff involvement. Previous eHealth programs developed to promote postsurgery rehabilitation have been acceptable to patients [9]. Another potential benefit is that eHealth-delivered care can be continued postdischarge from hospital, a component of hospital interventions that has been found to improve effectiveness [29].

Rates of engagement in risky behaviors such as heavy alcohol use, cannabis use, and tobacco smoking have been found to be higher in the orthopedic trauma population than the general population [19,30,31]. Continued tobacco use can have devastating effects on recovery from surgery, such as increased risk of postoperative infection [32-34], wound and flap necrosis [35], and a decrease in the tensile strength of wounds [36]. The benefits of abstinence after surgery are clear, with a review of 20 studies finding significantly fewer complications in former smokers when compared to current smokers postoperation [32]. The benefits of abstinence from postoperative smoking may include better wound healing, shorter length of hospital admission, decreased risk of mortality [37], as well as reduced interaction with prescribed medications [38]. Similar to tobacco use, alcohol and cannabis use can have a negative impact on recovery from surgery such as vasoconstriction resulting in decreased blood flow and delays in healing as well as lung disorders, if smoked (cannabis) [39]; and increased risk of infection and impaired wound healing (alcohol) [40]. Therefore, understanding the rates of usage of substances following orthopedic trauma may be a potential health risk behavior that needs addressing.

Characterization of orthopedic trauma patients has previously found they are more often younger males who come from a lower socioeconomic status, partake in more risky behavior, and have a lower level of educational attainment [31]. Younger males [3,41-43], who are of a higher socioeconomic status [41,43] and have attained a higher level of education [6,41,44], are more likely to use the Internet for health; however, younger males are also less likely to seek health care [45-48]. Therefore, online programs may provide an option to increase the care they receive during admission and postdischarge.

Previous research suggests that 75% to 92% of orthopedic trauma patients use the Internet [49-51]. Between 45% and 58% reported using the Internet for health information [49,50] and the majority used the Internet at home [51]. Further, using the Internet for postsurgery follow-up has been found acceptable by patients in this population [52,53]. This suggests that online health behavior change interventions may be well received by patients.

Although rates of access to the Internet are high, there is limited information about interest in using the Internet for health and no knowledge regarding the characteristics of patients more likely to use the Internet for health. Such information helps develop eHealth interventions that reach and engage the highest number of the target population. Because previous rates of current tobacco smoking, alcohol, and cannabis use are high among orthopedic trauma patients, an online program may be a potential option to address these risky health behaviors. Therefore, this study of hospitalized orthopedic trauma patients has a number of aims:

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1. Describe rates of Internet use, device use, and interest in using the Internet for health;
2. Examine patient characteristics associated with frequent (at least weekly) Internet use and interest in using the Internet for health; and
3. For patients who smoke, measure patient preferences for types of smoking cessation programs for use at home and while in hospital.

Methods

Design and Setting

An online cross-sectional survey was conducted with orthopedic trauma inpatients in two public hospitals in New South Wales, Australia. Surveys were conducted between April 2015 and September 2016. Ethics approval was obtained from Hunter New England Human Research Ethics Committee (approval number: 14/02/19/4.04), with site approval from the University of Newcastle Human Research Ethics Committee (approval number: H-2014-0081) and the South West Sydney Human Research Ethics Committee (approval number: HREC/14/HNE/46; SSA/14/LPOOL/191).

Participants

Patients were eligible if they had been admitted to hospital with a fracture, were aged between 18 and 80 years, and were able to read and comprehend written English. Patients judged incapable of providing consent by the research personnel were not approached to take part.

Patients were approached during admission by a research assistant (RA) to participant in an online health survey of orthopedic trauma patients. The RAs were provided daily with a list of new orthopedic trauma admissions from a research nurse. New admissions were approached consecutively by the RAs who assessed eligibility and gained informed consent. If an individual was too sick to be seen or was busy with medical staff on the day they were first approached, they were approached the following day. All participants were provided with a survey number to de-identify their results.

Measures

Existing validated items were used or adapted where possible [54-57]. Survey items are provided in Multimedia Appendix 1 and form part of a larger survey, which took respondents approximately 15 minutes to complete.

Participant Demographics

Respondent characteristics, such as gender, age, country of birth, indigenous status, marital status, education, main source of income, household income, and health insurance type, were all assessed.

Smoking Status and Smoking-Related Variables

Current smoking status was determined for all respondents using the questions: "Do you currently smoke tobacco?" (yes, daily; yes, at least once a week; yes, less than once a week; no, not at all) and "Have you smoked at least 100 cigarettes or a similar amount of tobacco in your life?" (yes; no; not sure) [57].

Alcohol Use

The Alcohol Use Disorder Identification Test (AUDIT-C) [54] was used to determine alcohol usage. Scoring for the AUDIT-C ranges from zero to 12 with cut-offs of three for females (sensitivity: 66%-73%; specificity: 91%-94%) [58,59] and four for males used to indicate heavy drinking (sensitivity: 86%; specificity: 72%-89%) [54,59].

Cannabis

Recent cannabis use was measured using a single item based on questions asked in the Opiate Treatment Index (OTI) [55]. Respondents were asked: "Have you used cannabis (marijuana, dope, grass, hash, pot) in the last 30 days?" (yes; no).

Internet-Related Questions

Individuals were asked questions relating to their use of the Internet [56] and if they would use the Internet to improve their health. Respondents were asked: (1) "In the last 12 months, how often have you accessed the Internet?" (every day; a few times per week; about once a week; less than once a week; not at all); (2) "In the last 12 months, did you access the Internet through any of the following? Computer (desktop or laptop), smartphone (eg, iPhone or Android), tablet (eg iPad), a device not owned by you (eg, a friend's smartphone, library or work computer)" (yes; no); (3) "Would you use the Internet to help improve your health?" (yes; no); and (4) "Do you have a computer with Internet access at home?" (yes; no).

Interest in Quit-Smoking Programs

Individuals who indicated that they were current tobacco users and had the Internet at home were also asked questions related to their interest in using a quit-smoking program on their computer at home and what type of quit-smoking program they would be interested in using while in hospital. Respondents were asked: "Would you use a quit-smoking program on your computer at home?" (definitely yes; maybe; unlikely; no) and "If available, what types of quit-smoking programs would you be interested in using while in hospital? DVD/television, printed booklet, telephone counseling, mobile phone text messaging, Internet program, face-to-face counseling" (yes; no).

Analysis

All data were stored on secure servers at the University of Newcastle and were exported into STATA version 13 (StataCorp LP, College Station, TX, USA) for analysis.

Descriptive statistics of participant sociodemographics are presented as numbers and percentages for categorical variables and means (standard deviation) or median (interquartile range) for continuous variables, depending on distribution of the data. Binary logistic regressions were used to examine the associations between age, gender, income, and education with at least weekly Internet use and with interest in using the Internet for health. At least weekly Internet access was determined by combining "every day," "a few times per week," and "about once a week." Variables entered in the model were selected a priori and included factors that have been previously associated with tobacco smoking in medically ill and general populations: age, gender, country of birth, education, marital status, and household income [60-62].

Adjusted odds ratios with 95% confidence intervals and *P* values were calculated for variables in the models. Significance was determined at *P*<.05. Collinearity of variables related to weekly Internet use and interest in using the Internet for health were checked using variance inflation factors (VIFs). No variables were found to be collinear, with all VIFs less than two.

Results

A total of 1708 orthopedic trauma admissions occurred during the study period, of which 1128 were approached and 819 subsequently agreed to participate in the survey (72 refused, 103 were too ill to participate, and 134 were not eligible; response rate: 72.61%). Some respondents dropped out during survey completion due to fatigue. A total of 803 individuals completed the survey (completion rate: 98.0%). Of these individuals, 175 (21.8%) identified as current tobacco users and form the subpopulation analyzed in this paper. A total of 173 current smokers completed the survey (completion rate: 98.9%). Due to the format and branching of survey questions, not all smokers answered the same questions (eg, individuals who did not own a computer at home were not asked if they would use a smoking cessation program on their computer at home).

Patient Demographics

Table 1 contains a summary of patient demographic information.

Rates of Internet Use and Type of Technology

Table 2 shows the rates of Internet use, access to the Internet at home, and types of technology used to access the Internet for the sample and by smoking status.

Interest in Using Technology for Health

Overall rate of agreement in using the Internet to improve health for the whole population was 56.6% (357/631) and 53.5% (76/489) for current tobacco users (Table 2).

Interest in Smoking Cessation Programs

Looking specifically at interest in smoking cessation programs for current tobacco users, Table 3 indicates that the majority (47.1%, 49/104) of current tobacco smokers would "definitely yes" or "maybe" use a quit-smoking program on their computer at home.

Table 1. Sociodemographic characteristics of the sample.

Sociodemographic characteristic and response options	Total (N=819)
Gender, n (%)	
Male	489 (59.7)
Female	330 (40.3)
Age (years)	
Mean (SD)	50.5 (17.7)
Median (IQR)	54 (35-66)
Country of birth, n (%)	
Australia	688 (84.1)
Other	130 (15.9)
Indigenous status, n (%)	
Aboriginal	39 (4.8)
Torres Strait Islander	4 (0.5)
Both Aboriginal and Torres Strait Islander	1 (0.1)
Neither	774 (94.6)
Marital status, n (%)	
Married	336 (41.1)
De facto/living with partner	135 (16.5)
Separated/divorced	86 (10.5)
Single	204 (24.9)
Widowed	57 (7.0)
Education, n (%)	
No formal education	4 (0.5)
Primary school	17 (2.1)
High school (7-10)	241 (29.5)
High school (11-12)	131 (16.0)
TAFE or trade	311 (38.0)
University	114 (13.9)
Main source of income, n (%)	
Paid employment (either full or part time)	427 (52.2)
Government pension or benefit	293 (35.8)
Family member	29 (3.6)
Savings or retirement funds	37 (4.5)
Other	32 (3.9)
Household income (AUS$), n (%)	
<$20,000 per year	80 (9.8)
$20,000-$50,000 per year	213 (26.1)
$51,000-$70,000 per year	129 (15.8)
$71,000-$100,000 per year	92 (11.3)
>$100,000 per year	101 (12.4)
Prefer not to state	200 (24.5)
Insurance type, n (%)	(n=815)

Sociodemographic characteristic and response options	Total (N=819)
Comprehensive private health insurance	253 (31.0)
Private health insurance-without extras	51 (6.3)
Private health insurance-extras only	34 (4.2)
Department of Veteran's Affairs white or gold card	11 (1.4)
Health care concession card	243 (29.8)
None of these	223 (27.4)
Smoking status, n (%)	(n=803)
Daily smoker	157 (19.6)
Occasional smoker	18 (2.2)
Exsmoker	235 (29.3)
Nonsmoker	393 (48.9)
AUDIT-C, n (%)	(n=795)
Nondrinker	185 (23.3)
Non-heavy drinker	198 (24.9)
Heavy drinker	412 (51.8)
Cannabis use last 30 days, n (%)	(n=811)
No	732 (90.3)
Yes	79 (9.7)

Table 2. Rates of Internet use, types of technology used, and interest in using the Internet for health for the sample.

Question and response options	Smoker, n (%)	Nonsmoker, n (%)	Total, n (%)[a]
Internet access last 12 months	(n=173)	(n=617)	(N=790)
Every day	82 (47.4)	355 (57.5)	437 (55.3)
A few times per week	19 (11.0)	92 (14.9)	111 (14.1)
About once a week	9 (5.2)	16 (2.6)	26 (3.2)
Less than once a week	11 (6.4)	29 (4.7)	40 (5.1)
Not at all	52 (30.1)	125 (20.3)	177 (22.4)
Devices used to access the Internet last 12 months	(n=173)	(n=617)	(n=790)
Computer (desktop or laptop)	87 (50.3)	426 (69.0)	513 (64.9)
Smartphone	113 (65.3)	418 (67.9)	531 (67.3)
Tablet	48 (27.8)	222 (36.0)	270 (34.2)
A device not owned by you	42 (24.3)	176 (28.6)	218 (27.6)
Do you have a computer at home with Internet access?	(n=153)	(n=554)	(n=707)
Yes	99 (64.7)	423 (76.4)	522 (73.8)
Would you use the Internet to improve your health?	(n=489)	(n=142)	(n=631)
Yes	76 (53.5)	281 (57.5)	357 (56.6)

[a] Respondents with available data.

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Table 3. Interest in smoking cessation program (current smokers only, n=175).

Question and response options	n (%)
Would you use a quit-smoking program on your computer at home? (n=104)[a]	
Definitely yes	18 (17.3)
Maybe	31 (29.8)
Unlikely	16 (15.4)
No	39 (37.5)
If available, what type of quit-smoking program used while in hospital? (n=159)[a]	
DVD/television	37 (22.6)
Printed booklet	42 (26.4)
Telephone counseling	35 (22.0)
Mobile phone text messaging	37 (23.3)
Internet program	46 (28.9)
Face-to-face counseling	52 (32.7)
None of these	73 (45.9)

[a] Current smokers with available data.

The Relationship Between Age, Gender, Smoking Status, and Substance Use With at Least Weekly Internet Usage

The odds of having at least weekly Internet access was 1.08 times lower per year older (95% CI 0.90-0.93, $P<.001$). The odds of at least weekly Internet access were found to be 2.21 times higher if the respondent was born overseas when compared to Australian born (95% CI 1.27-3.82, $P=.005$), 3.75 times higher if the individual had a tertiary education (95% CI 2.41-5.84, $P<.001$), 3.51 times higher if the individual was a nonsmoker (95% CI 2.03-6.09, $P<.001$), and 1.90 times higher for a heavy drinker when compared to a nondrinker (95% CI 1.15-3.14, $P=.01$) (Table 4).

The Relationships Between Age, Gender, and Substance Use With Interest in Using the Internet for Health

The odds of being interested in using the Internet to improve health was 1.02 times lower for each year older (95% CI 0.97-0.99, $P<.001$). Conversely, the odds of being interested in using the Internet to improve health was 2.48 times higher for individuals if they had a tertiary education (95% CI 1.66-3.07, $P<.001$), 1.85 times higher if the individual had a high school education (95% CI 1.09-3.15, $P=.02$), and 2.5 times higher if the participant had a household income of more than AUS $100,000 (95% CI 1.25-4.97, $P=.009$) (Table 5).

Discussion

A minimum of at least weekly Internet usage was slightly lower in this sample of orthopedic trauma patients than the national average (72.5% vs 86%) [6]. As expected, age and education were both found to be associated with at least weekly Internet access. Country of birth, educational attainment, smoking status, and alcohol consumption were also found to be significant predictors of Internet access. These are important patient characteristics to note because rates of substance use and factors around their use and treatment often differ between cultures [63], a point which may need considering in the development of any eHealth interventions for substance use within this population. Further, when examining Internet use by current smoking status, the percentage of at least weekly access dropped to 63.6%. This may indicate that an online smoking cessation program may only benefit those individuals who are younger and who have a greater level of educational attainment. This is important because the development of an online program may segregate a portion of the population who are unable to access the Internet postdischarge (if hospitals provide devices and Internet access to use during admission). Further, this may reflect the lower socioeconomic status of trauma patients [31] and current tobacco users [64], with younger age and a higher level of education attainment related to higher rates of Internet usage [3,41,44]. Differences in access to the Internet may deepen the digital divide in receipt of care, with age and education [44] found to be associated with access to eHealth interventions. However, previous research suggests the digital divide to be a myth in the orthopedic trauma population [51], although results from this study may suggest otherwise. Therefore, the possibility of a digital divide should be acknowledged during intervention development and implementation, with alternate care designed for those who may not have access.

Table 4. Logistic regression of the associations with at least weekly Internet use for the whole sample (N=805).

Variable	At least weekly Internet use, n (%)	Crude OR (95% CI)	P	AOR[a] (95% CI)	P
Age		0.93 (0.92-0.94)	<.001	0.92 (0.90-0.93)	<.001
Gender			.001		.50
Male	378 (78.1)	Ref		Ref	
Female	208 (64.8)	0.52 (0.38-0.71)		1.16 (0.75-1.79)	
Country of birth			.25		.005
Australia	486 (72.0)	Ref		Ref	
Other	100 (76.9)	1.30 (0.83-2.02)		2.21 (1.27-3.82)	
Education			<.001		<.001
No formal/primary school/high school (7-10)	130 (50.4)	Ref		Ref	
High school (11-12)	97 (75.2)	2.98 (1.87-4.77)	<.001	1.37 (0.77-2.46)	.29
TAFE trade/university	359 (85.9)	5.99 (4.15-8.66)	<.001	3.75 (2.41-5.84)	<.001
Marital status			.005		.07
Married/de facto	353 (76.6)	Ref		Ref	
Single/widowed/ separated/divorced	233 (67.7)	0.64 (0.47-0.88)		0.67 (0.44-1.03)	
Household income (AUS$)			<.001		.21
<$50,000	178 (61.6)	Ref		Ref	
$51,000-$100,000	169 (77.2)	2.11 (1.42-3.13)	<.001	1.26 (0.75-2.11)	.38
> $100,000	93 (93.0)	8.28 (3.71-18.51)	<.001	2.45 (0.98-6.13)	.06
Prefer not to state	146 (74.1)	1.79 (1.20-2.66)	.004	1.10 (0.66-1.83)	.71
Smoker			.003		<.001
Current	110 (63.6)	Ref		Ref	
Nonsmoker	463 (75.0)	1.72 (1.20-2.47)		3.51 (2.03-6.09)	
Cannabis use			.51		.63
No	526 (72.5)	Ref		Ref	
Yes	60 (76.0)	1.20 (0.70-2.06)		0.84 (0.40-1.73)	
Alcohol consumption			<.001		.04
Nondrinker	100 (54.6)	Ref		Ref	
Non-heavy drinker	148 (75.5)	2.56 (1.65-3.96)	<.001	1.67 (0.96-2.90)	.07
Heavy drinker	324 (79.0)	3.13 (2.15-4.55)	<.001	1.90 (1.15-3.14)	.01

[a] Model adjusted for age, gender, country of birth, marital status, household income, current smoking status, cannabis use, and alcohol consumption. AOR: adjusted odds ratio.

Table 5. Logistic regression of associations with interest in using the Internet for health for the whole sample (n=644).

Variable	Interested in using Internet for health, n (%)	Crude OR (95% CI)	P	AOR[a] (95% CI)	P
Age		0.98 (0.97-0.99)	<.001	0.98 (0.97-0.99)	<.001
Gender			.81		.36
Male	226 (57.2)	Ref		Ref	
Female	140 (56.2)	0.96 (0.70-1.32)		1.19 (0.82-1.75)	
Country of birth			.82		.45
Australia	304 (57.0)	Ref		Ref	
Other	62 (55.9)	0.95 (0.63-1.44)		1.20 (0.75-1.90)	
Education			<.001		<.001
No formal/primary school/high school (7-10)	82 (38.7)	Ref		Ref	
High school (11-12)	63 (60.6)	2.44 (1.51-3.94)	<.001	1.85 (1.09-3.15)	.02
TAFE Trade/University	221 (67.6)	3.27 (2.28-4.69)	<.001	2.48 (1.66-3.70)	<.001
Marital status			.54		.76
Married/de facto	213 (57.9)	Ref		Ref	
Single/widowed/ separated/divorced	153 (55.4)	0.91 (0.66-1.24)		1.06 (0.73-1.54)	
Household income (AUS$)			<.001		.001
<$50,000	121 (51.7)	Ref		Ref	
$51,000-$100,000	98 (63.6)	1.63 (1.08-2.48)	.02	1.50 (0.94-2.40)	.09
>$100,000	64 (82.1)	4.27 (2.27-8.04)	<.001	2.50 (1.25-4.97)	.009
Prefer not to state	83 (46.6)	0.82 (0.55-1.21)	.31	0.73 (0.47-1.12)	.15
Smoker			.40		.67
Current	76 (53.5)	Ref		Ref	
Nonsmoker	281 (57.5)	1.17 (0.81-1.71)		1.10 (0.70-1.73)	
Cannabis use			.96		.86
No	330 (56.8)	Ref		Ref	
Yes	36 (57.1)	1.01 (0.60-1.72)		1.06 (0.57-1.95)	
Alcohol consumption			.04		.63
Nondrinker	69 (47.6)	Ref		Ref	
Non-heavy drinker	91 (58.3)	1.54 (0.98-2.43)	.06	1.26 (0.76-2.08)	.37
Heavy drinker	198 (60.2)	1.66 (1.12-2.47)	.01	1.20 (0.77-1.87)	.41

[a] Model adjusted for age, gender, country of birth, marital status, household income, current smoking status, cannabis use, and alcohol consumption. AOR: adjusted odds ratio.

Just over half the respondents indicated that they would be interested in using the Internet for health, with interest in using the Internet for health found to be associated with younger age, higher education, and higher household income. Other research has found greater use of the Internet for health by users with higher socioeconomic status [65] and this too may contribute to the potential for a digital divide in this population. Alternatively, patients may simply be unaware of what eHealth programs are and what they could deliver. In a large mental health survey, attitudinal resistance toward Internet-based interventions was cited as a possible explanation for lack of interest in using the Internet for heath [66]. Patient education of eHealth programs may counter this effect [67].

Tobacco smoking in particular is a serious threat to the recovery and health of orthopedic trauma patients. When respondents who were current tobacco users were asked what types of quit-smoking programs they would prefer to use while in hospital, an Internet program was supported, second only to face-to-face counseling. Given there are a multitude of barriers to the delivery of face-to-face smoking cessation counseling, these results suggest online programs may be well received by patients who smoke. Continuing to address smoking in the orthopedic trauma population has the added benefit of reducing the overall health-related costs, both to the individual and the health care system.

Limitations

The main limitation of this study is that the sample was recruited from two hospitals and the results are not generalizable to other hospital population patients groups (eg, cardiac patients) because characteristics between different medical groups differ, with orthopedic trauma patients being usually younger, risk-taking males [31].

Implications

These results suggest that access to the Internet and interest in using the Internet for health may be acceptable to some orthopedic trauma patients. Patients who use tobacco reported interest in receiving additional support to quit during admission through eHealth interventions. The provision of care through eHealth interventions may change the landscape of the health care environment in primary settings because it may provide a form of care that is acceptable to patients, while addressing some of the limitations to the provision of care by staff (ie, lack of appropriate knowledge or skills [24-27], time constraints, and lack of resources) [23,27,28]. Although no health behavior change intervention programs for orthopedic trauma patients are known to the authors, online programs have been implemented in other medical populations [68,69], with mixed effects found. Further, smoking cessation-specific eHealth interventions have been implemented in the general population and have been found to be effective [70-72].

Notably, a Cochrane review of smoking cessation for hospitalized patients found interventions that are more intensive and contain at least one month follow-up after discharge from hospital are effective at increasing cessation following hospital admission [29]. Therefore, online programs could be used postdischarge, providing the recommended follow-up support.

Conclusions

Online health programs appear to be of interest to orthopedic trauma patients. In particular, development of online programs to assist patients who smoke to quit smoking during their hospitalization and postdischarge may be suitable for this population. An online program could be acceptable to the majority of trauma patients that are current tobacco users who desire more help to quit. The development of novel approaches to providing health care may change the landscape of the primary health setting.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Supplementary file.

[PDF File (Adobe PDF File), 36KB - mental_v4i2e18_app1.pdf]

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Abbreviations

AUDIT-C: Alcohol Use Disorder Identification Test
OTI: Opiate Treatment Index
RA: research assistant
VIF: variance inflation factor

Viewpoint

Supporting Homework Compliance in Cognitive Behavioural Therapy: Essential Features of Mobile Apps

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Abstract

Cognitive behavioral therapy (CBT) is one of the most effective psychotherapy modalities used to treat depression and anxiety disorders. Homework is an integral component of CBT, but homework compliance in CBT remains problematic in real-life practice. The popularization of the mobile phone with app capabilities (smartphone) presents a unique opportunity to enhance CBT homework compliance; however, there are no guidelines for designing mobile phone apps created for this purpose. Existing literature suggests 6 essential features of an optimal mobile app for maximizing CBT homework compliance: (1) therapy congruency, (2) fostering learning, (3) guiding therapy, (4) connection building, (5) emphasis on completion, and (6) population specificity. We expect that a well-designed mobile app incorporating these features should result in improved homework compliance and better outcomes for its users.

Homework Non-Compliance in CBT

Cognitive behavioral therapy (CBT) is an evidence-based psychotherapy that has gained significant acceptance and influence in the treatment of depressive and anxiety disorders and is recommended as a first-line treatment for both of these [1,2]. It has also been shown to be as effective as medications in the treatment of a number of psychiatric illnesses [3-6]. Homework is an important component of CBT; in the context of CBT, homework can be defined as "specific, structured, therapeutic activities that are routinely discussed in session, to be completed between sessions" [7]. Completion of homework assignments was emphasized in the conception of CBT by its creator, Aaron Beck [8]. Many types of homework are

prescribed by CBT practitioners, including symptom logs, self-reflective journals, and specific structured activities like exposure and response prevention for obsessions and compulsions. These can be divided into the following 3 main categories: (1) psychoeducational homework, (2) self-assessment homework, and (3) modality-specific homework. Psychoeducation is an important component in the early stage of therapy. Reading materials are usually provided to educate the client on the symptomatology of the diagnosed illness, its etiology, as well as other treatment-relevant information. Self-assessment strategies, including monitoring one's mood using thought records, teach the patients to recognize the interconnection between one's feelings, thoughts, and behaviors [8]. For example, depressed patients may be asked to identify thinking errors in daily life and document the negative influences

these maladaptive thinking patterns can produce on their behaviors. Various psychiatric disorders may require different types of modality-specific homework. For example, exposure to images of spiders is a treatment method specific to arachnophobia, an example of a "specific phobia" in the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) [9]. Homework is strategically created by the therapist to correct and lessen the patient's psychopathology. The purpose of these exercises is to allow the patients to practice and reinforce the skills learned in therapy sessions in real life.

Homework non-compliance is one of the top cited reasons for therapy failure in CBT [10] and has remained a persistent problem in the clinical practice. Surveys of practitioners have suggested rates of non-adherence in adult clients of approximately 20% to 50% [10,11] while adherence rates in adolescents have been reported to be approximately 50% [12]. Many barriers to homework compliance have been identified in the literature; to facilitate discussions, they can be divided into internal and external factors. Internal factors originate from a client's own psychological environment while external ones are created by external influences. Internal factors that have been identified include lack of motivation to change the situation when experiencing negative feelings, the inability to identify automatic thoughts, disregard for the importance or relevance of the homework, and the need to see immediate results [12-14]. Various external factors have also been identified, including the effort associated with pen-and-paper homework formats, the inconvenience of completing homework because of the amount of time consumed, not understanding of the purpose of the homework, lack of instruction, and failure to anticipate potential difficulties in completing the homework [14-16]. There is strong evidence suggesting that homework compliance is integral to the efficacy of CBT in a variety of psychiatric illnesses. In the treatment of depression with CBT, homework compliance has been correlated with significant clinical improvement and shown to predict decreases in both subjective and objective measures of depressive symptoms [17-23]. Similarly, homework compliance is correlated with short-term and long-term improvement of symptoms in anxiety disorders, including generalized anxiety disorder (GAD), social anxiety disorder (SAD), hoarding, panic disorder, and post-traumatic stress disorder (PTSD) [17,24-32]. Fewer studies have been done on homework compliance in other psychiatric conditions, but better homework compliance has been correlated with significant reductions in pathological behaviors in psychotic disorders [33,34], cocaine dependence [35,36], and smoking [37]. Two meta-analyses further support the notion that greater homework adherence is associated with better treatment outcomes in depression, anxiety-related disorders, and substance use [38,39].

The Utility of Technology in Enhancing CBT Homework

Despite its demonstrated efficacy, access to CBT (as well as other forms of psychotherapy) remains difficult due to the limited number of practicing psychotherapists and the cost of therapy sessions [40]. With the rise of mass-market mobile communication devices such as the iPhone or other kinds of mobile devices with app capabilities (smartphones), new solutions are being sought that will use these devices to provide therapy to patients in a more cost-effective manner. Mobile phones with app capabilities are portable devices that combine features of a cellphone and a hand-held computer with the ability to wirelessly access the Internet. Over time, ownership of mobile phones in North America has grown [41,42] and progressively lower prices have further reduced barriers to their use and ownership [43,44]. As more and more people acquire mobile phones, the acceptance of and the demand for mobile health solutions have been on the rise [45]. Boschen (2008), in a review predating the popularization of the modern mobile phone, identified the unique features of the mobile telephone that made it a potentially suitable vehicle for adjunctive therapeutic applications: portability, acceptability, low initial cost, low maintenance cost, social penetration and ubiquity, "always on," "always connected," programmability, audio and video output, keypad and audio input, user-friendliness, and ease of use [46]. Over the last decade, modern mobile phones have supplanted the previous generation of mobile telephones; progressive increases in their computing power, ongoing advances in the software that they run and interact with (eg, JAVA, HTML5, etc.), common feature sets across different operating systems such as Google Inc.'s Android or Apple Inc.'s iOS, and adoption of common hardware elements across manufacturers (eg, touch screens, high-resolution cameras, etc) have enabled the development of platform-independent apps for mobile phones, or at least apps on different platforms with comparable functionality (eg, apps written for Apple's HealthKit or the apps written for Microsoft's HealthVault).

The popularization of the smartphone presents a unique opportunity to enhance CBT homework compliance using adjunctive therapeutic applications such that well-designed mobile software may be able to diminish barriers to CBT [40] by making CBT therapists' work more cost-effective. However, there are no guidelines and no existing research that directly address the design of mobile phone apps for this purpose. Given this gap in the literature, we searched MEDLINE (1946 to April 2015) and PsycINFO (1806 to April 2015) for all articles related to "cognitive behavioral therapy", "homework", "mobile applications" and "treatment compliance or adherence", and reviewed articles related to (1) mobile technologies that address homework completion, (2) essential features of therapy, or (3) barriers to homework completion in CBT. In this article, we propose a collection of essential features for mobile phone-based apps that will optimally support homework compliance in CBT.

A Proposed List of Essential Features for Mobile Apps That Optimally Support CBT Homework Compliance

In order to be effective for patients and acceptable to therapists, an optimal mobile phone app to support CBT homework compliance should conform to the CBT model of homework while addressing barriers to homework compliance. Tompkins (2002) provides a comprehensive guideline on the appropriate ways to provide CBT homework such that homework should

be meaningful, relevant to the central goals of therapy, salient to focus of the session, agreeable to both therapist and client, appropriate to sociocultural context, practiced in session to improve skill, doable, begin small, have a clear rationale, include written instructions, and include a backup plan with homework obstacles [47]. In addition, the therapist providing the homework needs to be curious, collaborative, reinforce all pro-homework behavior and successful homework completion, and emphasize completion over outcome [47]. By combining Tompkins' guidelines with the need to reduce barriers to homework compliance (as described above), we obtained the following list of 6 essential features that should be incorporated into mobile apps to maximize homework compliance: (1) congruency to therapy, (2) fostering learning, (3) guiding therapy, (4) building connections, (5) emphasizing completion, and (6) population specificity.

Congruency to Therapy

Any intervention in therapy needs to be relevant to the central goals of the therapy and salient to the focus of the therapeutic session. A mobile app is no exception; apps have to deliver useful content and be congruent to the therapy being delivered. There are different types of homework in CBT, including (1) psychoeducational homework; (2) self-assessment homework; and (3) modality-specific homework. Which types are assigned will depend on the nature of the illness being treated, the stage of treatment, and the specific target [48]. An effective app supporting homework compliance will need to be able to adjust its focus as the therapy progresses. Self-monitoring and psychoeducation are major components in the early stage of therapy. Thought records can be used in depression and anxiety while other disorders may require more specific tasks, such as initiating conversation with strangers in the treatment of SAD. Therefore, the treatment modules delivered via mobile phones should meet the specific needs of therapy at each stage of therapy, while also providing psychoeducation resources and self-monitoring capabilities.

Psychoeducational Homework

While there are large amounts of health-related information on the Internet, the majority of information is not easily accessible to the users [49]. Mobile apps can enhance psychoeducation by delivering clear and concise psychoeducational information linked to the topics being covered in therapy. As psychoeducation is seen as a major component of mobile intervention [50], it has been incorporated into several mobile apps, some of which have been shown to be efficacious in treating various psychiatric conditions, including stress [51], anxiety and depression [52], eating disorders [53], PTSD [54], and obsessive compulsive disorder (OCD) [55]. For example, Mayo Clinic Anxiety Coach is a mobile phone app "designed to deliver CBT for anxiety disorders, including OCD" [55]. The app contains a psychoeducational module that teaches the user on "the use of the application, the cognitive-behavioral conceptualization of anxiety, descriptions of each anxiety disorder, explanations of CBT, and guidance for assessing other forms of treatment" [55]. The benefits of delivering psychoeducation via a mobile phone app are obvious: the psychoeducational information becomes portable and is easily

accessed by the patient. Furthermore, the information is also curated and validated by proper healthcare authorities, which builds trust and reduces the potential for misinformation that can result from patient-directed Internet searches. However, psychoeducation on its own is not optimal. Mobile interventions that also incorporate symptom-tracking and self-help interventions have resulted in greater improvement when used for depression and anxiety symptoms than those that deliver only online psychoeducation [50].

Self-Assessment Homework

In contrast to conventional, paper-based homework, mobile apps can support in-the-moment self-assessments by prompting the user to record self-report data about the user's current state [56]. While information collected retrospectively using paper records can be adversely affected by recall biases [57], mobile apps enable the patient to document his or her thoughts and feelings as they occur, resulting in increased accuracy of the data [58]. Such self-assessment features are found in many mobile apps that have been shown to significantly improve symptoms in chronic pain [59,60], eating disorders [61], GAD [62], and OCD [55]. Continuing with the previous example, the Mayo Clinic Anxiety Coach offers a self-assessment module that "measures the frequency of anxiety symptoms" with a self-report Likert-type scale [55]. The app tracks users' progress over time based on the self-assessment data; users reported liking the record of daily symptom severity scores that the application provides.

Modality-Specific Homework

Evidence suggests that a variety of modality-specific homework assignments on mobile apps are effective, including relaxation practices, cognitive therapy, imaginal exposure in GAD and PTSD [54,57], multimedia solutions for skill learning and problem solving in children with disruptive behavior or anxiety disorders [63], relaxation and cognitive therapy in GAD [62], or self-monitoring via text messages (short message service, SMS) to therapists in bulimia nervosa [61]. Mayo Clinic Anxiety Coach, for example, has a treatment module for OCD that "guides patients through the use of exposure therapy" [55]; patients can use this to build their own fear hierarchies according to their unique diagnoses. Users reported liking the app because it contains modality-specific homework that can be tailored to their own needs. Novel formats, such as virtual reality apps to create immersive environments, have been experimented with as a tool for facilitating exposure in the treatment of anxiety disorders with mostly positive feedback [64-66]. Apps that provide elements of biofeedback (such as heart rate monitoring via colorimetry of users' faces using the mobile phone's camera), have recently begun to be deployed. So-called "serious games," (ie, games developed for treatment purposes), are also showing promise in symptom improvement in certain cases [51,67,68].

Fostering Learning

Doing CBT homework properly requires time and effort. As noted above, any sense of inconvenience while doing the homework may hamper a patient's motivation to complete the homework. While patients may appreciate the importance of doing homework, they often find the length of time spent and

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the lack of clear instructions discouraging, resulting in poor engagement rates [49,52]. Therefore, it makes sense that the tasks should be simple, short in duration to begin with, and include detailed instructions [47], since homework completion rates have been shown to be correlated with patients' knowing exactly what to do [33,69]. Many apps incorporate text messaging-based services or personalized feedback to encourage dynamic interactions between the therapist and the client [59]. However, the types of homework delivered by these apps are fixed. An app that adapts the contents to the user's progress in learning homework tasks would be more engaging and effective since therapy should be a flexible process by nature. Ideally, the app would monitor and analyze the user's progress and adjust the homework's content and difficulty level accordingly. While the effectiveness of this type of app has not been studied, a similar app has been described in the literature for treating GAD [62]. This app, used in conjunction with group CBT, collected regular symptom rating self-reports from patients to track anxiety. Based on patients' ratings, the app would respond with encouraging comments and invite patients to practice relaxation techniques or prompt the patient to complete specific built-in cognitive therapy modules if their anxiety exceeded a threshold rating. Despite the simple algorithm used to trigger interventions, use of the app with group CBT was found to be superior to group CBT alone.

Guiding Therapy

Therapists have a number of important roles to play in guiding and motivating clients to complete homework. First, the therapist needs to address the rationale of the prescribed homework and work with the client in the development of the treatment plan [47]. Failure to do this has been identified as a barrier to homework compliance. Second, the therapist should allow the patient to practice the homework tasks during the therapy sessions [47] in order to build confidence and minimize internal barriers, such as the failing to identify automatic thoughts. Lastly, the therapist has to be collaborative, regularly reviewing homework progress and troubleshooting with the patients [47,70]; this can be done during or in between homework assignments, either in-person or remotely (ie, via voice or text messaging) [60,71].

Reviewing and troubleshooting homework has been seen as a natural opportunity for apps to augment the role of therapists. Individualized guidance and feedback on homework is found in many Internet-based or mobile apps that have been shown to be effective in treating conditions such as PTSD [72], OCD [55], chronic pain [59,60], depression and suicide ideation [71], and situational stress [73]. Moreover, providing a rationale for homework, ensuring understanding of homework tasks, reviewing homework, and troubleshooting with a therapist have each individually been identified as predictors of homework compliance in CBT [74,75]. However, despite incorporating a variety of features including self-monitoring, psychoeducation, scheduled reminders, and graphical feedback [52], automated apps with minimal therapist guidance have demonstrated elevated homework non-completion rates of up to 40%, which is less than ideal.

Building Connections

The effects of technology should not interfere with but rather encourage a patient's ability to build meaningful connections with others [76]. The therapeutic alliance between the therapist and the client is the strongest predictor of therapeutic outcome [77] and has been suggested to predict level of homework compliance as well [78]. While there is no evidence so far to suggest that technology-based interventions have an adverse effect on the therapeutic alliance [79,80], this conclusion should not be generalized to novel technologies as their impact on therapeutic alliance has not been well studied [81].

An arguably more significant innovation attributable to technology has been its potential to allow patients to form online communities, which have been identified as useful for stigma reduction and constructive peer support systems [82]. Online or virtual communities provide patients with a greater ability to connect with others in similar situations or with similar conditions than would be possible physically. Internet-delivered CBT that includes a moderated discussion forum has been shown to significantly improve depression symptoms [83]. Furthermore, professional moderation of online communities increases users' trust of the service [84]. Therefore, including social platforms and online forums in a mobile app may provide additional advantages over conventional approaches by allowing easier access to social support, fostering collaboration when completing homework, and enabling communication with therapists.

Emphasizing Completion

A patient's need to see immediate symptomatic improvement is an impediment to homework compliance since the perception of slow progress can be discouraging to the user [35]. To address this issue, it is important for both therapists and mobile apps to emphasize homework completion over outcome [47]. While a therapist can urge the client to finish uncompleted homework during the therapy session to reinforce its importance [47,85], there is little a therapist can do in between therapy sessions to remind clients to complete homework. In contrast, a mobile app can, for example, provide ongoing graphical feedback on progress between sessions to motivate users [52,86], or employ automatic text message reminders, which have been demonstrated to significantly improve treatment adherence in medical illnesses [87]. These features have previously been incorporated into some technology-based apps for homework adherence when treating stress, depression, anxiety, and PTSD [52,54,88] with significant symptom improvement reported in one paper [71].

Population Specificity

Homework apps should, where relevant or useful, explicitly be designed taking into account the specific characteristics of its target audience, including culture, gender, literacy, or educational levels (including learning or cognitive disabilities). One example of how culture-specific design features can be incorporated can be found in Journal to the West, a mobile app for stress management designed for the Chinese international students in the United States, which incorporates cultural features into its game design [89]. In this game, breathing

activity is associated with the concept of "Qi" (natural energy) in accordance with Chinese traditions; the name of the game itself references to a famous Chinese novel and the gaming environment features inkwash and watercolor schemes of the East Asian style, making the experience feel more "natural" as reported by the users. A different approach to tailoring design is taken by the computer-based games described by Kiluk et al [68] that combine CBT techniques and multi-touch interface to teach the concepts of social collaboration and conversation to children with autism spectrum disorders. In these games, the touch screen surface offers simulated activities where children who have difficulties with peer engagement can collaborate to accomplish tasks. Children in this study demonstrated improvement in the ability to provide social solutions and better understanding of the concepts of collaboration. Although the population-specific design is intuitively appealing, the degree to which it can enhance homework compliance has yet to be investigated.

Other Considerations

There are several additional issues specific to mobile apps that should be carefully considered when developing mobile apps for homework compliance. Because of screen sizes, input modes, the nature of electronic media, etc, standard CBT homework may need to be translated or modified to convert it into a format optimal for delivery via a mobile phone [47]. The inclusion of text messaging features remains controversial, in part because of concerns about client-therapist boundary issues outside the therapy sessions [90]. One potential solution is to use automated text messaging services to replace direct communication between the therapist and the client so the therapist can't be bombarded by abusive messages [52,61,91,92]. Privacy and security issues are also real concerns for the users of technology [93], although no privacy breaches related to text messaging or data security have been reported in studies on mobile apps so far [88,94-98]. Designers of mobile apps should ensure that any sensitive health-related or personal data is stored securely, whether on the mobile device or on a server.

Finally, while this paper focused on "essential" features of apps, this should not be misunderstood as an attempt to itemize all elements necessary for designing a successful piece of software. Good software design depends on many important elements that are beyond the scope of this paper, such as a well-designed user interface [99] that is cognitively efficient relative to its intended purpose [100] and which makes effective use of underlying hardware.

Discussion

The popularization and proliferation of the mobile phone presents a distinct opportunity to enhance the success rate of CBT by addressing the pervasive issue of poor homework compliance. A variety of barriers exist in traditional, paper-based CBT homework that can significantly hamper clients' motivation to complete homework as directed. The 6 essential features identified in this paper can each potentially enhance homework compliance. Therapy congruency focuses the features of the

app on the central goal of therapy and fostering learning eases engagement in therapy by reducing barriers. Apps should help the therapist guide the client through therapy and not hinder the therapeutic process or interfere with patient's building connections with others. It is crucial that homework completion be emphasized by the app, not just homework attempting. Population-specific issues should also be considered depending on the characteristics of targeted users.

As an example of how this applies in practice, "Mental Health Telemetry-Anxiety Disorders" (MHT-ANX) is a new mobile app developed by the Centre for Mobile Computing in Mental Health at Sunnybrook Health Sciences Centre in Toronto that helps patients monitor their anxiety symptoms using longitudinal self-report. The symptom log is therapy congruent to the practice of CBT since it promotes patients' awareness of their anxiety symptoms and the symptoms' intensity. The simplicity of the app makes it easy for patients to learn to use, consistent with the need for fostering learning and increasing compliance. The MHT-ANX app was designed to share patient data with their clinicians, helping clinicians guide patients through therapy and more readily engage in discussion about symptom records, thus potentially enhancing the therapeutic relationship. Homework completion is emphasized both by automated text message reminders that the system sends and by questions presented by MHT-ANX that focus on how homework was done. While there are few population-specific design issues obvious at first glance in MHT-ANX, the focus groups conducted as part of our design process highlighted that our target group preferred greater privacy in our app rather than ease of sharing results via social media, and prioritized ease-of-use. While not yet formally assessed, reports from staff and early users suggest that MHT-ANX has been helpful for some patients with promoting homework compliance.

Limitations and Future Challenges

The feature list we have compiled is grounded in current technology; as technology evolves, this list may need to be revised. For example, as artificial intelligence [101] or emotional sensing [102] develops further, we would expect that software should be able to dynamically modify its approach to the user in response to users' evolving emotional states.

Conclusion

This paper presents our opinion on this topic, supported by a survey of associated literature. Our original intention was to write a review of the literature on essential features of apps supporting CBT homework compliance, but there was no literature to review. The essential features that are the focus of this article are summaries of key characteristics of mobile apps that are thought to improve homework compliance in CBT, but randomized trials assessing the impact of these apps on homework compliance have not yet been done. We would anticipate synergistic effects when homework-compliance apps are used in CBT (eg, if measures of progress collected from an app were used as feedback during therapy sessions to enhance motivation for doing further CBT work), but the actual impact and efficacy of therapy-oriented mobile apps cannot be predicted without proper investigation.

Conflicts of Interest

None declared.

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Abbreviations

CBT: cognitive behavioral therapy
GAD: generalized anxiety disorder
MHT-ANX: Mental Health Telemetry-Anxiety Disorders
OCD: obsessive compulsive disorder
PTSD: post-traumatic stress disorder
SAD: social anxiety disorder

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Original Paper

Clinical Insight Into Latent Variables of Psychiatric Questionnaires for Mood Symptom Self-Assessment

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Abstract

Background: We recently described a new questionnaire to monitor mood called mood zoom (MZ). MZ comprises 6 items assessing mood symptoms on a 7-point Likert scale; we had previously used standard principal component analysis (PCA) to tentatively understand its properties, but the presence of multiple nonzero loadings obstructed the interpretation of its latent variables.

Objective: The aim of this study was to rigorously investigate the internal properties and latent variables of MZ using an algorithmic approach which may lead to more interpretable results than PCA. Additionally, we explored three other widely used psychiatric questionnaires to investigate latent variable structure similarities with MZ: (1) Altman self-rating mania scale (ASRM), assessing mania; (2) quick inventory of depressive symptomatology (QIDS) self-report, assessing depression; and (3) generalized anxiety disorder (7-item) (GAD-7), assessing anxiety.

Methods: We elicited responses from 131 participants: 48 bipolar disorder (BD), 32 borderline personality disorder (BPD), and 51 healthy controls (HC), collected longitudinally (median [interquartile range, IQR]: 363 [276] days). Participants were requested to complete ASRM, QIDS, and GAD-7 weekly (all 3 questionnaires were completed on the Web) and MZ daily (using a custom-based smartphone app). We applied sparse PCA (SPCA) to determine the latent variables for the four questionnaires, where a small subset of the original items contributes toward each latent variable.

Results: We found that MZ had great consistency across the three cohorts studied. Three main principal components were derived using SPCA, which can be tentatively interpreted as (1) anxiety and sadness, (2) positive affect, and (3) irritability. The MZ principal component comprising anxiety and sadness explains most of the variance in BD and BPD, whereas the positive affect of MZ explains most of the variance in HC. The latent variables in ASRM were identical for the patient groups but different for HC; nevertheless, the latent variables shared common items across both the patient group and HC. On the contrary, QIDS had overall very different principal components across groups; sleep was a key element in HC and BD but was absent in BPD. In GAD-7, nervousness was the principal component explaining most of the variance in BD and HC.

Conclusions: This study has important implications for understanding self-reported mood. MZ has a consistent, intuitively interpretable latent variable structure and hence may be a good instrument for generic mood assessment. Irritability appears to be the key distinguishing latent variable between BD and BPD and might be useful for differential diagnosis. Anxiety and sadness

are closely interlinked, a finding that might inform treatment effects to jointly address these covarying symptoms. Anxiety and nervousness appear to be amongst the cardinal latent variable symptoms in BD and merit close attention in clinical practice.

Introduction

Regular monitoring of symptom severity and disease progression in mental disorders is widely encouraged in treatment guidelines [1,2]. This had been typically achieved using patient reported outcome measures (PROMs), that is, self-assessment of mood on standardized questionnaires. Originally, questionnaires were paper-based and more recently computer-based [3,4]; however, recent technological developments have generated considerable interest in capitalizing the wide availability of smartphones to embed questionnaires in purpose-built apps [5-9]. This approach has advantages because mood self-assessment is reported in real time alleviating the issue of recall bias [10].

One approach toward PROMs is to develop generic instruments capturing universal outcomes that are relevant across a wide range of diseases and conditions such as pain and fatigue. This motivated the development of the patient reported outcomes measurement information system (PROMIS), an instrument for self-reporting physical, mental, and social health aspects in the general population [11-13]. Some associated toolbox measures have been developed using the item banks within PROMIS to cover specific populations, for example, those diagnosed with a neurological condition or disorder [14]. Universal measures such as PROMIS are undoubtedly useful for large-scale studies facilitating direct comparisons across diverse cohorts and diseases; however, by design, they are not necessarily sensitive to capturing all the intricate symptom changes of specific diseases. The alternative approach to generic instruments is to develop tailored disease-specific (also known as disease-attributed) instruments that may be of particular significance from a clinician's perspective for effective assessment and monitoring of symptoms within a specific disease or condition. Both universal PROMs and disease-specific PROMs have merits and shortcomings, and the decision to use either approach depends upon the aims of a study.

In this study, we focus on mining PROMs using disease-specific clinical scales to better understand the underlying symptoms in bipolar disorder (BD) and borderline personality disorder (BPD), comparing findings against healthy controls (HC). BD is characterized by recurrent alternating periods of elated mood (known as mania or hypomania, depending on symptom severity) and depression, which is usually more common [15]. Symptom-free periods in BD are known as euthymia. Symptom management is typically achieved using long-term medication [16], including mood stabilizers and antipsychotics [15]. BPD is characterized by splitting (failing to form a cohesive whole taking into account positive and negative traits for self and others), impulsivity, irritability, negative criticism, difficulty to regulate emotions, depression, anxiety, and anger [17]. The dominant treatment modality is psychotherapy although pharmacotherapy is common in clinical practice. BD and BPD can be clearly distinguished using laboratory measures of social cooperation and reward learning [18] but in clinical practice their distinction can be far more challenging because of the overlap in the diagnostic criteria. Correct diagnosis is critical given the divergent treatment approaches. Mood monitoring is commonly used in both clinical groups although the interpretation of their mood scores has often been challenged as positive responses are thought to reflect very different underlying psychological processes.

A critical aspect of understanding PROMs is deciphering the underlying structure inherent in the questionnaires eliciting the participants' responses. That is, identifying some characteristics (latent variables) which are not directly observed through the items in the questionnaires but which are inferred through algorithmic processing of the observed items. One of the main advantages of using latent variables is explaining most of the data using a few variables which may be tentatively interpretable. They comprise items grouped together, thus indicating which different symptoms may be related. Hence, latent variables might offer additional insight into the underlying mood symptoms, and suggest new directions for clinical assessment and care.

The aims of this study were to: (1) explore the latent variable structure of a recently introduced psychiatric questionnaire known as Mood Zoom (MZ) [9] to understand better its properties and internal structure, (2) identify differences in the latent variables of the MZ questionnaire for the three studied cohorts (BD, BPD, and HC) and observe how well they differentiate the patient cohorts and benchmark findings against HC, and (3) explore three other widely used psychiatric questionnaires and identify their internal consistency across cohorts and their potential similarities with MZ.

Methods

Data

The data were collected as part of a large ongoing research project known as automated monitoring of symptom severity (AMoSS) [9]. We record mood, activity, and physiological variables using a variety of sensors [19,20]. The study is observational and independent of participants' clinical care: we recruited 141 participants, and their demographic details are summarized in Table 1. The participants were recruited for an initial 3-month study period, with an option to remain in the study for 12 months or longer. The patient cohorts were mainly recruited from other ongoing studies in Oxfordshire or from individuals who had previously registered interest to be involved

in future research; in particular, some of the BD participants have had multiple years of experience in mood self-reporting. The age-matched HC were recruited by means of advertising in commonly used forums locally.

We excluded data from participants who either withdrew consent (1 participant) or completed participation without providing at least two months of useful data for all questionnaires (9 participants). We processed data from 131 participants, 120 of whom had provided data for at least three months, and 108 of whom had provided data for at least 12 months. All participants gave written informed consent to participate in the study. All patient participants were screened by an experienced psychiatrist (KEAS) using the structured clinical interview for diagnostic and statistical manual of mental disorders, 4th edition (DSM IV) and the borderline items of the international personality disorder examination (IPDE) [21]. The study was approved by the NRES Committee East of England- Norfolk (13/EE/0288) and the research and development department of Oxford Health NHS Foundation Trust.

Questionnaires for Mood Self-Monitoring

The participants reported their mood on a weekly basis using three validated questionnaires: (1) Altman self-rating mania scale (ASRM) [22] to assess mania, (2) quick inventory of depressive symptomatology (QIDS) self-report [23] to assess depression, and (3) generalized anxiety disorder (7-item) (GAD-7) [24] to assess anxiety. These three questionnaires were completed on the Web using the true colors (TC) system: the participants had been previously registered on the website and would need to provide their log in credentials to securely connect to their TC page. In all cases, the participants were requested to complete ASRM, QIDS, and GAD-7 reporting the average symptoms during the preceding week. The MZ questionnaire [9] was completed on a daily basis using a custom-based smartphone app developed for the needs of the AMoSS project.

ASRM is comprised of 5 items: (1) mood, (2) self-confidence, (3) sleep disturbance, (4) speech, and (5) activity. Items are scored on a 0 (symptom-free) to 4 (present nearly all the time) scale, and the total ASRM is computed by adding up the items in the 5 sections giving rise to the range 0 to 20. Miller et al [25] proposed a cut-off score of 5.5 assess a manic episode.

QIDS is comprised of 16 items, where each item is scored on a 0 (symptom-free) to 3 scale. The items map onto 9 DSM-IV symptom criteria domains for depression: (1) sad mood, (2)

concentration, (3) self-criticism, (4) suicidal ideation, (5) loss of interest, (6) energy or fatigue, (7) sleep disturbance, (8) changes in appetite or weight, and (9) psychomotor agitation or retardation. Each domain is either the highest score of a subset of the 16 QIDS items or one of the original QIDS items; see Rush et al for details [23]. Each domain contributes 0-3 points, and adding up these domains gives rise to the QIDS total score ranging from 0 to 27. The suggested clinical ranges are 5 or less denoting normal, 6-10 denoting mild depression, 11-15 denoting moderate depression, 16-20 denoting severe depression, and 21-27 denoting very severe depression [23,26].

GAD-7 is comprised of 7 items which are scored on a 0 (symptom-free) to 3 (nearly every day) scale, with total scores ranging from 0 to 21. Kroenke et al [27] endorsed using the threshold cut-offs at 5, 10, and 15 to denote mild, moderate, and severe anxiety, respectively.

MZ is comprised of 6 items: (1) anxious, (2) elated, (3) sad, (4) angry, (5) irritable, and (6) energetic. Each item is scored on a Likert scale ranging from 1 ("not at all") to 7 ("very much"). Participants were prompted to complete MZ during the study daily in the evening at a prespecified chosen time.

Samples Used for the Four Questionnaires

We constructed 4 data matrices to contain the data for subsequent processing, one data matrix for each of the questionnaires. Subsequently, we worked independently on each of those 4 matrices to determine properties applicable to each of the questionnaires.

For ASRM we used a 5719×5 data matrix. There were 2363 samples for BD, 1298 samples for BPD, and 2058 samples for HC.

For QIDS we used a 4871×9 data matrix. There were 2054 samples for BD, 1099 samples for BPD, and 1718 samples for HC.

For GAD-7 we used a 5652×7 data matrix. There were 2208 samples for BD, 1389 samples for BPD, and 2055 samples for HC.

For MZ we used a 44725×6 data matrix (44725 samples and 6 items). There were 17317 samples for BD, 11120 samples for BPD, and 16288 samples for HC.

Any missing entries (~20% as we reported in our previous study [9]) had been removed before reporting these figures.

Table 1. Summary of the key demographics of participants in automated monitoring of symptom severity (AMoSS).

	Bipolar disorder	Borderline personality disorder	Healthy controls
Originally recruited	53	34	54
Processed data from	48	32	51
Days in study, median (IQR[a]range)	365 (325; 69-867)	364 (194; 81-858)	363 (191; 80-651)
Age (years), median (IQR range)	38 (19; 18-64)	34 (14 21-56)	37 (20; 19-63)
Gender (male)	17	2	18
Unemployed	7	15	6
Any psychotropic medication	47	23	0
Lithium	19	0	0
Anticonvulsant	19	1	0
Antipsychotic	33	6	0
Antidepressants	17	23	0
Hypnotics	3	2	0

[a]IQR: interquartile range.

Data Preprocessing

Before processing the data, we standardized entries to reflect individual reporting bias so that they are directly comparable across participants. This preprocessing step was deemed necessary because the same level of mood may be assigned a different item score by different participants, and hence the raw item scores are not directly comparable across participants. Therefore, for each questionnaire, we subtracted from each item entry the mean value of that item per participant. Effectively, this transformed the discrete data matrices into continuous data matrices. This step is particularly useful in combination with the latent variable structure approach described below.

Extracting Latent Variable Questionnaire Structure Using Sparse Principal Component Analysis

Given a data matrix $\mathbf{X}$ $N \times M$ that is, a collection of the questionnaire entries comprising N samples (observations) and M variables (for this study M is the number of items of the investigated questionnaire), we wanted to obtain its internal structure, which is potentially governed by some unseen variables. That is, we wanted to project the information inherent in the original items in such a way that we could identify a robust set of some new variables that might offer new or alternative insights into the hidden structure in the data, that is, identify the latent variables.

The mathematical approaches to achieve this can be generally divided into linear and nonlinear methods, depending on how the original variables in the data matrix are combined to derive the latent variables. Although sophisticated nonlinear methods may work well in complicated toy problems, they are often more difficult to interpret than some standard linear projection techniques (which in many practical settings may also work very well). One of the most widely used methods for detecting the latent variable structure of a data matrix is principal component analysis (PCA) [28]. PCA computes linear combinations of the M variables, known as principal components. The principal components are projected in

orthogonal directions (hence, they are linearly uncorrelated) and successively explain the largest possible remaining variance in the data. The coefficients each variable in $\mathbf{X}$ contributes toward predicting the principal components are known as the loadings. The PCA structure looks like the following:

$$P_1 = l_{11} \cdot x_1 + l_{12} \cdot x_2 + l_{13} \cdot x_3 + \ldots + l_{1M} \cdot x_M$$

$$P_2 = l_{21} \cdot x_1 + l_{22} \cdot x_2 + l_{23} \cdot x_3 + \ldots + l_{2M} \cdot x_M$$

$$\ldots$$

$$P_M = l_{M1} \cdot x_1 + l_{M2} \cdot x_2 + l_{M3} \cdot x_3 + \ldots + l_{MM} \cdot x_M$$

In the equation, $P_1 \ldots P_M$ are the principal components, $x_1 \ldots x_M$ are the items in each questionnaire, and l_{ij} refers to the loading of the j th item contributing toward the computation of the i th principal component (and all the l_{ij} entries form the loading matrix $\mathbf{L}$). Usually, we only want to work on the first few principal components, which explain most of the variance in the data.

In practice, each principal component is a linear combination of all the original variables; that is, the loadings are generally non-zero, and therefore the interpretation of the resulting principal components may be challenging. Ideally the structure (ie, collectively the loadings) should be simple, comprising a few non-zero entries associating a small subset of the variables in subset of the $\mathbf{X}$ with the principal components, and still maximizing as much of the explained variance in the data as possible. Hence, researchers have developed various sparse PCA (SPCA) approaches to promote principal components that are dependent only on a small set of variables in the original data matrix. Inherently, there is a compromise to be made between the interpretability of the principal components and the explained variance [29-32].

In this study, we followed the methodology proposed in Hein and Buehler [32] tocompute SPCA using an L1-based regularization to minimize the number of contributing items toward each principal component. The compromise between

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the cardinality (number of contributing items in each principal component) versus the explained variance was optimized using trial and error in order to obtain principal components that explained as much of the variance as possible, while still being easily interpretable.

Density Plots and Statistical Hypothesis Testing

We computed the densities using kernel density estimation with Gaussian kernels to visualize the differences in the latent variables for the three cohorts and used the 2-sample Kolmogorov-Smirnov goodness-of-fit statistical hypothesis test to determine whether the distributions are statistically significantly different. We tested the null hypothesis that the random samples are drawn from the same underlying continuous distribution.

Differentiating Cohorts Using Divergence Metrics

Next, we wanted to quantify the difference in the distributions of the principal components for the different groups. The computation of effect sizes is one widely used approach to quantify these differences, but relies on having Gaussian distributions which is not necessarily the case here. A more generic methodology to quantify differences between two distributions relies on the divergence metrics [33,34]. The divergence metrics make no strong hypotheses about the underlying distributions (primarily that they exist and are continuous) and can be thought of as robust approaches to measure how much two distributions differ. Here, we report the commonly used symmetric Kullback-Leibler divergence to quantify differences between two distributions. The distributions were computed using kernel density estimation with Gaussian kernels.

Results

Latent Variable Questionnaire Structure

Table 2 presents the latent variable structure for the MZ questionnaire using the standard PCA. The tentative labeling of the resulting principal components was driven by the members of the AMoSS team with clinical background and decided by consensus from all authors. The presence of non-zero loadings for all items obstructs the clear interpretation of the underlying meaning of the principal components. For example, the first principal component for BD and BPD could be tentatively interpreted as "negative affect" since the MZ items with a negative connotation tend to dominate; nevertheless, there is non-negligible contribution by all items thus complicating the task of understanding the latent variable

meaning. Similarly, the second principal component could be considered to denote the "positive affect" since the 2 key items with large loadings denote positive feelings; nevertheless, there is some nonnegligible contribution from the remaining items. Moreover, it is not easy to interpret the third principal component (henceforth, when a latent variable cannot be interpreted in a simple term, it is left blank). These findings motivated the search for computing sparse principal components.

In Table 3 we present the findings using SPCA, which leads to more interpretable latent variables. We note that in this case the results are more intuitively understandable compared with Table 2, since the loading matrix comprises many non-contributing items toward the computation of the principal components. Crucially, the principal components are identical for the 3 groups (with different order), supporting the concept of a coherent internal MZ latent variable structure in the study of the 3 cohorts investigated here. Furthermore, the results reported using SPCA in Table 3 provide further intuitive understanding into the key latent variables of Table 2; essentially, the "negative affect" was decomposed into its two constituents, "anxiety and sadness" and "irritability," while the "Positive affect" seen in Table 2 remained unaffected. Finally, the order of the principal components for each of the 3 cohorts is revealing about the latent variables which are most predictive in each case: for the patient cohorts, anxiety and sadness appears to be the most important mood symptom characteristic, whereas in HC most of the variance is explained using the "positive affect."

Next, we applied SPCA on ASRM (Table 4), QIDS (Table 5), and GAD-7 (Table 6). The aim was to determine how stable the latent variables of each questionnaire are across groups, and determine whether there are some latent variables common across the investigated questionnaires and MZ.

The latent variable structure of ASRM is not consistent across the 3 groups, but it is consistent for the psychiatric groups. Some of the computed latent variables are not easily interpretable: for example, it is not clear how we should interpret the latent variable consisting of the items "sleepy" and "talkative." The "positive affect" in the ASRM latent variable reported in Table 4 for BD and BPD appears to be very similar with the "positive affect" reported in Table 3 for MZ. This is a finding that could have been reasonably expected on the basis of the key items identified for the 2 questionnaires. In general, the HC participants in AMoSS did not exhibit manic episodes and their ASRM variability was very low. Thus, the findings for the HC group should be interpreted very cautiously as possibly due to lack of data.

Table 2. Mood zoom (MZ) latent variable structure using standard principal component analysis (PCA).

MZ item	P1	P2	P3
Bipolar disorder			
Anxious	0.52	0.10	0.81
Elated	−0.19	0.72	0.07
Sad	0.49	0.09	−0.05
Angry	0.45	0.17	−0.44
Irritable	0.47	0.19	−0.38
Energetic	−0.19	0.63	0.03
% total variance explained	57.8	77.2	84.6
Tentative interpretation	Negative affect	Positive affect	
Borderline personality disorder			
Anxious	0.51	−0.01	0.39
Elated	−0.13	0.70	0.24
Sad	0.48	−0.24	0.56
Angry	0.48	0.24	−0.36
Irritable	0.51	0.27	−0.49
Energetic	−0.07	0.58	0.32
% total variance explained	48.9	69.6	81.2
Tentative interpretation	Negative affect	Positive affect	
Healthy controls			
Anxious	0.18	0.57	−0.06
Elated	0.74	−0.23	−0.63
Sad	0.15	0.50	−0.02
Angry	0.12	0.37	0.03
Irritable	0.12	0.46	0.05
Energetic	0.61	−0.17	0.77
% total variance explained	51.7	78.2	87.8
Tentative interpretation	Positive affect	Negative affect	

Table 3. Sparse mood zoom (MZ) latent variable structure.

MZ item	P1	P2	P3
Bipolar disorder			
Anxious	0.75	0	0
Elated	0	−0.64	0
Sad	0.66	0	0
Angry	0	0	0.62
Irritable	0	0	0.79
Energetic	0	−0.77	0
% total variance explained	33.1	56.6	75.8
Tentative interpretation	Anxiety and sadness	Positive affect	Irritability
Borderline personality disorder			
Anxious	0.66	0	0
Elated	0	0	−0.71
Sad	0.75	0	0
Angry	0	0.67	0
Irritable	0	0.74	0
Energetic	0	0	−0.70
% total variance explained	31.5	54.9	74.7
Tentative interpretation	Anxiety and sadness	Irritability	Positive affect
Healthy controls			
Anxious	0	0.73	0
Elated	−0.66	0	0
Sad	0	0.68	0
Angry	0	0	−0.59
Irritable	0	0	−0.81
Energetic	−0.75	0	0
% total variance explained	37.9	58.9	73.5
Tentative interpretation	Positive affect	Anxiety and sadness	Irritability

QIDS appears to have a very inconsistent structure when examined with SPCA. In most cases, it is not easy to interpret what the resulting principal components mean; this may reflect that the QIDS items are disjoint, and there is no clear underlying latent variable structure.

GAD-7, like QIDS, is not very consistent across the 3 cohorts. Moreover, some of the resulting latent variables are difficult to interpret, for example, the meaning of the principal component comprised of the items "relaxed" and "restless." Nevertheless, some of the latent variables across cohorts are consistent: the latent variable "nervousness" explains most of the variance in HC and BD. This is effectively the equivalent latent variable of MZ "anxiety and sadness" in Table 3.

Table 4. Sparse Altman self-rating mania (ASRM) scale latent variable structure.

ASRM item	P1	P2	P3
Bipolar disorder			
Happy	0.65	0	−0.45
Confident	0	0	−0.89
Sleepy	0	0.92	0
Talkative	0	0.38	0
Active	0.76	0	0
% total variance explained	50.1	69.1	82
Tentative interpretation	Positive affect	Sleepy and talkative	Assertiveness
Borderline personality disorder			
Happy	0.57	0	−0.58
Confident	0	0	−0.81
Sleepy	0	0.88	0
Talkative	0	0.47	0
Active	0.82	0	0
% total variance explained	47.4	67	80.9
Tentative interpretation	Positive affect	Sleepy and talkative	Assertiveness
Healthy controls			
Happy	0.90	0	0
Confident	0.44	0	0
Sleepy	0	0	0
Talkative	0	0.31	−0.95
Active	0	0.95	0.31
% total variance explained	39.7	66.2	79.9
Tentative interpretation	Assertiveness	Active and talkative	Quiet and active

Differentiating Cohorts

We investigated whether the principal components could differentiate the 3 cohorts in the study, BD, BPD, and HC. Since only MZ has a consistent latent variable structure across all 3 cohorts, the comparisons are only reported for that questionnaire in Table 7.

The densities of the principal components for the 3 cohorts are presented in Figures 1,2, and 3. In all cases, we found that the 2-sample Kolmogorov-Smirnov test rejected the null hypothesis that the samples were drawn from the same distribution, for all comparisons (P=0.001) this verifies the results expected following visual inspection of the densities.

We summarized the MZ latent variable values and quantified the differences between pairs of distributions using the symmetric Kullback-Leibler divergence in Table 7.

Overall, the findings in Table 7 suggest that the computed sparse principal components can adequately differentiate cohorts for all pairwise comparisons. We remark that the "irritability" principal component leads to clearer separation visually, a finding which is also reflected in the divergence values reported in Table 7. These results suggest that "irritability" swings may be one of the crucial differentiating factors between these 2 psychiatric cohorts.

Table 5. Sparse quick inventory of depressive symptomatology (QIDS) self-report latent variable structure.

QIDS item	P1	P2	P3
Bipolar disorder			
Sleep	0	−0.96	0
Sad	−0.72	0	0
Appetite or weight	0	0	−0.98
Concentration	0	0	0
Self-view	−0.69	0	0
Suicide	0	0	0
Interest	0	0	0
Energy	0	0	−0.22
Restless	0	-0.28	0
% total variance explained	30.2	50.4	68.4
Tentative interpretation	Esteem and sadness	Sleep changes	Appetite and energy
Borderline personality disorder			
Sleep	0	0	0
Sad	0	0	0
Appetite or weight	0	−0.94	0
Concentration	0	0	0
Self-view	0	0	0.89
Suicide	0	0	0.45
Interest	−0.78	0	0
Energy	−0.62	0	0
Restless	0	−0.33	0
% total variance explained	31.2	50.3	68
Tentative interpretation	Energetic	Appetite and restlessness	Self-esteem and suicide
Healthy controls			
Sleep	−0.99	0	0
Sad	0	0	−0.83
Appetite or weight	0	−0.96	0
Concentration	0	0	0
Self-view	0	0	−0.55
Suicide	0	0	0
Interest	0	0	0
Energy	−0.15	−0.29	0
Restless	0	0	0
% total variance explained	37.9	59.7	76
Tentative interpretation	Sleep	Appetite and energy	Esteem and sadness

Table 6. Sparse generalized anxiety disorder 7 (GAD-7) latent variable structure.

GAD-7 item	P1	P2	P3
Bipolar disorder			
Nervous or anxious	−0.75	0	0
Control worries	−0.67	0	0
Worried	0	0	0
Relaxed	0	−0.37	0.54
Restless	0	0	0.84
Irritable	0	−0.93	0
Afraid	0	0	0
% total variance explained	41.2	60.5	72.9
Tentative interpretation	Nervousness	Irritability and relaxation	Activity
Borderline personality disorder			
Nervous or anxious	0	0	0
Control worries	0	0	−0.71
Worried	0	0	−0.70
Relaxed	0.63	0	0
Restless	0.78	0	0
Irritable	0	0.81	0
Afraid	0	0.58	0
% total variance explained	29.3	48.4	69.8
Tentative interpretation	Activity	Irritability and fear	Worry
Healthy controls			
Nervous or anxious	0.81	0	0
Control worries	0.58	0	0.46
Worried	0	−0.23	0.89
Relaxed	0	0	0
Restless	0	0	0
Irritable	0	−0.97	0
Afraid	0	0	0
% total variance explained	36.2	59.9	73.5
Tentative interpretation	Nervousness	Irritability and worry	Worry

Table 7. Summary statistics for the sparse principal components computed in Table 3, and symmetric Kullback-Leibler divergence for pairwise comparisons across the 3 groups (BD, BPD, HC).

Sparse principal component	BD[a] Median (IQR[d])	BPD[b] Median (IQR)	HC[c] Median (IQR)	BD versus BPD (divergence)	BD versus HC (divergence)	BPD versus HC (divergence)
Mood Zoom						
P1[e]	−0.16 (1.89)	−0.12 (2.56)	−0.08 (0.63)	1.78	4.46	4.72
P2[f]	0.16 (1.60)	0.11 (1.98)	0.03 (1.29)	1.15	0.97	1.25
P3[g]	−0.27 (1.47)	−0.16 (2.31)	−0.05 (0.34)	3.67	3.17	6.78

[a]BD: bipolar disorder.

[b]BPD: borderline personality disorder.

[c]HC: healthy controls.

[d]IQR: interquartile range.

[e]P1= "anxiety and sadness."

[f]P2= "positive affect."

[g]P3= "irritability."

Figure 1. Density estimates of the "anxiety and sadness" principal component for the three cohorts.
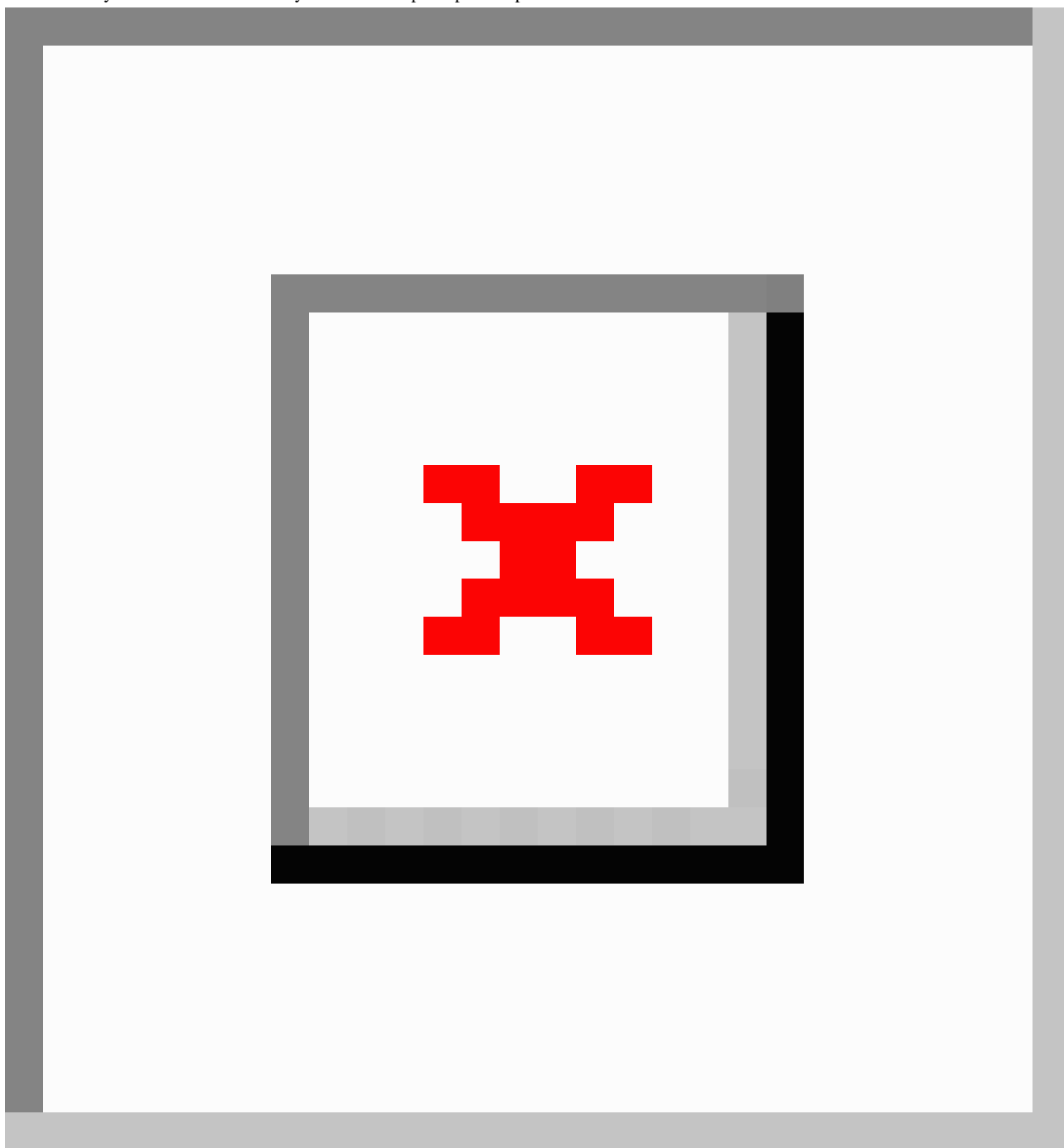
Figure 2. Density estimates of the "positive affect" principal component for the three cohorts.
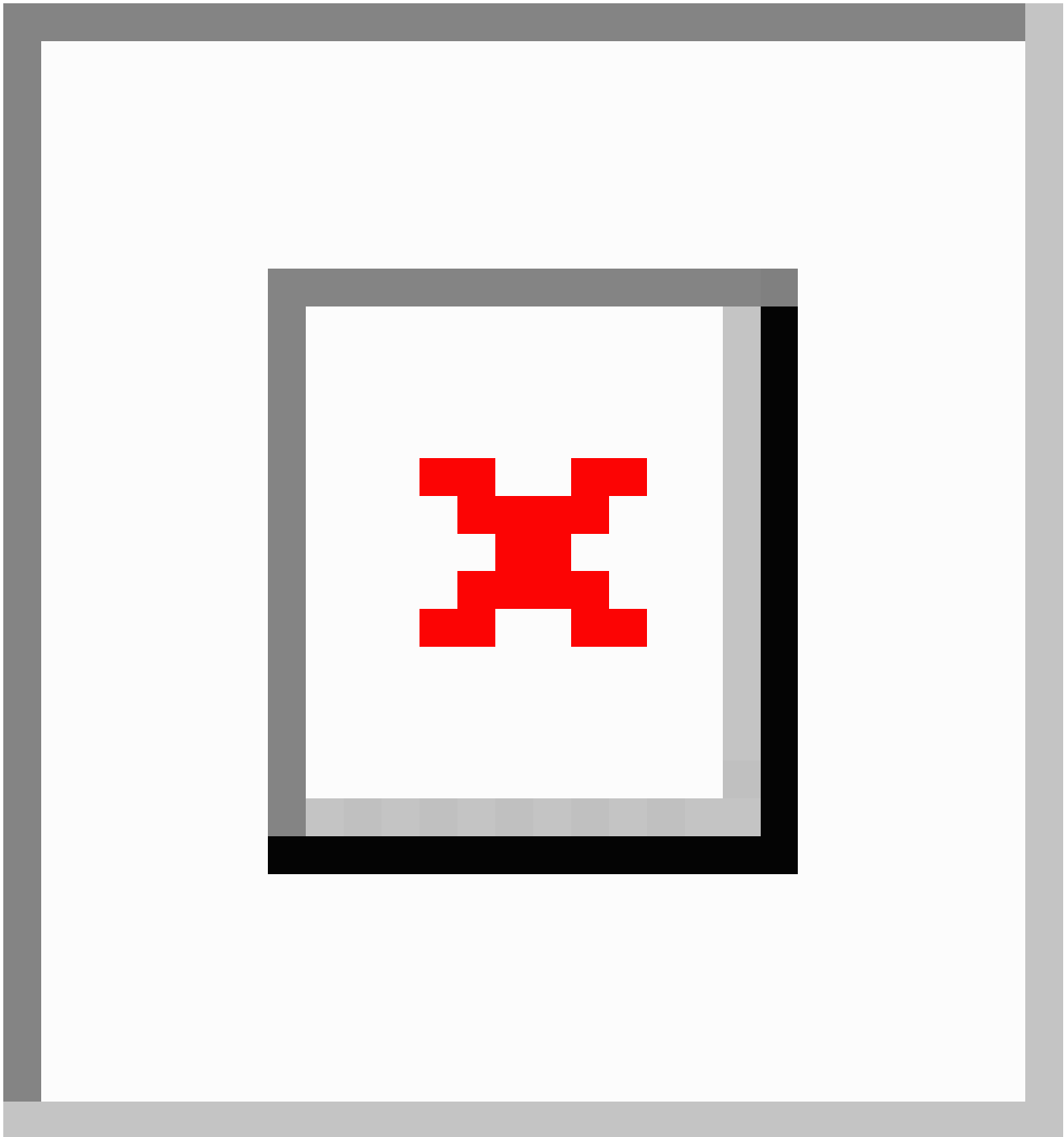
Figure 3. Density estimates of the "irritability" principal component for the three cohorts.
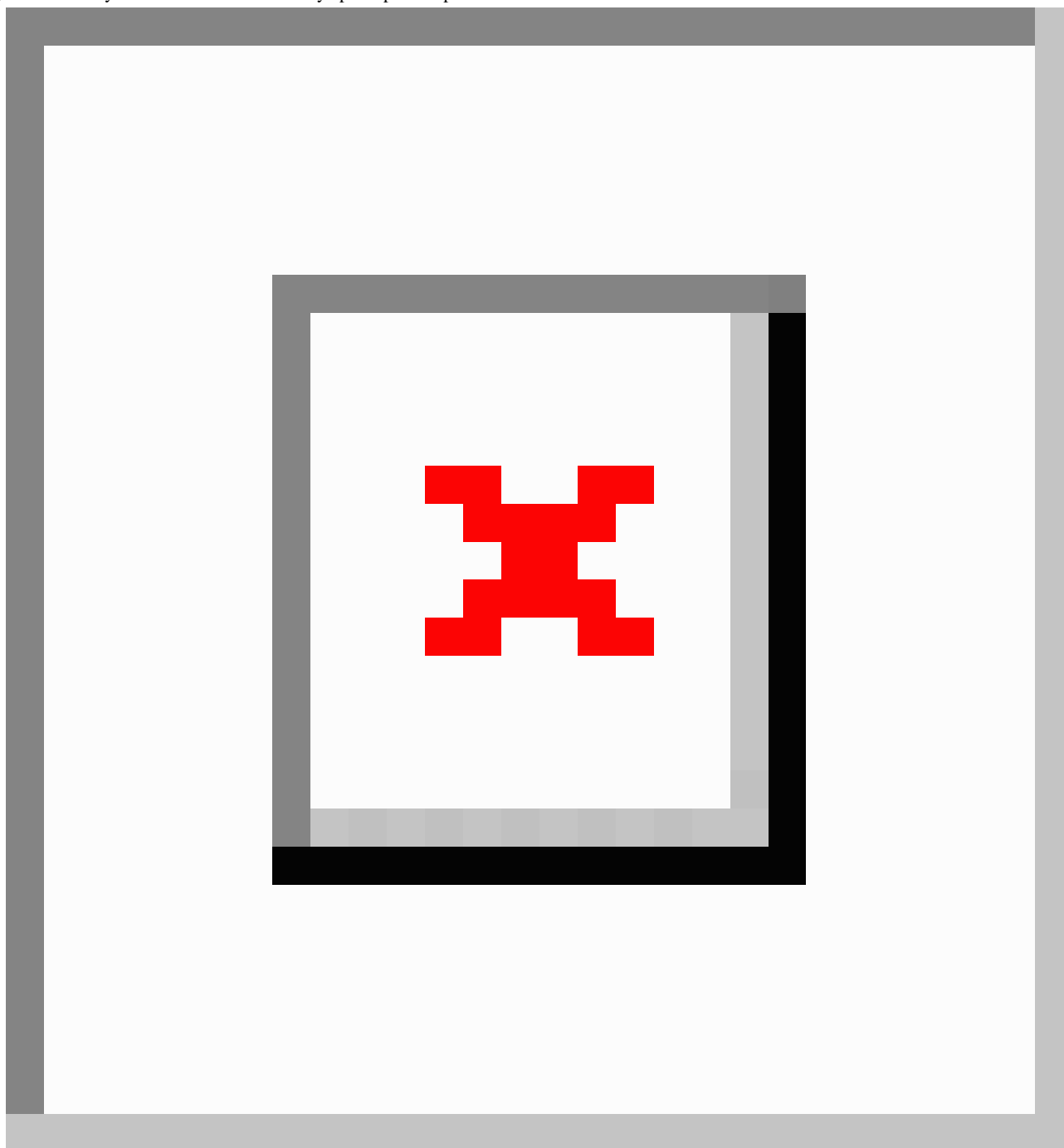
Discussion

Principal Findings

We have applied a recently developed form of SPCA to explore the latent variables of four psychiatric questionnaires across BD, BPD, and HC. We emphasize that the SPCA used here was guided primarily by the need to develop simple latent variables that would facilitate interpretation over and above findings computed using the standard PCA. As expected, in most cases the loadings in the patient cohorts were more similar compared with HC. The latent variable structure was stable across all three cohorts for MZ and stable across the patient cohorts for ASRM. On the contrary, the latent variable structure was quite different for the three cohorts for QIDS and GAD-7. Broadly speaking,

having the same latent variables across cohorts indicates internal consistency of a questionnaire and is a convenient property because it enables direct quantitative comparisons of the resulting latent variables (see Table 7). On the other hand, having different resulting latent variables across cohorts could lead to the identification of the most prominent mood item cluster constellations in each case.

The recently proposed MZ [9] can be described in terms of three latent variables which can be tentatively interpreted as (1) anxiety and sadness, (2) irritability, and (3) positive affect. These three latent variables explain about 75% of the variance (Table 3), which is consistent across the three studied cohorts (BD, BPD, and HC). Moreover, the anxiety and sadness principal component explains most of the variance for the BD

and BPD cohorts, while the positive affect explains most of the variance for HC. Similarly, the primary latent variable in GAD-7 for BD was "nervousness." Thus, BD participants are strongly affected by anxiety, which is known to be a common comorbid factor [35]; this further supports the argument that anxiety should be customarily monitored longitudinally in addition to the cornerstone mania and depression symptoms [17]. However, the first two MZ latent variables appear to have considerable overlap between the psychiatric groups. The latent variable that differentiates BD from BPD best is "irritability" (see Table 7). Our findings suggest that BPD participants exhibit considerably larger irritability variability compared with BD participants. Further work is required to investigate how this finding might be used by psychiatrists in the challenging setting of differential diagnosis between the 2 groups [36].

The latent variable structure of ASRM was identical for BD and BPD but differed when compared with HC; this may indicate that the psychiatric groups have the same underlying effects when reporting mania symptoms. However, we view this finding very cautiously, because the ASRM variability was extremely low for HC. Sleep appears to be a key item in the latent variables of QIDS for HC and BD but not BPD. This might reflect a true difference in the perception of the effect of sleep on mood symptoms in BPD; again, this finding should be treated with caution because most BPD participants in the study were unemployed and hence, this may have skewed their responses.

It is difficult to cross-reference the questionnaires since they have been fundamentally developed to capture different mood symptoms (ASRM for mania, QIDS for depression, and GAD-7 for anxiety). Nevertheless, we have seen that irritability is a key latent variable in MZ, and that item dominates the second latent variable in GAD-7. Similarly, "anxiety and sadness" is the primary latent variable of MZ, which is similar to the first latent variable observed for BD and HC in GAD-7 (Table 6). To test whether we can obtain cross-referenced latent variables among questionnaires, we merged ASRM, QIDS, and GAD-7 in a single dataset and applied SPCA for each of the three cohorts (results not shown). In almost all cases, the latent variables computed were clustered within the items of the same questionnaire and were typically dominated by QIDS items, with findings similar to those reported in Table 6. This suggests that depression-related symptoms explain most of the variance overall across the three questionnaires, a finding which is in agreement with the BD literature [15].

Understanding and interpreting the latent variables may have important implications for understanding mood traits and mood trait interactions and could lead into new hypotheses and clinical research insights. We found that anxiety and sadness are mood characteristics that covary consistently across groups (Table 3) indicating they are comorbid symptoms [37], and corroborating contemporary clinical practice treatment approaches often jointly addressing both [38]. Similarly, the latent variable comprising the items "elated" and "energetic" (Table 3) suggests there is a general underlying feeling of positive affect linking euphoria and energy. Crucially, this latent variable was found to be explaining most of the variance in the data for HC but not for the patient groups. The last MZ latent variable comprises the

"angry" and "irritable" items, in line with results reported by Pasquini et al [39] who studied major depressive disorder using a very different clinical scale and processed their data using factor analysis to derive the same component. The current study's results generalize their main conclusion that psychiatrists should be aware of the relevance of this dimension in assessment and treatment of BD and BPD. The latent variable which we called "assertiveness" (Table 4) indicates that the "happy" and "confident" items cluster together across all three cohorts and is particularly prominent in HC explaining most of the variance. This finding may have wider implications suggesting that increasing someone's perceived happiness may also boost confidence. We also reported on a latent variable comprising sadness and low self-esteem (Table 5), which is common in BD and HC; some studies have empirically linked depleted self-esteem with increased depressive symptoms [40]. The corresponding latent variable for BPD comprises the intricately intertwined "self-esteem" and "suicide" items; hence, low self-esteem may have considerably more severe consequences for this patient group compared with BD, suggesting experts may need to be particularly vigilant in the morale of their BPD patients. Finally, in Table 6 the irritability item dominates the second latent variable of GAD-7 in all cohorts; however, it is grouped with a different item in each case: (1) "relaxation" for BD, (2) "fear" for BPD, and (3) "worry" for HC. Hence, the mood trait expressed in the "angry" item in MZ appears to act as an umbrella term capturing different mood aspects that appear in GAD-7 for each of the three cohorts.

Comparison With Prior Work

We have presented results from a relatively large number of participants in the context of longitudinal mood monitoring, tracking their mood variation for multiple months as opposed to other studies, which were confined to a few weeks (eg, [7,41]). Moreover, we elicited answers to multiple questionnaires, whereas most studies had focused on a single questionnaire to investigate symptom variation, for example, depression [41-43]. Additionally, most other studies focus solely on a single disorder, for example, BD [5,41-43], whereas we have also recruited people diagnosed with BPD and compared findings against HC.

There is a large number of PROMs developed for (1) the general population, (2) broad population cohorts (eg, people diagnosed with mental disorders), and (3) specific disorders such as BD. Well-known generic instruments include the profile of moods state (POMS) [44] and the positive and negative affectivity schedule (PANAS) [45]. The full-length form of POMS comprises 65 items whereas the short form comprises 35 items [44]; the user would likely need 5-10 min to complete these. Based on the original items, POMS computes the participant's mood profile comprising the following mood dimensions: (1) anger-hostility, (2) confusion-bewilderment, (3) depression-dejection, (4) fatigue-inertia, (5) tensor-anxiety, (6) vigor-activity, and (7) friendliness. Although these seven dimensions bear similarities with the 6 MZ items, we emphasize that the two methods actually exhibit some differences in terms of the mood profiles assessed, and more importantly have very different approaches at how these mood characteristics are computed. They are evaluated directly on a 7-point Likert scale

in MZ, whereas they are computed in POMS from the originally 35 or 65 items, each of which is rated on a 5-point Likert scale. PANAS comprises 20 items in total (10 for positive affect, 10 for negative affect), each of which is rated on a 5-point Likert scale. Again, although there is some overlap in terms of the items used in PANAS and MZ, the two methods are different both in terms of the actual items used (for example PANAS does not include the MZ items "anxious" and "sad") and also in terms of the Likert scale length (5-point for PANAS). Therefore, MZ has subtle but important differences when compared with POMS and PANAS. The major advantage of MZ is that it is a very compact questionnaire developed primarily to capture the main mood swings in BD and BPD, while at the same time fitting a smartphone screen [9]. Thus, its completion takes only a couple of seconds, which is likely a critical aspect when requesting participants to fill in a questionnaire daily and longitudinally, and it is probably one of the reasons it was well-received and led to over 80% long-term adherence [9].

Alternative specialized PROM instruments such as the young mania rating scale (YMRS) [46] to assess mania symptoms and patient health questionnaire-9 (PHQ-9) [47] to assess depressive symptoms have been used in some related studies. It is difficult to argue which measure is more appropriate in either case. The use of ASRM and QIDS in this study over YMRS and PHQ-9 reflects more a pragmatic legacy approach; many of the BD participants in the AMoSS study have been recruited from a larger study where they have been reporting ASRM and QIDS for several years (in some cases more than 7 years) as part of the Oxford NHS TC system. Therefore, at the beginning of the study, we decided to continue using these questionnaires that will enable long-term BD monitoring on the same clinical scales and might provide further insight into seasonality effects and long-term symptom changes.

Clinical diagnosis of mental disorders has traditionally relied on conventional DSM guidelines, which is a symptom-based approach. A relatively recently proposed framework for studying mental disorders is the research domain criteria (RDoC), which aims to provide a more inclusive, multidimensional approach including genetic, neural, and behavioral features [48]. One of the RDoC dimensions is "self-reports" (interview scales, questionnaires) and is assessed on items comprising the latent categories "negative valence" (anxiety, fear) and "positive valence" (motivation, responsiveness). Therefore, there is some overlap in the computed MZ latent variables and the suggested RDoC self-reports dimension. We remark that the RDoC was conceived as a diagnostic category agnostic framework to be adapted by researchers based on their needs, proposing a continuum of assessment rather than a categorical-based assessment. This study's findings could be used to inform the self-reports dimension of the RDoC, particularly since we found the MZ latent variables to be stable across the psychiatric cohorts and HC.

Although some previous studies have studied the internal consistency of psychiatric questionnaires [49,50], to the best of our knowledge, no study has investigated the internal structure of different questionnaires across psychiatric groups using SPCA to obtain interpretable latent variables. One method that has

often been successfully used to compute latent variables in the field of psychiatry is item response theory (IRT), for example, see Rush et al [23]. Mathematically, IRT operates on discrete data; however, since we process datasets comprising attributes in the continuous domain, the implicit assumptions for using IRT are not valid.

In a recent previous study [9], we had introduced MZ and used PCA to investigate its properties. We had reported two principal components across the three cohorts (BD, BPD, and HC), which we referred to as "negative MZ" and "positive MZ." The presence of a positive affect and negative affect had been previously described in studies of normal emotion in psychology [51]. This study's findings provide further insight into the "negative affect" MZ; it can be further decomposed into two components, which we interpret as "anxiety and sadness" and "irritability."

Limitations

Notwithstanding the relatively large number of participants for the studied patient groups, there were certain limitations. First, we used three widely established questionnaires used for self-assessment of mood symptoms (ASRM, QIDS, and GAD-7) and the recently proposed MZ. There are numerous other questionnaires in the psychiatric literature, some of which have also been used in the context of BD.

Second, most of the BD participants were recruited from a larger study; therefore, they might be more compliant than a new cohort in this diagnostic group. However, we stress that participants were originally recruited for 3 months with the option to stay longer; the majority found the study engaging and provided data for at least a year. Although the study cohort was representative of a subgroup of psychiatric outpatients, it did not include those who were psychotic or who had significant comorbidities. Moreover, the vast majority of the BD cohort was euthymic for the larger part of the AMoSS study with very few participants exhibiting the characteristic alternating periods of mania and depression. Future studies could investigate differences within BD to compare questionnaire latent variable structures and loadings of a euthymic subgroup versus a subgroup cycling through mania and depression.

Third, the study was observational in nature, and we had very little contact with participants. The pharmacological treatment at trial onset was recorded, but we do not have accurate information on changes in medication through the duration of the study. All the reported scores rely on self-assessment; there is a lack of ongoing clinical assessment by experts to validate the findings. For example, Faurholt-Jepsen et al [52], in a meta-analysis study, reported that self-reported measures on mania may not be reflective of the true clinical condition.

Finally, there are multiple machine learning techniques to determine the latent variable structure of the data. In addition to different types of SPCA with different penalties and regularization settings, there are alternative techniques such as factor analysis, non-negative matrix factorization, and more complicated manifold embedding methods [28,53]. Ultimately, all these algorithms need to balance between the explanatory power and the interpretability of the computed latent variables.

Future studies could investigate further into more complicated schemes and latent variable structures.

We tried to identify the underlying psychological processes for the three cohorts by interpreting the latent variables computed from a single modality: self-assessed questionnaires. It could be argued that using latent variables compared with single items might be more robust in defining underlying psychological processes because they rely on multiple items which covary, and hence these provide a better means to identify differences between cohorts. Nevertheless, this argument would need to be validated using additional data looking at more detailed aspects about how these facets overlap with markers from other modalities. We have collected a large set of additional modalities in AMoSS (electrocardiogram, geolocation, activity, sleep, and social interaction) which we will be exploring in future work. Ultimately, as suggested in RDoC, mental health is not a single-dimensional concept, and fusing information from multiple modalities can bring additional key insights and improve understanding of the underlying processes and clinical assessment.

Conclusions

The findings in this study further support the recent introduction of MZ in clinical psychiatric practice. Its structure in terms of the first three principal components is consistent across BD, BPD, and HC, and the order of the principal components can be tentatively understood intuitively. ASRM is consistent for the patient groups versus HC. QIDS and GAD-7 are more varied and do not lead to easily interpretable principal components. We found that BD and BPD are very similar in terms of some standardized questionnaires (ASRM) but quite divergent in terms of QIDS and GAD-7. Further work is warranted to understand the similarities and differences between BD and BPD, which may facilitate differential diagnosis and long-term monitoring of their treatment approaches.

Conflicts of Interest

ACB has received salaries from P1vital Ltd. GMG has held grants from Servier; received honoraria for speaking or chairing educational meetings from Abbvie, AZ, GSK, Lilly, Lundbeck, Medscape, Servier; advised AZ, Cephalon/Teva, Lundbeck, Merck, Otsuka, P1vital, Servier, Sunovion and Takeda; and holds shares in P1vital.

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Abbreviations

AMoSS: automated monitoring of symptom severity
ASRM: Altman self-rating mania
BD: bipolar disorder
BPD: borderline personality disorder
DSM: diagnostic and statistical manual of mental disorders
GAD-7: generalized anxiety disorder (7-item)
QIDS: quick inventory of depressive symptomatology
HC: healthy controls
IPDE: international personality disorder examination
MZ: mood zoom

PANAS: positive and negative affectivity schedule
PCA: principal component analysis
POMS: profile of moods state
PROM: patient reported outcome measures
RDoC: research domain criteria
SPCA: sparse principal component analysis
TC: true colors
YMRS: young mania rating scale

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Original Paper

Initial Progress Toward Development of a Voice-Based Computer-Delivered Motivational Intervention for Heavy Drinking College Students: An Experimental Study

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Abstract

Background: Computer-delivered interventions have been shown to be effective in reducing alcohol consumption in heavy drinking college students. However, these computer-delivered interventions rely on mouse, keyboard, or touchscreen responses for interactions between the users and the computer-delivered intervention. The principles of motivational interviewing suggest that in-person interventions may be effective, in part, because they encourage individuals to think through and speak aloud their motivations for changing a health behavior, which current computer-delivered interventions do not allow.

Objective: The objective of this study was to take the initial steps toward development of a voice-based computer-delivered intervention that can ask open-ended questions and respond appropriately to users' verbal responses, more closely mirroring a human-delivered motivational intervention.

Methods: We developed (1) a voice-based computer-delivered intervention that was run by a human controller and that allowed participants to speak their responses to scripted prompts delivered by speech generation software and (2) a text-based computer-delivered intervention that relied on the mouse, keyboard, and computer screen for all interactions. We randomized 60 heavy drinking college students to interact with the voice-based computer-delivered intervention and 30 to interact with the text-based computer-delivered intervention and compared their ratings of the systems as well as their motivation to change drinking and their drinking behavior at 1-month follow-up.

Results: Participants reported that the voice-based computer-delivered intervention engaged positively with them in the session and delivered content in a manner consistent with motivational interviewing principles. At 1-month follow-up, participants in the voice-based computer-delivered intervention condition reported significant decreases in quantity, frequency, and problems associated with drinking, and increased perceived importance of changing drinking behaviors. In comparison to the text-based computer-delivered intervention condition, those assigned to voice-based computer-delivered intervention reported significantly fewer alcohol-related problems at the 1-month follow-up (incident rate ratio 0.60, 95% CI 0.44-0.83, *P*=.002). The conditions did not differ significantly on perceived importance of changing drinking or on measures of drinking quantity and frequency of heavy drinking.

Conclusions: Results indicate that it is feasible to construct a series of open-ended questions and a bank of responses and follow-up prompts that can be used in a future fully automated voice-based computer-delivered intervention that may mirror more closely human-delivered motivational interventions to reduce drinking. Such efforts will require using advanced speech recognition capabilities and machine-learning approaches to train a program to mirror the decisions made by human controllers

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in the voice-based computer-delivered intervention used in this study. In addition, future studies should examine enhancements that can increase the perceived warmth and empathy of voice-based computer-delivered intervention, possibly through greater personalization, improvements in the speech generation software, and embodying the computer-delivered intervention in a physical form.

Introduction

In the United States, heavy drinking among college students is a major public health concern that results in negative consequences for both drinking and nondrinking students [1]. The well-developed literature shows that brief, single-session interventions can reduce a variety of problematic drinking outcomes in college students [2-6]. Among the most well studied of these interventions are those based on principles of motivational interviewing (MI) [7], and interventions utilizing MI principles appear to have the largest effects on drinking outcomes [6]. More recently, some components of MI-based brief interventions have been adapted for delivery by computer. Evidence suggests that students receiving computer-delivered interventions reduce problematic drinking [3], which can reduce costs and improve dissemination compared to more traditional face-to-face interventions. However, meta-analyses exploring the effects of computer-delivered and face-to-face interventions across studies show that face-to-face interventions may produce longer-lasting effects than computer-delivered interventions [8,9], and that face-to-face interventions may outperform computer-delivered interventions in their impact on drinking quantity, peak blood alcohol content, and alcohol-related problems [10-16]. Together, these studies suggest that computer-delivered interventions may be useful tools for helping college students build motivation to change their drinking, but that they fall short of face-to-face interventions in some important ways.

A central tenet of MI, supported by research, is that the elicitation of "change talk" (ie, verbal behavior that is supportive of behavior change) is a key active ingredient of the intervention that predicts later changes in behavior [17-20]. This change talk is elicited in face-to-face MI interventions through open-ended questions and reflective listening techniques (including simple reflections, paraphrased reflections, double-sided reflections, and summarizations) that allow clients to hear their own change talk. MI process research shows that clients are, in fact, significantly more likely to engage in change talk directly following simple reflections, complex reflections, and open questions posed by the interventionist [21]. Although existing computer-delivered interventions can elicit information from users and provide personalized feedback, their capacity to utilize complex reflections and open-ended questions effectively may be limited. Furthermore, existing computer-delivered interventions rely on a personal computer (PC) keyboard, mouse, or touchscreen to capture participant's responses that lack the capacity to allow users to speak aloud and to hear their own change talk, which may be an important factor in the success

of MI interventions. These limitations in existing computer-delivered interventions could be mitigated by allowing voice-based interaction between the human user and the computer-delivered intervention. In a voice-based system, users could respond to open questions about their behaviors and attitudes with natural language, and the computer-delivered intervention could use reflective listening techniques to encourage deeper reflection and highlight discrepancies between current behavior and desired goals.

There are numerous challenges to developing a voice-based computer-delivered intervention that mirrors the processes occurring in human-delivered MI more closely than existing computer-delivered interventions. Although it is relatively straightforward to program open-ended prompts for a computer to deliver using speech software and although natural language recognition programs are becoming increasingly sophisticated [22-24], understanding the meaning of the users' speech in response to open questions is a far greater challenge [25,26]. Making a conversation with a computer-delivered intervention feel natural and empathic requires substantial development efforts. Nonetheless, the questions and prompts used in MI follow some prototypical forms, and users' responses to specific questions are likely to fall within a relatively limited and definable set of topics [27]; the limited universe of potential questions and content of responses could make feasible the development of a voice-based computer-delivered intervention that responds appropriately to users [28].

The purpose of this project was to take initial steps toward development of a voice-based computer-delivered intervention by creating a system of questions and responses that would mirror the content and style of a brief MI. For this initial development, we chose to create a "Wizard of Oz" computerized system where participants would speak directly to a computer screen and a human controller would select appropriate responses and follow-up questions from an onscreen menu, which would then be "spoken" by the computer using voice-generation software. Thus, our software was responsible for answer generation and speech synthesis, and a human operator handled the problem of speech understanding and dialog flow. Because automating these features will require significant engineering work, we focused on the proof of concept as demonstrated by this mixed human/computer approach. The system was designed to ask open-ended questions, encourage deeper reflection of motivations, and provide MI-consistent responses such as paraphrased reflections, double-sided reflections, affirmations, and summary statements.

We tested the feasibility and acceptability of our human-controlled version of a voice-based computer-delivered

intervention with a sample of heavy drinking college students. We examined (1) participants' ratings of how well the voice-based computer-delivered intervention attained key goals of MI, such as understanding the participant, being nonjudgmental, and being empathic and engaging; (2) whether participants were willing to set a goal to change drinking during the interaction; and (3) whether participants accepted a printed sheet on tips for reducing drinking at the end of the session. We also conducted a follow-up assessment with participants 1 month after the initial interaction with the voice-based computer-delivered intervention in order to test our primary hypotheses that participants receiving the voice-based computer-delivered intervention would report a significant increase in perceived importance of changing their drinking and report significant reductions in drinking and alcohol-related problems, consistent with the literature on computer-delivered interventions in college student populations. In order to gauge in a preliminary manner how the voice-based computer-delivered intervention might differ in its effect from traditional text-based computer-delivered intervention, we randomized one-third of participants to a text-based computer-delivered intervention, which matched the voice-based computer-delivered intervention in content, but relied on mouse and keyboard entries of participant responses and provided only text-based responses from the computer. We compared the voice-based computer-delivered intervention to the text-based computer-delivered intervention on acceptability measures. We also examined the drinking outcomes of participants assigned to the voice-based computer-delivered intervention versus the text-based computer-delivered intervention at 1-month follow-up. Given the literature cited previously regarding the importance of change talk and our supposition that a voice-based computer-delivered intervention may increase processing of change talk through verbalization, we hypothesized that the voice-based computer-delivered intervention, compared to the text-based computer-delivered intervention, would result in greater increases in perceived importance of changing drinking and greater reductions in drinking behavior and related problems. These secondary hypotheses were considered preliminary because the study was not fully powered to assess differences between conditions over time, and our emphasis was on the overall direction of effects across measures.

Methods

Participants

Participants were recruited from local colleges and universities using flyers and Web-based advertisements. Eligible participants were enrolled in undergraduate or graduate programs in the Northeastern United States, were 18 years of age or older, and endorsed at least one episode of heavy drinking (≥5 drinks in a single sitting for men, ≥4 drinks for women) in the past 30 days.

Power and Sample Size Determination

Sample size was determined by taking the following considerations into account. First, we wanted ample power to detect—within the voice-based computer-delivered intervention condition—significant changes in importance of changing drinking and drinking-related outcomes, our primary hypotheses. An initial sample size of 60, assuming an 85% follow-up rate, provided power of .94 to detect a medium effect size of $d=0.50$ and power of .80 to detect a somewhat smaller effect size of $d=0.40$; this power was determined to be adequate for the primary hypotheses. We also wanted to acquire a large enough body of verbal participant responses and human-controller response selections to facilitate future machine-learning approaches to approximate the decisions that human controllers made (results not described here). Results of machine-learning approaches could be used as the initial seeds for developing a fully automated voice-based computer-delivered intervention, and we decided that having 60 completed sessions should provide a minimal level of data to initiate that work. Given resource limitations, we were not able to randomize 60 participants to the text-based computer-delivered intervention using a 1:1 allotment. Therefore, we used a 2:1 randomization scheme, with 60 participants randomized to the voice-based computer-delivered intervention and 30 to the text-based computer-delivered intervention. Those sample sizes provided only power of .60 for an effect size of $d=0.50$ for between-groups differences; power was .80 to detect an effect size of $d=0.63$.

Procedure

All procedures were approved by the Brown University Institutional Review Board. Following eligibility assessment by telephone, those who appeared eligible were invited for a baseline session, which occurred in the laboratory. At the baseline interview, participants first completed written informed consent followed by measures of demographics, alcohol use over the past 30 days, alcohol-related problems, and importance of changing drinking. Breath alcohol concentration was measured at baseline; those with values greater than zero were asked to reschedule. After baseline assessments were completed, participants were randomized in a 2:1 ratio using the urn procedure [29,30]—to ensure equal balancing on gender and number of heavy drinking days—to one of two experimental interventions: (1) a human-controlled voice-based computer-delivered intervention with computer-generated voice communication or (2) a computer-based text-and-click entry interface comparison condition.

Thirty days after the baseline session, email links were sent with instructions to complete follow-up surveys. (See Figure 1 for participant flow through follow-up.) Participants were paid US $20 for completing the baseline appointment and US $30 for completing the follow-up assessment.

Figure 1. Participant flow.
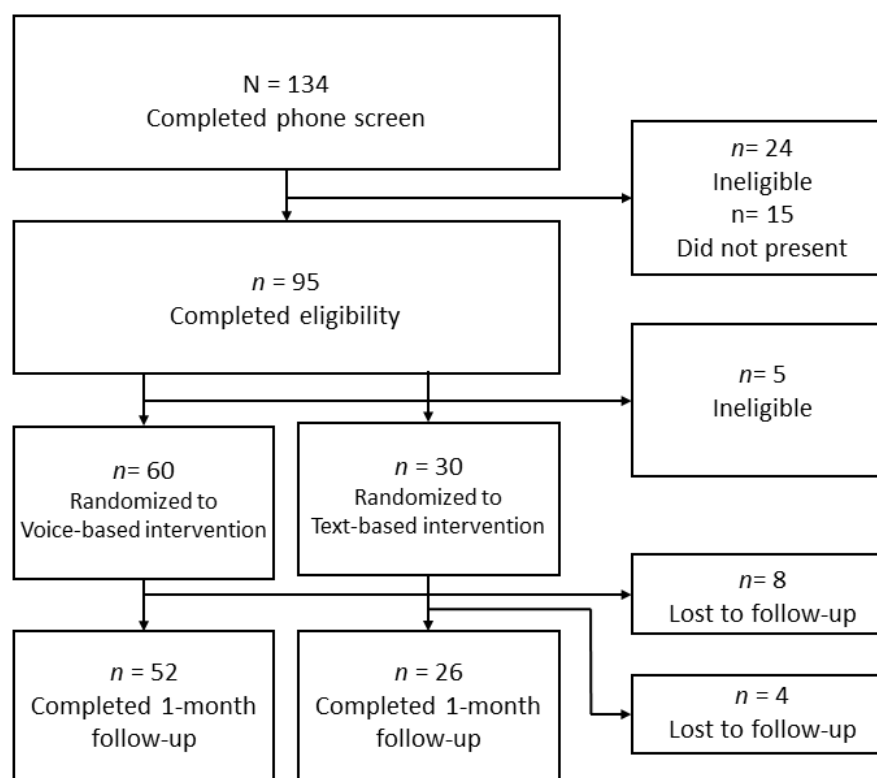
Measures

Alcohol use over the past 30 days was assessed using an online timeline follow-back measure [31], which assessed the number of standard drinks (12 oz beer, 5 oz wine, 1-1.5 oz liquor as a "shot" or in a mixed drink) participants consumed each day over the past 30 days and the approximate number of hours over which these drinks were consumed. Alcohol-related problems were assessed using the Brief Young Adult Alcohol Consequences Questionnaire (BYAACQ) [32]. Dichotomous items (yes/no) were summed for a total number of alcohol-related consequences experienced in the past month. The BYAACQ has been demonstrated to be sensitive to changes in alcohol use over time [33] and has shown high internal consistency in research with college students (alpha=.89 [32]). The importance of changing drinking was assessed with a single item ("How important is it to change your drinking?"), which was rated on a 0="not at all important" to 10="extremely important" scale; this measure has been used previously in college-aged samples [34] and has shown to be predictive of change in alcohol use behaviors in prospective analyses [34]. Each of these measures was also collected online at follow-up, 30 days after the baseline and brief intervention.

To assess the extent to which the system approximated MI counseling characteristics, we administered two brief surveys, specifically designed for this project, to all participants that contained (1) five items (7-point Likert scale: 1="not at all" to 7="very") reflecting general therapist traits (eg, warmth, understanding) as well as (2) eight items (4-point Likert scale: 1="strongly disagree" to 4="strongly agree") reflecting MI strategies (eg, helped me to talk about my ideas for change). Both the five-item scale assessing general therapist traits and

the eight-item scale assessing MI strategies demonstrated good internal consistency (Cronbach alpha=.89 and .83, respectively).

Other relevant measures were assessed from within the intervention as participants completed it, including whether participants (1) set a goal for reducing their drinking and/or (2) agreed to receive further information on changing their drinking.

Brief Motivational Intervention Computerized Delivery Systems

The computer-delivered interventions contained several common facets. They both assessed users' levels of drinking and provided feedback in the form of peer-based norms. The computer-delivered interventions assessed positive and negative consequences of drinking, and used 0 to 10 rulers to assess participants' perceived importance of and confidence in changing drinking behavior, followed by assessment of reasons for those ratings. Finally, if participants endorsed willingness, the computer-delivered interventions assisted users in setting a goal for change. Additional information (a pamphlet) on reducing drinking was also offered to users at the end of the session.

Participants assigned to the text-based computer-delivered intervention completed the session with no observer, interacting with the system by entering their responses using a keyboard and mouse. For example, the system presented an onscreen question asking what the user liked about drinking, and the participant responded by viewing a list of possible options and checking the corresponding boxes that applied to their experience. The system then reflected the positive and negative consequences endorsed by the participant in text presented on the computer screen.

Participants assigned to the voice-based computer-delivered intervention completed the intervention by speaking to the system. Their verbal responses were captured by a microphone in the interview room and were monitored by a research assistant outside of the room, who could also see the participant through a one-way mirror. The research assistant listened to the questions that the system asked and based on a participant's responses selected appropriate paraphrases of content or prompts to the participant for further information from a pre-established list of possible responses. For example, the system verbally asked what the user liked about drinking and, as the user responded verbally, the human controller checked off responses such as drinking "helps you have fun" or that drinking "tastes good." The positive and negative consequences of drinking were then verbally reflected to the participant via computerized voice, with the phrases strung together to create a double-sided reflection: "On the one hand you like that drinking..., but on the other hand, you do not like that..." The voice-based computer-delivered intervention also allowed custom user responses to be entered and allowed the human controller to have the system inject common follow-up questions and comments, such as "Can you repeat that?" and "What else?" The voice used to speak the computer responses was selected from the standard speech-to-text voice options available on Mac OS X.

Statistical Analysis

We first examined participants' ratings of the characteristics of the voice-based computer-delivered intervention to determine how well the system met the objective of reflecting positive therapist traits (eg, how supportive was the system) and MI-based therapy traits (eg, how well did the system help you talk about your own reasons for change). We compared these ratings to those given to the text-based computer-delivered intervention using *t* tests. We also examined participants' willingness to set a goal related to reducing alcohol consumption and to take additional information on how to limit alcohol use at the end of the session; we used chi-square tests to compare the proportion of participants setting goals and accepting information in the voice-based computer-delivered intervention and text-based computer-delivered intervention conditions. We next examined follow-up data, starting with an examination of how those completing follow-ups differed from those not completing follow-ups. We then conducted paired *t* tests to test the hypothesis that participants receiving voice-based computer-delivered intervention would show significant increases from baseline to the 1-month follow-up in perceived importance of changing drinking and confidence in their ability to change drinking and would show significant decreases in drinking and alcohol-related problems. To test our secondary hypotheses regarding differences between the voice-based and text-based computer-delivered interventions, we conducted linear regressions to test the effects of experimental condition on self-rated importance of changing drinking and confidence in ability to change drinking, as well as number of drinks consumed per week at the 1-month follow-up. Both number of heavy drinking days and number of alcohol-related problems (BYAACQ) represented count data and therefore were analyzed with a negative binomial distribution and logit link function. For each regression model, the experimental condition was dummy-coded as the primary independent variable with text-based computer-delivered intervention as the reference group; gender and the respective baseline assessment of the dependent variable were entered as covariates.

Results

Preliminary Analyses

Demographic characteristics of the 90 participants in the study are shown in Table 1, broken down by experimental condition.

System Traits

General therapist traits were rated at the midpoint between "not at all" and "very" for the voice-based computer-delivered intervention group, and participants agreed that the voice-based computer-delivered intervention system was consistent with MI counseling style (mean 3.0). Within the voice-based computer-delivered intervention condition, 61% (37/60) of participants were willing to set a goal to reduce their drinking, and 60% (36/60) accepted additional information on reducing their drinking at the conclusion of the session. As shown in Table 2, there were no significant differences in ratings of therapist and MI traits between the voice-based computer-delivered intervention and text-based computer-delivered intervention conditions. Similarly, chi-square analyses revealed no significant difference between conditions on willingness to set a goal (voice-based intervention: 36/59, 61%; text-based intervention: 18/30, 60%) or take additional information (voice-based intervention: 36/60, 60%; text-based intervention: 14/29, 48%), respectively, at the end of the session.

Table 1. Demographics for the full sample and intervention.

Variable	Total (N=90)	Computer-delivered intervention	
		Voice (n=60)	Text (n=30)
Age (years), mean (SD)	21.6 (2.8)	21.7 (2.3)	21.47 (3.5)
Gender, n (%)			
Female	51 (57)	32 (53)	19 (63)
Male	38 (42)	27 (45)	11 (37)
Other	1 (1)	1 (2)	0 (0)
Race, n (%)			
Asian	12 (13)	8 (13)	4 (13)
Black	13 (14)	12 (20)	1 (3)
Biracial	1 (1)	1 (2)	0 (0)
Multiracial	5 (6)	3 (5)	2 (7)
Other race	5 (6)	3 (5)	2 (7)
Pacific Islander	1 (1)	0 (0)	1 (3)
White	53 (59)	33 (55)	20 (67)
Years of education, mean (SD)	15.0 (1.7)	15.1 (1.5)	14.9 (1.8)
Full-time student, n (%)	43 (48)	27 (45)	16 (53)

Table 2. Ratings of therapist and brief motivational interviewing traits by intervention.

Traits	Computer-delivered intervention, mean (SD)		t_{76}	P	α
	Voice	Text			
Therapist traits[a]			0.882	.46	.89
How engaging was the system?	4.6 (1.4)	4.3 (1.7)			
How empathetic was the system?	3.7 (1.5)	4.3 (1.6)			
How warm was the system?	3.8 (1.5)	4.0 (1.7)			
How well did the system understand you?	4.4 (1.6)	4.5 (1.9)			
How satisfied did you feel with the system?	4.3 (1.5)	4.7 (1.6)			
Total	4.2 (1.2)	4.4 (1.5)			
Brief motivational interviewing traits[b]			–0.555	.48	.83
Was easy to interact with	3.0 (0.6)	3.2 (0.6)			
Understood me	2.8 (0.7)	2.8 (0.7)			
Asked about my ideas before presenting its own	3.2 (0.5)	2.9 (0.6)			
Helped me talk about my own reasons for change	3.1 (0.6)	2.8 (0.7)			
Respected my ideas about how I might make changes	3.1 (0.5)	2.9 (0.6)			
Did not push me into something I wasn't ready for	3.1 (0.6)	3.0 (0.5)			
Accepted that I might not want to change	3.0 (0.7)	2.9 (0.7)			
I felt engaged in the session (willing to discuss drinking)	3.1 (0.7)	3.0 (0.6)			
Total	3.0 (0.4)	2.9 (0.5)			

[a] Five items rated on a 7-point Likert scale (1="not at all" to 7="very").

[b] Eight items rated on a 4-point Likert scale (1="strongly disagree" to 4="strongly agree").

Drinking-Related Outcomes

Attrition analyses were conducted to assess if there were any significant differences between participants who completed the follow-up assessment and those who did not. Noncompleters were not significantly different from completers in terms of demographics, number of drinks consumed per week, or number of heavy drinking episodes in past month. However, a significant difference was observed between completers and noncompleters in number of alcohol-related problems (BYAACQ), with noncompleters (n=12; voice: n=8, 13%; text: n=4, 13%) endorsing significantly more alcohol-related problems at baseline (mean difference 2.94; t_{87}=–2.195, P=.03). The baseline BYAACQ score for noncompleters was not significantly different between conditions (t_{10}=0.69, P=.51).

Paired t tests showed significant main effects of time indicating reductions in drinks consumed per week (t_{51}=–3.56, P=.001), number of heavy drinking days (t_{51}=–4.53, P<.001), and reported problems with alcohol use (t_{51}=–3.60, P=.001) from baseline to the 1-month follow-up assessment in the voice-based computer-delivered intervention condition. Participants in the voice-based computer-delivered intervention condition also reported a significant increase in importance of changing drinking (t_{49}=2.60, P=.01) from baseline to 1-month follow-up; however, no significant change was observed in reported confidence to change drinking behaviors (t_{51}=1.47, P=.15; see Table 3 for means and SDs).

Table 3. Baseline and follow-up alcohol-related measures for the full sample and by condition.

Variable	Full sample, mean (SD) (N=90)		Voice-based computer-delivered intervention, mean (SD) (n=60)		Text-based computer-delivered intervention, mean (SD) (n=30)	
	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up
Number of drinks per week[a]	10.1 (8.2)	7.5 (6.0)	9.6 (7.2)	7.0 (5.4)	11.2 (9.9)	8.6 (7.0)
Number of heavy drinking days[a]	4.4 (3.5)	2.8 (2.7)	4.3 (3.3)	2.7 (2.8)	4.6 (3.9)	2.9 (2.5)
Alcohol-related problems[a]	6.1 (4.3)	4.9 (4.2)	5.9 (4.3)	4.0 (3.3)	6.5 (4.1)	6.8 (5.2)
Importance of changing drinking	2.7 (2.2)	3.5 (3.0)	2.5 (2.0)	3.6 (3.1)	3.0 (2.5)	3.3 (2.9)
Confidence to change drinking	7.7 (2.1)	8.3 (1.9)	7.8 (2.1)	8.4 (1.8)	7.7 (2.2)	8.2 (2.3)

[a] Number of drinks per week and number of heavy drinking days in the past month were collected via Alcohol Timeline Follow-back. Alcohol-related problems experienced in the past month were assessed via BYAACQ.

Covarying baseline alcohol-related problems, participants randomized to the voice-based computer-delivered intervention reported 40% fewer alcohol-related problems at follow-up compared to participants in the text-based condition (incident rate ratio [IRR]=0.60, 95% CI 0.44-0.83, P=.002). Experimental condition did not significantly predict number of drinks consumed per week (B=–0.12, 95% CI –0.41 to 0.17, P=.41), number of heavy drinking days (IRR 1.07, 95% CI 0.75-1.53, P=.72), or rated importance of changing drinking (B=0.76, 95% CI –0.51 to 2.03, P=.24) at the 1-month follow-up, covarying for the respective dependent variable at baseline.

Discussion

This study represents a promising initial step toward developing a computer-delivered intervention for heavy drinking that relies on an interactive voice-based system rather than a traditional keyboard-and-mouse text-based system. Results showed that it was feasible to create a set of predetermined questions and responses that were sufficient to direct a user through the typical components of a brief MI, while demonstrating to users that their responses were heard and understood. Participants receiving the voice-based computer-delivered intervention agreed that the system demonstrated MI-consistent behavior (eg, helped me talk about reasons for change, asked me about my ideas before presenting its own), and displayed at least moderate levels of general therapist traits (eg, was understanding, was engaging). When compared to a text-based computer-delivered intervention, the voice-based

computer-delivered intervention appeared to perform equally well in terms of these system ratings. Although no significant differences on the total score for either scale were observed between conditions, several ratings on the individual-item level that might have been expected to be greater for the voice-based computer-delivered intervention were observed to be numerically lower than the text-based computer-delivered intervention; for example, empathy and warmth were rated lower on average for the voice-based computer-delivered intervention. The observation that the point-and-click interface (text-based computer-delivered intervention) may be rated at least as, if not more, empathetic/warm than the voice-based computer-delivered intervention highlights potential areas for improvement. We speculate that the voice we used for the voice-based computer-delivered intervention system, which had a distinctly robotic tone, may have contributed to these relatively low user ratings. Furthermore, we did not have an onscreen avatar or other visual presence during the session, and some participants expressed, while interacting with the voice-based computer-delivered intervention, that they were unsure whether they should be speaking to the static image on the computer screen or looking elsewhere.

Participants in the voice-based computer-delivered intervention condition reported significant decreases in number of drinks consumed and number of heavy drinking days, and significant increases in perceived importance of changing drinking, but confidence in their ability to change drinking, which was high at baseline, did not increase significantly. The voice-based

computer-delivered intervention, compared to the text-based computer-delivered intervention, did not result in significantly greater change on any of these variables, and the differences between the conditions on these variables were small. However, we did observe a significant difference between conditions in alcohol-related problems reported at 1-month follow-up. Specifically, those randomized to the voice-based computer-delivered intervention, compared to those in the text-based computer-delivered intervention, reported about a 40% lower number of alcohol problems in the month after intervention. Although drinking was reduced following both computer-delivered interventions, only the voice-based computer-delivered intervention appeared to lead to a reduction in alcohol problems.

The fact that the voice-based computer-delivered intervention, compared to the text-based computer-delivered intervention, resulted in significantly lower alcohol-related problems but did not appear to have a greater effect on reducing alcohol consumption was unexpected. However, previous studies have demonstrated that alcohol consumption and problems have distinct etiological pathways [35,36], and may not respond to intervention in parallel. Moreover, two previous studies examining face-to-face MIs have demonstrated intervention effects for reducing alcohol problems in the absence of reducing alcohol consumption [37,38]. It may be that verbalizing the problems experienced due to drinking may help individuals think forward to potential problems and be more aware of the need to protect against these. However, future studies are required to identify specific factors that account for the differences in alcohol-related problems observed between the voice-based and text-based computer-delivered interventions.

Several important limitations should be taken into consideration when evaluating results of this study. First, the sample consisted of college-aged participants who met criteria for heavy drinking, but whose overall levels of drinking were relatively low compared to other intervention studies with college students (eg, [39]); thus, these results may not generalize to non-college-aged populations or heavier drinking college populations. Second, participants were aware that their responses to the voice-based computer-delivered intervention were being audio-recorded and were audible to the research assistant, which may have made them feel less comfortable in the interaction. Third, this study compared voice-based computer-delivered intervention to a text-based computer-delivered intervention that followed the same intervention content and outline rather than to an existing empirically supported text-based computer-delivered intervention. This comparison was to allow us to determine experimentally whether the difference in delivery format was acceptable to participants. Results of this study are not intended to support the efficacy of the voice-based computer-delivered intervention relative to an established intervention. The human-controlled voice-based computer-delivered intervention was developed as a proof of concept and should not be considered an ecologically valid or practical health intervention in its present form. The voice-based computer-delivered intervention was only compared to the text-based computer-delivered intervention rather than a human interventionist. Therefore, the fact that acceptability ratings

were equal between the voice-based computer-delivered intervention and the text-based computer-delivered intervention may overestimate the system's performance on these ratings relative to comparing them to a human interventionist. Fourth, in regard to the changes reported in alcohol-related behaviors, we are unable to evaluate the effect of assessment reactivity on outcomes; it is possible that completing the laboratory-based assessment and Web-based follow-up assessment may have influenced participants' alcohol-related behaviors and accounts for the reductions in drinking we observed [40]. Finally, the study was powered to detect medium-sized reductions in alcohol use and problems within the voice-based computer-delivered intervention condition rather than to test differences relative to the text-based computer-delivered intervention. Therefore, analyses comparing the voice-based computer-delivered intervention to the text-based computer-delivered intervention should be considered preliminary.

The task of constructing a voice-based computer-delivered intervention that can ask questions about alcohol use and respond in a manner consistent with MI practice is a challenging one. First, the voice-based computer-delivered intervention used in this study relied on a human controller. We have recorded participant responses and therefore can analyze the participant verbal behavior that led to specific choices by the human controller about which response button to push. Machine-learning algorithms may be able to detect the key verbal content and configurations that suggest the appropriate response, which can then be used to develop a prototype of an automated system.

Prior research has shown that people respond more strongly to automated systems that are more emotive in speech and animation. For example, users tasked with training a robot how to dance trained with the robot longer and with more accurate examples when the robot's reactions to its progress were more emotive [41]. For similar reasons, it will be important to examine modifications to the voice-based computer-delivered intervention system that may help to increase therapist and MI ratings. For example, the current voice-based computer-delivered intervention system used a standard computerized voice (macOS VoiceOver); voices that better approximate natural human speech may increase user acceptability ratings, particularly those that reflect human traits (warmth, empathy).

The use of a voice-based system that can allow for greater personalization of the computerized interventionist (eg, allowing the system to introduce itself and address the participant directly) may help to increase general therapist ratings. The system could also be made more sophisticated by creating ways in which information obtained earlier in the interaction are reintroduced later in the interaction, such as when the user is making a change plan. This would be particularly important in regards to change talk, which could be reiterated in later portions of the session to make it more salient to the user. Identifying mediating variables that account for the differences observed between the interventions will help inform future directions for improving the voice-based computer-delivered intervention. In particular, it would be useful to know what strategies participants used to avoid alcohol-related problems. That information could be used,

in turn, to improve the voice-based computer-delivered intervention by highlighting those potential strategies when completing a change plan. Finally, an emerging line of experimental research has shown that compared to screen avatars, embodied robots (ie, robots that have a physical form and are in the room with participants) elicit greater engagement and compliance from people who are following directions from the automated system [42,43]. Embodying the computer-delivered intervention in a robot may be a powerful means of increasing participants' perceptions of the computer-delivered intervention's empathy and warmth and may increase overall engagement with the system.

Acknowledgments

Conflicts of Interest

None declared.

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Abbreviations

BYAACQ: Brief Young Adult Alcohol Consequences Questionnaire
IRR: incident rate ratio
MI: motivational interviewing
PC: personal computer

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Original Paper

Health App Use Among Individuals With Symptoms of Depression and Anxiety: A Survey Study With Thematic Coding

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Abstract

Background: Researchers have largely turned to commercial app stores, randomized trials, and systematic reviews to make sense of the mHealth landscape. Few studies have approached understanding by collecting information from target end users. The end user perspective is critical as end user interest in and use of mHealth technologies will ultimately drive the efficacy of these tools.

Objective: The purpose of this study was to obtain information from end users of mHealth technologies to better understand the physical and mental health apps people use and for what purposes.

Methods: People with depressive or anxious symptoms (N=176) seeking entry into a trial of mental health and well-being apps for Android devices completed online questionnaires assessing depression and anxiety (Patient Health Questionnaire-9 and Generalized Anxiety Disorder-7), past and current mental health treatment-seeking behavior, overall mobile device use, and use of mobile health apps. Participants reported the physical health and mental health apps on their devices and their reasons for using them. Data were extracted from the participant self-reports and apps and app purposes were coded in order to categorize them.

Results: Participants were largely white, middle-aged females from the Midwest region of the United States recruited via a health care organization and Web-based advertising (135 female, 41 male, mean age 38.64 years, age range 19-75 years.) Over three-quarters (137/176, 77.8%) of participants indicated having a health app on their device. The top 3 kinds of apps were exercise, fitness, and pedometers or heart rate monitoring apps (93/176, 52.8%); diet, food, or calorie counting apps (65/177, 36.9%); and mental health/wellness apps (46/177, 26.1%). The mean number of mobile physical and mental health apps on a participant's phone was 2.15 (SD 3.195). Of 176 participants, 107 (60.8%) specifically reported the top 5 health apps that they used and their purposes. Across the 107 participants, a total of 285 apps were reported, with 139 being unique apps. The majority of these apps were free (129/139, 92.8%). Almost two-thirds of participants (67/107, 62.6%) reported using health apps at least on a daily basis.

Conclusions: Among those seeking support for their well-being via physical and mental health apps, people are using a variety of health apps. These people use health apps on a daily basis, especially free apps. The most common reason for using a health app is to track some health-related data; for mental health apps specifically, training or habit building was the most popular reason. Understanding the end user perspective is important because it allows us to build on the foundation of previously established mHealth research and may help guide future work in mHealth.

Trial Registration: Clinicaltrials.gov NCT02176226; https://clinicaltrials.gov/ct2/show/NCT02176226 (Archived by WebCite at http://www.webcitation.org/6rGc1MGyM)

(JMIR Ment Health 2017;4(2):e22)   doi:10.2196/mental.7603

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Introduction

The landscape of behavioral health care is rapidly being redefined by the creation and deployment of mobile apps for a variety of health conditions. Excitement for the growing field of mHealth comes from multiple stakeholder groups, including patient and provider end users, health care providers, researchers, and funders. This enthusiasm has fueled efforts to design, develop, and deploy mHealth quickly in an attempt to capitalize on users' interests while adding value to the health care system. Indeed, an overwhelming number of mHealth apps are currently available to the public. One report from the IMS Institute for Healthcare Informatics estimated that a combined 165,000 mHealth apps were available for download between the Apple iTunes and Google Play stores [1]. Most of the downloads, however, are concentrated on a few apps, with only 36 health apps accounting for nearly half of all downloads and the largest group of apps receiving fewer than 5000 downloads. Thus, by exploring the apps that are most commonly downloaded by particular user groups, we may be able to better understand the types of health apps they may be likely to use and examine what those apps do. In this paper, we explore self-reported health app use by people with symptoms of anxiety and depression seeking support from mental health apps.

Researchers have previously sought to make sense of the large number of health apps available and often focused on general or physical health [2-4], although several reviews of mental health apps exist as well [5-12]. These reviews use different approaches, such as (1) exploring commercial app stores [6,10,12], (2) reviewing existing scientific literature [2,5], and (3) a combination of app store and scientific literature reviews [3,4,7-9,11].

Through the exploration of the app marketplaces, researchers can evaluate what people are using by examining download rates, app rankings, or by investigating the apps themselves [3,4,6,7,9,12]. By reviewing scientific literature, researchers can explore the common principles or treatment strategies used in apps and the efficacy of these apps at achieving their clinical targets [5,7,8,11]. By synthesizing controlled trials of health apps, researchers compile evidence exploring their benefits in behavior change, disease management, and symptom reduction [2,5]. Thus, the combination of app store reviews, scientific literature searches, and trials have helped sketch an important understanding of health apps. Nevertheless, there are gaps in what we know of health app use from the end user perspective.

For researchers with a vested interest in evaluating, developing, and deploying mHealth apps, it is critical to understand and include end user experiences and perspectives because they are key stakeholders [13,14]. Unfortunately, studies including the end user perspective are mostly lacking.

One notable exception is a survey conducted by Krebs and Duncan [15] which explored health app use by surveying users of those apps. The study conducted a cross-sectional survey of 1604 people recruited through a quota sampling method. Fitness and nutrition were the most common categories of apps mentioned, with users reporting using health apps for exercise, nutrition, weight management, and checking blood pressure. For example, over half of the people surveyed reported downloading health apps to track physical activity. Additionally, almost one-half reported using health apps to track eating or to lose weight, and one-third reported using health apps to learn exercises. Most users noted learning about health apps via the app store, from a family member or friend, or from Web searches. A large portion of the survey participants (41.27%) said they would not pay for health apps. Overall, this study demonstrates that health apps are widely used; we build upon this work by exploring mental health app use in addition to physical health app use. We were interested in focusing on mental health apps because mental health app use might vary from patterns of physical health app use more generally.

In this paper, we aim to learn more about physical health and mental health app use from the perspective of users with symptoms of depression and anxiety who are interested in exploring such resources for their own benefit. We are specifically interested in learning which kinds of physical and mental health apps these individuals use and what purposes these apps serve for them. By focusing on the apps by use and why, rather than examining the general availability of apps available on the app stores, we may gain greater insight into the health apps people use, the functions of those apps, and the purposes they serve in people's lives. Ultimately, this information might help shape the design and development of future mHealth tools.

Methods

Participants

Android smartphone users were recruited from March 2015 through March 2016 as potential study participants for a field trial of the IntelliCare suite of Android smartphone apps for the treatment of depression and anxiety [16]. Our sample includes people who enrolled in that IntelliCare study, people who were found to be ineligible for that study, and people who were found eligible but ultimately did not enroll. It is worth noting that the common unifying characteristic of the participants is that they were personally seeking Android smartphone apps for treatment of depression or anxiety.

Recruitment

Participants came from a variety of recruitment sources, with the most common being referrals from a health care organization, Web-based advertising, news stories, advertisements on local public transportation, and word of mouth. The remaining participants came from the Google Play Store, research registries, other research studies, social media, fliers, and other sources.

Procedures

All potential study participants underwent a multistage screening procedure. First, people completed a brief, 15-minute phone

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screening with a member of the research staff. If participants were deemed eligible through the phone screening, they were sent the study consent form. When a participant signed the consent form, a member of the research staff reviewed the consent over the phone with the participant, at which point the individual was scheduled for the final eligibility assessment which consisted of completing online questionnaires and a phone interview.

The online questionnaires evaluated symptoms of depression and anxiety using the Patient Health Questionnaire-9 (PHQ-9) [17] and the Generalized Anxiety Disorder-7 (GAD-7) [18], respectively, mental health treatment history, mobile phone use, health app use, and top 5 most used health apps. As we were interested in the apps people had on their Android smartphones before commencing treatment in that study, in this paper we report data from those who partially or fully completed the online questionnaires. Participants were compensated US $20 for completing the online questionnaires. The Northwestern University Institutional Review Board approved all study procedures.

Eligibility Criteria

Participants were eligible to pass from phone screening to consent form to final assessment if they met the following inclusion criteria:

- PHQ-8 score of 10 or greater [19] or a GAD-7 score of 8 or greater [18] at the time of phone screening
- Owned an Internet-ready Android smartphone with a data package and text plan and were familiar with how to use it
- Were able to speak and read in English
- Were aged 18 years or older (age 19 years in Nebraska, by state law)
- Were US citizens

Participants were excluded at the time of phone screening if they self-reported any of the following:

- Having visual, hearing, voice, or motor impairment that would prevent completion of study procedures
- Diagnosis of psychotic disorder, bipolar disorder, dissociative disorder, or another disorder for which participation was inappropriate or dangerous
- Severe suicidality, including ideation, plan, and intent
- Taking an antidepressant or anxiolytic medication for less than 14 days, not taking a stable dose, or plans to change dose
- Having used any of the IntelliCare apps for a week or more over the past 3 months prior to phone screening

Measures

Online Questionnaires

Participants completed online questionnaires including questions regarding (1) depressive symptoms as indicated by the PHQ-9 [17], a measure that has been shown useful for identifying depression in clinical settings [20,21]; (2) anxiety symptoms as indicated by the GAD-7 [18], a measure that has been shown useful for identifying anxiety in clinical settings [22]; (3) current and past mental health treatment; (4) mobile phone use; (5) health app use; and (6) top 5 most used health apps (see

Multimedia Appendix 1 for exact questions developed by the Center for Behavioral Intervention Technologies that were used to query mental health treatment, mobile phone use, health app use, and top 5 most used health apps). Questions were presented to each potential study participant in the same order. The online questionnaires took approximately 30 minutes to complete.

Current and Past Mental Health Treatment

This 16-item self-report questionnaire, developed by the Center for Behavioral Intervention Technologies, queried about current and past mental health treatment related to depression and anxiety. Participants responded yes or no to questions such as "Are you currently receiving help for depression?" and "Have you ever sought help for depression?"

Mobile Phone Use

This 3-item self-report questionnaire, developed by the Center for Behavioral Intervention Technologies, assessed smartphone use. Participants used a 5-point Likert-type scale, ranging from less than 30 minutes to more than 3 hours, to indicate how much time they spent on their mobile phones on an average day doing the following: calls only, reading (eg, email, text messages, websites, digital books), and using mobile apps.

Health App Use

This 14-item self-report questionnaire asked participants to indicate what kind of physical and mental health apps they currently have on their mobile device. They indicated yes or no to 12 categories of physical and mental health apps and had the opportunity to report other types of physical or mental health apps while also reporting the number of health apps they currently had on their smartphones. These categories were constructed through a review, conducted by our research team consisting of clinical psychologists and research staff with experience in eHealth/mHealth, of the types of health apps that are available on app stores and are discussed in the literature. Final categories were reviewed by the team and agreed upon through consensus.

Top Five Most Used Health Apps

This 25-item self-report questionnaire, developed by the Center for Behavioral Intervention Technologies, asked participants to enter information on up to 5 physical and mental health apps on their smartphone, selecting the most frequently used apps if they used more than 5. For each app named, participants reported the name of the app, what they used the app for (the app's purpose), frequency of use (on a 4-point Likert-type scale: multiple times per day, at least once a day, several times per week, or less than once per week), and whether the app was used in the past week (yes/no) or past 24 hours (yes/no).

Data Review and Coding

App Standardization

As an initial step in evaluating the data from the Top 5 Most Used Health Apps questionnaire, one reviewer (CKR) standardized the titles of each health app, referencing the Google Play Store to confirm the correct title, spelling, capitalization, version, and price. For example, Fitbit, fit bit, and FitBit were all coded as the same app (Fitbit) whereas Womanlog and

Womanlog Pro were considered 2 distinct health apps due to a difference in app version and price.

All participant-reported apps were assumed to be Android apps accessible via the Google Play Store. In the rare instance when a health app could not be located in the Google Play Store, the reviewer used an Internet search to confirm the title and existence of the health app and its price. In some instances when the reviewer was uncertain whether or not the app was the correct one being referenced, she read through the marketing description of the app in the app store for confirmation.

General App Categorization

The mHealth app categories outlined in a report from the IMS Institute for Healthcare Informatics [1] were adapted to characterize the health apps indicated by the participants. The 2 main mHealth app categories were disease and treatment management and wellness management, and the subcategories were health care management, disease-specific, and other for the former main category and fitness, lifestyle and stress, diet and nutrition, and women's health and pregnancy for the latter main category. Categorizations were completed by 2 reviewers (CKR and SMS), who discussed categories until consensus was reached. Upon discussion, a third category group, nonhealth, was added with the following subcategories: entertainment, productivity, and social to capture apps that were not designed for health purposes but participants reported using for such. All health apps were also coded as either physical heath, mental health, or other.

App Purposes

For the participant self-reported app purposes, the first reviewer (CKR) used a thematic grouping qualitative approach, identifying common themes in the free responses to create a set of broad categories [23]. Participant self-reported purposes were closely read, then used to inform the creation of potential categories; once a set of categories was created, the reviewer again went through the original self-reported purposes to ensure categories portrayed the raw text as best as possible. The reviewer went through this kind of iterative process multiple times until all raw text fit neatly into a sensible category and all extraneous categories were removed.

App purpose was determined on a case-by-case basis for each individual participant's response such that an app could serve different purposes across various participants. By using this end user–centric approach, categories stemmed from the actual use of the app by each participant rather than imposing a predetermined structure to the app purposes based on app store descriptions or content analysis.

Developer-Intended App Purposes

Using the finalized set of categories created through qualitative coding of participant self-reports, the first reviewer (CKR) coded each of the participant-mentioned apps based on the brief, marketing material (eg, text and screenshots) found when searching and clicking on that respective app in the Google Play Store. In the rare instance when a health app could not be located in the Google Play Store, the reviewer used an Internet search to locate other marketing material to code the developer-intended purpose.

IntelliCare Apps

Since participants were being recruited into a trial to evaluate the IntelliCare app suite for Android devices developed by the Center for Behavioral Intervention Technologies, many of the participants had IntelliCare apps on their Android smartphone at the time of screening as a result of recruitment methods. Thus, we also identified and marked each app that belonged to the IntelliCare app suite because the penetration of IntelliCare apps is likely higher in this population than would be expected in a separate mental health app-seeking population.

Statistical Analyses

Demographic, clinical, and app characteristics were reported as frequencies and percentages for categorical variables and means and standard deviations for continuous variables. Measures assessing levels of depression and anxiety were reported as means and standard deviations. App characteristics were compared between participants meeting a diagnosis cut-off of depression or anxiety and no diagnosis using a chi-square test for categorical variables. Participants partially or fully completing the online questionnaire pack were included in analyses. Analyses were performed using SPSS versions 23.0 and 24.0 (IBM Corp).

Results

Participants

Of the 177 participants who received the online questionnaires, 176 participants partially or fully completed them; 1 participant did not start the questionnaires at all and thus was excluded. Ultimately, a total of 176 participants (135 female, 41 male, mean age 38.64 years, age range 19-75 years) were recruited. All participants were Android users as necessitated by the eligibility criteria to be able to use the IntelliCare suite of apps [16]. Detailed demographic and sample information further characterizing these participants is displayed in Table 1.

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Table 1. Participant demographic and sample information (N=176).

Variable	Number n (%)
Age	
19-24 years	29 (16.5)
25-34 years	58 (33.0)
35-44 years	32 (18.2)
45-54 years	28 (15.9)
55-64 years	21 (11.9)
65+ years	7 (4.0)
Not reported	1 (0.6)
Race	
African American	16 (9.1)
Asian	7 (4.0)
American Indian	1 (0.6)
Biracial	5 (2.8)
Native Hawaiian/Pacific Islander	0 (0)
Not reported/did not identify	3 (1.7)
White	144 (81.8)
Ethnicity	
Hispanic or Latino	9 (5.1)
Not Hispanic or Latino	166 (94.3)
Not reported	1 (0.6)
Highest level of education	
Some high school	1 (0.6)
Completed high school/general equivancy diploma	6 (3.4)
Some college	34 (19.3)
2-year college (associate degree)	18 (10.2)
4-year college (Bachelor of Arts, Bachelor of Science)	61 (34.7)
Master's degree	25 (14.2)
Doctoral degree	5 (2.8)
Professional degree (Doctor of Medicine, Juris Doctor)	5 (2.8)
Not reported	21 (11.9)
Current employment status	
Employed	111 (63.1)
Unemployed	19 (10.8)
Disability	11 (6.3)
Retired	8 (4.5)
Other	6 (3.4)
Not reported	21 (11.9)
Marital status	
Single	52 (29.5)
Married/domestic partner	55 (31.3)
Separated	2 (1.1)

Variable	Number n (%)
Divorced	18 (10.2)
Widowed	3 (1.7)
Living with significant other	25 (14.2)
Not reported	21 (11.9)
Household income	
<$25,000	28 (15.9)
$25,000-49,999	30 (17.0)
$50,000-74,999	27 (15.3)
$75,000-99,999	25 (14.2)
$100,000-124,999	14 (8.0)
$125,000-149,999	9 (5.1)
$150,000+	17 (9.7)
Not reported	26 (14.8)
Region of the United States	
Northeast (CT, MD, NJ, PA)	8 (4.5)
Southeast (AL, FL, GA, LA, MS, NC, TN, VA)	14 (8.0)
Midwest (IA, IL, IN, KS, MI, MN, MO, OH, WI)	128 (72.7)
Southwest (AZ, NM, TX)	11 (6.3)
West (CA, CO, HI, OR, UT, WA)	14 (8.0)
Outside of the United States	1 (0.6)
Recruitment source	
Health care organization	52 (29.5)
Web-based advertising (eg, Craigslist, Reddit, ResearchMatch)	38 (21.6)
News stories	23 (13.1)
Local public transportation advertisements	10 (5.7)
Word of mouth	10 (5.7)
Social media (eg, Facebook, Instagram)	5 (2.8)
Google Play Store	5 (2.8)
Referral from another research study	3 (1.7)
Fliers	2 (1.1)
Illinois Women's Health Registry	2 (1.1)
Other sources	26 (14.8)

Table 2. Daily mobile phone use (N=176).

Activity	<30 minutes n (%)	30 minutes to 1 hour n (%)	1 to 2 hours n (%)	2 to 3 hours n (%)	>3 hours n (%)
Average time spent for calls only	100 (56.8)	45 (25.6)	10 (5.7)	10 (5.7)	11 (6.3)
Average time spent for reading (eg, email, text messages, websites, digital books)	15 (8.5)	34 (19.3)	43 (24.4)	42 (23.9)	42 (23.9)
Average time spent using mobile apps	24 (13.6)	39 (22.2)	43 (24.4)	38 (21.6)	32 (18.2)

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Depression, Anxiety, and Mental Health Treatment

Participants tended to have moderate levels of depression (PHQ-9 mean score 12.38, SD 5.12, range 2-24) as well as moderate levels of anxiety (GAD-7 mean score 10.76, SD 4.92, range 0-21). The majority of participants (149/176, 84.7%) met the cut-off for a diagnosis of depression or anxiety with 69.9% (123/176) meeting for depression and 69.3% (122/176) meeting for anxiety. Many had sought mental health treatment in the past including 81.8% for depression (144/176) and 67.0% for anxiety (118/176). Many were currently in treatment with 50.6% (89/176) for depression and 40.9% (72/176) for anxiety.

Mobile Phone and Health App Usage

In total, 77.8% (137/176) of the participants indicated having at least 1 health app on their smartphone, and 86.4% (152/176) of the participants indicated using mobile apps longer than half an hour each day. Table 2 includes information on daily mobile phone use.

On average, participants had 2 health apps on their smartphones (mean 2.15, SD 3.195) with the number of health apps ranging from 0 to 20. The top 3 kinds of physical and mental health apps on people's phones were exercise, fitness, pedometers or heart rate monitoring apps (93/176, 52.8%), diet, food, or calorie counting apps (65/176, 36.9%), and mental health/wellness apps

(46/176, 26.1%). Table 3 includes the types of health apps on participant devices.

General App Categorization

Only a subset of the participants (107/176, 60.8%) provided more detailed information regarding the specific apps they used and their purposes. Overall, 285 app entries were identified across those 107 users, and 139 unique apps were named.

With regard to the categorizations completed by the 2 reviewers (CKR and SMS), agreement was present for 89 of 139 apps (64.0%). For the remaining 50 apps, the 2 reviewers discussed categories until consensus was reached. Based on the coding of app categories, a majority of the apps (80/139, 57.6%) were for physical health conditions and just over a quarter (39/139, 28.1%) were for mental health. The remaining 20 apps (14.4%) were neither physical health nor mental health apps but apps designed for other purposes that people responded as being health apps that they used. Thus, a third category group, nonhealth, was added with subcategories entertainment, productivity, and social to capture apps that were not technically health apps but that participants indicated using for their health and well-being. Table 4 displays the percentages of apps falling into each category and subcategory divided into physical health, mental health, other, and total.

Table 3. Types of health apps currently on mobile phone (N=176). Note: Types of health apps are drawn verbatim from the questionnaire presented to participants (available in Multimedia Appendix 1)

	Yes n (%)	No n (%)	Not reported n (%)
Exercise, fitness, pedometer, or heart rate monitoring	93 (52.8)	82 (46.6)	1 (0.6)
Diet, food, or calorie counter	65 (36.9)	111 (63.1)	0 (0)
Weight	39 (22.2)	137 (77.8)	0 (0)
Period or menstrual cycle	32 (18.2)	144 (81.8)	0 (0)
Blood pressure	6 (3.4)	170 (96.6)	0 (0)
WebMD	23 (13.1)	153 (86.9)	0 (0)
Pregnancy	4 (2.3)	172 (97.7)	0 (0)
Diabetes	0 (0)	176 (100)	0 (0)
Medication management (tracking, alerts, etc.)	17 (9.7)	159 (90.3)	0 (0)
Mood	29 (16.5)	147 (83.5)	0 (0)
Sleep	36 (20.5)	140 (79.5)	0 (0)
Mental health/wellness	46 (26.1)	129 (73.3)	1 (0.6)
Other	21 (11.9)	153 (86.9)	2 (1.1)

Table 4. Categories of apps reported.

	Physical health N=80 n (%)	Mental health N=39 n (%)	Other N=20 n (%)	Total N=139 n (%)
Disease and treatment management	15 (18.8)	15 (38.5)	0 (0)	30 (21.6)
Disease-specific	3 (3.8)	14 (35.9)	0 (0)	17 (12.2)
Health care management	7 (8.8)	0 (0)	0 (0)	7 (5.0)
Other	5 (6.3)	1 (2.6)	0 (0)	6 (4.3)
Wellness management	65 (81.3)	24 (61.5)	0 (0)	89 (64.0)
Diet and nutrition	13 (16.3)	0 (0)	0 (0)	13 (9.4)
Fitness	37 (46.3)	0 (0)	0 (0)	37 (26.6)
Lifestyle and stress	5 (6.3)	24 (61.5)	0 (0)	29 (20.9)
Women's health and pregnancy	10 (12.5)	0 (0)	0 (0)	10 (7.2)
Nonhealth	0 (0)	0 (0)	20 (100)	20 (14.4)
Entertainment	0 (0)	0 (0)	3 (15.0)	3 (2.2)
Productivity	0 (0)	0 (0)	12 (60.0)	12 (8.6)
Social	0 (0)	0 (0)	5 (25.0)	5 (3.6)

Table 5. Top 10 most frequently named apps (N=107).

App name	Code	Number n (%)
S Health	Wellness management: fitness	21 (19.6)
MyFitnessPal	Wellness management: diet and nutrition	21 (19.6)
Fitbit	Wellness management: fitness	15 (14.0)
Thought Challenger[a]	Disease and treatment management: disease specific	12 (11.2)
Daily Feats[a]	Disease and treatment management: disease specific	7 (6.5)
IntelliCare Hub[a]	Disease and treatment management: other	7 (6.5)
WebMD	Disease and treatment management: disease specific	7 (6.5)
Day to Day[a]	Disease and treatment management: disease specific	6 (5.6)
Google Fit	Wellness management: fitness	5 (4.7)
Headspace	Wellness management: lifestyle and stress	5 (4.7)

[a]Apps were part of the IntelliCare app suite.

Table 5 displays the names of the top 10 apps, all of which were at least mentioned by 5 participants.

Of the remaining 129 apps, 2 apps had 4 mentions, 13 apps had 3 mentions, 17 apps had 2 mentions, and 97 apps had 1 mention. Most of the participant-identified apps were free (129/139, 92.8%), with the most expensive app costing $5 and the average cost of downloaded apps being US $0.20 (SD $0.84). Furthermore, 4 of the top 10 apps were part of the IntelliCare app suite (see Table 4).

There were no statistically significant differences between participants who met the threshold for depression or anxiety and those who did not with regard to the types of physical health and mental health apps that they reported downloading. See Multimedia Appendix 2 for additional tables displaying the breakdown of general app categorization and app purposes by diagnosis cut-off for depression or anxiety among the 107 participants who each provided more detailed app information for up to 5 health apps.

App Purposes

App purpose was tied to each person's individual use of an app, and Table 6 displays the coding of the app purposes based on the full number of 285 app reports. The most common reason people reported for using these health apps were for different purposes of tracking (117/285, 41.1%).

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Table 6. Purposes for health app use (N=285).

App purpose	Category description	Number n (%)
Tracking total	Track one or more variables	117 (41.1)
Tracking	Track a single variable	81 (28.4)
Tracking multiple	Track multiple variables	36 (12.6)
Training/habit building	Long-term training or building a habit	69 (24.2)
Provides routine/activity	Provide exercise or routine	17 (6.0)
Instrument/tool	Used as an instrument or tool	16 (5.6)
Portal	Centralize medical experience, or coordinating a suite of apps	11 (3.9)
Resource	Helpful educational information or information database	11 (3.9)
Multipurpose	Purpose touched on two or more of the other categories	8 (2.8)
No purpose identified yet	App that had been downloaded, but not used enough to report a specific purpose	8 (2.8)
Work	Used for one's profession	7 (2.5)
Transactional	Functioning as a scheduler or helping fulfill a transaction	6 (2.1)
Entertainment	A game or used to pass time	5 (1.8)
Reminder	Remind user of something	5 (1.8)
Not in Use	Not actually used, or app simply came preloaded on device	3 (1.1)
Community	Socialize or communicate with others	2 (0.7)

Across the 139 distinct apps noted by participants, the majority of those apps (112/139, 80.6%) only had 1 app purpose across the participants who mentioned them, (ie, Headspace was only used for training/habit building across the 5 participants that mentioned it). A notable proportion (27/139, 19.4%) of the apps had 2 or more app purposes across the participants who identified using them (ie, 3 participants indicated using Google Fit for tracking, a fourth participant used it for tracking multiple, and a fifth participant used it as an instrument or tool). Of these 27 apps, 21 apps had 2 app purposes identified, 3 apps had 3 app purposes, and 1 app had 6 app purposes. S Health, the app with 6 app purposes, had the following purposes identified: (1) tracking (pedometer), (2) tracking multiple (tracking steps, heart rate, weight), (3) instrument or tool (heart rate monitor), (4) resource (health information), (5) not in use (I don't, it's loaded on my phone), and (6) no purpose identified yet (it came pre-installed on my Samsung Galaxy Note 4).

In terms of usage of these apps, most of the reported apps (188/285, 66.0%) had been used in the past week, and many apps (118/285, 41.4%) had been used within the past 24 hours. This is consistent with reports that participants used these apps frequently with 13.7% of apps (39/285) being used multiple times per day, 22.5% of apps (64/285) being used at least once a day, 24.2% of apps (69/285) being used several times per week, and 39.6% of apps (113/285) being used less than once a week.

One-third of app reports (95/285, 33.3%) were identified as mental health apps, with ultimately 39 distinct mental health apps reported by over half of participants (56/107, 52.3%). The majority of mental health apps reported were used for purposes of training or habit building (57/95, 60.0%) followed by tracking (11/95, 11.6%); the remainder served the following purposes:

instrument or tool (8/95, 8.4%), portal (6/95, 6.3%), no purpose identified yet (6/95, 6.3%), provides routine or activity (5/95, 5.3%), tracking multiple (1/95, 1.1%) and not in use (1/95, 1.1%).

Most of the reported mental health apps (67/95, 70.5%) had been used in the past week, and many mental health apps (42/95, 44.2%) had been used within the past 24 hours. This is consistent with reports that participants used mental health apps frequently with 10.5% of mental health apps (10/95) being used multiple times per day, 29.5% of mental health apps (28/95) used at least once per day, 21.1% of mental health apps (20/95) being used several times per week, and 38.9% of mental health apps (37/95) used less than once per week. Just under a quarter of participants (26/107, 24.3%) indicated using mental health apps on a daily basis.

Developer-Intended App Purposes

The majority of the 139 apps that our participants noted were intended by developers to be multipurpose (80/139, 57.6%). The remaining 59 apps had the following intended purposes: (1) instrument or tool (13/139, 9.35%), (2) training or habit building (12/139, 8.63%), (3) tracking multiple (9/139, 6.47%), (4) resource (6/139, 4.32%), (5) provides activity or routine (5/139, 3.60%), (6) tracking (5/139, 3.60%), (7) community (4/139, 2.88%), (8) portal (2/139, 1.44%), (9) entertainment (1/139, 0.72%), (10) reminder (1/139, 0.72%), and (11) transactional (1/139, 0.72%).

Discussion

Principal Findings

This study evaluated health app downloads and use from an end-user perspective by gathering information from participants seeking support for depression and anxiety from an Android mobile app treatment. The results of this study indicated that among this sample, the use of health apps was already quite high. Furthermore, although the specific apps that people downloaded were quite diverse, the purposes for using these apps tended to be quite similar with tracking being the most popular purpose for using a health app. This is further supported by the number of participants using apps where tracking would be a common function such as exercise, fitness, pedometer, or heart rate monitoring; diet, food or calorie counting; menstrual cycle; medication management; mood; and sleep.

Among mental health apps, training or habit building was the most popular purpose that participants indicated for using these specific kinds of apps. Furthermore, while many app developers intended their respective app to be multipurpose, our participants largely used an app for a single purpose. These findings raise questions about health app use and might offer guidelines as to the type of apps and functionality that might be worth developing in the future. Alternatively, these findings might be due to the types of apps currently available on the marketplace, and it might be useful to develop more apps with novel features. This alternative deserves additional consideration in both the design and evaluation of future mobile apps.

Although over three-fourths of participants indicated that they had at least 1 health app on their mobile device, only 60% of our participants actually self-reported the specific apps that they used. It could be that reporting which apps they are using is more difficult than simply endorsing that they are using health apps. In such a case, the answers to this question might better reflect actual use of health apps. Given these were individuals seeking enrollment in a study for the IntelliCare app suite [16], we expected the number of participants reporting health apps to be high. However, our finding that a majority of people are using health apps and that this does not seem to differ between those likely to have clinical levels of distress is similar to findings from other studies [15,24]. There were no statistically significant differences in the kinds of health apps that our participants noted using based on whether they met for depression and/or anxiety or neither. This is consistent with another report [24] finding that healthy individuals and those with chronic conditions may differ minimally when it comes to their use of health apps and the kinds of apps they would be interested in using. Thus, our sample might be generalizable to other health app users.

People reported using health apps often. Almost two-thirds of our sample used a health app at least once per day. Again, this was quite similar to previous findings where nearly two-thirds of participants in 1 study reported opening a health app at least once per day [15]. This is interesting, however, given the overwhelming literature shows low rates of long-term engagement with such tools when examined in the research literature [25,26]. It is possible that (1) consumer apps that are available in the app stores are more engaging despite not being consistently based on empirical research, (2) that people tend to cycle between different apps such that at a given time point they report high use of apps, but use of a single app over time would look much lower, or (3) our sample was unique in that participants were specifically seeking out the IntelliCare apps for their mental health and well-being. Given our methodology, we are unable to disentangle these possibilities, and future studies might consider longitudinal examinations of people's use of health apps downloaded from commercial stores to learn more about which apps people persist with and which get abandoned. Additionally, the use of health apps continues to grow, and it is possible that health apps have become more accepted and integral parts of people's lives, which would account for the increased levels of use as compared to data from previously published research literature.

It is worth noting that almost half of the top 10 apps belonged to the IntelliCare app suite, which we believe is a byproduct of this specific group of participants seeking enrollment in a trial of the IntelliCare app suite for Android smartphones [16]. The other apps in the list of top 10 were apps that have been identified as popular health apps in other sources—S Health, MyFitnessPal, Fitbit, WebMD, Google Fit, and Headspace (eg, MyFitnessPal, Fitbit, and WebMD [15]). S Health, one of the apps most frequently identified by our participants, actually comes preloaded on most Android devices and may be a function of that rather than users seeking out health apps. While some participants identified a purpose for S Health, a small number noted that it was merely on their phone but that they did not use it or did not have a purpose for it yet. Ultimately, this again points to the dominance of a relatively few health care apps [1].

Across other reviews of app purposes, the most frequently listed app purposes were some variation of education, treatment or relief, and screening or assessment; tracking (also referred to as symptom monitoring or management) was in the minority of app purposes listed and accounted for less than 10% of health apps [6,7,10]. In our study, however, the substantial majority of app purposes were for tracking. This variation may be a result of the difference in methodological approach, as the reviews had categorized app purposes by looking at apps in consumer app stores, whereas our approach used participant self-reported responses.

On the other hand, one review looking at mental health apps for bipolar disorders in consumer app stores did find that apps with tracking purposes represent a substantial proportion (35/82, 42.7%) of health apps [12]. This same review also showed that the number of resource apps (32/82, 39.0%) was comparable to tracking apps. Interestingly, in our study, while tracking apps were found in similar numbers (53/139, 38.1%) to that review, the number of apps indicated as resources apps by our participants was lower (6/139, 4.3%). Thus, the popularity of tracking apps and not other kinds of apps (eg, resource apps) in our study challenges the notion that participants use tracking apps merely because they are most available in consumer app stores. Instead, end users may be specifically seeking out apps with tracking purposes. By collecting end user self-reported responses, we are better capturing how end users use health

apps as opposed to relying solely on information from commercial app stores to inform our understanding of mHealth use.

In terms of the types of apps people download, 3 overwhelming trends emerged: (1) most apps were free, (2) a substantial proportion were used for the purposes of tracking, and (3) mental health apps were most commonly used for purposes of training or habit building. Given that many successful apps on the marketplace tend to focus on doing one thing really well, a future direction for health apps could be to provide a compelling and engaging user experience that builds on tracking and training or habit building for mental health apps specifically. Advances in concepts like self-experimentation and building technologies to help users learn more about links between triggers, behaviors, and symptoms could be a useful starting point to develop this user experience [27]. It is also unlikely that a paid tracking or training or habit-building app would be able to do well in the consumer marketplace given the number of available apps that do this for free, even if not designed specifically for mental health.

A few participants also reported using nonhealth apps for health purposes. This form of app usage is mostly missing when using a strategy that focuses on identifying health apps on the marketplaces or research trials. Other research, however, has suggested several ways in which standard smartphone features or nonhealth apps can serve health purposes. These include alarms [28], Web searches [29], calendar apps [30], and social media [30-32]. This is consistent with some of the apps reported by our participants, such as Google Sheets, which one participant used for migraine tracking. Indeed, nonhealth apps and standard features might have better, more generalizable functionality and better meet user needs. It is also possible health apps that meet user needs and have desired functions do currently exist but users may have a difficult time finding them [15]. Nevertheless, this finding suggests that examining how people use nonhealth apps to support their health care behaviors and needs could prove to be a productive route for researchers to gain new insights for future mHealth tool development.

Our observation that people use tools to manage physical and mental health that were not explicitly designed for those purposes also suggests that incorporating those tools into a digital mental health care system may prove useful. Indeed, general purpose apps may even include functionality consistent with mental health treatment principles. For instance, in April 2016, Google Calendar added a new Goals feature that incorporates principles of behavioral activation. Behavioral activation relies on scheduling and monitoring day-to-day activities and increasing positive activities while bringing awareness to one's mood and interactions with the environment [33]. The Google Goals feature asks users to choose a personal goal, break that goal into discrete subgoals, and schedule times to complete those subgoals [34]. Goals even helps find open time in the user's Google Calendar to accomplish these subgoals. Furthermore, Goals uses machine learning to help suggest and schedule goal-related events on a user's behalf based on that user's previous pattern of event scheduling. Though Google Calendar with its Goals feature is not necessarily marketed as a health app, the app's functionality may prove useful for users'

physical and mental health-related goals. Furthermore, as companies expand their range of products and services to meet the needs of their consumers, the distinction is becoming more blurred between health and nonhealth apps.

The authors experienced first-hand the challenges of working with an ever-evolving app marketplace. At times, the authors resorted to Internet searches to find information on participant-mentioned apps that were missing from the Google Play Store. This approach helped the reviewers locate apps that had been renamed or retired from the time participants indicated them to the time the reviewers looked over the data. For example, one participant noted using an app called Skin Deep, which was later integrated into the EWG's Healthy Living app. At other times, information found in the Google Play Store was misleading. In one instance, an app that was advertised as free, Micromedex Drug Reference, was discovered to be a paid app as noted in the fine print of the description and confirmed by user reviews in the app store. Furthermore, searches for specific app names might bring up numerous other apps because of app store ranking algorithms before the desired apps were to appear. Not surprisingly, other researchers have noted some of these same difficulties [3,11,35]. Thus, researchers who work with app stores should prepare for these kinds of challenges and use alternate methods, such as Internet searches, to assist in finding missing details or supplemental information.

Limitations

It is worth acknowledging again that the participants in this study were potential participants seeking enrollment in a trial of mental health apps. Thus, these participants are likely not reflective of the general public in terms of their overall mobile health app use and their motivation to use mobile-based mental health resources. Also, most of the participants had sought mental health services in the past and many were still engaged in treatment. This might reflect additional motivation to use services, and health app downloads and usage might be greater than would be reflected in a wider cross-section of the population. Nevertheless, these users may be representative of those who download and use mHealth tools; the apps used and reasons for using them could be particularly informative for the development of new tools. Although participant self-reported data did not support the notion that there were differences in the kinds of physical health and mental health apps on individuals' phones depending on whether their symptoms met the threshold for depression or anxiety, it is still possible that differences do exist.

Our recruitment strategy focused on Android users (as necessitated by the trial to which this study was linked [16]), thus our participants and their mobile health app use may differ from users of Apple, Windows, or other devices [24]. Certain apps, such as S Health, come preloaded onto Android devices and might be used simply for convenience purposes and would not be present among non-Android users.

In terms of demographic backgrounds, our sample is not representative of the US population. Our sample was largely white and female, with higher levels of income and education, living in the Midwest region of the United States. Nevertheless, certain aspects of demographic information in our sample do

seem representative of smartphone users (eg, income, education level) according to one more recent report [36]. Future research should aim to gather a sample representative of the population on multiple demographic levels, including gender, race, ethnicity, income, education, and region.

Finally, we relied on self-report data rather than usage statistics or other passively collected and more objective data such as app downloads. For researchers with a vested interest in the end user experience, participant self-report data may provide information that indicates what kinds of apps people use and the functions those apps serve.

Future Research

The findings from this study contribute to the evergrowing field of mHealth by exploring health app use reported by users interested in receiving mental health resources via apps. The area of mHealth is still evolving, especially for mental health, and information from all stakeholder groups, including end users, will help build a strong foundation of knowledge. It would be helpful to use more diverse methods (eg, passive data collection such as usage statistics and longitudinal studies) to further explore this space, but this study is a practical first step

in learning more about what people download and why. By understanding the kinds of apps individuals are already using, we may be better able to suggest and design other apps that users could also find useful [37].

Conclusion

This study helps bridge gaps in current knowledge of health app download and use. Reviews of scientific literature and app stores provide important perspectives; however, end user perspectives are also necessary for a more complete and nuanced picture. Furthermore, beginning with end users and what they are able to get on their devices helps mend the discrepancy that exists between the research literature and commercial app marketplaces [11,38]. This allows investigation into the true diversity of health app use that exists, both in terms of the number and types of apps as well as illustrating that people use a variety of different health apps for various reasons to improve their physical health and mental health. Although some purposes appeared to be more popular (eg, tracking or training and habit building) there were numerous purposes that users reported. Expanding the use of end user feedback in the growing research literature will help ensure an app marketplace that can be rigorous, relevant, and responsive.

Conflicts of Interest

DCM has received honoraria from Optum Behavioral Health and has an ownership interest in Actualize Health. SMS receives funding from the One Mind Institute to support PsyberGuide.

Multimedia Appendix 1

Screenshots of questions used to query current and past mental health treatment, mobile phone use, and health app use.

[PDF File (Adobe PDF File), 463KB - mental_v4i2e22_app1.pdf]

Multimedia Appendix 2

Tables displaying breakdown of app purposes and general coding of apps by cut-off for depression and/or anxiety.

[PDF File (Adobe PDF File), 308KB - mental_v4i2e22_app2.pdf]

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Abbreviations

GAD-7: Generalized Anxiety Disorder Scale-7
PHQ-8: Patient Health Questionnaire-8
PHQ-9: Patient Health Questionnaire-9

Original Paper

Diversity in eMental Health Practice: An Exploratory Qualitative Study of Aboriginal and Torres Strait Islander Service Providers

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Abstract

Background: In Australia, mental health services are undergoing major systemic reform with eMental Health (eMH) embedded in proposed service models for all but those with severe mental illness. Aboriginal and Torres Strait Islander service providers have been targeted as a national priority for training and implementation of eMH into service delivery. Implementation studies on technology uptake in health workforces identify complex and interconnected variables that influence how individual practitioners integrate new technologies into their practice. To date there are only two implementation studies that focus on eMH and Aboriginal and Torres Strait Islander service providers. They suggest that the implementation of eMH in the context of Aboriginal and Torres Strait Islander populations may be different from the implementation of eMH with allied health professionals and mainstream health services.

Objective: The objective of this study is to investigate how Aboriginal and Torres Strait Islander service providers in one regional area of Australia used eMH resources in their practice following an eMH training program and to determine what types of eMH resources they used.

Methods: Individual semistructured qualitative interviews were conducted with a purposive sample of 16 Aboriginal and Torres Strait Islander service providers. Interviews were co-conducted by one indigenous and one non-indigenous interviewer. A sample of transcripts were coded and thematically analyzed by each interviewer and then peer reviewed. Consensus codes were then applied to all transcripts and themes identified.

Results: It was found that 9 of the 16 service providers were implementing eMH resources into their routine practice. The findings demonstrate that participants used eMH resources for supporting social inclusion, informing and educating, assessment, case planning and management, referral, responding to crises, and self and family care. They chose a variety of types of eMH resources to use with their clients, both culturally specific and mainstream. While they referred clients to online treatment programs, they used only eMH resources designed for mobile devices in their face-to-face contact with clients.

Conclusions: This paper provides Aboriginal and Torres Strait islander service providers and the eMH field with findings that may inform and guide the implementation of eMH resources. It may help policy developers locate this workforce within broader service provision planning for eMH. The findings could, with adaptation, have wider application to other workforces who work with Aboriginal and Torres Strait Islander clients. The findings highlight the importance of identifying and addressing the particular needs of minority groups for eMH services and resources.

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Introduction

Background

Addressing the mental health and wellbeing needs of Australian Aboriginal and Torres Strait Islander people is a priority of the Australian Federal Government [1,2]. The high levels of psychological distress, mental health disorders and related conditions, alcohol and other drug misuse, and suicide among indigenous populations in developed countries like Australia, New Zealand, Canada, and the United States are well documented [3-6]. Mental health profiles for indigenous populations living in postcolonial societies are largely attributed to the complex and cumulative impacts of the colonization process on the lived experience of indigenous people [1,7-9].

Yet indigenous peoples around the world, in both developing and developed countries, are among the least likely to have access to mental health and related services [10]. Providing accessible and effective mental health and wellbeing services to minority indigenous populations in developed countries is challenged by a variety of factors:

- Geographic distance from services for indigenous people living in remote locations [10]
- Lack of coordination between health and other government sectors that mitigates against addressing broad social, cultural, and historical determinants of health and wellbeing [7,11]
- Discord between biomedical and indigenous understandings of mental health, social and emotional wellbeing, and the treatment and management of mental ill health [10,7,11]
- Lack of cultural congruence in service delivery and lack of cultural competence of mental health staff [10,11]

In Australia the term *social and emotional wellbeing* offers an alternative and more positive term to mental health. The term social and emotional wellbeing emerged in Australia in the 1980s as a reaction against and an alternative to conventional psychiatric mental health terminology [7]. The term attempts to express a more holistic conception of health and mental health and includes the social, political, and historical determinants of health.

The Australian Federal Government's eMental Health Strategy [2] aims to increase availability and accessibility to low- to medium-intensity mental health services for all Australians through the promotion of eMental Health (eMH) resources. Examples of eMH resources that have garnered support for Aboriginal and Torres Strait Islander people are the *AIMhi Stay Strong* app for mobile tablets [12], which is a culturally specific practitioner-led therapeutic tool; the *Mindspot Clinic Indigenous Wellbeing Course* [13], which is a culturally adapted online assessment and treatment program; and *beyondblue* [14], which is a prominent website for depression and anxiety that includes a campaign on the impact of racism on mental health.

Promoting eMH resources and training service providers working with Aboriginal and Torres Strait Islander people and Aboriginal and Torres Strait Islander service providers in the use of eMH resources is one priority within the strategy.

Services and Workforces

A model of wellbeing by Milroy [15] describes the range of services that impact on the social and emotional wellbeing of Aboriginal and Torres Islander people as including:

- Inadequate training for the level of responsibility expected
- prevention, promotion, and early intervention services
- comprehensive primary health care
- secondary, tertiary, and specialized health care
- government sector (housing, employment, education, justice, recreation, disability, welfare, and social services)

Many of these services, particularly in the government sector and some sections of the health sector, are not formally recognized or funded as delivering mental health services, yet they support the social and emotional wellbeing of Australian Aboriginal and Torres Islander people [7].

The Aboriginal and Torres Strait Islander service provider workforce is a small community-based cross-sectoral workforce that plays an essential role in supporting the social and emotional wellbeing of Aboriginal and Torres Strait Islander people. They work mainly in either the health or community services sector. In Australia, Aboriginal and Torres Strait Islander health workers carry out a variety of roles including cultural brokerage between clients and the health system, health promotion, environmental health, clinical, and community work [16]. Similar workforces in other developed countries are Maori community health workers in New Zealand [17] and community health representatives who work with American Indians and Alaskan Natives in Canada and the United States [18]. Community workers are employed across a range of community-based social welfare services with the overall aim of improving social inclusion and social functioning for their clients [19].

As minority workforces working with a minority population, Aboriginal service providers face particular challenges:

Inadequate training for the level of responsibility expected

- Excessive client workloads
- Clients with extremely complex problems; volatile clients; violence; mental health; drug and alcohol; and grief, loss, and trauma
- Blurred boundaries between work, community, and private life
- Racism [20,21]

eMental Health Implementation Studies

Despite the potential that eMH offers to improve access to mental health interventions, the implementation of eMH by health services and health professionals has been reported as uniformly low, both in Australia and Europe [22,23]. Research efforts in the eMH field to date have primarily focused on establishing an evidence base for the effectiveness of individual eMH resources, particularly low-intensity online symptom-focused treatment interventions. Less focus has been placed on investigating how to facilitate the implementation of eMH by health services or how to improve the uptake of eMH by users and help seekers [24]. Such is the gap between effectiveness and implementation that in 2015 a large-scale,

5-year empirical implementation study was launched across 15 European regions to investigate the factors that hinder or promote the use of Internet interventions in practice [23].

Implementation studies of eMH in health and related workforces are generally more theoretical than empirical [25]. Theoretical frameworks and models typically focus on describing enablers and barriers to the implementation of technological innovations within workforces [26,27]. How individual practitioners might integrate eMH resources into routine practice is one factor identified in the eMH implementation literature [24]. Puszka et al [25] describe the degree to which eMH resources can be integrated into usual practice as one important factor in mediating use. Yet within the eMH implementation literature there are, at time of writing, no studies that empirically report on the manner in which health professionals are using eMH resources in their routine practice.

This study aims to extend the findings of two previous studies into eMH implementation within the particular context of service delivery to Aboriginal and Torres Strait Islander people [25,28]. These previous studies investigated different stakeholder perspectives on the potential implementation of eMH resources among Aboriginal and Torres Strait Islander health and community services workers. One investigated the perspectives of managers of health services on the requirements for implementing eMH resources [25]. The other investigated trainer/consultant observations about the uptake of eMH resources by Aboriginal health professionals during participation in an eMH training and consultation program [28]. Both studies found sets of interconnected enablers and barriers to the implementation of eMH resources that included attitudes and skills of the individual worker, the organizational systems within which they work, their clients, and the design of the eMH resources themselves.

There are no studies to date that have investigated the manner in which Aboriginal and Torres Strait Islander health and community services workers have integrated eMH resources in their routine practice, as reported by practitioners themselves.

Purpose of the Study

The purpose of this exploratory study is to investigate how Aboriginal and Torres Strait Islander service providers in one regional area of Australia, northern New South Wales, have used eMH resources in their practice after participating in an eMH training program and what types of eMH resources they used.

Methods

Setting

The project within which this study took place has been engaged in the promotion and training of eMH with Aboriginal and Torres Strait Islander service providers for the last 3 1/2 years in a regional/rural area of Australia, northern New South Wales. The project is one partner in the Australian Federal Government's national e-Mental Health in Practice project.

A previous paper from this project examined observations of the uptake of eMH by Aboriginal and Torres Strait Islander

service providers during training from the perspective of the trainers/consultants [28]. In this study, a sample from the same population was interviewed in their workplaces 4 to 8 months after training to investigate the use of eMH in participants' routine practice.

Ethics approval was gained from the North Coast New South Wales Human Research Ethics Committee (076) and the Aboriginal Health and Medical Research Council Human Research Ethics Committee (955/13).

Recruitment

The population from which the study sample was drawn was 28 Aboriginal and Torres Strait Islander service providers who had participated in an eMH training program that involved either a 2- or 3-day eMH training workshop followed by up to 6 monthly skills-based follow-up consultation sessions [28].

Purposive sampling was used to recruit participants from this population to ensure representation across different ages and genders, a range of services and locations, and varying degrees of engagement with the training program.

Sample

The 16 Aboriginal and Torres Strait Islander service providers interviewed in this study were employed in either the government health sector (n=4), mainstream nongovernment community service organizations (n=6), or Aboriginal and Torres Strait Islander–controlled health and community service organizations (n=6). Most workers (15/16) interviewed were employed in identified Aboriginal and Torres Strait Islander positions, and half (8/16) were female. Job titles demonstrate employment in a broad cross-section of positions that included health education, wellbeing, mental health, family services, disability, and alcohol and other drugs. Participants in this study were not trained mental health professionals.

All but one interviewee had completed or was currently enrolled in a formal qualification relevant to their position. Qualifications ranged from vocational certificates or diplomas (n=26) to postgraduate university master's degree (n=1). Some interviewees held multiple qualifications at varying levels. The most frequently reported fields of study were Aboriginal health (n=5), community services (n=5), counseling (n=4), and alcohol and other drugs (n=4). One participant was enrolled in a psychology degree program at time of interview. In addition to formal courses, interviewees reported completing a range of short training courses relevant to eMH, the most popular being *Mental Health First Aid* [29] and suicide prevention.

Data Collection

Two interviewers, an external qualitative researcher (JB) and an Aboriginal health professional/doctoral student (DR), conducted 16 semistructured qualitative interviews of approximately 60 minutes duration. The interviews were conducted 4 to 8 months after the completion of an extended eMH training program that included workshops and skills-based follow-up consultation sessions. At the commencement of each interview, participants were asked to describe the service within which they worked, their job title, their level of qualification, their relevant history of short course training and professional

development, and their role. The interview questions focused on 3 main areas of investigation: participant experiences of the training and consultation sessions, participant uptake of eMH resources subsequent to the training, and participant needs for and access to supervision.

Data Analysis

Thematic analysis of the qualitative data relevant to this study from the 16 interviews was conducted using the method described by Braun and Clarke [30]. They describe a 6-step process of thematic analysis: familiarize with the data, generate initial codes, search for themes, review themes, define and name themes, and produce a report.

Two researchers (JB and DR) separately read a random sample of 8 transcripts and identified relevant data extracts from each interview. The data extracts were then peer reviewed and amended. Each researcher separately created a set of initial codes for the 8 sample interviews. The codes were peer reviewed and amended. The initial codes were then applied to the remaining 8 transcripts and tested, discussed, and amended by the two researchers. All the data extracts were then collated under the final codes. Each theme was analyzed and coded for subthemes.

Results

Context of Practice

Participants described their roles as having a broad scope that reflected the social determinants of social and emotional wellbeing of their clients. Participants described working with clients in the areas of housing support, drug and alcohol, domestic violence, criminal justice diversionary programs, child protection, and family support. They engaged in health education, crisis management, counseling, and social support and inclusion. One participant referred to himself as a *jack-of-all-trades* given the broad scope of problems and issues he encountered with his clients.

Participants highlighted the number of clients who present to them in crisis and with complex needs and the impact on their client load of referrals from mainstream agencies. They spoke of the unique and complex relationships they have with the communities to which they belong and with whom they work.

Participants all worked in community-based organizations and with only one exception engaged with their clients either in their homes, in community settings away from their place of employment, or in outdoor areas connected to their workplaces. One participant worked in a medical community outreach program. Participants engaged with clients either individually for outreach support or counseling; in families for family outreach support; or in groups for rehabilitation, education, and support.

Purpose of eMental Health Practice

Of the 16 participants interviewed, 9 had implemented eMH resources into their practice with their clients since completing an eMH training program. Figure 1 describes the variety of uses to which they put eMH resources with their clients.

Figure 1. Purpose of eMental Health practice.

Inform and Educate

There were various ways that workers used eMH resources to provide information and education to their clients. Workers engaged in information sharing and education with individual clients and with groups of clients. These events were scheduled or spontaneous, one-off or ongoing. Workers used eMH resources with their clients or referred their clients to relevant information or education resources.

> We used the Ice one [YouTube clip] in a good session because it tells you about how when ice [crystal methamphetamine] is injected or smoked and it goes into your brain what it does to your brain and what it does to your body.

> There is a quit smoking one. Like a game show about quitting smoking and it's indigenous-specific so we use that with our clients.

> ...if you're talking to a client, you can speak to him and you can say, "Okay, well, look up this program," and maybe we'll get some information, we'll talk about it.

In addition to informing and educating clients, one worker described the role that Facebook plays in informing and educating other workers and the community about resources and programs that are available.

> A lot of that information is actually getting out there via Facebook. I think beyondblue has got a great program. Mindspot comes up a lot. There's programs for people with cannabis misuse. There's all sorts of stuff you see coming and I'll always share that stuff, because it might be someone that's sitting there and thinking "I'm not comfortable going to my Aunty up the road." That gives them a choice.

Assess

Depending on the type of service in which they work, workers undertook a variety of assessments with their clients. Assessments could range from mandatory mental health assessments required by child protection authorities to intake assessments tailored to the particular service, for example, drug and alcohol services or community-based wellbeing services. Assessments could be of individual clients or families, adults, or children. Assessments could be formal and worker-led or informal client-led self-assessments.

The workers who participated in this study had previously been trained in the use of a culturally adapted mobile app called *AIMhi Stay Strong*, which some participants were using for assessment.

> We used to just sit at the desk...and I'm just asking them questions off the computer...I found [Stay Strong] a lot more engaging than sitting at the desk. We'd sit out in the open and do it, and they felt really comfortable.

> What I find with the young fellas is that I don't have to do anything. I just turn it on and say, look...I explain to them what it is and what to do, because next time we meet, we can have a look at it again.

> They just do it themselves. Really simple...Then I'll check it and it's all done properly.

Case Plan or Manage

The majority of workers in this study worked in services that used case planning with clients. Workers managed an allocated caseload of clients. Workers used a variety of terms to describe the manner in which they managed their clients over time. These included service planning, goal setting, life coaching and checking in. Depending on the service, case planning may be a formal process mandated by the service or an informal ongoing check-in process.

Some participants reported using *Stay Strong* with clients as a case management tool. Particular mention was made of the goal setting function within this app.

> We make a plan of what they want to achieve in the next 3 or 6 months and then we support them in that plan just as kind of coaches, life coaches, so that's my kind of role.

> When I go down to see these clients, I just usually take the app with me and open it up. We look at it together and I say, "What's changed?"

> We found out the younger ones like setting themselves up with goals. They were really looking forward to see what they can change in their life. They're like, "Yeah, well, we're going to check this out next time we sit down," and go over it and see if they reached a goal or they're moving towards where they want to be.

Respond to Crises

Despite the majority of workers in this study having a case load and working within a case planning framework, many described their working lives as being driven by client crises, external demands from other services, and cultural or community responsibilities.

> Going online, finding all these different [telephone] numbers...because there are times I wouldn't happen to make it back out [to a community], or there might be a drama, or dilemma, or something happened in the community. There are emergency numbers that you can access.

Refer to eMental Health Resources

Participants referred to a range of health and social services. They describe using technology to access the websites and contact details of agencies to which they can then refer their clients, refer clients to eMH resources like online programs and mobile apps, and refer clients to emergency telephone numbers and hotlines. Throughout the comments about this particular activity ran a theme of encouraging agency and independence in their clients.

> Instead of me specifically using a tool for anxiety...I might go to beyondblue anxiety. I think if they actually want to do anything about it I wouldn't really have that conversation with them. I'd probably need to take them to a doctor.

Just mention it. If they [clients] choose to put it on there [onto their mobile phones] themselves, then they'll come back and go, "I got one. It seems to be working good." ...then they'll show me what they've got or tell me how it's going, if they enjoyed it, or if it worked, or just tell me how it worked for them.

If my client tomorrow, if he's got a smartphone or if he's got an iPad, I would say, you should have a look at this by yourself or check it out and he can do all the stuff on it himself.

I sometimes will Google [with] clients, find information and numbers and things.

Part of my work, if I'm out in the community I can just say to the younger ones, or family members, "There are websites that you can look at, also. It helps me to look at some numbers, like contact numbers, maybe, grief, or loss, or suicide, or whatever."

Support Social Inclusion

Workers used eMH resources to engage with clients for the purpose of connecting them to relevant social and community services, building social skills, and supporting clients practically toward employment, education, and training.

> *I work with people who have mental illnesses. They might need help just with day to day stuff and also social stuff, so getting them connected into the community so that they have more support networks. I use different technology to achieve that. We all have an iPad, so we take that with us everyday and have lots of apps and access to Internet, videos, all sorts of stuff, music, just to help our participants get used to accessing the Internet services for information.*

Care for Self and Family

Participants reported using eMH resources for themselves and their families to help manage stress and anxiety.

> *I think I actually applied to do a Mindspot one. I do experience anxiety sometimes. I guess it's more people need to be aware that they matter. It's that self-care stuff.*

> *I used them for myself. The meditation one.*

> *I can even use them with my own family members. When my brother-in-law's not well, I do that Stay Strong. I say to him, "Just have a look."*

> *The meditation one. I asked one of my aunties if she'd be interested, but she doesn't know how to use a computer, so I showed her on mine. She loved it.*

Types of eMental Health Resources

Participants reported using a variety of types of eMH resources with their clients. They used both culturally specific and mainstream resources, described below

Information Websites and Online Telephone Crisis and Support Services

Participants referred clients to popular mainstream mental health websites like *beyondblue* and *Mindspot* and referred clients to major mainstream online telephone crisis support services like *Lifeline*. The range of information websites and support services websites extended beyond the field of mental health and into health and welfare services.

Online Symptom-Based Treatment Programs

While participants were aware of online symptom-based treatment programs and some had promoted them to their clients, no one had embedded them into their practice. One participant had accessed an online treatment program for anxiety for their personal use but then disengaged with it. Some participants were using *Stay Strong* as a practitioner-led assessment and case-planning tool while others were encouraging clients, and in some cases family members, to use the app independently of the worker.

Online Health Prevention Programs

Participants reported using two culturally specific online health prevention programs—one aimed at smoking cessation and the other aimed at managing cannabis use.

YouTube

Participants used YouTube clips for health information, particularly information about alcohol and other drugs, and for music for relaxation purposes.

Self-Help Mobile Apps

Participants in this study used self-help relaxation and breathing apps for the management of stress.

Within the context of their practice and their interactions with clients, only eMH resources that could be accessed via a mobile device (either a smartphone or a tablet) were used. Most of the client interactions occurred in community settings and often occurred outside in parks or outside the building of the service where they worked. Some participants referred clients to eMH resources that require a desktop computer (for example *Mindspot*) and one participant used a desktop computer to access *Mindspot* for her own self-care. Table 1 reports on the types of eMH resources that were used for particular purposes.

Table 1. Types of eMental Health resources used.

Use	Type of eMH[a]
Inform and educate	Videos (for example, alcohol and other drug videos on YouTube), Facebook, mental health website (*beyondblue*), online treatment program (*Mindspot*), online health prevention programs (for example, to quit smoking, manage cannabis use)
Assess	*AIMhi Stay Strong* app
Case plan or manage	*AIMhi Stay Strong* app
Respond to crises	Online emergency telephone numbers and services
Refer to eMH resources	Mental health website (*beyondblue*), information websites, online services and contact information (for example, health and welfare services, grief, loss, suicide), mobile apps (for example, meditation, breathing)
Support social inclusion	Information websites, health and welfare services, music, videos
Care for self and family	Mobile apps (for example, meditation, *AIMhi Stay Strong*), online treatment program (*Mindspot*)

[a]eMH: eMental Health.

Discussion

Principal Findings

The findings from this exploratory study provide a detailed description of how one group of Aboriginal and Torres Strait Islander service providers report on how they have integrated eMH resources into their practice after an eMH training course, and the types of eMH resources that they are choosing to use with their clients.

In summary, the study found that 9 of the 16 participants had implemented eMH resources into their routine practice following an eMH training program. The findings demonstrate that participants were using eMH resources for informing and education, assessment, case planning and management, referral, responding to crises, supporting social inclusion, and self and family care. Participants chose a variety of types of eMH resources to use with their clients, both culturally specific and mainstream. While they referred clients to online treatment programs, they used only eMH resources designed for mobile devices in their face-to-face contact with clients.

The findings highlight the particular cultural and professional context within which Aboriginal and Torres Strait Islander service providers engage with their clients.

Purpose of eMental Health Practice

In the absence of other studies of utilization of eMH by other health or related workforces, it is difficult to compare or contrast the findings from this study with other studies.

The only point of comparison that can be made is with a conceptual paper by Reynolds et al [31] that describes a set of clinical practice models to guide primary health care professionals and peer workers in the use of online assessment or screening and psychological treatment programs. The 5 clinical practice models are described on a continuum of therapist involvement: promotion, case management, coaching, symptom-focused treatment, and comprehensive therapy. Clinical practice models have become a popular benchmark for the development of clinical guidelines for the implementation of eMH across primary health care professions [32].

The participants in this study did report engaging in promotion and referral, case management and coaching with their clients, but symptom-focused treatment and comprehensive therapy lay outside both their expertise and their roles.

While they did refer clients to one online assessment or screening and psychological treatment program (*Mindspot*), participants in this study did not integrate this type of eMH resource into their practice.

Comparing the findings from this study with the conceptual clinical practice models described in Reynolds et al [31] is of limited use for 3 reasons. First, the primary target audience for the clinical practice models is allied health professionals working in clinical settings. While the Reynolds et al paper also includes peer workers and nonclinical workers, it assumes those workers are working under clinical supervision. Second, the models described in Reynolds et al [31] focus on the use of only one type of eMH resource—online assessment or screening and psychological treatment programs. Third, caution must be taken in assuming a commonality of practice across different professional contexts. Terms like coaching, for example, have different tacit meanings within different professional contexts. What coaching means to a clinical psychologist may be quite different to what coaching means to a community-based welfare worker.

Types of eMental Health Resources

Overview

Overall, the findings of this study demonstrate a clear preference among this cohort for a variety of eMH resources that have been designed for or can be easily accessed through mobile devices (smartphones and tablets). This finding is in accord with findings from a number of studies that confirm the mobile smartphone with a prepaid service plan as the digital device of choice amongst Aboriginal and Torres Strait Islanders [33,34]. This preference is significant to our understanding of the choices that Aboriginal and Torres Strait Islander service providers and clients make about eMH resources, as it leads to eMH resources designed for mobile devices, resources that do not require long periods of time on the Internet, and resources that are not expensive to download.

Low-Intensity eMental Health Resources

Participants did not choose eMH resources designed to treat low-intensity mental health disorders like anxiety or depression. While it is not clear why this cohort did not use mainstream online symptom-based psychological programs, some inferences can be drawn from related evidence. One is that the service providers under study are not trained mental health specialists and, while their clients do present with mental health disorders, the treatment of those disorders falls outside their scope of practice [28]. Another is the reported discomfort Aboriginal people feel with the negative connotations that symptom-based mental health diagnoses carry as opposed to more culturally sympathetic conceptions of social and emotional wellbeing [7,25].

The only online treatment program to which workers referred clients was the *Mindspot* program, which offers the only culturally adapted version of a mainstream online assessment and treatment program (the *Mindspot Clinic Indigenous Wellbeing Course*). A recent study of the profile of users accessing the *Mindspot* website reports that Aboriginal and Torres Strait Islanders visited the site at a rate that closely matched national population statistics [35].

Some participants did use *Stay Strong* for client assessment and as a case management and care planning tool, as identified in Puzka et al [25]. This preference adds weight to the suggestion that eMH resources designed within a social determinants of social and emotional wellbeing framework may better capture Aboriginal conceptions of mental health than eMH resources based on biomedical models [25].

It is possible that if and when more culturally relevant treatment programs become available Aboriginal and Torres Strait Islander service providers may be more likely to refer their clients to these services or integrate them more fully into their case management models if they were to be given the training to do so.

The choice of mobile apps by participants in this study related only to the management of stress via relaxation and meditation apps. This preference may be explained by the high rates of psychological distress reported in the Aboriginal and Torres Strait Islander community and the high prevalence of stressors and stressful events in their lives [36]. It is also possible that these workers consider stress management to fall within their professional expertise and scope of practice, where the clinical management of anxiety and depression and other mental health disorders does not. There was no evidence that this cohort was using mobile apps for clinical purposes such as symptom assessment or the tracking of treatment progress.

Health Education and Health Promotion Resources

Bennett-Levy et al [28] highlighted the importance of matching types of eMH resources to particular work roles. The authors of this study queried the suitability of therapy-oriented resources for Aboriginal and Torres Strait Islander service providers, who may better be described as health educators than clinicians and therefore may be more comfortable using eMH resources with a health education or health promotion focus.

Participants in this study used a variety of types of eMH resources to inform and educate their clients about mental health and social and emotional wellbeing that included information websites, online health prevention programs, and YouTube videos. They also reported using Facebook as a means of keeping themselves updated and informed professionally.

Consistent with the findings from an earlier study [28], participants in this study had continued to implement Youtube clips into their practice. Rice et al [37] report a cultural compatibility between multimedia and the orally and visually oriented culture of Aboriginal and Torres Strait Islanders. Another study [38] reported on Aboriginal and Torres Strait Islander preferences for narrative story-telling approaches in Internet resources provided by government. The evidence suggests the potential that YouTube videos have for engaging Aboriginal and Torres Strait Islanders in eMH.

However, establishing an evidence base for the use of health information and health promotion resources will require researchers to broaden their focus from online treatment programs [28]. One systematic literature search found, for example, that of 60 indigenous health promotion tools available, only 11 had been evaluated for impact after implementation and only 5 of those reported strong impacts [39].

Overall, the findings from this study confirm a number of key features that may distinguish Aboriginal and Torres Strait Islander service providers from other health professionals. The contexts within which they work, the manner in which they use eMH resources, and the types of eMH resources they use with their Aboriginal and Torres Strait Islander clients all deserve separate and distinct investigation and reporting. To conflate these workers within a homogenized discourse about the implementation of eMH among health professionals is to miss the distinctive role they play and the unique opportunities they offer in the overall delivery of services to Aboriginal and Torres Strait Islander people.

Limitations

This study has drawn on experiences and insights from Aboriginal and Torres Strait Islander service providers from one regional area of Australia. Given the diversity of roles and contexts of Aboriginal service providers across Australia [20], it is unclear to what extent the findings from this study can be generalized to urban or remote community contexts.

The participants in this study had all attended an eMH training workshop, and 13 of these participants had attended follow-up eMH consultation sessions. In the course of both the training workshop and the follow-up consultation sessions, participants were introduced to particular eMH resources. While participants did report independently searching for, choosing and implementing eMH resources, their training experience will have influenced the choice of eMH resources that they subsequently used in their practice 6 to 8 months later.

Future Research

The findings from this small exploratory study need testing in different locations and with a national sample of Aboriginal and Torres Strait Islander service providers.

There is scant research that focuses on populations of consumers and their preferences for eMH services and resources [24]. One systematic review of studies of eMH services for anxiety and depressive disorders found that the current profile of users of these services is female, more educated, and socially advantaged [24]. In these studies ethnicity was infrequently reported. There is only one small study to date of Aboriginal and Torres Strait Islander acceptability of two culturally specific mental health apps [40], and one study of access and engagement rates by Aboriginal and Torres Strait Islander people of one online psychological assessment and treatment program [35]. More research needs to be conducted on the preferences of Aboriginal and Torres Strait Islander people for various types of eMH resources.

Opportunities may lie, for example, with the relative youthfulness of the Aboriginal and Torres Strait Islander population [3]. Young Aboriginal and Torres Strait Islanders are competent, confident, and frequent users of digital technology and social media [37]. They employ digital technologies and social media for culturally specific purposes including maintaining community and family and kinship connections and affirming cultural identity. In addition, a number of studies comment on the unrealized potential for health education and health promotion programs to harness this dynamic digital space [37,33].

Conclusions

This paper demonstrates that the manner in which a particular workforce integrates eMH resources into their practice is highly contextual and suggests that a one-size-fits-all approach to eMH implementation is of limited value to the field. Workforces, and the professions within them, each have characteristics that will offer both opportunities and constraints to the manner in which they use eMH resources and the types of eMH resources they choose to use. At time of writing it seems particularly important that the eMH field expand its focus from allied primary health care professionals who work in clinical settings to workforces that are community-based and who may work outside the traditional health system. In particular, policy makers and workforce trainers need to recognize the diversity of workforces that support the social and emotional wellbeing of Aboriginal and Torres Strait Islander people and other minority populations.

The findings reported in this paper may be useful to those working within indigenous communities in postcolonial countries other than Australia. While eMH does not appear to have yet gained traction among indigenous communities in New Zealand or North America, eMH offers the global indigenous community an opportunity to share experiences and eMH resources across national borders.

This paper also highlights the importance of identifying and addressing the particular needs and user preferences for eMH of minority groups generally and in this case Aboriginal and Torres Strait Islander people. If eMH is to improve accessibility to and equity in the mental health system rather than further entrench existing inequalities, the field needs to foster the production of culturally relevant resources, services, and treatment modalities that both support social and emotional wellbeing and treat mental health disorders.

Conflicts of Interest

None declared.

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Abbreviations

eMH: eMental Health

Original Paper

Use of New Technologies in the Prevention of Suicide in Europe: An Exploratory Study

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Abstract

Background: New technologies are an integral component of today's society and can complement existing suicide prevention programs. Here, we analyzed the use of new technologies in the prevention of suicide in 8 different European countries.

Objective: The aim of this paper was to assess the opinions of professionals in incorporating such resources into the design of a suicide prevention program for the region of Zamora in Spain. This investigation, encompassed within the European project entitled European Regions Enforcing Actions against Suicide (EUREGENAS), includes 11 regions from 8 different countries and attempts to advance the field of suicide prevention in Europe.

Methods: Using a specifically designed questionnaire, we assessed the opinions of 3 different groups of stakeholders regarding the use, frequency of use, facilitators, content, and format of new technologies for the prevention of suicide. The stakeholders were comprised of policy and public management professionals, professionals working in the area of mental health, and professionals related to the social area and non-governmental organizations (NGOs). A total of 416 participants were recruited in 11 regions from 8 different European countries.

Results: The utility of the new technologies was valued positively in all 8 countries, despite these resources being seldom used in those countries. In all the countries, the factors that contributed most to facilitating the use of new technologies were accessibility and free of charge. Regarding the format of new technologies, the most widely preferred formats for use as a tool for the prevention of suicide were websites and email. The availability of information about signs of alarm and risk factors was the most relevant content for the prevention of suicide through the use of new technologies. The presence of a reference mental health professional (MHP) was also considered to be a key aspect. The countries differed in the evaluations given to the different formats suggesting that the cultural characteristics of the country should be taken into account.

Conclusions: New technologies are much appreciated resources; however they are not often underused in the field of suicide prevention. The results of this exploratory study show that new technologies are indeed useful resources and should be incorporated into suicide prevention programs.

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Introduction

Suicide is a severe public health problem and one of the most common forms of unnatural deaths worldwide [1]. Globally, around 800,000 people commit suicide every year and it is estimated that for every person who commits suicide another 20 people have attempted to do so [2]. During the second half of the last century, suicide was one of the 3 main causes of death in people in the 15 to 44 age group [3]. Despite this, suicide rates are not stable over time and they show short-term variations and trends [4]. Currently, the mean rate of suicide worldwide is 11.6 cases per 100,000 people [5], and there are substantial country-specific differences around the world, with greater differences observed between culturally different populations [6].

Overall, Europe has a high rate of suicide, but the epidemiology of suicide varies among the different countries [7]. Some countries, such as Finland, Hungary, and the Baltic countries, together with Russia and Belarus, have the highest suicide rates in the world, with 40 suicides per 100,000 people. By contrast, countries in the south of Europe such as Italy, Spain, and Greece, have low levels [8]. Although Spain is among the European countries with the lowest rates of suicide, suicide levels have increased considerably in recent years. According to data from the National Institute of Statistics (NIS), suicide is the first cause of unnatural deaths in Spain, and in 2012, the number of suicides increased by 11.3%, the highest rate recorded since 2005 [9].

The economic and human costs of suicidal behavior are very high for the individuals involved, including their families and society in general. In the United States, it has been estimated that deaths due to suicide cost the country around US $26 billion per year in medical costs and absence from work [10].

Suicidal behavior is a complex phenomenon consisting of biological, clinical, psychological, and social factors [11]. Research has shown that some characteristics that are crucial for evaluating the risk of suicide can be identified [12] and that these risk factors can provide early signals as well as pathways for preventive interventions aimed at reducing the probability that a person will attempt to commit suicide [13]. Suicide is tightly linked to the model of the society in which an individual lives, there being a direct relationship between the experience of stress factors or unfavorable alterations in a person's environment and the risk of suicide [14-16]. It has been reported that inhabiting an environment with good living conditions and without economic hardships decreases the risk of suicide [17-19]. For example, divorced individuals have a greater risk of suicide [20]. On the other hand, religion is generally a protective factor such that the degree of religiousness is indirectly proportional to suicide risk [21,22].

Suicidal acts are usually preceded by "softer" manifestations such as thoughts of death or suicidal ideation [23]. The progression from thought to actually committing suicide represents the transition from a slight symptomatology to a more severe one [24]: prodromic symptomatology is a risk factor for future admission to hospital or a factor of risk of death by suicide [25]. Many studies, both clinical and community-based, have reported consistent empirical evidence that the presence

or history of mental illness is the greatest risk factors for suicide in the general population [26], with mood swings, the loss of control over impulsive behavior, alcohol and substance abuse, psychotic ,and personality disorders being responsible for the highest risks of suicide and suicidal behavior [27]. It has been estimated that between 80% and 95% of people who commit suicide, including adolescents and elderly persons, have some kind of psychiatric disturbance [28]. Of all psychiatric diseases, affective disorders, and in particular recurrent major depressive disorder (MDD), are those that involve the greatest risk of suicide in both men and women in almost all age ranges [29]. Epidemiological studies have suggested that 15% of individuals with recurrent MDD have attempted to commit suicide at some time in their lives [30].

Suicide and suicide prevention are attracting increasing attention worldwide [31]. The act of committing suicide impacts all levels of society and results in an increase in the risk of attempts at suicidal behavior by others in the environment surrounding the person who dies. Suicide should thus not be considered an individual problem, but rather a problem that affects that person's family, his or her surroundings, and society in general. Accordingly, it is crucial to seek a strategy aimed at preventing suicide at the public health level and not focused exclusively on the individual level [32]. Further, suicide is tightly linked to other forms of violence and health problems [33]. Over the past 20 years, public health systems have attempted to calculate suicide rates, identify the risk factors and protective factors, and have tried to develop effective strategies for preventing suicide. However, a significant amount of work remains to be done in these areas; one of the emerging challenges for public health systems is how to determine the ways of disseminating and putting into practice "what we know" about the prevention of suicide on a large scale in order to achieve an impact at a demographic level [10]. As such, it has been proposed that to carry out programs aimed at preventing suicide it is imperative to be knowledgeable about the people involved with and related to suicide.

Stakeholders are individuals, groups, or organizations that participate directly in decision making and actions [34] and many groups have demonstrated the importance of stakeholders in the design of strategies for intervention in the field of general clinical practice [35], mental health [36], and more specifically, in the field of suicide prevention [37].

New technologies are an integral component of today's society and are under constant development and expansion. There are many contexts in which new technologies play a relevant role and their use in the health field is expanding [38], especially in the area of mental health [39,40]. The aim of this paper was to (1) assess the opinions of stakeholders from different European countries regarding the use of new technologies for the prevention of suicide, such as informative websites, online self-help interventions, electronic therapy (e-therapy) interventions, interactive websites (chats), Internet forums, social networks, and apps; and (2) assess their opinions in incorporating such resources into the design of a suicide prevention program in Zamora, Spain. This investigation, encompassed within the European project entitled European Regions Enforcing Actions against Suicide (EUREGENAS),

included 11 regions and attempted to promote the field of suicide prevention in Europe [41].

Methods

Participants and Procedure

Within the context of the EUREGENAS project, our study aimed at evaluating—on a European scale—the actions to be implemented and considered effective in the prevention of suicide. The objective was to determine the different points of view and the possibilities of introducing these actions. Beginning with a first consultation with the partners involved in the project and an in-depth review of the literature, a list of possible stakeholders of interest was proposed. The 3 main categories of stakeholders established were: (1) decision policy makers (DPM), stakeholders in the political and public management field; (2) mental health professionals (MHP), stakeholders working in the area of mental health; and (3) professionals related to the social area and those working in non-governmental organizations (NGOs) (NGOs/Social Area) (Multimedia Appendix 1).

A total of 416 participants were recruited in 11 regions from 8 different European countries according to the following

inclusion criteria: (1) workers belonging to the 3 professional groups selected for this study (DPM, MHP, NGOs/Social Area); (2) experienced in the field of suicide; (3) aged between 18 to 65 years old.

Variables and Instruments

Specific questionnaires were tailored to the various stakeholders and were used as tools to obtain the information necessary for assessing needs. The questionnaires included closed questions about the use of new technologies for the prevention of suicide and sociodemographic data (gender, age, professional category). The questionnaires were created by project partners, and subsequently revised by all the members of the project. They were drafted originally in English and translated into the mother tongue of the various project partners. The projects partners distributed approximately 60 questionnaires each and were administered face-to-face or via email.

A total of 416 questionnaires were completed (Table 1). The gender distribution was 39.7% (165/416) men and 60.3% women (251/416). With respect to age, 61.8% (257/416) were aged between 40 and 59 years, 26.8% (111/416) between 20 and 39 years, and 11.4% (48/416) were over 60 years of age.

Table 1. Questionnaires administered by country (N=416).

Country	Stakeholders, n (%)			
	DPM[a]	MHP[b]	NGO[c]	Total
Belgium	14 (3.4)	19 (4.6)	15 (3.6)	48 (11.5)
Finland	7 (1.7)	21 (5.0)	31 (7.5)	59 (14.2)
Germany	9 (2.2)	9 (2.2)	12 (2.9)	30 (7.2)
Italy	10 (2.4)	13 (3.1)	9 (2.2)	32 (7.7)
Romania	10 (2.4)	19 (4.6)	3 (0.7)	32 (7.7)
Slovenia	10 (2.4)	11 (2.6)	9 (2.2)	30 (7.2)
Spain	17 (4.1)	92 (22.1)	45 (10.8)	154 (37.0)
Sweden	10 (2.4)	13 (3.1)	8 (1.9)	31 (7.5)
Total	87 (20.9)	197 (47.4)	132 (31.7)	416 (100.0)

[a]DPM: decision and policy maker.

[b]MHP: mental health professional.

[c]NGO: non-governmental organization.

Statistical Analyses

The data obtained from the questionnaires were analyzed using the SPSS v19 software package. Once the data was gathered, and depending on the study objectives, comparisons of means were performed to gain a general idea of the scores obtained on the different items. After this first descriptive analysis, multivariate analysis of variance (MANOVA) was implemented to determine the existence of significant differences. Finally, using multidimensional scaling (ASCAL), we sought to visually recognize the dimensional patterns in the preferences of the

training formats both by country and by the participants involved in the investigation.

Results

Utility and Frequency

The utility of the new technologies evaluated from 1 (not very useful) to 5 (very useful) and was judged positively in all the countries with a mean (SD) of 3.93 (0.78). However, the frequency of use, evaluated from 1 (never) to 5 (always), was low with a mean (SD) of 1.79 (1.08). Belgium was the only country that approached a moderate frequency (Figure 1).

Figure 1. Country-specific differences in utility and frequency.
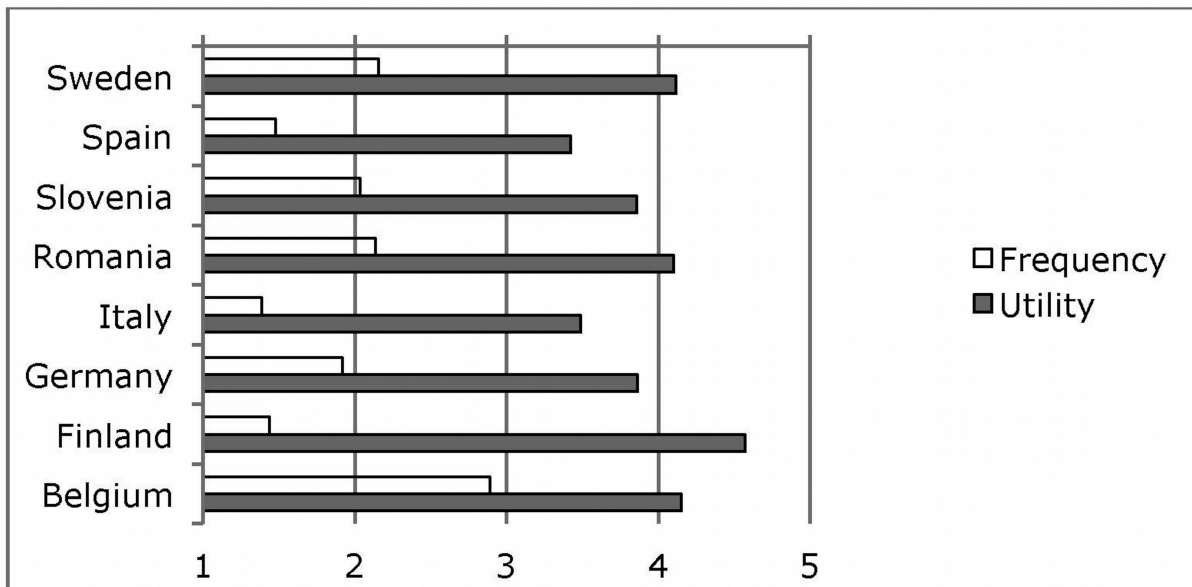
Figure 2. Relevant content for the prevention of suicide with new technologies.
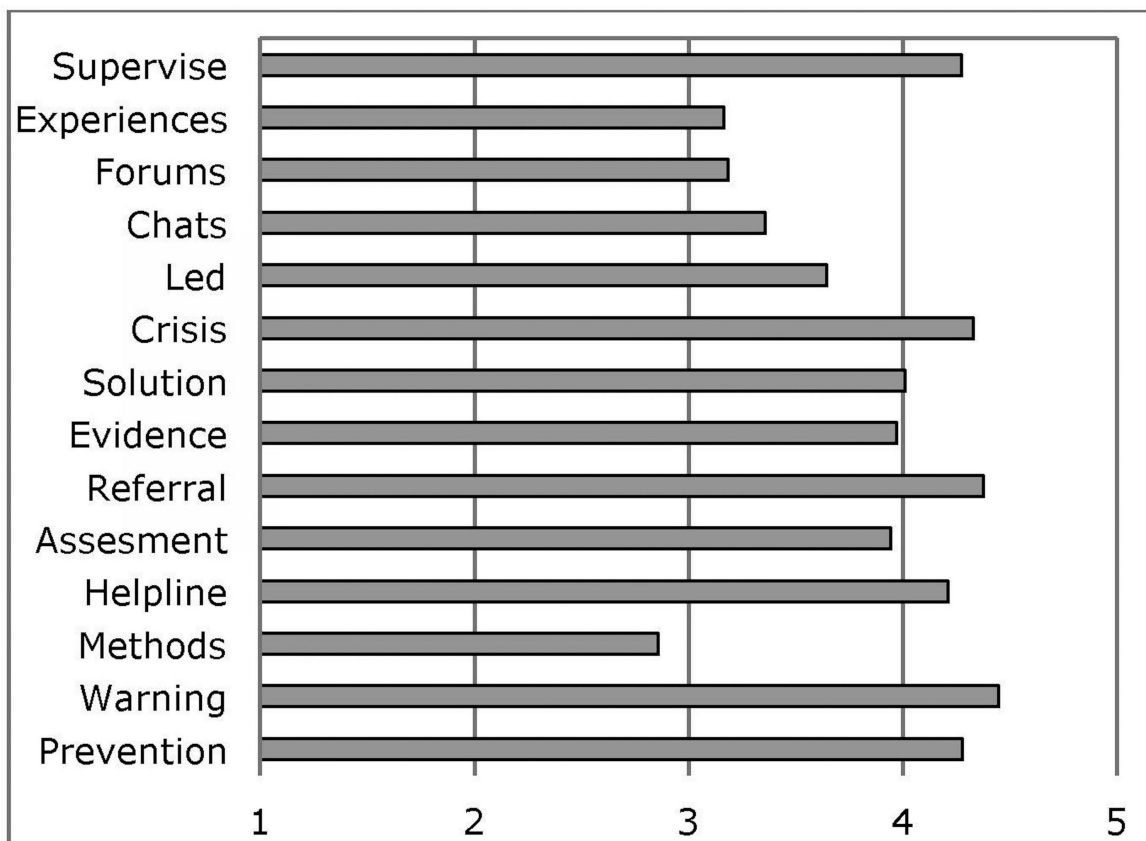
MANOVA failed to reveal significant differences among stakeholders with regards to utility (P=.138) or frequency of use (P=.141). In contrast, there were significant differences between the countries, both regarding utility ($P<.001$) and frequency of use ($P<.001$). Finland, Sweden, Belgium, and Romania considered the technologies to be more useful than Spain ($P<.01$). Belgium used them the most frequently while Finland, Spain, and Italy used them the least.

Facilitators

The elements that would facilitate the use of new technologies for the prevention of suicide (Textbox 1) were assessed on a scale ranging from 1 (not at all) to 5 (absolutely).

Textbox 1. Elements that would facilitate the use of new technologies.

Element
Training: more information about the issue through training
Newsletters: more information about the issue through informative bulletins
Automated: automated apps (ie, those that do not require constant supervision)
Accessible: ease of access
Anonymity: guaranteed anonymity
Time: saving time
Cost: saving money
Free: no additional costs (freeware)

It was determined that accessible was the most important element (4.15), followed by free (4.12), anonymity (3.91), training (3.77), time (3.67), cost (3.51), newsletters (3.23), and finally automated (3.16). These factors were judged differently by the various stakeholders (Pillai's trace test $P<.001$). MHPs found training more importance than DPMs ($P<.001$). In contrast, DPMs attributed more importance to cost than the MHPs ($P<.001$). NGOs attributed intermediate values between both DPMs and MHPs, with no significant differences. The elements also had country-specific differences (Pillai's trace test $P<.001$). For example, Romania valued training the most, Sweden valued accessible the most, whereas Slovenia valued newsletters, automated, and time the most.

Relevant Content for the Prevention of Suicide

The following content were evaluated on a scale ranging from 1 (not necessary) to 5 (absolutely necessary): (1) prevention (information about the prevention of suicide); (2) warning (information about the warning signs and risk factors); (3) methods (information about how people commit suicide); (4) helpline (online help links for the prevention of suicide) (5)

assessment (scales of risk assessment); (6) referral (referral to a professional and/or organization); (7) evidence (evidence-based therapy); (8) solution (offer solutions to the people at risk of committing suicide); (9) crisis (crisis contingency plans in cases of high suicide risk); (10) led (chats guided by a professional); (11) chats (chats and Internet support forums); (12) forums (Internet chats and forums for therapeutic uses); (13) experiences (exchange of experiences between people at risk of committing suicide); and (14) supervise (supervision by a professional).

With the exception of methods, the evaluation was positive (>3). The content with the best evaluations were warning, referral, crisis, supervision, and prevention. The least well-evaluated were experiences and forums (Figure 3).

Statistically significant differences were found among the stakeholders (Pillai's trace test $P<.001$). DPMs attributed less value to helpline than MHPs ($P=.004$) and the NGOs ($P=.001$). They also gave more importance to referral than NGOs ($P=.012$). In contrast, MHPs attributed less importance than DPMs to led ($P=.019$) and to chats ($P=.008$).

Figure 3. Format-specific preferences of new technologies.

Figure 4. Country-specific format preferences.

Statistically significant differences were also observed between countries (Pillai's trace test *P*<.001). Pairwise comparisons revealed differences in the importance of some content (*P*<.01). Specifically, Italy had the lowest evaluations for all of the content except evidence, which was evaluated less by Finla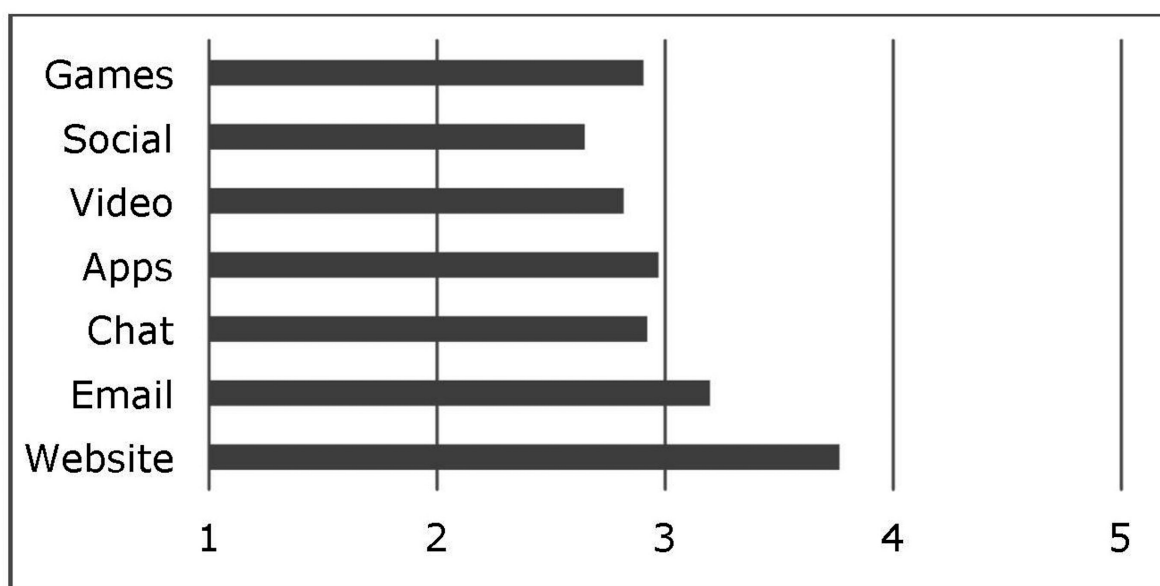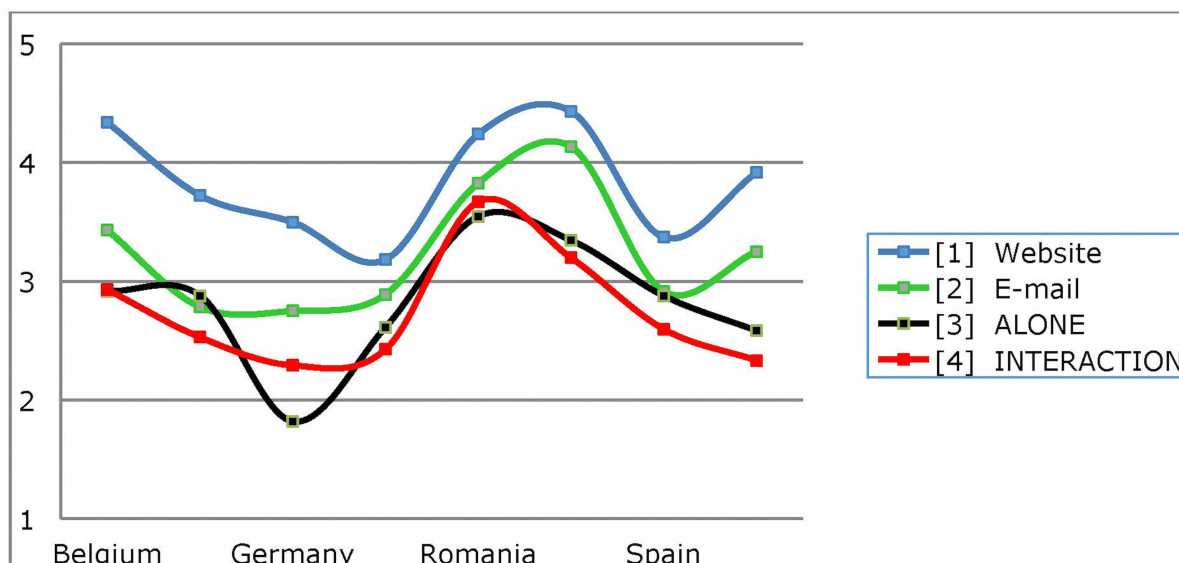nd. Solution was evaluated less well by Belgium, whereas supervise was evaluated less well by Sweden. The highest evaluations corresponded to Romania and Slovenia in all the content except assessment and referral, which were better evaluated by Finland and Belgium, respectively.

Preferred Formats

Formats were also assessed on a scale ranging from 1 (never) to 5 (always). The mean evaluations are shown in Figure 3. Website was the most preferred format, followed by email. The other formats did not reach a frequent intention of use. In addition, a MANOVA comparison did not reveal significant differences among the stakeholders for any of the formats (Pillai's trace test *P*=.468), although there were differences among countries (Pillai's trace test *P*<.001). Slovenia gave the highest evaluations to games, social networks, email, and website, while Romania scored video, apps, and chat the highest.

ASCAL was implemented to explore structure in the preferences for the various formats. Two underlying dimensions were detected that permitted the identification of 2 differentiated criteria in format preference. The fitting of the data to these dimensions was excellent (stress=.04; r square = .988). The following differentiated types were detected: (1) website (focused on personalized information); (2) email (focused on personal and/or individual communication); (3) games, videos, and apps (focused on activities that do not require interaction and can be done alone [ALONE]); and (4) social networks and chats (focused on activities that do require social interaction [INTERACTION]).

Website was determined to be the most preferred, with a mean (SD) value of 3.76 (1.22), followed by email, with a mean (SD) of 3.20 (1.26). Finally, no differences were found between

ALONE and INTERACTION, with mean (SD) values of 2.94 (1.12) and 2.80 (1.20), respectively.

No differences were detected regarding the preference for format types (Pillai's trace test, *P*=.134). In contrast, there were country-specific differences (Pillai's trace test, *P*<.001) (Figure 4).

Pairwise comparisons (Bonferroni correction, *P*<.05) revealed that website was more preferred by Slovenia, Belgium, and Romania, than Italy and Spain. Email was more preferred by Slovenia and Romania than by Finland. ALONE was more preferred by Romania and Slovenia than by Germany, and INTERACTION was more preferred by Romania than by all the other countries.

Discussion

Principal Findings

It is known that new technologies are increasingly important in daily life, especially among young people. This has led companies, policy makers, and other stakeholders to use them more frequently in order to access their target population and achieve their aims. Notwithstanding, within the sphere of public health the use of such technologies is still in its infancy, especially in the case of suicide and its prevention. There is evidence that suggests the probable benefit of Web-based strategies in suicide prevention [42]. In this sense, the findings of the present study confirm their scant application as all of the countries ranked them as rarely, with the exception of Belgium that ranked them as sometimes. Despite this, the results of this exploratory study suggested that the use of new technologies for the prevention of suicide could be well-accepted among the various stakeholders. As such, utility was assessed positively in all the countries included in the study, with Finland evaluating it the highest, whereas Spain and Italy, although still positive, assessed it the lowest. These findings confirmed the cultural differences with regards to both the use of new technologies and the problem of suicide, since northern European countries

had a more positive view of the use of new technologies than countries in the south of Europe [43]. This may be correlated to the degree of implementation of new technologies in each of the respective countries and their use in public health services.

All the evidence suggests a need to promote suicide prevention programs based on new technologies that will serve to gain better access to the younger sector of society. It is clear that new technologies can be a tool that complements existing suicide prevention programs; the view of stakeholders, from the areas of education, health, and social and legal affairs, is that they are an instrument to be developed and tested. In a recent review, Robert and colleagues affirmed that the Internet is useful for linking people who feel lonely or isolated, can provides access to suicide prevention information and resources, and can influence vulnerable people to attempt suicide, but it can also be used to prevent self-harm and suicide [44].

Taking into account the possibility of developing technological applications to improve the prevention of suicidal behavior, we analyzed the factors that would facilitate a more generalized use of new technologies. In general, all the proposals made were evaluated positively as factors, such that promoting the more widespread use of these technologies could offer a broad solution in which to act, emphasizing the accessibility and availability of free software. In light of the results, such promotion should be focused and dependent on the receivers. For example, in the case of mental health workers, training should be stressed in order to palliate the lack of knowledge and/or availability of resources to implement the new technological applications in this field. By contrast, in the case of MPS, it would be of greater interest to stress the low costs of the resources. These data are consistent with our findings in that countries in which they are considered to have greater applicability, it is most important to foster accessibility and use, whereas in countries in which their applicability is not considered so highly, it is more important to focus on training. As a result, it is necessary to promote training, especially in European countries, and increase accessibility at a country level. To achieve this, the European Union should make efforts to offer a global space of communications to facilitate these developments. Recently, de Beurs and colleagues showed the efficacy of an electronic learning (e-learning)- supported "Train-the-Trainer" program. This program would be an effective strategy for implementing clinical guidelines and improving care for suicidal patients [45].

Another important aspect to be taken into account is the applications should be developed with the use of new technologies. For example, those involving the following were considered to be of greatest interest: warning, prevention, supervise, crisis, referral, and helpline, as compared with other content proposed. These observations showed that the most important contribution of the use of new technologies was linked to the monitoring of persons at risk of suicide and providing them with the opportunity to access attention. In this sense, helpline, warning, supervise, and crisis scored the highest. It should be noted that epidemiological data are currently allowing the identification of populations at risk of engaging in suicidal behavior; that specific treatments are available, and that perhaps the best contribution of new technologies lies in their providing

the opportunity to monitor and intervene rapidly in this at-risk population when a critical situation occurs. It is also necessary to consider that there are differences in the appreciations of technologies between the various stakeholders. MHPs confer greater importance to referral than DPMs, which may be explained by their being able to access or attend to this at-risk population. On the other hand, DPMs gave more importance to led and chat than MHPs because they may value the positive effect of mutual support. The mental health network, which has the capacity and the obligation to carry out group interventions, psychoeducation, and pharmacological treatment when there is an associated psychiatric disorder, values as more relevant the ability to detect cases of very high risk or cases in crisis, and that under such circumstances, the person can be referred to a mental health center. A meta-analysis of computer-based psychological treatments for depression shows the efficacy and effectiveness of such treatments in diverse settings and with different populations [46]. By contrast, in other prevention resources, or for professionals working in prevention, more importance is given to the social function of the new technologies. In this sense, they are not counterpoised elements, even though from the care-taking point of view it appears that the detection and monitoring of limit cases are elements to be incorporated into the applications so that they will be well-accepted by health professionals, especially professionals working in the field of mental health. This, however, does rule out applications that favor social relations and even direct contact with the user. Likewise, differences are also seen among countries, although they may be due to the high evaluation levels in most of the content given by Slovenia and Romania in comparison with the other countries.

Finally the formats website and email were the ones most highly valued. The other formats received a low evaluation, with social networks the least well valued. The differences among countries again place Slovenia and Romania as the countries that ranked website and email the highest, as opposed to Italy and Germany, which ranked them the lowest. These findings may be related to the most widely used formats, and hence, are considered of greater utility than the other formats, which, although with increasing penetration into society, especially among young people, are not considered as relevant, at least in the initial stages. Several studies have evaluated the effectiveness of Web-based interventions for suicidal thoughts [47-49]. As such, it is important to consider the type of formats that emerge in ASCAL analyses. The underlying structure allowed us to identify 4 format types: (1) website (oriented more towards information); (2) email (oriented more towards personal and/or individual communication); (3) ALONE (oriented more towards resources that can be used alone, such as games, videos, and apps); and (4) INTERACTION (oriented more towards social interaction via chats or social networks).

There are thus 2 criteria that should be taken into account. The first compares the resources based on the solitary/interactive nature of their use. With respect to solitary use, website and ALONE are resources that users can make use of when alone and they do not require interaction with other people. On the other hand, interactive use (email and INTERACTION), were characterized by the fact that users must interact with other

people. In the case of email, the interaction is personalized while in the case of social networks it collective. In either case, the user must be able to perform such interactions. The second criterion compares resources that require greater activity by users with resources that demand less activity. In the first case, one would be dealing with ALONE-type activities, which demand a sufficient level of activity to be able to watch a video on YouTube, become involved in a video game, or download an app with the purpose of gaining greater efficiency in the use of the technology. Social network or chat (INTERACTION) resources would also be included within this set of resources that require a certain level of activity to become engaged in group interactions. Alternatively, resources that do not require the same level of activity, either because they are individualized interactions (not collective, since they are real or virtual), such as communication by email or the search for information via websites. A striking observation in the results was that greater importance was given to the simplicity of the resource, especially in northern European countries, as compared with the socialization or not of the resources. In this sense, the impact of simplicity is less in countries in the south of the continent such as Italy, Spain, and even Romania, and to some extent Slovenia, than in northern countries since in the former the scores were very close for all the options.

These resources suggest a specificity that should be taken into account in their adaptations for the different aims for which they can be used. It is likely that some of them may be better used than others for certain purposes or types of user. When comparing the evaluations by the stakeholders, no differences between them were seen; however, they did receive country-specific evaluations. These differences possibly reflect diversity in the more or less communicative character of the cultures as well as in the value of social interaction in the various countries studied. Accordingly, the peculiarities of each country should be taken into account in order to design programs that incorporate the resources that best match the social psychology of the users to which they are directed. It is interesting that Germany is the country that most values the use of resources that facilitate socialization and interaction. It is also striking that in all the countries, websites were considered to be the most widely accepted resource. This could be attributed to the search for simplicity or as the first step taken when a situation arises.

Limitations and Strengths

The questionnaires used to collect the data were generated internally by the members of the project and did not take into account psychometric criteria. The principal aim of the project was to analyze the knowledge of relevant professionals in the suicide field to improve and create prevention programs of suicide in different regions of Europe. It should be noted that the questionnaire were not designed to be a tool used in the prevention of the suicide, rather were made as data compilation tools. In addition, the questionnaires were not translated in a homogenous way but were translated by different project partners, using different resources for the various languages.

The stakeholders involved in the study were not randomly selected and thus do not represent stakeholders as a whole. The number of stakeholders involved in the study differed per country, as well as did their motivation for participating. The sociodemographic data collected in the questionnaires (gender, age, and professional category) could have impacted the findings, but was not possible to control because of the small study sample size. However, the goal of the study was to make a first assessment of the usefulness of new technologies in prevention approaches for suicide. From this point of the view, the results of the study must be interpreted from a qualitative standpoint. In all cases, the stakeholders were selected following the same criteria and were persons involved direct or indirectly with suicide and the consequences of it. Therefore, in all cases, their opinions were derived from their knowledge about this problem. Indeed, involving diverse stakeholders to try to reach a consensus is increasingly well-accepted as the future of collaborative, influential research [50].

Taking into account these limitations, the differences between countries can be associated to different perspective of the specific stakeholders selected instead of proper general differences between countries. However, the data may be used to better understand the possibilities and potential benefits of the use of new technologies in suicide prevention. To our knowledge, this if the first study examining country-specific differences in Europe about this topic.

Conclusion and Clinical Implications

The results of this exploratory study showed that new technologies are useful resources that can offer possibilities in the field of suicide prevention. We found new technologies to be well-accepted and well-valued by the various stakeholders (MHPs, DPMs, and NGOs). As such, they should be used in suicide prevention programs. Placing greater importance on resources that are accessible, free, can guarantee anonymity, incorporate training for mental health professionals, and reduce the time required for suitable management through automation, would facilitate and possibly increase the use of these resources.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Categories and subcategories of stakeholders.

[PDF File (Adobe PDF File), 243KB - mental_v4i2e23_app1.pdf]

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Abbreviations

ASCAL: multidimensional scaling
DPM: decision and policy maker
EUREGENAS: European Regions Enforcing Actions against Suicide
MANOVA: multivariate analysis of variance
MDD: major depressive disorder
MHP: mental health professional
NGO: non-governmental organization

Original Paper

Public Acceptability of E-Mental Health Treatment Services for Psychological Problems: A Scoping Review

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Abstract

Background: Over the past decades, the deficient provision of evidence-based interventions for the prevention and treatment of mental health problems has become a global challenge across health care systems. In view of the ongoing diffusion of new media and mobile technologies into everyday life, Web-delivered electronic mental health (e-mental health) treatment services have been suggested to expand the access to professional help. However, the large-scale dissemination and adoption of innovative e-mental health services is progressing slowly. This discrepancy between potential and actual impact in public health makes it essential to explore public acceptability of e-mental health treatment services across health care systems.

Objective: This scoping review aimed to identify and evaluate recent empirical evidence for public acceptability, service preferences, and attitudes toward e-mental health treatments. On the basis of both frameworks for technology adoption and previous research, we defined (1) perceived helpfulness and (2) intentions to use e-mental health treatment services as indicators for public acceptability in the respective general population of reviewed studies. This mapping should reduce heterogeneity and help derive implications for systematic reviews and public health strategies.

Methods: We systematically searched electronic databases (MEDLINE/PubMed, PsycINFO, Psyndex, PsycARTICLES, and Cochrane Library, using reference management software for parallel searches) to identify surveys published in English in peer-reviewed journals between January 2010 and December 2015, focusing on public perceptions about e-mental health treatments outside the context of clinical, psychosocial, or diagnostic interventions. Both indicators were obtained from previous review. Exclusion criteria further involved studies targeting specific groups or programs.

Results: The simultaneous database search identified 76 nonduplicate records. Four articles from Europe and Australia were included in this scoping review. Sample sizes ranged from 217 to 2411 participants of ages 14-95 years. All included studies used cross-sectional designs and self-developed measures for outcomes related to both defined indicators of public acceptability. Three surveys used observational study designs, whereas one study was conducted as an experiment investigating the impact of brief educational information on attitudes. Taken together, the findings of included surveys suggested that e-mental health treatment services were perceived as less helpful than traditional face-to-face interventions. Additionally, intentions to future use e-mental health treatments were overall smaller in comparison to face-to-face services. Professional support was essential for help-seeking intentions in case of psychological distress. Therapist-assisted e-mental health services were preferred over unguided programs. Unexpectedly, assumed associations between familiarity with Web-based self-help for health purposes or "e-awareness" and intentions to use e-mental health services were weak or inconsistent.

Conclusions: Considering the marginal amount and heterogeneity of pilot studies focusing on public acceptability of e-mental health treatments, further research using theory-led approaches and validated measures is required to understand psychological facilitator and barriers for the implementation of innovative services into health care.

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Introduction

Many individuals with mental health problems do not receive prompt professional support delivered face-to-face in health care in times of need. More and more persons thus tend to seek help for mental health purposes on the Internet. Limited resources of health care units as global key issue for the large-scale dissemination of interventions for the prevention and treatment of common mental health problems thus require innovative strategies. Given the persisting problem of treatment gaps in mental health care, providing effective treatments via the Internet has been suggested as a cost-efficient way to expand public access to mental health services on a large scale [1-3].

Web-based and computerized, respectively electronic mental health (e-mental health) services use new media and innovative digital technologies to provide screening, psychoeducation, health promotion, prevention, self-help, counseling, therapy, and aftercare [3-6]. Evidence-based e-mental health treatments are available for mental health problems concerning mood [7,8], anxiety [9-11], substance abuse [12], and eating disorders [13]. Delivery modes and treatment formats vary from unguided Web-based self-help treatments services to therapist-guided e-mental health treatments. In controlled trials, especially therapist-guided, Internet-based cognitive behavior therapy (iCBT) approaches achieved effect sizes, satisfaction, and adherence rates comparable to those of traditional face-to-face CBT [14]. However, poor engagement of primary care patients [15-17] and the slow diffusion of e-mental health into mental health care indicated acceptability issues as barrier for the dissemination of e-mental health treatments [2,6]. This outlined discrepancy between promising research findings and the weak uptake of e-mental health treatments in real-world help-seeking contexts needs clarification about facilitators and barriers of successful dissemination of e-mental health [6]. While facilitators of Web-based treatments' uptake such as the specific role of professional support in therapeutic outcomes [18,19] and the familiarity with Web-based media [20] are discussed, predictors of seeking help outside the context of clinical trials largely remain unclear. This outlined discrepancy between research and practice makes it thus necessary to identify indicators of public acceptability of e-mental health [6].

Previous research on acceptability of digital health interventions has emphasized the central role of profoundly understanding the views and needs of persons using digital health interventions [21]. For this purpose, theoretical frameworks appear applicable to investigate public acceptability of e-mental health treatments. For instance, the diffusion of innovation theory [22] aims to explain how the dissemination and adoption of innovative technologies develops from a sociological perspective. However, this theory deals with complex developments over a period. From a psychological viewpoint, as stated in this paper, technology acceptance models (TAM) appear better applicable.

TAM provide an empirically grounded framework to understand facilitators and barriers of individual intentions to use and the adaption of information technology (IT) [23]. The "Unified Theory of Acceptance and Use of Technology" (UTAUT) [24] is an expansion of the original TAM-framework, which is based on elements of eight models developed in IT acceptance, psychological, and sociological research, such as the diffusion of innovation theory [22]. To examine determinants of technology use and behavioral intentions to use, the UTAUT provides different key determinants of IT acceptance and moderators such as age, gender, and experience. UTAUT research showed that the determinant "performance expectancy" that includes the domains "perceived usefulness," "relative advantage," "outcome expectations," and "extrinsic motivation" is the best predictor for IT acceptance in terms of intentions to use [24,25].

Over the past decades, the utility of the UTAUT has been confirmed in several IT-driven organizational contexts, such as the adoption of eHealth by health care providers [26]. Although the UTAUT is still rarely cited in research targeting the uptake of e-mental health treatments, some components of the framework can be found in recent surveys, such as perceived usefulness (helpfulness) and intentions to use e-mental health. In addition, most studies investigated preferences and attitudes toward e-mental health services not in the general population, but within specific populations, including adolescents [27-30], patients [31,32], and health professionals [33,34]. Furthermore, various nonclinical surveys targeted Web-based self-help and health information. For instance, Oh et al [27] explored user preferences and perceptions of helpfulness of self-help websites among young Australians. Given the impact of moderators as stated in the UTAUT [24], these findings obtained from selected target groups appear barely transferable to public acceptability of e-mental health treatments.

Hence, to predict psychological facilitators and barriers of the large-scale uptake of e-mental health treatments in public health there is need to look at the findings of surveys examining public options about these innovations with samples consisting of a diverse cross-section of the general population (in terms of data collection in the respective regional context of individual studies). Yet, public opinions about e-mental health treatments have been scarcely considered in earlier stages of e-mental health development. Previous reviews have thus mainly targeted the evidence base for the effectiveness of Web-based therapies for diagnosed mental disorders [7-14] and Web-based self-help formats [35]. Other types of existing e-mental health reviews focused on proposed relative advantages and challenges for mental health care [1-3,17]. Considering the above-outlined divide between the overall good satisfaction or acceptability of participants in controlled trials and the low impact in health care across the globe [2,3,6,17], a scoping review targeting the "status quo" of public acceptability of e-mental health through

the identification of potential indicators of acceptability (ie, perceived helpfulness and intentions to use) can offer first insights into the "black box" of prospective service users. By this means, a scoping review can help derive implications for both outcomes in systematic reviews and strategies in public health initiatives that aim to better meet (information) needs of a broad range of citizens.

Therefore, the purpose of this scoping review was to determine the international "status quo" of public acceptability of e-mental health treatment services across different health care systems. On the basis of previous work [23,24], both (1) perceived helpfulness and (2) intentions to use in case of future mental health problems (likelihood of future use) were chosen as potential indicators for public acceptability of e-mental health treatment services. In the UTAUT, perceived usefulness (helpfulness) is a component of performance expectancy affecting intentions to use, which in turn predict actual usage (adoption). The term "public" refers to the general population of the country or region where research has been conducted. To make meaningful interpretations, surveys eligible for inclusion in this scoping review need to contrast both indicators for at least two distinctive provision modes of mental health treatment services (relative advantage; eg, preference of Web-based vs traditional services, guided vs unguided Web-based programs). Another purpose of this mapping was to reduce heterogeneity of results, which should allow implications for research questions in future reviews and public health strategies. Accordingly, we addressed the following research questions:

1. Perceived helpfulness of e-mental health treatments: Do persons recruited from the general population perceive e-mental health treatment services as helpful treatment options in case of (impeding) emotional problems? To answer this question, two subquestions with comparators (preference) were formulated: Are there mental health service type-specific differences in the assessment of the perceived helpfulness, depending on (1a) the delivery mode (Web-based vs face-to-face) or (1b) the provision of professional guidance (unguided vs guided e-mental health services)?

2. Intentions to use e-mental health treatments: To what extent are persons recruited from the general population willing to use e-mental health treatments in case of emotional problems? In other words, are there mental health service type-specific differences in intentions to use e-mental health treatment services, depending on (2a) the delivery mode (Web-based vs face-to-face) or (2b) the provision of professional guidance (unguided vs guided e-mental health services)?

Methods

Overview

The conduction and reporting of this scoping review refers to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines [36], as far as applicable. Due to the focus of this scoping review, we could not apply all of the 27 items suggested by the PRISMA consortium. As mentioned by Liberati et al [36], the PRISMA statement is designed for systematic reviews and meta-analyses of

randomized controlled trials (RCTs) and is not fully applicable to other types of reviews of health research. Thus, we do not report these items of the PRISMA checklist: data collection process, summary of measures, synthesis of results, and risk of bias across studies (eg, gray literature) and additional analyses.

Eligibility Criteria

Eligible studies (1) recruited participants from the general population, (2) were conducted outside the context of clinical studies, (3) compared public views about different provision modes of mental health treatment services, (4) scoped on indicators of public acceptability of e-mental health treatments (perceived helpfulness and intentions to use), and (5) used cross-sectional (quasi-) experimental study designs.

(P) Populations

This review included articles targeting a broad range of participants from the general population (representative or convenience samples with participants over the age of 14 years). As we reviewed international research, the definition of general population depended on the region of data collection in individual studies.

(I) Interventions

This scoping review was concerned with observational surveys on the assessment of public views on e-mental health conducted outside the context of diagnostic, psychosocial, or therapeutic interventions. Experiments could be considered. Interventions (e-mental health treatments) assessed in surveys were fictional.

(C) Comparators

Studies were included in this review if they aimed to assess public acceptance, expectations, or attitudes toward e-mental health services in case of emotional distress (comparisons of at least two provision modes were obligatory, differing in delivery modes and/or professional support = relative advantage). For instance, eligible studies compared public opinions about (1) e-mental health and face-to-face treatments and/or (2) guided and unguided e-mental health treatments.

(O) Outcomes

As outlined before, we defined indirect individual determinants (indicators) for public acceptability of e-mental health treatments: (1) perceived helpfulness and (2) intentions to future use e-mental health services in case of emotional distress. In addition, we aimed to explore factors explaining variance in public attitudes, such as IT user experience.

(S) Study Designs

Eligible surveys included quantitative data collection through questionnaires in cross-sectional observational or experimental studies.

Information Sources

We systematically searched electronic databases (MEDLINE/Pubmed, PsychARTICLES, PSYNDEX, PsycInfo, and Cochrane Library) to identify empirical surveys scoping on indicators of public acceptability of e-mental health treatments published in peer-reviewed journals between January 2010 and December 2015. We chose these specific medical and

psychological databases because our review focused on psychological aspects of e-mental health uptake. We limited the time span to the five years of diffusion (2010-2015) because the diffusion of innovation is complex, varying across settings and periods [22]. This decision was also based on previous experience with database searches for literature regarding this research field (Multimedia Appendix 1). As a result of this earlier work, we did not search for studies published before 2010 to reduce heterogeneity of results for this scoping review (given the assumed stage of familiarity with new media, diffusion of mobile phone–delivered mobile Internet, and advances in e-mental health). The last date we searched databases and additional sources for literature was the February 15, 2016.

Search

We used the following keywords for database searches: "e-mental health" AND ("attitude" OR "acceptability" OR "acceptance" OR "preference" OR "perception" (Boolean operator). We used the commercial reference management software Citavi (Swiss Academic Software, Switzerland) to conduct the searches in electronic databases simultaneously (to avoid duplicates and irrelevant records). In other words, we searched all databases together in one step (using the same keywords for each database). Due to the novelty of the distinct research field of interest, we included the keyword "e-mental health" that is not listed in medical subject headings (MeSH terms). For additional searches via ResearchGate and Google Scholar, we used further keywords, such as "online self-help," "online therapy," "Internet-based psychotherapy," and "iCBT." Furthermore, we screened bibliography lists of papers identified through electronic databases. In this scoping review, we did not search the gray literature for publication bias.

Study Selection

The study selection process involved different stages and reviewers (CS, JA, and JK).

Step 1: Systematic Review (Previous Work)

Two reviewers (CS, JA) searched databases independently in December 2015 (CS), January (CS, JA), and February 2016 (JA). JA and CS independently searched and reviewed the literature from January 2005 to December 2015 for articles scoping on public attitudes toward e-mental health published in both English and German peer-reviewed journals (separate database searches). The search strategy was broad and included all age groups, study designs, and subgroups outside of clinical trials (professionals, clients, risk groups). The search was monitored and cross-checked by a third investigator (JK). CS reported the results of 24 reviewed studies in her Bachelor's thesis (completed in April 2016). Key findings of this review were presented as poster at the Fourth European Society for Research on Internet (ESRII) conference in September 2016 in Bergen, Norway (Multimedia Appendix 1).

Step 2: Scoping Review

On the basis of key findings of this initial review (Multimedia Appendix 1), a second search for this scoping review was conducted using Citavi (JA, JK) and compared with previous results obtained in the first stage (JA, CS). In case of

inconsistencies, JK decided on study selection to achieve consensus (April 2016).

The search strategy we used in February 2016 involved a parallel database search to avoid duplicates and irrelevant records for the scoping review. Database searches were conducted mainly in January 2016. Last searches for additional studies were conducted in February 2016. For the selection process, two reviewers (CS, JA) independently conducted a broad study search and selection procedure for the systematic review (January 2005 to December 2015) and a narrowed search strategy to reduce heterogeneity of records via parallel searches (January 2010 to December 2015) for the scoping review (JA, JK). After reading the titles and abstracts of records, we screened full-texts for meeting the inclusion criteria of this scoping review. Studies were scoped on predefined indicators of public acceptability of e-mental health treatment services. Consequently, we excluded surveys with data collected in efficacy or feasibility studies, clinical RCTs, reviews, or case studies. Studies targeting specific groups (eg, adolescents), qualitative surveys, and articles published in other than English language were excluded, too. Key findings of this scoping review were presented as poster at thirtieth European Health Psychology Society (EHPS) conference in August 2016 in Aberdeen, Scotland (Multimedia Appendix 2).

Data Items

As noted above, the rationale of this scoping review was based on findings of a previous systematic review (see Multimedia Appendix 1). Research questions were developed using the PICOS approach as suggested by the PRISMA statement [36]: (P) populations, (I) interventions, (C) comparators, (O) outcomes, and (S) study designs (for details, see the Eligibility Criteria subsection). Indicators of public acceptability were perceived helpfulness and intentions to use (likelihood of future use) e-mental health treatment services.

Risk of Bias in Individual Studies (Study Quality Assessment)

JA and JK evaluated the study quality with an adapted version of the Newcastle-Ottawa scale (NOS) [37] for cross-sectional studies by Herzog et al [38]. The NOS consists of three categories with different rating dimensions for quality assessment. The first category, "selection" (maximum 5 of 10 stars), includes (1) "representativeness of the sample" (four rating options, maximum 1 star), (2) "sample size" (two options, maximum 1 star), (3) "non-respondents" (three options, maximum 1 star), and (4) "ascertainment of the exposure (risk factor)" (three options, maximum 2 stars). The second category, "comparability" (maximum 2 of 5 stars), includes "assessment of control variables" (two options, maximum 2 stars). The third category, "outcome" (maximum 3 of 10 stars), consists of (1) "assessment of the outcome" (four options, maximum 2 stars) and (2) "statistical test" (two options, maximum 1 star). As information on the scoring (cut-off thresholds; poor-fair-good) of the NOS is under development for observational nonrandomized studies [37], we did not refer to NOS scoring algorithms suggested for quality assessments of RCTs because they were hardly convertible. Instead, we developed the following heuristics for thresholds (maximum 10 stars): 0-3

stars (poor quality), 4-6 stars (fair quality), and 7-10 stars (good quality). Due to the novelty of the scoped research field (mainly pilot studies), we assessed studies as fair in their quality if the categories "selection" and "outcome" were both assigned with at least two stars per study. Because we focused on (nonrandomized) surveys, we found it problematic to define stars for "comparability" obligatory for the quality assessment.

Results

Study Selection

In total, we identified 76 records through parallel database searches. Of initially 77 records, one duplicate was removed. Figure 1 illustrates the study selection procedure. After removing 13 records through their title, we screened 63 abstracts. We

excluded 56 records. Removed publications were reviews, effectiveness and feasibility RCTs, studies with clinical scope, case studies, or surveys out of our scope in terms of population, measured constructs, or interventions. After obtaining and reading seven full-texts, we finally excluded further three papers [39-41], which did not have their scope on the predefined indicators of public acceptability. Finally, we included four publications [6,42-44] in this scoping review. One included paper [42] was obtained from the reference list of another article [43]. We achieved consensus regarding the study selection for this scoping review (JA, JK, CS).

Study Characteristics

Table 1 summarizes the study characteristics and central findings of the four included studies published between 2010 and 2014.

Figure 1. PRISMA (preferred reporting items for systematic reviews and meta-analyses) flow diagram of study selection.
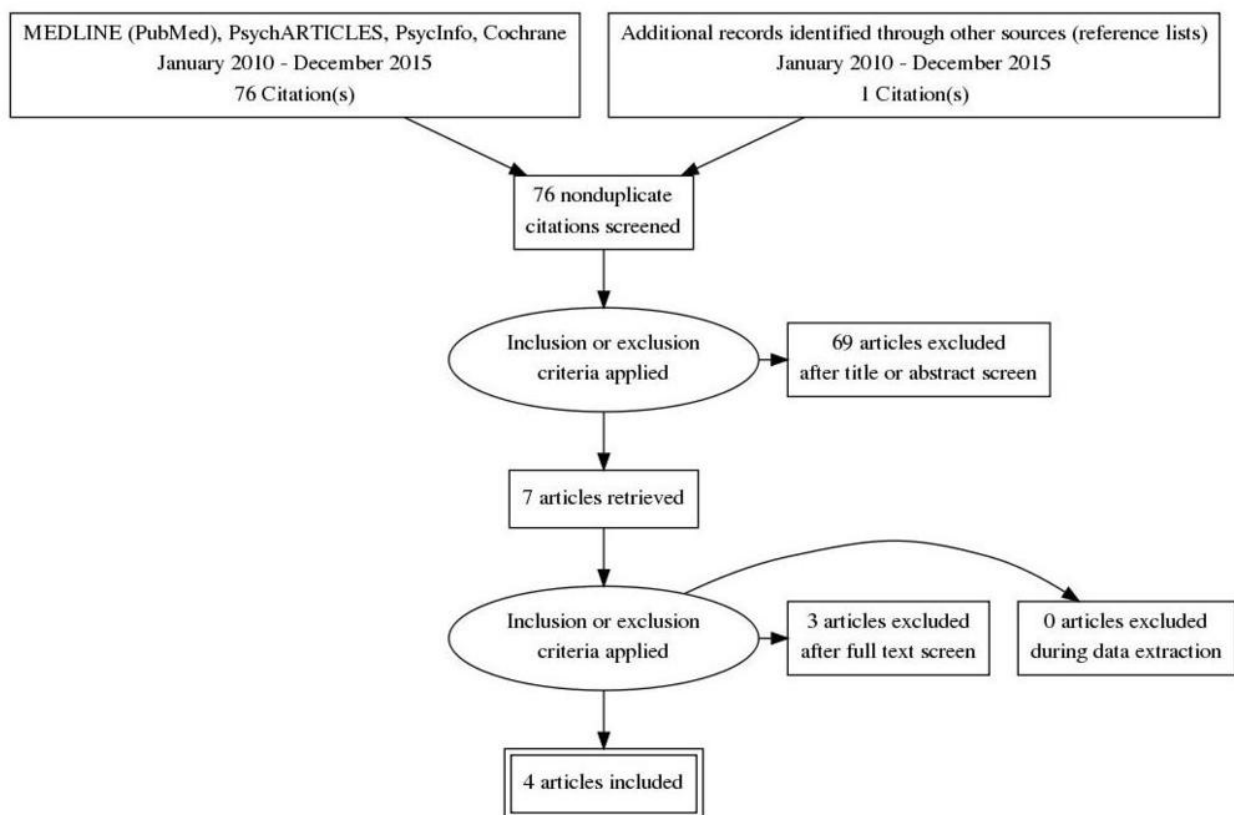
Table 1. Summary of study characteristics and main findings.

Study	Design	Aims	Sample[a]	Method and instruments[b]	Main findings
Klein and Cook [42][c]	Cross-sectional online survey	To identify differences between "e-preferers" and "non e-preferers" on the perceived helpfulness and intentions to use e-mental health in comparison to traditional services	Online sample (N=218) of the Australian general population. Age range = 18-80 years; Mean 36.6 (SD 14.5) years Female (75.7%) *"e-prefers" (n=50); "non e-prefers" (n=168) 63.9% with mental health service experience*	Self-developed online survey "e-preference" (grouping condition) Perceived helpfulness of 11 mental health services (helpful, neither, harmful) Concerns using e-mental health Likelihood of future using mental health services (intentions to use) Four validated measures on self-stigmatization (DDS), locus of control or LOC (MHLC-C), big-five personality traits (TIPI), and learning style (VARK) Response rate (completed survey): 91.3% (n=199)	Preference toward using traditional to e-mental health services (77.1% were "non e-preferers") "e-preferers" were more willing to use and assess e-mental health services as more helpful Previous experience with mental health services included psychologists (84.2%), information websites (71.2%) "non e-preferers" were more concerned about confidentiality "e-preferers" scored higher on self-stigma and chance LOC; "non e-preferers" scored higher on emotional stability and doctor LOC (for instance)
Casey et al [43][d]	Cross-sectional online RCT[e] (mixed factorial design)	To determine the impact of educational information on attitudes (ie, perceived helpfulness and intentions to use different e-mental health services	Online sample (N=217) of the Australian general population. Age range = 17-60 years; Mean 29.7 (SD 11.9) years Female (78%) *groups: text (n=66), film (n=72), control (n=70)*	Self-developed online survey, a modified version of another measure [42] Perceived helpfulness of four e-mental health services (online counseling, information websites, and online program with or without therapist contact) Likelihood of future using e-mental health services (intentions to use) Concerns regarding the usage of e-mental health Random assignment of respondents to one of three conditions (text intervention, film intervention (2.5 minutes), or no intervention or control condition)	Preference toward using e-mental health services with therapist assistance The likelihood of using e-mental health services was improved in the text condition group, but not in the film condition group Neither the text- nor video-based information affected the perceived helpfulness of e-mental health in comparison to the control condition
Eichenberg et al [44][f]	Cross-sectional survey (panel interviews)	To explore public media use, the perceived impact of health information sources, and the intentions to use e-mental health in comparison to traditional services (for anxiety)	Representative sample (N=2411) of the German general population Age range = 14-90 years; Mean 51.0 (SD 18.6) years Female (53.2%) *41% never used computers*	Self-developed survey (pretest for with n=67) Public media use, preferred sources of health information, and their impact on health behavior Use of and willingness to use psychological online counseling, and media-assisted therapy in comparison to traditional face-to-face mental health services in case of emotional distress	Preference toward using traditional to e-mental health services Previous use of the Internet for health information was associated with a higher willingness to use online counseling Sociodemographic data (eg, younger age, female gender, higher education) and Internet usage corresponded with intentions to use e-mental health
Musiat et al [6][g]	Cross-sectional Web-based survey	To explore acceptability of e- and m-mental health services in comparison to traditional services (attitudes and expectation, and intentions to use)	Web-based sample (N=490) of the English general population Age range =18-78 years; Mean 26.7 (SD 8.9) years Female (78.2%) *49% with history of mental health problems, 22% with current mental health issues*	Self-developed survey (12 important domains were grounded on ratings of a focus group of service users) Previous and current psychological problems, help-seeking behavior, and computer literacy Expectations, attitudes, and acceptability ratings: importance of domains of mental health services Perceived benefits and likelihood of future use of e-mental health and m-mental health in comparison to traditional face-to-face therapy and self-help books	Preference toward using traditional to e-mental health programs and m-mental health apps Face-to-face treatments were most likely to meet respondents' expectations in most important domains (eg, helpfulness, credibility) Overweight of negative attitudes and expectations about e-mental health and m-mental health self-help services mHealth apps had the lowest acceptability ratings when compared with other mental health services

Participants and Study Characteristics

Samples of the general population were surveyed in two studies from Australia [42,43], one study from Germany [44], and another study from England [6]. One study collected data via panel interviews in cooperation with a market research institute [44]. The other three studies were Web-based surveys recruiting participants through social media websites, e-mail, flyers, and undergraduate courses [6,42,43]. Sample sizes ranged from 217 to 2411 respondents (age span: 14-95 years). The oldest included publication by Klein and Cook [42] examined whether individual differences exist between persons who prefer e-mental health services and those who prefer traditional services among an Australian Web-based sample (n=218). The second included study by Casey et al [43] investigated whether brief text- or film-based educational interventions improve attitudes toward e-mental health services among an Australian Web-based sample (n=217). The third included study by Eichenberg et al [44] explored the use of public media for mental health purposes among a representative sample of the German general population (n=2411). The fourth included study by Musiat et al [6] explored public acceptability of e-mental health and mobile (mHealth) self-help treatment services among a British Web-based sample (n=490).

Interventions

Fictional e-mental health treatment services described for acceptability assessments. Klein and Cook [42] investigated perceived helpfulness and the intentions to use 11 different traditional and e-mental health services, which included general practitioner (GP), psychologist, psychiatrist, counselor, self-help book, information website, Web-based or telephone counseling, Internet-based program with or without therapist assistance, and prescribed medication. The RCT by Casey et al [43] was conducted using a modified version of another measure [42] with four e-mental health services (therapist-assisted e-mental health treatments, unguided e-mental health treatments, information websites, and online counseling). Study participants were randomly assigned to either one of two experimental conditions (film- or text-based information) or the control group. The educational material contained information about e-mental health. In the film condition, a 25-year-old male read the text (two and a half minutes) [43]. Eichenberg et al [44] explored the impact of health information sources (eg, GP, psychologist, and websites), awareness and use of online counseling, and intentions to use mental health services (face-to-face and Web-based or virtual reality treatments). Musiat et al [6] asked their respondents to indicate whether the four mental health services meet their expectations (face-to-face therapy, self-help

books, and both e-mental health and mHealth self-help treatment services).

Comparators

To investigate individual differences between "e-preferers" and "non e-preferers," Klein and Cook [42] used four validated measures on stigma perception, locus of control, learning styles, and "Big-5" traits. Casey et al [43] compared attitudes between those who received psychoeducation and the control group. Group comparisons in the study by Eichenberg et al [44] involved experience with using the Internet for mental health purposes and sociodemographic differences. The survey by Musiat et al [6] compared differences in computer literacy, demographic background, and history of mental health problems.

Outcomes

Klein and Cook [42] used both self-developed survey and four validated measures. The self-developed survey included perceived helpfulness and intentions to use 11 mental health services. Participants in the RCT by Casey et al [43] were asked to indicate perceived helpfulness and intentions to use four e-mental health services. Participants in the study by Eichenberg et al [44] were asked to indicate the perceived impact of health information sources on their health behavior and intentions to use four mental health services. Musiat et al [6] asked their respondents to indicate their views about four mental health services on 12 domains identified through a focus group as important for mental health services (eg, helpfulness).

Study Designs

All studies were cross-sectional studies collecting data through self-report measures. One study was an experimental RCT [43], whereas the other three were quasi-experimental surveys [6,42,44].

Preferred Sources and Use of Mental Health Services

Study findings on preferred mental health services investigated in two of four studies revealed that most participants reported having most often accessed traditional mental health services (eg, GPs, psychologists) and health information websites [42,44]. Individual differences in service usage were investigated in three studies [6,42,44]. In the survey by Klein and Cook [42], the smaller subgroup of "e-preferers" (50/218) has significantly more often indicated to have accessed online counseling (15%) than the larger subgroup of "non e-preferers" (168/218; experience with online counseling: 3.6%). In contrast, the German study revealed [44] that only 14 of 2411 participants (0.6%) reported experience with online counseling; the awareness of online counseling was highest in Web-based health information users, but overall low (11% of n=2411). In the study

by Musiat et al [6] 49% of the sample (240/490) reported previous mental health problems and 22% (107/490) indicated current issues; of these persons with prior or current mental health problems, most received a formal diagnosis (60%) and reported experience with help-seeking (85%). Of the 12 domains provided, "helpfulness" was rated as most important for the decision to engage with mental health services. In line with other included Web-based surveys [42,43], this sample consisted mainly of young, well-educated persons with good computer literacy [6].

Assessment of Study Quality on the Review Level

As shown in Table 2, we evaluated the quality of the studies included in this review as fair, scoring 5 of 10 stars on average. There were issues for the domain "comparability" as the NOS is not designed for scoping reviews. Each study received at least two stars for selection and outcome, but only the RCT [43] received a star for comparability. In addition to limitations, the studies also had several strengths. Musiat et al [6] involved the best described evidence-based measure. However, this could be not emphasized through higher NOS scores. However, the theoretical framework for the assessment of core constructs (attitudes, preference, and technology acceptance) remained largely unclear across included studies.

Table 2. The Newcastle-Ottawa scale (NOS) for cross-sectional studies for the assessment of quality of surveys included in this scoping review. This summary does not include single results for subsections.

Study	Selection[a] (maximum 5 stars)	Comparability (maximum 2 stars)	Outcome (maximum 3 stars)	Total score (maximum 10 stars)
Klein and Cook [42]	***	-	**	*****
Casey et al [43]	****	*	**	*******
Eichenberg et al [44]	***	-	**	*****
Musiat et al [6]	***	-	**	*****

[a]One star for sample size "justified and satisfactory" was only given when the sample was representative or when both a justification for the sample size (eg, power analyses) and a satisfactory sample size were reported.

Selection

All studies had justified, sufficient sample sizes. Eichenberg et al [44] had the largest and the only representative sample in this review. Regarding the feasibility of self-developed surveys on indicators of public acceptability, all included studies provided satisfactory information. One of four studies [44] reported pretests. Musiat et al [6] involved a qualitative participatory approach for the measurement development (focus group interviews). Casey et al [43] provided data on internal consistencies of their modified measure. Three studies described response rates and data exclusions [6,42,43]. Klein and Cook [42] combined a self-developed survey and validated measures. However, the self-developed measure concerned main outcomes and thus one star was assigned. Alpha reliabilities were reported for validated measures from original papers [42].

Comparability

Only the study by Casey et al [43] was conducted as RCT (one star for control of most important factors). However, as an open access Web-based survey the control of additional factors was questionable. The other studies were noncontrolled observational studies; none of them received a star in this section.

Outcome

Each study used self-report measures (assessment of outcome, with one star) and clearly described the used statistical test (one star). In view of the early stage of measurement development for public acceptability assessment, two stars were assigned to all included (pilot) studies.

Synthesis of Results

We mapped the research findings into two main categories. To answer the research questions, we summarized the study findings on main outcomes for the constructs: (1) perceived helpfulness and (2) intentions to use either e-mental health or traditional mental health services as indicators of public acceptability.

Main Findings on Perceived Helpfulness of E-Mental Health Treatment Services

Three of the four studies [6,42,44] compared individual expectations and perceptions about the helpfulness between traditional and e-mental health treatment services. Survey findings indicated that respondents perceived traditional therapy services significantly more helpful for mental health problems than e-mental health treatment services [6,42,44]. Klein and Cook [42] confirmed that "e-preferers" (one-third of the sample) endorsed information websites and Web-based programs without therapist assistance as significantly more helpful than "non e-preferers." "Non e-preferers" indicated to perceive GPs, psychologists, counselors, telephone counseling services, and prescribed medication as significantly more helpful than "e-preferers." There was no significant difference in perceived helpfulness of Web-based programs with therapist assistance between e-preference groups, though "non e-preferers" expressed more concerns about Web-based treatments, such as confidentiality issues [42]. Musiat et al [6] showed that e-mental health and mHealth treatment services scored highest on domains such as convenience of access, anonymity, and being free of charge than traditional services. Face-to-face therapy was considered as most acceptable in terms of meeting respondents' expectations about mental health services in most domains, such as helpfulness, credibility, provision of support,

or being appealing. mHealth treatment apps were associated with the lowest acceptability compared with e-mental health programs, face-to-face therapy, and self-help books [6]. Furthermore, both Australian studies revealed that therapist-assisted Web-based programs were perceived as significantly more helpful than Web-based treatments without therapeutic guidance [42,43]. Educational interventions used in the RCT by Casey et al [43] had no significant impact on perceived helpfulness of e-mental health services.

Main Findings on Intentions to Use E-Mental Health Treatment Services

Three of the four included studies [6,42,44] compared intentions to use traditional and Web-based treatment services. Results showed that most respondents indicated being more likely to use face-to-face psychotherapy than media-assisted treatments for mental health problems. Guided e-mental health programs were associated with improved intentions to use across studies. For instance, Casey et al [43] revealed significantly lower intentions to use Web-based programs without therapist assistance in comparison to therapist-assisted Web-based programs, information websites, and online counseling. Furthermore, participants who received text-based educational information reported a significant higher likelihood of future use of different e-mental health services (ie, health information websites, online counseling, and programs with or without therapist assistance) in comparison to the control condition. In contrast, no significant effect of film-based educational information on intentions to use e-mental health services was identified [43].

Considering individual differences, Klein and Cook [42] confirmed that "non e-preferers" indicated being more likely to access traditional services provided by psychologists, whereas the far smaller amount of "e-preferers" (one-third of the sample) was more willing to access e-mental health services (ie, online counseling, information websites, and Web-based programs with or without therapist assistance). Conversely, "non e-preferers" reported being likely to use the Internet to seek for health information, but not for treatment. In the German study [44], perceived impact of health information sources corresponded with intentions to use mental health services. Frequent Internet use was associated with intentions to seek mental health advice online. Additional analyses revealed that younger age, being single, higher education level, and household income correlated with intentions to use e-mental health services for psychological distress [44]. Musiat et al [6] showed that respondents who had sought help for mental health problems reported significantly lower intentions to use mHealth treatment apps.

Discussion

The purpose of this scoping review was to identify the status quo of public preferences, attitudes, and acceptability of e-mental health treatments across different regional contexts. As indicators for the large-scale acceptability, we defined both (1) perceived helpfulness and (2) intentions to use e-mental health treatment services. In the literature, we identified and

reviewed four eligible surveys published between 2010 and 2015. The main findings and implications are discussed.

Summary of Evidence

We identified the following aspects as main findings of included surveys:

Health information websites are widely used and accepted as easy accessible information sources for mental health purposes in everyday life [6,42-44].

Compared with face-to-face treatments, the acceptability of e-mental health treatments services was lower in terms of both the indicators, that is, perceived helpfulness and intentions to use [6,42,44], with the exception of "e-preferers" [42].

Professional support seems to be important for decision making in the context of impending help-seeking intentions. In case of emotional distress, both face-to-face treatments services [6,42,44] and therapist-assisted e-mental health interventions were preferred over unguided Web-based programs [42,43] and self-help books [6]. Perceived helpfulness and intentions to use e-mental health treatments varied across service types provided in the reviewed surveys.

In the RCT [43], neither film- nor text-based educational material has affected perceived helpfulness. Only the text-based material yielded to improved intentions to use Web-based programs, whereas the film intervention was ineffective.

Perceived Helpfulness as Indicator for Public Acceptability of E-Mental Health

Most participants surveyed in three of the four studies [6,42,44] reported perceiving traditional interventions as more helpful than e-mental health treatment services. However, Musiat et al [6] argued that low "e-awareness" together with the questionnaire design (comparisons between established and novel approaches) might have led participants to believe that face-to-face psychotherapy was a "benchmark." Thus, perceptions of helpfulness of e-mental health treatments may have been biased toward negative assessments [6]. Nonetheless, it could be also argued that not the delivery mode (Web-based or face-to-face) is essential, but therapeutic assistance is the key for large-scale acceptability. This argument is supported by the observation that assessments of perceived helpfulness were generally informed for therapist-assisted interventions across included studies (both guided e-mental health and face-to-face treatment services) in comparison to unguided services [6,42-44], including conventional self-help books [6]. The role of e-mental health literacy in attitudes remains unclear. The provision of educational information about e-mental health [43] was ineffective in influencing perceptions of helpfulness across four e-mental health types (ie, guided and unguided Web-based programs, online counseling, and information websites).

Intentions to Use as Indicator for Public Acceptability of E-Mental Health

Consistent with the findings for the acceptability indicator "perceived helpfulness," three of the four included studies (comparing Web-based and traditional services) suggested an overall higher likelihood to use face-to-face therapy than

e-mental health treatments in case of emotional distress [6,42,44]. In addition, the RCT by Casey et al [43], which compared e-mental health services, revealed the highest likelihood of future for therapist-assisted Web-based programs. This conclusion is also in line with the results for perceived helpfulness. Interestingly, only the text-based material was associated with improved assessments regarding intentions to future use e-mental health, since the (identical) film-based intervention was shown being ineffective [43].

Moreover, sociodemographic group differences in intentions to use e-mental health treatments were only found in the German survey using a representative sample [44]. Internet users appeared generally more open to use e-mental health services such as information websites and online counseling in case of emotional distress [42,44]. This indicated the relevance of familiarity with new media and e-awareness for acceptability [6]. However, the evidence base for these correlative associations (as identified in this scoping review) is too small to derive definitive conclusions.

Another point worthy of note is the coherence of lower public acceptability of e-mental health in comparison to face-to-face services identified across included studies, although data were collected in different countries varying basically in their stage of implementation of e-mental health into routine care.

Comparisons With Previous Work

Several findings identified in this scoping review are consistent with previous research. For instance, there was coherence between assessments of perceived helpfulness and intentions to use across all studies included in this review. Oh et al [27] have also demonstrated that perceived helpfulness of e-mental health services was associated with improved acceptability and intention to use Web-based self-help websites in young Australians. Most studies targeting attitudes or indicators of acceptability of e-mental health treatments surveyed not the samples of the general population, but specific populations such as adolescents [27-30] or patients [31,32]. This limitation is important because these studies are not directly applicable to public acceptability research. Selective samples are an issue for the generalizability of study findings in e-mental health research [20]. In contrast to the three Web-based surveys [6,42,43] included in this review, the representative sample from Germany [44] revealed sociodemographic differences in user experience, preferred services, awareness, and intentions to use e-mental health. The study by Eichenberg et al [44] has shown that experience with e-mental health was associated with improved intentions to use such services [44]. This result is in line with another Australian study by Gun et al [39] that has also confirmed that both professionals and laypersons who have previously used e-mental health services were more likely to evaluate Web-based treatments as acceptable. However, it should also be noted that the Australian survey by Klein and Cook [42] indicated lower acceptability of e-mental health compared with traditional mental health treatments despite the familiarity of participants with e-mental health services, such as information websites and Internet-delivered interventions. Framework for technology adoption also indicated that experience or familiarity with innovative technology can inform

their acceptance [20,22-24]. The UTAUT [22,23] suggested habits or experience as important moderator of intentions to use a technology. Thus, the regional context of included studies and stage of implementation of e-mental health service into health care should be considered for the interpretation of results. In contrast to the English [6] and the two Australian Web-based surveys [42,43] included in this scoping review, the German survey [44] was conducted in the context of a health care system being at an early stage of e-mental dissemination in public mental health care [1,17]. The representative German sample consisted of a relatively high number of respondents who indicated being nonusers of the Internet or infrequent users of new media and computer technologies; furthermore, Eichenberg et al [44] identified both low usage and awareness of online counseling in the German general population in 2010 (year of data collection). These contextual factors can be interpreted according to the diffusion of innovation theory [22], in which familiarity with the innovation and time for adoption play crucial roles for dissemination. Thus, the rather low public acceptability observed internationally raises doubt if the mere exposure with e-mental health services in primary care is the "condition sine qua non" for improved public acceptability.

Sociodemographic differences in help-seeking intentions were identified by Crisp and Griffiths [40]. The authors have demonstrated that Australians who were interested in participating in e-mental health programs were more likely female, "older" in average than most respondents, higher educated, divorced, and reported a history of mental health problems (depressive symptoms) as well as lower self-stigma in comparison to individuals who denied attending an e-mental health intervention. These findings are partly in line with sociodemographic differences found in the representative sample, such as education level [44]. However, two Web-based studies included in this scoping review showed conflicting results. For instance, Klein and Cook [42] showed that "e-preferers" were more likely to express self-stigma than "non e-preferers." Furthermore, Musiat et al [6] revealed that persons with a history of mental health problems expressed the lowest acceptability for mHealth treatment services. This scoping review was also not designed to clarify in which cases experience with traditional mental health care (and history of mental disorders) is positive or negative for the individual acceptability of e-mental health treatments. In the two included studies [6,42], relatively high numbers of participants reported experience with mental health care services and seeking help. It thus appears that sample characteristics and recruitment contexts are crucial to explain such inconsistencies. Nevertheless, due to methodological heterogeneity the results of these studies [6,40,42] should be compared cautiously.

Unfortunately, Casey et al [43] have not measured the mental health status or previous service experience with mental health care among respondents as potential factors for mostly nonsignificant findings of their RCT (especially in terms of the ineffective film-based material). In contrast to this finding, another RCT from Germany conducted by Ebert et al [45] with depressive primary care patients showed that a film intervention has yielded to significantly improved acceptability of an e-mental health treatment in comparison to the control condition.

However, the film in the clinical trial [45] was with a duration of 7 minutes longer than the film used in the RCT by Casey et al [43]. In addition, the language, target group, setting, and content of the educational intervention differed across both RCTs. Therefore, it is recommended that future research should systematically vary provision modes or information material to identify most effective features and address both facilitators and barriers in terms of technology use. In accordance with a review by Lal and Adair [3], concerns reported in included studies [6,42,43] were mostly related to data security issues. These concerns could function as barriers to use e-mental health services and their impact thus needs further clarification.

Taken together, the (not directly targeted) question whether e-awareness and e-mental health literacy are key facilitators for the acceptability of e-mental health and mHealth treatment services [6] could not be answered in this scoping review (not our focus) and should be hence addressed in upcoming reviews.

Limitations

This scoping review has several limitations. On the study level, the external validity of three of four studies [6,42,43] using self-report measures in Internet-based open access surveys is questionable. Web-based data collection modes resulted in selective samples, which mainly comprised young, well-educated, and female respondents. Conversely, it can be argued that these sample characteristics are common features of e-mental health service users and that selection bias is a general problem in e-mental health research [17,20]. Furthermore, we have also identified sources of heterogeneity in terms of varying ways of operationalization of psychological constructs such as attitudes. Moreover, exploratory statistical analyses undertaken in the three included quasi-experimental studies involved subsample comparisons (sociodemographic differences in intentions to future use e-mental health) between unequally sized groups [6,42,44]. In addition, all included studies operationalized intentions to use mental health services in the (assumed) absence of mental health problems. However, Musiat et al [6] revealed that nearly one-fourth of their sample indicated current mental health problems. On the review level, the search strategy we used may have led to incomplete retrieval of records, which is an important point to consider for systematic reviews. For instance, we searched databases using "e-mental health" as a non-MeSH term. In addition, despite the existence of checklists for reporting results of e-health studies [46], terminology is inconsistent in the e-health research literature [47]. In this sense, various keywords for similar service types are an obstacle for reviews. Furthermore, we used the NOS for the quality assessment despite potential reliability issues [48]. A final point to consider is that the clear majority of eHealth publications reports positive conclusions [49]. This indicates a risk for publication bias, which we have not examined in this review. Concerning both methodological issues of included studies and poor evidence base for public acceptability, findings presented in this review should be interpreted cautiously. Nonetheless, to our knowledge, this is the first review targeting indicators of public acceptability of e-mental health treatments.

Implications for Practice and Research

Considering the popularity of health information websites [42,44] on the one hand and slow implementation of e-mental health into health care systems on the other, it appears surprising that both potential facilitators and barriers of public acceptability of these innovative treatment services are still understudied [6]. All survey included in this scoping review were pilot studies with diverse strengths and limitations. This scoping review derived several implications. Considering neutral or even negative attitudes toward e-mental health treatment services identified across studies, promoting "e-awareness" among citizens and professionals has been suggested as a promising strategy for strengthening their public acceptability in the long run [6,43]. Promoting e-health literacy is essential since lacking computer or new media competencies hinder service users from effectively searching and using health information on the Internet [50]. Considering the impact of e-mental health literacy on help-seeking behavior in general, it should be considered that the evidence base is too small to derive more precise recommendations [50,51]. In addition, it remains unclear how information material should be designed to improve attitudes toward e-mental health treatments [43]. On the basis of the heterogeneity of study findings on public acceptability, it can be concluded that targeting the general population and using questionnaires (risk of biased assessments based on vague definitions of laypersons as respondents) involves many uncertainties. Hence, studies using qualitative methods to survey preferences and attitudes toward e-mental health in specific target groups can complement quantitative research. For instance, studies in e-mental health research have used focus group interviews [6,28,29]. Such qualitative studies in university settings have shown concerns about data security and confidentiality that can turn out as key obstacle to use e-mental health services [52,53].

Furthermore, this scoping review has identified opportunities to improve the validity of self-developed measures. All studies included in this scoping review appeared to have grounded their self-developed measures mainly on research evidence, without referring to applicable theoretical frameworks, such as the diffusion of innovation theory [22] and the UTAUT [23,24]. Nonetheless, it is apparent that such frameworks need to be adapted for e-mental health research. Recent studies [54-56] have already shown opportunities for transferring the UTAUT to eHealth uptake research. These adaptions can help determine key factors for public acceptability of e-mental health. However, it should also be considered that the complexity of health care is associated with limitations for using the UTAUT for this purpose [26]. As complement research strategy, theory-led, participatory frameworks such as the person-based approach [21] can add further value toward a deeper understanding of individual needs in the context of digital health interventions through using qualitative or mixed methods. Overall, having a toolkit of such evidence-based approaches provides further flexibility in the emerging field of public acceptability of e-mental health treatments. However, collaborative interdisciplinary approaches require more time and efforts than quantitative surveys, and thus mixed methods are promising strategies.

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Given the significance of innovative treatment strategies for public health, it can be anticipated that the evidence base for public acceptability and attitudes toward e-mental health services will grow in the next years. Future reviews could thus address both questions left open in this scoping review and compare study findings on acceptability of e-mental health between different groups of adopters, such as patients and clinicians [57] or laypersons and health professionals. For instance, Carper et al [33] showed rather negative attitudes toward e-mental health treatments among help-seeking persons, whereas surveyed health professionals tended to report neutral views. Such discrepancies appear interesting for further investigations. Furthermore, individual differences between different groups of adopters such as "e-preferers" [6] should be also further clarified. In essence, an understanding of facilitators and barriers of public acceptability of e-mental health treatment provides orientation to not get lost in e-mental health implementation.

Conclusions

This scoping review has explored both perceived helpfulness and intentions to use as indicators of public acceptability of e-mental health treatment services. Findings of four included pilot studies have indicated professional support as key facilitator of public acceptability of traditional and e-mental health services. While e-awareness was also suggested as a factor improving the uptake of e-mental health, associations with intentions to use digital interventions were rather anecdotal. Thus, the impact of e-mental health literacy and informed decision-making on e-mental health uptake should be further explored. However, the small evidence base and methodological issues of included surveys such as Web-based data collection or unclear theoretical framework underpinning self-developed measures left several questions open. To assess and understand the complex field of public acceptability of e-mental health treatments, consistent operationalization of constructs in future studies is required.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Poster presentation of the previous review at the 4th ESRII conference.

[PDF File (Adobe PDF File), 679KB - mental_v4i2e10_app1.pdf]

Multimedia Appendix 2

Poster presentation of the scoping review at the 30th EHPS conference.

[PDF File (Adobe PDF File), 1MB - mental_v4i2e10_app2.pdf]

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Abbreviations

CBT: cognitive behavior therapy
e-mental health: electronic mental health
GP: general practitioner
iCBT: Internet-based cognitive behavior therapy
IT: information technology
MeSH: medical subject headings
m-mental health: mobile mental health
NOS: Newcastle-Ottawa scale
PRISMA: preferred reporting items for systematic reviews and meta-analyses
RCT: randomized controlled trial
TAM: technology acceptance model
UTAUT: unified theory of acceptance and use of technology

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Original Paper

Perspectives of Family Members on Using Technology in Youth Mental Health Care: A Qualitative Study

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Abstract

Background: Information and communication technologies (ICTs) are increasingly recognized as having an important role in the delivery of mental health services for youth. Recent studies have evaluated young people's access and use of technology, as well as their perspectives on using technology to receive mental health information, services, and support; however, limited attention has been given to the perspectives of family members in this regard.

Objective: The aim of this study was to explore the perspectives of family members on the use of ICTs to deliver mental health services to youth within the context of specialized early intervention for a first-episode psychosis (FEP).

Methods: Six focus groups were conducted with family members recruited from an early intervention program for psychosis. Twelve family members participated in the study (target sample was 12-18, and recruitment efforts took place over the duration of 1 year). A 12-item semistructured focus group guide was developed to explore past experiences of technology and recommendations for the use of technology in youth mental health service delivery. A qualitative thematic analysis guided the identification and organization of common themes and patterns identified across the dataset.

Results: Findings were organized by the following themes: access and use of technology, potential negative impacts of technology on youth in recovery, potential benefits of using technology to deliver mental health services to youth, and recommendations to use technology for (1) providing quality information in a manner that is accessible to individuals of diverse socioeconomic backgrounds, (2) facilitating communication with health care professionals and services, and (3) increasing access to peer support.

Conclusions: To our knowledge, this is among the first (or the first) to explore the perspectives of family members of youth being treated for FEP on the use of technology for mental health care. Our results highlight the importance of considering diverse experiences and attitudes toward the role of technology in youth mental health, digital literacy skills, phases of recovery, and sociodemographic factors when engaging family members in technology-enabled youth mental health care research and practice. Innovative methods to recruit and elicit the perspectives of family members on this topic are warranted. It is also important to consider educational strategies to inform and empower family members on the role, benefits, and use of ICTs in relation to mental health care for FEP.

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Introduction

Information and communication technologies (ICTs) such as websites, social media, and mobile phones or tablet apps are increasingly recognized as having an important role in the delivery of mental health services. Some of the benefits associated with the use of ICTs include the potential to increase access to services, reduce service-related costs and social stigma, enhance service engagement, facilitate peer support, allow rapid access to information, and facilitate communication between patients and providers [1-3]. Mohr et al [4] cite videoconferencing, standard phone interventions, Web-based interventions, mobile technologies, and virtual reality as efficient enhancers of mental health outcomes when used as a complement to existing services.

Youth are often drawn to the Web during the onset of mental health issues or while receiving services [5,6]. Accordingly, in the early psychosis intervention literature, there are recent examples of studies evaluating young people's access and use of technology, as well as their perspectives on using technology to receive mental health information, services, and support [6-8]. However, limited attention has been given to the perspectives of family members in this regard.

Family members have an important role in the management, treatment, and outcomes of youth with psychosis [9,10]. Their participation in the treatment process has been associated with a significant reduction on the risk of relapse and hospitalization [11] and with an increase in compliance to treatment and medication [10]. Thus, as ICTs are increasingly introduced into the youth mental health care system, it will be important to involve family members, for example, by better understanding their perspectives on this subject matter. Consequently, this study aimed to explore the perspectives of family members on the use of ICTs to deliver mental health care to youth within the context of early intervention services for psychosis.

Methods

This study used a qualitative approach where family members of youth receiving services for a first-episode psychosis (FEP) were recruited to participate in focus group discussions on the topic of technology in relation to mental health service delivery.

Recruitment

A total of 12 participants (target sample was 12-18) were recruited from a specialized early intervention program for psychosis located in an urban Canadian setting. The program provides medical and psychosocial assessments and treatments to young people between the ages of 14 and 35 years who have experienced FEP, as well as monitoring and support to their family members. The clinical team screened potential participants for eligibility from the list of family members of young people currently involved in the program. Participants' whose family member was going through a crisis or was hospitalized at the time of the study were excluded. A member of the research team contacted interested participants, explained the project, confirmed eligibility, and inquired about availability to participate in a focus group. Written informed consent was obtained from all participants prior to participating in the study. This study was approved by the affiliated university-based ethics review board, and was part of a larger project on access and use of technology for mental health information, services, and support within the context of early intervention for psychosis.

Procedure

A total of 6 focus groups were conducted, with the number of participants in each group ranging from 1-4. Whereas the initial aim was to have 3 to 4 participants in each group, on some occasions, participants confirmed attendance but did not attend the scheduled meeting. In this case, if only 1 or 2 participants attended, the meeting was still held, and those who were unable to attend were invited to a subsequent meeting.

Focus groups were cofacilitated by 2 members of the research team and the duration of focus groups ranged from 90-120 min. A 12-item semistructured interview guide was constructed by the first author with additional input from the second author and was used to lead the focus groups. Examples of questions asked were: Have you used technology in the past to access mental health information, services, or support; if yes, what type of information or services did you search for? Did you find the results helpful? What are your thoughts on using technology to deliver mental health information, services, and support at (name of program)? What recommendations do you have for the use of technology in the delivery of mental health services for youth?

Each focus group session was audio-recorded and transcribed verbatim. The data was managed using Atlas.ti (Version 7.5.6) and the analysis and coding approach was informed by Braun and Clarke [12]. Codes were grouped in relation to similarity, categorized, and analyzed to assign meaning. An initial coding framework was developed based on transcripts from the first 3 focus groups, which closely reflected the topics addressed in the interview guide. The framework was further developed through review of the remaining transcripts and discussion with members of the research team. The coding framework was then piloted on 4 transcripts by 2 members of the research team, revised based on team consensus, and then systematically applied to all the data. The final framework consisted of 4 primary categories with respective subthemes: experience with services, not related to technology; experience with the use of technology; concerns; and recommendations. Following Braun and Clark's process [12], the qualitative thematic analysis was independent of theory and focused on the identification and organization of common themes and patterns observed across the dataset. In this paper, we report on the analysis of content from the last 3 categories that were directly related to technology. Some of the focus groups in the study were conducted in French; in this regard, all French quotations cited in the study were first translated into English, and then back translated into French for verification.

Results

Details on the sociodemographic characteristics of participants are provided in Table 1.

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Table 1. Sociodemographic breakdown of focus group participants (n=12).

Characteristics	n
Sex	
Male	1
Female	11
Age (years)	
48-62	8
Unknown[a,b]	4
Length of involvement in the program	
6-12 months	1
<6 months	3
>12 months	5
Unknown[a]	3
Self-reported ethno-cultural background	
White	10
Black	1
Asian	1
Education	
High school completed	1
CEGEP[c] or college completed	3
Undergraduate completed	1
Master degree	4
Unknown[a]	3
Employment status	
Not employed	1
Employed	2
Part-time	2
Full-time	4
Unknown[a]	3
Living situation	
With the family member involved in the program	9
Unknown[a]	3
Relationship with patient	
Mother	9
Step-Mother	1
Wife	1
Father	1
Annual income (CAD$)	
30,000 - 49,999/year	4
50,000/year and more	4
Did not indicate[b]	1
Unknown[a]	3

The results are organized into 4 topical areas: (1) access and use of technology, (2) concerns about using technology, (3) benefits, and (4) recommendations.

Access and Use of Technology

At the start of each focus group, participants were invited to describe their experiences of using technology, such as the Web, mobile technologies, and social media. Some of the participants reported having limited experience with using ICTs, citing personal and external reasons such as lack of time, poor familiarity with devices, lack of skills, and lack of need. Most participants did report using devices such as cellphones, tablets, computers, and televisions as platforms for entertainment (eg, movies and music), for managing daily activities and appointments (eg, calendars), to communicate with peers (eg, through chat rooms, forums on mental health, and blogs with testimonies), and to stay in communication with family members and health care professionals (eg, through emails and texting). In this regard, they highlighted the important role that technology plays in their daily lives:

My tablet is associated with leisure, games, or things like that. And my computer is associated with my work. Which means that...But, except that I still believe in technology. [P10]

Go look for news, go look for things that are new, whether it be via Twitter, via my emails...I would say that 80% of my interactions take place on that, whereas 15 or 20% will take place on the phone. So, technology, it's very important. [P11]

Some participants also described searching the Web for mental health information. This was even the case with participants who initially reported limited use of technology, for example, participant 2 had initially stated:

I don't find a need in it. For me, technological tools are to be used. And, if I don't need it, I will not go play with it just for the sake of it, to see what I can do with it. [P2]

Later in the discussion, P2 explained:

I looked at many websites. I watched video-conferences on websites that address mental illness. What were the different diagnoses? Also, I looked for online questionnaires. [P2]

Some mentioned that they searched for information on the Web particularly during the early course of their family member's illness and treatment:

I had no idea what psychosis was. It took me a long time before—and that's what I was reading about...I was just trying to collect information to see what he has. [P7]

Participants also described the need to search for more information following an initial visit to the emergency room with their family member during an episode of psychosis:

Don't have a choice. We go look for other resources because the ones that we get at the emergency do not treat the person...look here is a small piece of paper, a prescription, and bye. So then you don't have a choice but to go look elsewhere because you tell yourself, listen, I can't leave her like that. [P12]

Thus, participants searched for information on the Web pertaining to (1) psychosis, (2) resources for symptom management, (3) emergency numbers, (4) contact information to reach health care professionals and programs, and (5) recent advancements in mental health care (eg, on hospital websites). When they managed to find this type of information, their experiences were reported as being positive.

Concerns

Participants described several issues, challenges, and concerns encountered in their past use of technology. For example, one participant described how despite their best efforts, they were never able to find the information they were looking for:

Then, when our son had his episode, it's the first thing that I did, I went on the Internet, I went to see the website of the (local mental health institute). I really looked and looked. I didn't find what I wanted, but I looked. When I have a problem of some sort, it's my reflex. It's to go on the Internet. [P10]

Participants also highlighted specific concerns related to the negative impact of information on the Web on young people's mental health, coping, recovery, and treatment process. For example, one participant described how information on the Web affected adherence to medication:

He goes on the Internet too, though. He's obsessed with looking up his symptoms...Then, if he finds an article that says that the pills aren't good, I tell you he's quick to throw it back at you. "Look, mom, the pills, that's what they do, that's what they can do to me, that's what they can do to me."...Then, he tells me, look, this is serious. There's research on this, this can cause me damage. [P8]

Another participant described how information on the Web influenced the use of substance abuse:

He's often on the Internet. Yes, he always wants me to read something, listen to something, everything that talks about pot, and the benefits of pot. Yes, he is very convinced of that. He goes looking for that on the Internet. Which means that for me, personally, access to information is great, but there is a limit. [P9]

Others explained that Web-based interactions and communications can exacerbate social isolation. In this regard, they emphasized the value of reconstructing a social life in person as opposed to using social media, chat rooms, or Web-based dating services:

It takes face-to-face human contact. It takes someone who will motivate your youth. Technology, it's cold. [P9]

Another participant argued that the use of Web-based technologies might worsen psychosis:

Especially if you already have mental health problems, if you have suffered a psychosis in which reality was not really reality, your reality. And now you'll get into a situation where everyone is not quite real, is virtual. (…) It's even worse. For me, it can disturb more the state of mind...I think it might even affect normal people, eventually. [P2]

This same participant also raised the issue that young people with psychosis may not have the abilities to communicate effectively online because of apathy, anxiety, social withdrawal, lack of initiative, and decreased cognitive capacities.

Participants also highlighted how the use of certain ICTs might increase the potential for deception, misunderstanding, and abuse:

You know, you cannot read the unsaid in a chatroom, you know (…) You cannot see the nonverbal...It puts you on the wrong track, it can really lure you (…) you might think that this person here is the best person, the best friend in the world, but they might in fact be the worst. [P1]

Participants also raised concerns about the ability to manage the use of technology:

The evening of his crisis...He hadn't charged (his cellphone). He had forgotten to charge it, which means that it was in his pocket but it wasn't charged...He was lost in (urban city), but anyways, we ended up finding him... [P8]

Other issues and concerns participants raised related to the (1) relevance, quality, and source of mental health information, (2) addictive and time consuming nature of technology, (3) accessibility and reliability of technology (eg, unaffordability, Internet not working, thefts), (4) privacy and confidentiality, and (5) website characteristics (eg, interactive and user-friendly features, accessible nonmedical language).

Benefits

All participants expressed receptivity to the idea of using technology in relation to access to mental health information, communication with service providers and youth, and access to education and peer support. In terms of access to mental health information, one participant highlighted:

If you accumulate all the information and put it in the website...I think it will have a lot of positive aspects in the long run that could save a lot of money, that could save clients, that could save caregivers, that could save the family dynamics. [P7]

Participants also spoke about how Web-based information could help families anticipate and respond to a young person going through early stages of mental illness:

If there was a website where I could go in the beginning—right in the beginning where I called, right before he was really in psychosis. But if there was a website where I could say, you know, "XXXX, come sit with me. Look at this. We've got a plan over here. You know, we need to go to the hospital. This is what's going to happen in the hospital. Now if you agree or disagree, if you get ill or whatever, these are the legal steps in (city) that happens here,"...more like an education, you know?...all the things that are going to be happening to them, to their loved ones, whoever it is, it's like they need to have a sort of a picture of what they're looking at. [P7]

They emphasized that access to information on the Web was relevant because they did not want to overburden their child with questions:

I'm afraid to ask too many questions, if it's going ok? And, the medication, does it make you gain weight? Does it make you sleep? I don't want to bother him too much with that, you know...but if there are places where he can go and ask his own questions, and satisfy his curiosity, and that they are easily referenced, that could be interesting. [P11]

They also explained the benefits of technology for educating other family members and the public to help with stigma, mental health literacy, and reduce misconceptions:

It's friends and family who understand absolutely nothing. They ask all sorts of questions. They want to know is he schizophrenic or is he not schizophrenic? It comes back to that a lot. [P11]

It will reduce stigma...because anyone will be able to access it, it will go very fast...They'll go on our website and they say "Oh, I did not know that! That's what Johnny does at school. I'll contact his parents to watch it"...Something that is understandable, that is clear and that can be seen by anyone. I think it has tremendous benefits, you know. [P2]

In addition, they described that it can support a young person in managing symptoms and other related issues, such as substance use:

I think, for the kids, the children should have a website that should show them the early signs of taking these drugs—what can happen to them, to their brain cells and to the side effects of these drugs. [P4]

Finally, they believed that the use of Web-based technology could help health care providers remain up-to-date with new developments: *Like your website could help the doctors, the psychologists, you know? Because a lot of doctors, they've become doctors from a while back.* [P7]

In terms of facilitating communication with service providers and youth, they highlighted that this was particularly helpful during times of social withdrawal and isolation, for example, through texting:

She had isolated herself from all of her friends and all of that. She wasn't seeing anyone anymore. She

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wasn't going to school or to work. Which means she had completely isolated herself. Me, the fact that I was in the last few people, I was ok for texting, and she would respond, but I felt like it was holding by a thread...the thing I like as well about texting, it's that they are free to respond when they want to...it attracts attention too, and they feel like they are supported too. [P12]

In terms of the use of Web-based technologies to promote participation in family psychoeducation groups and peer support, participants highlighted how this would promote disclosure and be particularly helpful during winter weather:

Imagine that...because if you're not in front of the other person, you are able to reveal more things. So, I would think the only way you could do that would be on a Skype type thing. Like to have a virtual meeting, to have a virtual meeting, of course, it's more convenient for people, they don't have to get out at -20 in the middle of January. [P2]

Recommendations

Participants provided several recommendations in terms of future use of technology in youth mental health care, which could be categorized into 3 subthemes: (1) provide quality information in a manner that is accessible to individuals of diverse socioeconomic backgrounds, (2) facilitate communication with health care professionals and services, and (3) increase access to peer support. Each of these themes are elaborated in the following sections with examples of illustrative quotes provided in Table 2.

Providing Quality Information in an Accessible Manner

Participants explained that providing information about the services offered in an accessible and inviting manner would boost comfort in accessing mental health care services. They emphasized that Web-based information needs to be accessible to individuals across all levels of education, experience with mental illness, or experience with the mental health care system. Toward this end, they suggested providing information through a variety of tools and formats, such as movies, educational videos, websites, forums, and mobile phone apps. Moreover, they insisted that regardless of the means or tools, the primary goal of health care is to provide a common language for youth,

family members, and service providers. Participants also highlighted the opportunity for using technology to provide information on topics that are important for youth to know but are not necessarily prioritized during clinical meetings (eg, sex education).

Facilitating Communication With Health Care Professionals and Services

Participants made several suggestions on the use of technology to facilitate communication between youth, family, and health care providers, such as using shared calendars, having appointments online, using apps with a sharable journal of symptom tracking and management strategies, online forums, and chat rooms for clients and family members. They perceived the use of ICTs as complementary to in-person services provided by trained health care professionals. They cautioned, however, that if too much information and interaction was provided on the Web, people might not see the need to attend meetings with health care professionals.

Increasing Access to Education and Peer Support

Participants suggested that technology could be used to increase access to education and peer support. For example, psychoeducation could be accessed at home through webinars or prerecorded conferences. They highlighted that the latter could increase participation for people who might face challenges in attending and engaging in family support and education sessions that are typically only offered in-person. Participants also offered suggestions in relation to using technology to facilitate opportunities to receive peer support (either for family members or youth). To this end, some suggested volunteer peer-mentorship for clients and family members to help support newly diagnosed clients and their families. Some participants also suggested including contact information of volunteer clients and family members who would be willing to be mentors and provide support to newly diagnosed clients and their family members. They argued that a positive experience of service delivery supported by peer interaction could be beneficial to the service provider's image and reputation, as people will likely recommend the services with which they were satisfied. Key messaging should be to reduce misconceptions about mental health and provide support to families.

Table 2. Participants' recommendations.

Subthemes	Participant quote
Providing quality information in an accessible manner	"If we could write somewhere 'We are here to help you, we will find solutions,' then it would be so comforting. Sometimes just a little phrase to say, you know, we're here! As if to provide a bit of soothing...just be a little bit less medical and cold, you know, 'That's it, then that's the disease.' And, perhaps, use more words, a little more vulgarized [ie, accessible language]." [P1]
	"If we want to go get a larger clientele, they are not all university graduates. Which means that, it has to be simple sentences...Not too busy either, on the webpages." [P12]
	"Capsules of 15, 20, or 30 minutes, maybe not more than 20 minutes, 3 or 4 capsules on that and, this will help enormously because there is a big problem with that...I think you have all of the material to do this. And with technology, you can connect all this together." [P11]
Facilitating communication with health care professionals and services	"eHealth must be an additional service and it should encourage, either to the family or for customers, us, to get in touch with you." [P2]
	"And we mentioned lots of things: a website, chatrooms, SMS..." [P11]
Increasing access to education and peer support	"Peer support. Those who are ready to say: 'Ok, me, I could be listed on a call bank.' ...Then, say, 'I've been through what you have been through, you know. Then, on the phone, we can talk, we can go grab coffee together, if it's not too far for you.' You know, make it friendly and based on the human person." [P1]
	"To let them know that they are not alone—to let them know that mental illness is not something that is to be held against a person, that is not necessarily a...hum...a negative thing. It is just something within the person itself that can also come from a physical, biological, chemical imbalance." [P6]

Discussion

Principal Findings

To our knowledge, this is among the first (or the first) study exploring the perspectives of family members receiving services from a prevention and early intervention program for FEP on the use of technology within the context of mental health care. Participants faced several barriers in accessing mental health services, information, and support on the Web, such as lack of time, digital literacy skills, perceived need, and lack of affordability of ICT devices. However, both regular and occasional users identified a range of actual and potential benefits, as well as recommendations for using ICTs in youth mental health care. Research on the perspectives of individuals with diverse experiences and attitudes toward technology is warranted for the future development and implementation of ICTs in youth mental health care.

Participants' use of ICTs to support their family member is similar to those reported in the broader literature. For example, a review conducted by Park et al on health-related Web use by informal caregivers of children and adolescents, identified searching the Web for "disease specific information about disorders and treatments" and seeking "social support for emotional needs via a virtual community" as the most common use of the Web [13]. Moreover, in line with the barriers raised by participants about the importance of digital literacy and sociodemographic factors to access and use ICTs, Park et al also identified a digital divide linked to social status (racial and ethnic minorities) and education level in relation to Web access [13]. Furthermore, previous work by Klee et al [14] demonstrated that sociodemographic barriers can impede access to technology for individuals coping with mental illness and our study illustrates that this may be relevant for family members as well. Since mental health care settings and services can already be difficult to access and navigate, it is important that ICTs in this context help bridge the gap between family members and providers instead of widening it because of a lack of digital literacy or economic means.

Benefits identified by family members were consistent with perspectives obtained from youth in previous research. For example, Lal et al [6] found that youth valued the use of ICTs to access information and peer support to help cope and manage with mental health concerns. Concurrently, some of the concerns raised by family members were different than those identified by youth. For instance, family members in this study expressed concerns about the capacity of young people with psychosis to use and manage technologies, how ICTs could be addictive and time consuming, negatively impact treatment adherence, social recovery, and contribute to substance abuse; whereas youth in previous research placed more emphasis on concerns related to the quality, reliability, and trustworthiness of information available on the Web [6]. However, both family members and youth from previous research highlight the importance of safeguard measures, specifically the professional role in the use of ICT tools and platforms related to mental health care.

Implications for Practice

Family members highlighted several benefits and made specific suggestions around the use of ICTs to communicate with service providers. These suggestions and tools can inform and guide clinicians and researchers who wish to engage with family members via ICTs. Providing up-to-date quality information in an accessible language was of importance to participants as they emphasized that the objective of mental health care was to ensure communication between youth, family members, and service providers. Within the broader health literature, Park et al recommend that Web-based information targeting informal caregivers be "evidence based and written at a sixth-grade level" [13]. Participants in our study suggested using a variety of formats including movies, educational videos, website forums, and mobile phone apps to increase engagement with mental health care services. Those participants that had limited use of

technology also highlighted the importance of providing this information in both digital and print formats. In addition, participants listed tools to better reach and stay in contact with the clinical team, such as shared calendars, online appointments, sharable symptom tracking and management journals, as well as chat rooms and forums.

A second implication for practice included the concerns raised by participants that specifically relate to youth with psychosis. These perspectives of participants warrant further attention as they can limit the uptake of technology-enabled tools provided by specialized early intervention programs and discourage youth and family members from going on the Web to access mental health information, services, and support. Thus, it is important to consider educational strategies to inform and empower family members on the purpose, benefits, and use of ICTs in relation to mental health care for FEP. This education could be added as a component to psychoeducation workshops that are typically provided by health care providers in specialized early intervention programs. To address participants' concerns over potentially abusive or dangerous social interactions online for an at-risk population, family members may benefit from a discussion on evolving psychosocial behaviors that are defined differently by youth. For instance, a family member may interpret a young person spending "all day on the phone" as social withdrawal, whereas the young person may be using the phone to connect and exchange with formal or informal peer supporters. Likewise, a Web-based social interaction with a peer supporter may be more beneficial than a face-to-face interaction with a service provider that is asking routine or predetermined questions and who may be pressed for time [15]. Furthermore, mental health care professionals can draw from research on cyberbullying and online harassment to develop tools and safeguard measures to help youth recovering from FEP identify and appropriately respond to potentially problematic situations [16,17]. Providing strategies on cyberbullying to family members and youth also links to family members' recommendation to use technology to inform clients on topics not generally discussed in mental health care settings but that have a direct impact on recovery and well-being, for example sex education.

Future Research Directions

Future research could focus on family members' perspectives on the use of ICTs to support youth mental health care using a larger sample size. The latter could highlight the differences and similarities with the general population as well as compare responses between participants who regularly use ICTs and those who do not. A better understanding of the differences between heavy and nonusers may provide insight on accessibility and uptake of ICTs in mental health care service delivery. Moreover, building on previous studies conducted with youth [6] and the current study conducted with family members, it is important to also explore mental health care professionals' perspectives (benefits, concerns, and recommendations) on the use of ICTs to deliver mental health services to youth recovering from FEP and other mental health problems. A reflection and discussion on how to address and integrate the needs, concerns, and objectives identified by patients, family members, and health care professionals is

warranted to inform the development and implementation of ICT tools in youth mental health service delivery. The challenge in developing and implementing new ICT tools will be to effectively assess and respond to needs that are specific to each stakeholder as well as facilitate information sharing and communication among the 3 groups.

As family members strongly emphasized the need for Web-based platforms that can facilitate peer interaction in a safe context, further investigation could explore elements of Web-based platforms that increase or decrease feelings of safety and develop efficient safeguard measures. Similarly, Green et al [18] emphasize the importance of using tailored age-appropriate approaches that reflect youth cultures and lifestyles to engage youth in mental illness treatment, to increase their autonomy to manage their condition, and to improve social integration. In developing and implementing such approaches, it is also important to consider the various phases of illness and recovery pertaining to psychosis and how technology may be experienced differently during these different phases. This is an area that needs further research and innovation in terms of technologies as well as guidelines for using them.

Study Limitations

The small sample size of 12 participants limits the generalizability of the results. Although our original target sample was small (12-18), recruitment was challenging. Most family members contacted declined to participate in the study and some cancelled their engagement prior to the focus group or did not show up after confirming attendance. A possible explanation is the topic itself. The use of technology-enabled interventions and services targeting family members within the field of early intervention for psychosis (and other areas of mental health) is still in a stage of infancy and thus, potential participants may have not felt able to contribute meaningfully to the study. We had previously conducted a focus group research project on the topic of relapse recruiting from the same setting and experienced minimal challenges in terms of recruitment. Thus, given limited exposure to the topic of technology within the context of interacting with youth mental health services, potential participants may have perceived the topic as being irrelevant to their experiences of health care services or of low personal interest. The negative attitudes or concerns regarding the impact of technology on young people's mental health, may have also influenced family members' interest to participate in the study. There were also challenges in coordinating participants' schedules, even though groups were offered both in the afternoon and evening. Future research might consider recruiting participants from a broader range of sociodemographic characteristics as well as using surveys, individual interviews, or other innovative methods, rather than focus groups to better accommodate family members' time constraints and multiple obligations.

Conclusions

This study described the perspectives and experiences of family members on the use of ICTs to deliver mental health care services to youth who have experienced FEP. The findings support the importance for future attention on the development and testing of a variety of technology-enabled tools and services

to better meet the needs and preferences of family members in their efforts to understand, manage, and cope with psychosis and related concerns. Results also highlight the importance of mental health care providers to educate family members on technological tools, platforms, and resources currently available to support psychosis management and recovery. More information is needed on family members' perspectives to better inform the use of technology in the delivery of mental health care.

Acknowledgments

Conflicts of Interest

None declared.

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Abbreviations

FEP: first-episode psychosis
ICTs: information and communication technologies

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Original Paper

Preferences for Internet-Based Mental Health Interventions in an Adult Online Sample: Findings From an Online Community Survey

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Abstract

Background: Despite extensive evidence that Internet interventions are effective in treating mental health problems, uptake of Internet programs is suboptimal. It may be possible to make Internet interventions more accessible and acceptable through better understanding of community preferences for delivery of online programs.

Objective: This study aimed to assess community preferences for components, duration, frequency, modality, and setting of Internet interventions for mental health problems.

Methods: A community-based online sample of 438 Australian adults was recruited using social media advertising and administered an online survey on preferences for delivery of Internet interventions, along with scales assessing potential correlates of these preferences.

Results: Participants reported a preference for briefer sessions, although they recognized a trade-off between duration and frequency of delivery. No clear preference for the modality of delivery emerged, although a clear majority preferred tailored programs. Participants preferred to access programs through a computer rather than a mobile device. Although most participants reported that they would seek help for a mental health problem, more participants had a preference for face-to-face sources only than online programs only. Younger, female, and more educated participants were significantly more likely to prefer Internet delivery.

Conclusions: Adults in the community have a preference for Internet interventions with short modules that are tailored to individual needs. Individuals who are reluctant to seek face-to-face help may also avoid Internet interventions, suggesting that better implementation of existing Internet programs requires increasing acceptance of Internet interventions and identifying specific subgroups who may be resistant to seeking help.

Introduction

There has been rapid growth in the number and variety of Internet-based interventions targeting mental health problems in the community since the emergence of pioneering programs such as MoodGYM approximately 15 years ago. Evidence for Internet interventions (also referred to as "online programs") has also grown rapidly. Several meta-analyses have been conducted and report considerable evidence of effectiveness for programs to treat depression [1], anxiety [2], and substance use disorders [3,4], with emerging evidence of effectiveness for reducing suicidal ideation [5-7]. There is also evidence that such programs can be beneficial in a prevention setting [8,9]. However, there has been limited effort to disentangle the attributes of programs that are associated with better outcomes

beyond broad categories such as clinician guidance and length of program. Moreover, the development and implementation of such programs is rarely guided by the preferences of those in the community who may use them. By taking into account preferences in the community for the use of online programs, it may be possible to increase uptake and increase adherence, leading to better outcomes.

Internet-based mental health interventions have typically been modeled on a psychological therapy format. Most are based on some form of cognitive and/or behavioral therapy, in which 50-minute weekly consultations over 6 to 10 weeks are the norm. Consequently, lengthy weekly modules tend to have been adopted for Internet interventions. This structure is designed to allow users to learn and practice new skills over the week. However, much content on the Internet is not designed in this way, with users spending no more than 70 seconds on 80% of Web pages [10] and average YouTube videos lasting less than 5 minutes [11]. Therefore, it might be reasonable to infer that users of Internet interventions may have a preference for a different model of engagement with online programs than for face-to-face therapy.

User preferences may also influence other aspects of the design of Internet interventions. Preferences for modality of content, with choices including video (live action or animated), text, images, or a combination, might be associated with learning styles and impact on engagement with online content [12,13]. Characterizing these preferences in a community-based setting can consequently inform design choices for the development of new interventions. There has been limited research exploring user preferences for Internet interventions. A recent study by McClay and colleagues [14] in the area of online interventions for eating disorders has indicated that users had a preference for weekly engagement and sessions of 20 minutes or less. In a study of women with postpartum depression, 87.5% indicated a preference for intervention sessions of 15 to 30 minutes, whereas a third of women wanted videos to illustrate ways to cope and 65% wanted a chat room that was moderated by an expert in postpartum depression [15]. In examining preferences of young adults with first-episode psychosis, Lal et al [16] reported that a mixture of modalities (video, text, images) was preferred, whereas in a study of preferences for alcohol and drug websites, high-cost features (eg, videos, animations, and games) were less highly valued than website design/navigation, being open access, having validated content, and the option for email therapist support [17]. The relatability of content, a preference for action-based rather than talk-based therapies, and opportunities to build skills were highlighted as preferences for online mental health services by young men [18]. Few other studies have identified optimal frequency, duration, or modality of support.

Underlying these preferences is the assumption that individuals are willing to engage in online therapy. A number of studies have reported a greater preference for face-to-face therapy [17,19-21]. For instance, a study by Casey and colleagues [19] reported that even though participants perceived fewer barriers to online therapy, they still reported a greater intention to access face-to-face therapy. Identifying preferences for engagement with online versus face-to-face therapy is a key question in

determining the scope for broader uptake of Internet interventions in the community. Disadvantages of online therapy identified in previous research have included concerns about their helpfulness and credibility, suitability (low computer literacy), personability, and confidentiality, whereas advantages have included flexibility (time and location), accessibility, anonymity, user empowerment, and low effort [22-24]. Furthermore, testing predictors of preferences for online programs can assist in identifying subpopulations where engagement may be challenging. For instance, in a study of adolescent preferences for mental health services, male participants were 1.7 times more likely to prefer online services than female participants [24]. In another study of preferences, participants who preferred eHealth services were found to have higher stigmatized beliefs and lower scores on extraversion, agreeableness, emotional stability, and openness to experience than those who preferred traditional services [17]. Other factors reported to be associated with willingness to participate in an online intervention may include older age, female gender, being separated or divorced, being highly educated, history of depression, and lower levels of personal stigma and higher levels of depressive symptoms [25].

This study aimed to survey preferences for Internet-based mental health interventions in an online Australian sample. Specifically, the study aimed to determine optimal duration and frequency of modules or sessions, and whether there was a trade-off between duration and frequency or content. Preferences for modality of content were also examined to determine whether there was clear support for a particular format or platform for presenting therapeutic content and psychoeducation. Preferences for face-to-face versus Internet treatment were independently assessed, and predictors of these preferences were tested to identify subgroups where engagement in online programs may be particularly challenging. The questions used in the study were informed by the Discrete Choice Experiment approach [26,27]; however, the large number of attributes and potential attribute levels restricted the focus to only the main effects of each attribute of interest, ensuring response burden was not excessively onerous. The findings from this study may inform the development of new online mental health programs and better dissemination of existing programs.

Methods

Participants and Procedure

Australian adults were recruited on the social media platform Facebook between August 2014 and January 2015. Advertisements included the text "Complete a 20-30 min survey to help us develop online services for mental health" and the logo of the Australian National University (ANU). To enable comparison between young adults and older adults, purposive oversampling of those aged between 18 and 25 years was conducted, using targeted advertising to this age group. Advertisements linked directly to an online survey that included questions on preferences for Internet-based programs, Internet usage, and mental health status, with a separate set of questions on help seeking for suicidal thoughts that were not included in the current analyses. Individuals could also engage with the

study through a Facebook page, enabling sharing of the study through social networks. The survey was implemented online using LimeSurvey, with data stored on a secure server at ANU. From 859 individuals who engaged with the survey link, 673 (78.3%) respondents consented to participate in the study and 438 (50.9%) adults fully completed the survey and were included in these analyses. The study received ethical approval from the ANU Science and Medical Delegated Ethical Review Committee (protocol #2014/380, approved July 23, 2014).

Measures

Internet-based programs were defined for participants as websites that provided effective strategies to change unhelpful thinking patterns, effective strategies to change unhealthy lifestyle patterns, or effective strategies for relaxation. Interest in potential components of an Internet-based program was assessed based on perceived helpfulness (rated on a 5-point scale from "very unhelpful" to "very helpful") and appeal (rated on a 5-point scale from "very unappealing" to "very appealing"). Components queried included screening scales to assess mental health, feedback about mental health symptoms, information about mental health problems (eg, signs, symptoms, risk factors, treatments), strategies to change unhealthy lifestyles, strategies to change unhelpful thoughts, and negative feelings and relaxation strategies.

Preferences for duration and frequency of delivery of online mental health programs were assessed using four questions comparing different delivery scenarios based on low- or high-intensity programs and testing preferences for frequency or duration. The scenarios were chosen to probe preferences for brief versus long sessions (duration) and frequent versus extended sessions (frequency), reflecting the typical demands of existing Internet-based programs:

1. One 2-hour session on 1 day (ie, once-off long session) versus ten 12-minute sessions across 10 days (ie, multiple brief sessions)
2. Five 60-minute sessions over 5 weeks (ie, high-intensity weekly sessions) versus fifteen 20-minute sessions over 3 weeks (ie, moderate-intensity high-frequency sessions)
3. Fifteen 20-minute sessions over 3 weeks (ie, moderate-intensity high-frequency sessions) versus ten 10-minute sessions over 10 weeks (ie, extended period of brief weekly sessions)
4. Five 60-minute sessions over 5 days (ie, intensive sessions over a short period) versus five 60-minute sessions over 5 weeks (ie, intensive sessions over a long period)

In addition, willingness to participate in a 10-minute daily session or 50-minute weekly session was assessed by asking how many days/weeks participants would continue within such a program.

Preference for tailored versus generic programs was also assessed using a single item, comparing "a program that is tailored to your needs and preferences, that would take a little longer to assess your needs and preferences" to "a general program that is the same for everyone, without the need to assess needs and preferences." All preference items had a "no preference" response option.

Preferences for modality of online content delivery were based on items assessing preference for reading text (information) online, reading text (story) online, watching an animated video, watching a live action video, and looking at images/graphics. Each modality was rated on 5-point scale from "strongly avoid" to "strongly prefer." Similarly, preferences for setting of online content delivery were assessed using six items referring to hardware and location, each rated on a 6-point scale from "don't use" to "strongly prefer": smartphone at home, smart phone at work/school, laptop/desktop at home, laptop/desktop at work/school, tablet at home, and tablet at work/school.

Finally, preference for online programs compared to face-to-face programs was assessed by identifying whether individuals reported being "highly likely" or "likely" to use such a program if they were having a personal or emotional problem (face-to-face programs were specified as including counseling and group programs). Participants were categorized as likely to use (1) either face-to-face or online programs, (2) only face-to-face, (3) only online, or (4) neither face-to-face nor online. Preferences for online program use were further explored by asking about four situations in which the respondent might use such programs, with usage in each scenario rated on a 5-point scale from "highly unlikely" to "highly likely": (1) "if I wanted to increase my happiness and general well-being," (2) "if I was at risk of developing a mental health problem," (3) "if I was experiencing symptoms of a mental health problem," and (4) "if I had been diagnosed with a mental health problem."

Potential predictors of preferences included demographic characteristics (age, gender, level of education, linguistic diversity—English vs non-English—marital status, employment status), depression symptoms (Patient Health Questionnaire-9; PHQ-9 [28]), anxiety symptoms (Generalized Anxiety Disorder-7; GAD-7 [29]), suicidal ideation (Suicidal Ideation Attributes Scale; SIDAS [30]), Attitudes Toward Seeking Professional Help (ATSSPH [31]), access to broadband Internet and a device at home, and typical time spent on the Internet at school or work and home.

Analysis

Analyses were largely descriptive, reporting interest in components of online programs, preferences for duration/frequency, modality, and setting, and comparison between online and face-to-face. Bonferroni-adjusted post hoc paired t tests were used to compare item responses, with corrected alphas reported in the Results section. Predictors of preferences were examined using logistic regression models and a linear regression model on number of sessions that individuals reported they would complete. All analyses were conducted in SPSS version 23 (IBM Corp, Chicago, IL, USA).

Results

Of the 438 participants who completed the survey, the majority were female (78.5%, n=344) and the mean age was 34.9 (SD 15.5) years. By design, the group between 18 and 25 years was overrepresented (44.5%, n=195); the group between 26 and 45 years comprised 26.9% (n=118) of the sample and 28.5% (n=125) were aged 46 years or older. The sample was fairly

well educated; 37.4% (164/438) did not have postsecondary education; 14.4% (63/438) completed a certificate, diploma, or associate degree; 24.4% (107/438) completed a bachelor degree; and 23.1% (101/438) completed a higher degree. In addition, 45.4% (199/438) were current tertiary (university) students. Although most respondents spoke only English at home, 11.2% (49/438) reported speaking another language. Respondents were married (37.9%, 166/438), unmarried and not in a relationship (30.8%, 135/438), unmarried and in a relationship (18.9%, 83/438) or divorced/separated (11.0%, 48/438). Most respondents were employed, either in full-time (33.1%, 145/438) or part-time (32.8%, 144/438) work, although 9.4% (41/438) were unemployed and 23.9% (105/438) were not currently in the labor force (eg, maternity leave, retired, full-time students). Mental health symptoms were elevated in the sample, with mean PHQ-9 depression score of 10.2 (SD 7.4) and GAD-7 score of 7.7 (SD 6.3), indicating moderate levels of depression and anxiety symptoms. Some level of suicidal ideation in the past month was reported by 45.8% (201/438) of participants.

Interest in Potential Components of an Internet-Based Program

Table 1 reports the perceived helpfulness and appeal of various components or attributes of online mental health programs. Mean scores correspond to scale responses ranging from 1="very unhelpful/unappealing" to 5="very helpful/appealing." Bonferroni-adjusted post hoc paired *t* tests indicated that the first two components (screening and feedback) were rated significantly less helpful than other components (*P*<.001 for all comparisons except feedback vs relaxation strategies, *P*=.19), feedback was rated as significantly more helpful than screening alone (*P*<.001), and "strategies to change unhelpful thoughts and negative feelings" was perceived as significantly more helpful than "relaxation strategies" (*P*=.002). Similarly, the first two components (screening and feedback) were rated significantly less appealing than other components (*P*<.001 for all comparisons except feedback vs changing unhealthy lifestyles, *P*=.02, and feedback vs relaxation strategies, *P*=.009), feedback was rated as significantly more helpful than screening alone (*P*<.001), and the "thoughts and feelings" item was perceived as significantly more appealing than both "lifestyle" and "relaxation" strategies (*P*<.001 for both).

Preferences for Duration and Frequency

Participants had a preference for breaking up long sessions, with most (58.0%, 254/438) preferring ten 12-minute sessions across 10 days rather than a single 2-hour session (21.0%, 92/438; the remaining 21.0%, 92/438 had no preference).

However, for programs with higher intensity, this preference faded, with 42.5% (186/438) preferring fifteen 20-minute sessions over 3 weeks and 40.0% (175/438) preferring five 60-minute sessions over 5 weeks.

There were no strong preferences for frequency of program delivery when sessions were brief: 43.2% (189/438) preferred ten 10-minute sessions over 2 weeks and 35.8% (157/438) preferred ten 10-minute sessions over 10 weeks. However, frequency preferences became stronger with longer session duration, with 65.8% (288/438) preferring five 60-minute sessions over 5 weeks compared to 13.9% (61/438) preferring five 60-minute sessions over 5 days. In summary, participants generally had a preference for sessions of shorter duration, but if longer sessions were required, they preferred that sessions be delivered less frequently.

When asked how many sessions they would be willing to complete of a 10-minute daily session, the mean response was 13.8 (SD 10.6, range 0-30) sessions. Three-quarters of participants reported willingness to complete six or more sessions. Similarly, when asked about completion of 50-minute weekly sessions, participants reported a mean of 8.1 (SD 8.7, range 0-30) sessions, with three-quarters willing to complete three or more sessions.

Preferences for Tailoring

Participants reported a strong preference for tailored programs (tailored: 81.1%, 355/438; generic programs: 13.9%, 61/438; no preference: 5.0%, 22/438), even if that resulted in extra time required to assess needs and preferences.

Preferences for Modality and Setting

Table 2 shows preferences for modality, rated on a 5-point scale (1="strongly avoid" to 5="strongly prefer") and setting of use, rated on a 6-point scale (1="don't use," 2="strongly avoid" to 6="strongly prefer"). Overall, none of the modalities stood out as being strongly preferred. Bonferroni-adjusted paired *t* tests indicated that informational text and images were significantly preferred over any type of video (*P*<.001 for all comparisons), and narrative text was preferred over animated videos (*P*<.001). There were stronger preferences for specific settings and hardware for use, with greater preference for completion of online mental health programs using laptop/desktop computers over tablets and mobile phones (*P*<.001 for all comparisons), greater preference for mobile phones over tablets (*P*<.001 for all comparisons), and greater preference for completing programs at home rather than at work or school for each device (*P*<.001 for all comparisons).

Table 1. Helpfulness and appeal of components of online mental health programs (N=438).

Component[a]	Helpfulness		Appeal	
	Mean (SD)	Helpful, n (%)	Mean (SD)	Appealing, n (%)
Screening scales to assess mental health	3.75 (0.96)	305 (69.6)	3.40 (1.02)	216 (49.3)
Feedback about mental health symptoms	3.97 (0.85)	357 (81.5)	3.66 (0.95)	295 (67.4)
Information about mental health problems	4.12 (0.82)	382 (87.2)	3.91 (0.87)	344 (78.5)
Strategies to change unhealthy lifestyles	4.11 (0.83)	376 (85.8)	3.78 (0.92)	308 (70.3)
Strategies to change unhelpful thoughts and negative feelings	4.14 (0.88)	373 (85.2)	3.94 (0.91)	342 (78.1)
Relaxation strategies	4.04 (0.90)	346 (79.0)	3.81 (0.93)	298 (68.0)

[a] Rated on a 5-point scale (1="very unhelpful/unappealing" to 5="very helpful/appealing").

Table 2. Preferences for modality and setting of use (N=438).

Attribute	Mean (SD)	Prefer, n (%)	First preference, n (%)
Modality[a]			
Reading text (information)	3.63 (0.89)	267 (61.0)	158 (36.1)
Reading text (story)	3.49 (0.92)	245 (55.9)	76 (17.4)
Watching an animated video	3.19 (1.09)	194 (44.3)	65 (14.8)
Watching a live action video	3.31 (1.09)	218 (49.8)	84 (19.2)
Looking at images/graphics	3.61 (0.89)	281 (64.2)	55 (12.6)
Setting[b]			
Mobile phone at home	3.90 (1.59)	209 (47.7)	—
Mobile phone at work/school	3.36 (1.62)	133 (30.4)	—
Laptop/desktop at home	5.29 (0.97)	391 (89.3)	—
Laptop/desktop at work/school	3.81 (1.70)	199 (45.4)	—
Tablet at home	3.29 (1.98)	168 (38.4)	—
Tablet at work/school	2.38 (1.56)	50 (11.4)	—

[a] Rated on 5-point scale (1="strongly avoid" to 5="strongly prefer").

[b] Rated on a 6-point scale (1="don't use," 2="strongly avoid" to 6="strongly prefer").

Table 3. Reasons for using online mental health programs (N=438).

Reason for use[a]	Mean (SD)	Likely, n (%)
If I wanted to increase my happiness and general well-being	3.04 (1.29)	187 (42.7)
If I was at risk of developing a mental health problem	3.03 (1.24)	184 (42.0)
If I was experiencing symptoms of a mental health problem	3.47 (1.24)	265 (60.5)
If I had been diagnosed with a mental health problem	3.68 (1.26)	310 (70.8)

[a] Rated on a 5-point scale (1="highly unlikely" to 5="highly likely").

Preference for Online Programs Compared to Face-to-Face Programs

The majority (86.1%, 377/438) of participants reported that they would likely seek help from either an online or face-to-face source if they were experiencing a personal or emotional problem. More participants endorsed likelihood of using face-to-face sources only (25.3%, 111/438) than online programs only (14.4%, 63/438), although nearly half (46.3%, 203/438) reported that they would be likely to use both sources.

Four specific reasons for using online mental health programs were examined (Table 3). Participants reported that they would be most likely to use an online mental health program if they were diagnosed with a mental health problem, followed by experiencing symptoms of a mental health problem, followed by being at risk for a mental health problem and for increasing well-being, with no difference between these latter categories (P=.76), but significant pairwise differences otherwise ($P<.001$ for all comparisons).

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Predictors of Preferences

Tables 4 and 5 show the outcome of a series of logistic regression models examining predictors of various preferences: likely to use online programs, likely to use face-to-face programs, preference for video content, and preference for tailored content. A linear regression was also conducted to examine predictors of number of daily 10-minute sessions the individual reported they would complete. Younger age was associated with higher preference for online and lower preference for face-to-face programs. Females were more likely to report a preference for online programs. More education was associated with greater preference for online programs and greater preference for video content. Participants who were unmarried were less likely to have a preference for online programs, although they reported that they would complete more sessions of an online program than those who were married. Participants with more favorable attitudes toward seeking professional help had greater preference for both online and face-to-face programs, greater preference for tailored programs, and reported that they would complete more sessions of an online program. Internet availability and usage were not associated with preferences, although those with a broadband connection at home were less likely to have a sole preference for face-to-face programs. Finally, mental health symptoms had no relationship with preferences for online programs.

Table 4. Logistic and linear regression models of predictors of preferences for online mental health programs: likely to use online and likely to use face-to-face.

Independent variable	Likely to use online		Likely to use face-to-face	
	OR (95% CI)	P	OR (95% CI)	P
Age	0.98 (0.95, 1.00)	.04	1.04 (1.01, 1.07)	.01
Gender=female vs male	2.02 (1.21, 3.36)	.007	0.91 (0.48, 1.73)	.78
Education		.02		.20
Certificate/Diploma/Associates	2.83 (1.37, 5.85)	.005	0.89 (0.35, 2.24)	.80
Bachelor	1.71 (0.98, 2.99)	.06	0.88 (0.45, 1.72)	.71
Higher degree	2.02 (1.06, 3.85)	.03	0.44 (0.19, 0.98)	.046
High school or less (reference category)	1.00		1.00	
Speak English only at home	0.78 (0.39, 1.55)	.47	0.55 (0.24, 1.26)	.16
Marital status		.002		.50
Unmarried, no partner	0.34 (0.16, 0.71)	.004	0.70 (0.30, 1.63)	.41
Unmarried, partnered	0.32 (0.17, 0.60)	<.001	0.79 (0.38, 1.64)	.53
Divorced, separated, widowed	0.54 (0.27, 1.07)	.08	1.79 (0.65, 4.91)	.26
Married (reference category)	1.00		1.00	
Employment status		.10		.68
Unemployed	1.66 (0.76, 3.60)	.20	0.98 (0.40, 2.40)	.97
Not in labor force	1.71 (1.01, 2.89)	.04	1.32 (0.70, 2.49)	.39
Employed full/part time (reference category)	1.00		1.00	
Attitudes toward professional help seeking (ATSPPH-SF)	1.05 (1.01, 1.09)	.008	1.27 (1.20, 1.34)	<.001
Home Internet/hardware	0.43 (0.16, 1.14)	.09	0.17 (0.04, 0.76)	.02
Work/school Internet/hardware	1.35 (0.79, 2.30)	.27	0.89 (0.47, 1.70)	.73
Frequently use home Internet	0.74 (0.45, 1.21)	.23	0.58 (0.32, 1.03)	.06
Frequently use work/school Internet	0.70 (0.36, 1.36)	.30	1.08 (0.46, 2.50)	.87
Depression symptoms (PHQ-9)	0.99 (0.94, 1.05)	.76	0.98 (0.91, 1.04)	.48
Anxiety symptoms (GAD-7)	0.99 (0.93, 1.05)	.70	1.05 (0.98, 1.13)	.18
Suicidal ideation	0.99 (0.96, 1.01)	.31	1.00 (0.97, 1.03)	.91
Constant/intercept	2.14 (0.28, 16.31)	.46	0.01 (0.00, 0.21)	.002

Table 5. Logistic and linear regression models of predictors of preferences for online mental health programs: preference for video content, preference for tailored content, and number of sessions.

Independent variable	Preference for video content		Preference for tailored content		Number of sessions	
	OR (95% CI)	*P*	OR (95% CI)	*P*	Estimate	*P*
Age	1.00 (0.98, 1.02)	.97	0.98 (0.95, 1.00)	.09	9.66 (0.16, 19.16)	.55
Gender=female vs male	0.92 (0.56, 1.52)	.74	1.53 (0.86, 2.72)	.15	-0.24 (-2.69, 2.21)	.85
Education		.03		.45		
Certificate/Diploma/Associates	2.61 (1.33, 5.13)	.005	0.86 (0.38, 1.91)	.71	-1.60 (-4.65, 1.45)	.30
Bachelor	1.07 (0.60, 1.89)	.83	1.61 (0.77, 3.36)	.21	-1.19 (-4.56, 2.18)	.49
Higher degree	1.40 (0.74, 2.64)	.30	1.24 (0.58, 2.63)	.58	1.39 (-1.62, 4.41)	.37
High school or less (reference category)	1.00		1.00			
Speak English only at home	0.73 (0.38, 1.42)	.36	1.12 (0.50, 2.51)	.79	-2.08 (-5.30, 1.15)	.21
Marital status		.19		.78		
Unmarried, no partner	0.53 (0.25, 1.12)	.10	0.67 (0.27, 1.65)	.39	-1.23 (-4.55, 2.09)	.47
Unmarried, partnered	1.05 (0.58, 1.90)	.87	0.92 (0.43, 1.98)	.83	-5.17 (-9.58, -0.76)	.02
Divorced, separated, widowed	1.20 (0.62, 2.35)	.59	0.80 (0.37, 1.71)	.56	-4.48 (-8.46, -0.50)	.027
Married (reference category)	1.00		1.00			
Employment status		.65		.34		
Unemployed	1.33 (0.64, 2.79)	.45	1.17 (0.43, 3.19)	.76	-0.55 (-3.02, 1.92)	.66
Not in labor force	0.92 (0.55, 1.55)	.75	0.67 (0.36, 1.22)	.20	1.28 (-2.58, 5.14)	.52
Employed full/part time (reference category)	1.00		1.00			
Attitudes toward professional help seeking (ATSPPH-SF)	1.02 (0.99, 1.06)	.23	1.05 (1.00, 1.10)	.05	-2.42 (-6.76, 1.93)	.006
Home Internet/hardware	0.79 (0.33, 1.92)	.61	1.58 (0.57, 4.34)	.38	-0.63 (-3.14, 1.88)	.28
Work/school Internet/hardware	0.75 (0.45, 1.26)	.28	1.21 (0.64, 2.26)	.56	-0.10 (-2.41, 2.21)	.62
Frequently use home Internet	1.17 (0.72, 1.89)	.53	1.26 (0.68, 2.31)	.46	-1.37 (-4.55, 1.80)	.93
Frequently use work/school Internet	0.52 (0.26, 1.06)	.07	1.12 (0.53, 2.37)	.77	-0.03 (-0.14, 0.07)	.40
Depression symptoms (PHQ-9)	1.02 (0.96, 1.07)	.54	1.04 (0.97, 1.11)	.30	0.26 (0.07, 0.44)	.10
Anxiety symptoms (GAD-7)	1.00 (0.95, 1.06)	.95	0.98 (0.91, 1.05)	.59	0.22 (-0.04, 0.49)	.27
Suicidal ideation	0.99 (0.96, 1.02)	.48	1.02 (0.99, 1.06)	.23	-0.15 (-0.43, 0.12)	.53
Constant/intercept	0.36 (0.05, 2.70)	.32	0.60 (0.06, 6.36)	.67	0.04 (-0.09, 0.17)	.046

Discussion

There were a number of key findings from this study regarding the preferences of adults for delivery and usage of online mental health programs. The component of online programs that received the highest preference was "strategies to change unhelpful thoughts and negative feelings." This finding is consistent with the cognitive and/or behavioral strategies employed by most online mental health programs and is similar to previous research that identified opportunities to build skills as a preference for online programs [18]. Although screening and feedback about symptoms were less desirable components, there was a strong preference that material be tailored to the individual, even if that requires a screening process. Participants reported a preference for briefer sessions of online programs, consistent with previous findings [14]. However, there was a

trade-off between duration and frequency, with a preference for delivery of brief sessions over shorter periods, but a preference for greater time between sessions when programs included longer sessions. Participants with more positive attitudes toward seeking professional help were likely to endorse longer programs, suggesting that a more positive overall perspective on psychological treatments facilitates greater engagement with treatment programs. The desire for briefer programs may be met by the tailoring of content to individual needs [32], a greater focus on the core components of cognitive and behavioral therapies with an emphasis on overlearning [33], and delivery of activities to practice therapeutic strategies delivered offline through stand-alone worksheets or through mobile and ecological interventions [34].

There were mixed preferences for the modality of presentation, with some preferring text and others preferring images or videos.

This finding suggests a mixture of modalities may be acceptable, consistent with Lal et al [16]. Alternatively, providing users with the option to choose a presentation format that suits their preferences may also increase engagement. Few predictors of modality preferences were identified, although there was some indication that increased education was associated with greater preference for video-based programs. Despite the proliferation of mobile technology in recent years, most users reported a preference for accessing online programs through a laptop or desktop computer. It may be that the description of online programs did not specifically incorporate elements of mobile health programs, which may have raised concerns about the accessibility of online programs on mobile devices. Respondents also reported a preference for accessing programs in the home rather than at work or school, which may be related to privacy concerns.

There was a fairly high acceptance of online mental health programs, with 71% reporting that they would be likely to use an online program if they were diagnosed with a mental illness and 60% if they were experiencing "emotional or personal problems" more broadly. Use of online programs for subclinical states and to enhance well-being was somewhat lower but still remained above 40%. Face-to-face treatment was slightly preferred, in line with previous research [17,19-21], with 71% reporting they would use face-to-face treatment if experiencing emotional or personal problems. There may be a number of reasons for this preference, including a lack of familiarity with the evidence supporting e-mental health programs, conflation of evidence-based e-mental health programs with non-evidence-based websites, suspicion of therapy without direct human contact, or concerns about privacy of personal information in an online setting [17].

Factors associated with greater likelihood of using online programs included younger age, female gender, increased education, being married, and positive attitudes toward professional help seeking. A number of the factors identified are consistent with those reported by Crisp and Griffiths [25] as being associated with an interest in online programs, such as being older, female, separated or divorced, highly educated, and having lower levels of personal stigma. More positive attitudes toward professional help seeking were also associated with a greater likelihood of using face-to-face programs, suggesting these attitudes reflect a general tendency for engagement with psychological treatment. Older age and poorer access to Internet in the home were also associated with greater likelihood of using face-to-face treatment, indicating a divergence between younger and older participants and that access to technology remains a potential barrier to uptake of online services. The gender differences in likely use of online interventions is interesting because many assume that males engage in face-to-face services less than females because they do not like to talk about their problems; barriers men face are likely to be more diverse [35]. These findings suggest that males may similarly require additional persuasion to engage in online programs, suggesting that more work is needed to encourage uptake among males who less typically receive help for mental health problems than females [36]. Addressing the differences in preferences based on age, gender, and education requires

further research, identifying technological and structural processes required to make older and less educated individuals more comfortable with online programs. Further investigation of acceptance facilitating interventions [37] as an approach for increasing uptake of online interventions appears to be a promising avenue for bridging these divides.

Although this was one of the first studies to assess preferences for online mental health programs in the community, there were some limitations. The study assumed that participants had a shared understanding of what online programs can deliver to users. It was intended that this shared understanding be imparted by providing a definition of online programs to participants. However, preferences for use of online programs may be shaped by knowledge and attitudes toward such programs and past experience with online and face-to-face therapy. There may have been a diversity of experience, with some participants in the current study having extensive knowledge of online programs and some having no awareness before the survey. Therefore, interpretation of questions regarding preferences for use of online programs may have been entirely hypothetical for a section of the participants. Although analyses examined the role of attitudes toward professional help seeking in preferences for online programs, further examination of the roles of attitudes and knowledge regarding online programs in shaping preferences for care is warranted. Examination of additional factors associated with preferences is also encouraged because few strong predictors emerged from the regression analyses.

The sample was recruited online, which may be most appropriate for the study of preferences for online programs, although such samples may have limited representativeness of the broader community. In particular, participants had elevated mental health symptoms, probably reflecting self-selection into the study, and males were underrepresented. Although the study aimed to recruit a diverse sample, future research may benefit from targeting specific subgroups to ensure that the development of online programs takes into account diverse needs and preferences. Research on the preferences of males in particular is needed to ensure that their low usage of online (and in-person) services is not perpetuated. The study adopted elements of Discrete Choice Experiments, but the number of attributes of interest precluded a more thorough evaluation of interactions between preferences for different attributes of delivery. Further in-depth research of user priorities for different delivery attributes may provide additional insight into the optimal design of online programs. Finally, user-reported preferences may be quite different to preferences in practice (eg, it would be uncommon for users to complete eight weekly 50-minute sessions of an online intervention). In addition, the implementation of programs based on user preferences may not always have positive effects on outcome. Creating programs with the flexibility to accommodate diverse needs and preferences may be helpful for optimizing uptake and adherence.

In conclusion, this study identified preferences for components, duration, frequency, modality, and setting of online mental health programs. Developers of new programs may benefit from taking into account the preferences of potential users in the community because meeting these preferences may result in greater uptake and adherence. Furthermore, better

implementation of existing programs requires identifying subgroups of the population who may be resistant to addressing mental health symptoms using the Internet. This study identified that older people, males, less educated, and unmarried people may be less likely to engage in online mental health programs, along with people who have negative attitudes toward professional psychological treatments. The assumption that individuals who do not typically engage in face-to-face treatment will necessarily prefer online treatment may be inaccurate, suggesting that engaging these groups in appropriate treatment will require innovation and better matching of treatments with individual preferences.

Acknowledgments

Conflicts of Interest

None declared.

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Abbreviations

    ANU: Australian National University
    ATSSPH: Attitudes Toward Seeking Professional Help
    GAD-7: Generalized Anxiety Disorder-7

PHQ-9: Patient Health Questionnaire-9
SIDAS: Suicidal Ideation Attributes Scale

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Original Paper

A Systematic Review and Meta-Analysis of e-Mental Health Interventions to Treat Symptoms of Posttraumatic Stress

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Abstract

Background: Posttraumatic stress disorder (PTSD) is a stress disorder characterized by unwanted intrusive re-experiencing of an acutely distressing, often life-threatening, event, combined with symptoms of hyperarousal, avoidance, as well as negative thoughts and feelings. Evidence-based psychological interventions have been developed to treat these symptoms and reduce distress, the majority of which were designed to be delivered face-to-face with trained therapists. However, new developments in the use of technology to supplement and extend health care have led to the creation of e-Mental Health interventions.

Objective: Our aim was to assess the scope and efficacy of e-Mental Health interventions to treat symptoms of PTSD.

Methods: The following databases were systematically searched to identify randomized controlled trials of e-Mental Health interventions to treat symptoms of PTSD as measured by standardized and validated scales: the Cochrane Library, MEDLINE, EMBASE, and PsycINFO (in March 2015 and repeated in November 2016).

Results: A total of 39 studies were found during the systematic review, and 33 (N=3832) were eligible for meta-analysis. The results of the primary meta-analysis revealed a significant improvement in PTSD symptoms, in favor of the active intervention group (standardized mean difference=-0.35, 95% confidence interval -0.45 to -0.25, $P<.001$, I2=81%). Several sensitivity and subgroup analyses were performed suggesting that improvements in PTSD symptoms remained in favor of the active intervention group independent of the comparison condition, the type of cognitive behavioral therapy-based intervention, and the level of guidance provided.

Conclusions: This review demonstrates an emerging evidence base supporting e-Mental Health to treat symptoms of PTSD.

Introduction

Posttraumatic stress disorder (PTSD) is a stress disorder primarily characterized by four main symptom clusters: (1) unwanted intrusive re-experiencing of an acutely distressing, often life-threatening, event, (2) an ongoing state of hyperarousal, (3) an active avoidance of stimuli associated with an event that is perceived to be "traumatic", and (4) negative thoughts or feelings that began or worsened after the trauma. Symptoms relating to PTSD are also found in people who may

not have a formal diagnosis and can vary considerably in terms of severity. Other mental health problems such as poor anger control, drug and alcohol problems, and depression can develop alongside symptoms of PTSD, which can delay access to treatment and increase the burden of illness for individuals [1,2]. Research has shown that approximately half of those diagnosed with PTSD also suffer from major depressive disorder [3]. In most cases, depression typically improves during the course of treatment. However, some cases require specific treatment for depression prior to trauma-focused work. Disruptions to everyday functioning occurring within first 3 months following a "traumatic" event are classified by the *Diagnostic and Statistical Manual of Mental Disorders, 5th ed.* (DSM-5) [4] as an Acute Stress Reaction and PTSD thereafter. Prevalence rates calculated from data collected as part of the National Comorbidity Survey [5] estimate that 7.8% of people will experience PTSD at some point across their lifetime. This survey highlighted that some of the most commonly reported stressors were being directly involved in a life-threatening accident or critical illness; being involved in a fire, flood, or natural disaster; and being a witness to injury and threat to life or death of another person. Women were found to be at slightly higher risk than men (10.4 % vs 5.0%) [5]. Not all people who experience a trauma will develop PTSD, but factors that put people at greatest risk include prior trauma, family history of psychopathology, perceived life threat during the trauma, posttrauma social support, and peritraumatic dissociation [6].

Evidence-based psychological interventions have been developed to treat symptoms of PTSD, and the majority of these are designed to be delivered face-to-face using trained therapists. A recent systematic review and meta-analysis of psychological therapies for PTSD [7] described the evidence base for several types of psychological interventions. They separated trauma-focused cognitive behavioral therapy (TF-CBT) (eg [8]) from other forms of cognitive behavioral therapy techniques (non-TF-CBT). All the TF-CBT interventions involved exposure to aspects of the trauma such as revisiting the site where the traumatic event occurred with the aim of encouraging additional processing and updating the memory of the traumatic event, or "imaginal reliving" where individuals are supported to reimagine the trauma in sequence while vocalizing and reappraising the physical and cognitive reactions that occurred at the time of the event. The CBT interventions employed more general stress management techniques to help reduce anxiety (eg, relaxation). This paper also reviewed evidence for alternative psychological models including Eye Movement Desensitization and Reprocessing therapy (EMDR) [9,10] and psychodynamic approaches [11]. It was concluded that there were no differences in outcomes immediately posttreatment for TF-CBT, EMDR, and non-TF-CBT approaches, but that only TF-CBT and EMDR demonstrated sustained improvement between 1 and 4 months following treatment [7].

Access to evidence-based psychological interventions for PTSD remains a high priority in health care agendas, where screening and early interventions are recommended to prevent the development of more chronic presentations. However, mental health resources are often stretched and there is a need to think about extending access to such treatments. Information technology is becoming increasingly part of everyday life, and the possibility of seeking support and reputable information for mental health problems online is becoming more available. The Internet offers a means of accessing e-Mental Health resources for people in need of support, wherever they may be and at whatever time they require input. For people who are limited in their ability to access outpatient health services, be it due to funding, reduced physical mobility, lack of transport, or for fear of stigmatization, e-Mental Health services may be the most viable way for them to receive treatment in a timely and effective manner. Subclinical groups may benefit from evidence-based psychological approaches that prevent problems from worsening. There is an opportunity to increase accessibility of effective psychological support and empower people to take control and self-manage symptoms by embracing technological advances. This could either be via complete self-management or with some additional guidance.

There is already a good evidence base to support the effectiveness of e-Mental Health resources based on psychological models of therapy such as computerized CBT (cCBT) for treatment of depression and some anxiety disorders. Indeed, meta-analyses conclude that cCBT may be a very promising and efficacious treatment for depression within a diverse range of settings and clinical groups [12] as well as for panic disorder and phobia [13]. Research has shown that cCBT has the potential to be as effective as therapist delivered CBT [13-15], but that guidance yields better outcomes [12]. A number of previous systematic reviews and meta-analyses of e-Mental Health resources have included studies exploring treatments of PTSD (eg [16-20]) but only one recently published paper on e-Mental Health interventions for PTSD specifically [21]. This recent paper reviewed 20 randomized controlled trials of Web-based treatments for PTSD and concluded that CBT interventions significantly reduced symptoms compared to control conditions. They did not distinguish between CBT interventions that included an element of exposure as compared to more generic anxiety management tools, and they excluded studies that trialed interventions beyond the scope of CBT and expressive writing. A further systematic review of telepsychology has been published, which summarizes the evidence base to support interventions for PSTD provided remotely, for example, face-to-face therapy via videoconferencing technology [22]. However, this literature was considered beyond the scope of the current review, which aimed to focus on technology-supported interventions that enabled independent access to psychological treatment.

For the purpose of this review, e-Mental Health interventions are defined as psychological interventions delivered via the Internet through an interactive computer interface, including desktop and mobile devices. The aim was to evaluate the broader evidence base for e-Mental Health interventions (both Web-based and mobile-based) for treatment of symptoms associated with PTSD, specifically investigating the role of exposure exercises. In line with the latest review on face-to-face therapies for PTSD, the authors have retained the distinction made between TF-CBT and non-TF-CBT. EMDR and psychodynamic approaches were beyond the scope of this review as they have not yet been translated into e-Mental Health

formats. The choice was to include a broad range of clinical and subclinical groups, including people treated within a physical health setting and without a formal diagnosis of PTSD, to assess the possible scope of such interventions to aid self-management.

Methods

Search Strategy

The following databases were searched in March 2015 using the keywords and phrases detailed in Table 1 along with

equivalent Medical Subject Headings terms: Cochrane Library, MEDLINE, EMBASE, and PsycINFO. These searches were repeated in November 2016. Systematic reviews and meta-analyses published in the areas of technology-assisted self-help [19], computer-aided psychotherapy [17], and Internet or media-delivered CBT or other psychotherapies [16,18,20,21] for anxiety disorders and PTSD were hand searched to find studies. An additional systematic review on online interventions for cancer [23] was also hand searched. Trial registries and reference lists were searched for additional studies reporting analyzed results.

Table 1. Search terms for systematic review, combining Line 1 AND Line 2.

Search lines	Search terms	Filtered by
Line 1	PTSD OR (posttrauma* OR post-trauma*) AND (stress OR disorder*)	Title/Abstract
Line 2	(internet* OR web* OR tele* OR online OR "on-line" OR computer* OR mobile*) AND ("self-help" OR (self AND help) OR tool* OR resource* OR manual* OR package OR program* OR therap* OR intervention* OR application* OR technolog* OR device*) OR cCBT OR iCBT OR i-therapy OR itherapy OR e-therapy OR etherapy OR (virtual AND reality) OR avatar*	Title/Abstract

Eligibility Criteria

The titles and abstracts for all identified papers were screened against the following inclusion criteria: (1) randomized controlled trial (RCT), (2) psychological therapy administered via a Web-based or mobile platform designed to treat symptoms of PTSD, (3) adults (aged 18 or over), (4) experience of a possible single-event trauma, and (5) assessed and reported symptoms of PTSD with a validated measure immediately after intervention. There was no restriction in terms of severity of PTSD symptoms or type of traumatic life event, and RCTs were included if they compared a waitlist, treatment as usual, or an active intervention. Interventions where participants received supplementary guidance from a therapist or other technical assistant were included and considered separately. Reasons for the exclusion of studies included technology that was not Web-based or mobile-based; study designs that were not RCTs including experimental manipulations, duplications, or interim or additional analysis; no measure of PTSD; an evaluation of complex intervention that included a Web-based intervention but did not exclusively test this; unpublished and unable to access results through personal communication; narrative literature reviews; and published protocols with no results.

Study Selection

Two of the authors (SS and JB) read titles and abstracts of all potential papers independently and selected relevant articles for further review. Possible RCTs were read in full to determine if the trial met the inclusion criteria. This process was repeated after the second systematic search in November 2016 for articles published since March 2015.

Data Extraction and Management

Literature searches were completed using reference manager software (Endnote X6 and Mendeley). Data were extracted from

each paper on the (1) characteristics of each sample, including the population and demographic information such as the mean age or age range in years and the percentage of female participants, (2) characteristics of the treatment and control conditions, including the therapeutic model (for active conditions) and treatment duration, and (3) baseline and posttreatment scores on validated measures of PTSD. Authors were contacted directly for missing information. If the authors could not be contacted or did not respond, their papers were removed from the meta-analysis and included only in a narrative synthesis.

Risk of Bias

All studies were subject to a structured quality assessment to investigate risk of bias using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies [24]. This considered (1) selection bias, (2) study design, (3) confounders, (4) blinding, (5) data collection methods, and (6) withdrawals and dropouts. This is a standardized assessment tool that provides detailed guidance to aid classification of studies in terms of design quality. Additional areas of intervention integrity and appropriateness of the analysis are suggested as extra quality indicators but are not included in the total score on the measure. This information was collected and reported separately.

Outcomes

The primary outcome of interest was severity of PTSD, measured continuously using a validated self-report or clinician-rated measures. This was qualified by the mean score value (M) and standard deviation (SD) on these measures.

Characterization of the Interventions

Comparison Conditions

RCTs were subdivided and considered separately if they compared an active treatment condition to another active treatment condition or to a waitlist or treatment as usual (TAU) condition.

Model of Therapy

Studies were also considered separately depending on the therapeutic approach taken as part of active treatment condition. They were grouped as follows:

1. TF-CBT: treatment interventions that specifically involved exposure to aspects of the trauma and support to reappraise the physical and cognitive reactions that occurred at the time of the event.
2. Non-TF-CBT: treatment interventions based on the principles of CBT that employed more general stress management techniques to help reduce anxiety (eg, relaxation).
3. Other e-Mental Health interventions for treatment of PTSD: this category was included to capture treatment interventions that were not strictly designed based on CBT-based principles.

Guidance

Studies were further characterized by the level of guidance provided during this intervention and grouped as follows:

1. Individual tailored therapeutic feedback: feedback provided by a trained facilitator that related directly to the content of the therapeutic intervention.
2. Individual technical nontherapeutic support: support to facilitate technical functioning of the website or device that did not relate directly to the content of the therapeutic intervention.
3. Online discussion forum: a message board where participants could post messages and receive tailored feedback from a trained facilitator or peers.
4. Automated feedback only: feedback that was not individually tailored and was generated automatically in response to the completion of a task, for example.
5. Group feedback via videoconferencing: immediate feedback via videoconferencing provided by a trained facilitator or peers.
6. No guidance: no additional feedback or support in any form reported.

Data Analysis

To assess the impact of intervention on total PTSD scores, standardized mean differences (SMDs) were calculated using postintervention mean and standard deviation values, with 95% confidence intervals (CI), as the primary outcome measures. Missing standard deviation values were calculated from the confidence intervals, standard errors, and sample sizes reported in the papers where possible and where this was not possible, additional information was requested from authors. In some cases, papers reported the median and interquartile ranges instead of the mean and standard deviation values and so this extra information was sought from authors. These data were pooled in a random-effects meta-analysis using Review Manager 5.0. The I^2 statistic was calculated and used to assess heterogeneity of the studies included in each of the analyses. The following thresholds were followed: 0%-40% for unimportant heterogeneity, 30%-60% for moderate heterogeneity, 50%-90% for substantial heterogeneity, and 75%-100% for considerable heterogeneity [25].

Planned sensitivity analyses were conducted to test the robustness of the results. These included the exclusion of studies with a high risk of bias (defined as studies categorized as weak on the EPHPP tool) and where PTSD was not the primary outcome. Further planned subgroup analyses included the comparison condition (active comparison interventions vs waitlist or TAU control conditions), the model of therapy followed in the treatment condition (TF-CBT vs non-TF-CBT vs other models of therapy), and the type of guidance received during the treatment intervention (categorized as described in the section on guidance).

Results

Search Results

The search strategy conducted in March 2015 returned 2984 papers after duplicates were removed; 7 extra sources of information were obtained through hand searching or personal communication. A consensus was reached between two authors (SS and JB) that 30 RCTs met the inclusion criteria for the review. A further 9 papers were found following a repeat of this procedure in November 2016. Figure 1 shows a flowchart demonstrating this process for study selection of the final 39 papers included in the systematic review.

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Figure 1. Flowchart of papers obtained and screened in the systematic search.
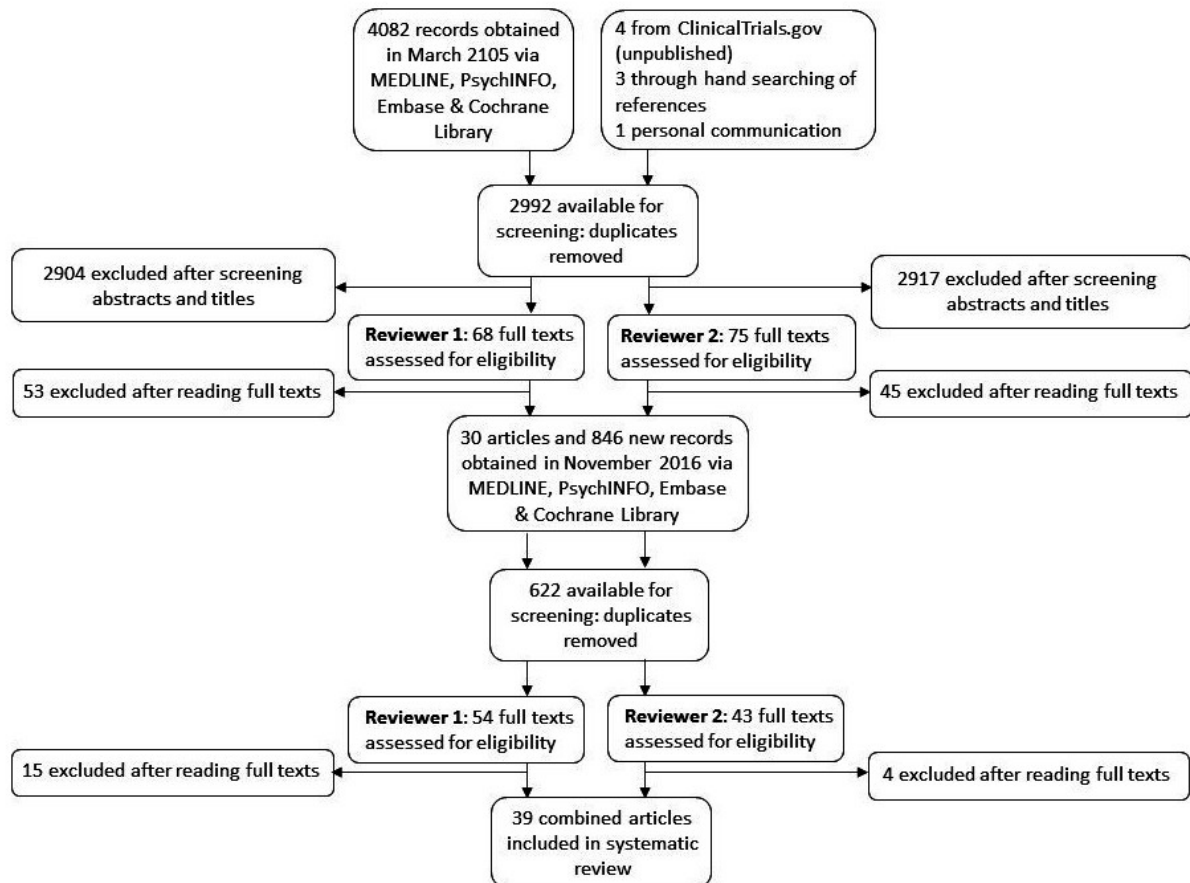
Description of the Studies

A description of key information characterizing the studies included in this review is provided in Multimedia Appendix 1 (separated into studies that compared to an active treatment condition) and Table 2 (studies that compared to a waitlist control).

Sample Sizes

The number of participants included in the RCTs ranged from 25 [45] to 1292 [56]. We found 14 other studies that included sample sizes ≥100: Beyer [27], N=163; Brief [29], N=600; Carpenter et al [30], N=132; Cieslak et al [32], N=168; Hirai et al [37], N=133; Hobfoll et al [38], N=303; Kersting et al [41], N=228; Knaevelsrud et al [43], N=159; Lange et al [46], N=101; Marsac et al [49], N=100; Mouthaan et al [51], N=300; Schoorl et al [57], N=102; Spence [59], N=125; and Wang et al [62], N=183.

Study Country

The countries where the research studies were carried out included the US (n=19), the Netherlands (n=5), Australia (n=4), Sweden (n=3), Germany (n=3), Switzerland (n=2), Canada (n=1), Poland (n=1), and China (n=1).

Sample Characteristics

Seven studies included a sample who met full *Diagnostic and Statistical Manual of Mental Disorders*-IV (DSM-IV) diagnostic

criteria for PTSD [28,39,42,43,57,58,62]. The majority of remaining papers reported on either university students [27,36,37,45], military service members and veterans [35,38,44,47,54], health and human service professionals [32], patients [26,30,51,53,55,63,64] or parents of patients [31,33,49] in medical settings, or other members of the wider community [40,41,46,48,50,52,61] self-reporting experience of a potentially traumatic event, receiving treatment from trauma-related services and or scoring high on a measure of PTSD, complicated grief, depression, or psychological distress. Two further studies included veterans self-reporting problems readjusting back into civilian life [56] or alcohol misuse [29]. Multimedia Appendix 1 provides further details of participant characteristics for each study.

Trauma Characteristics

Some studies focused on specific potentially traumatic events including bereavement [34,48,61] or loss of a child during pregnancy [40,41], physical injury or diagnosis of a chronic health condition such as cancer to oneself or a close other [26,30,31,33,49,51,53,63,64], organ transplant [55], complicated childbirth [52], as well as exposure to combat [29,35,38,44,47,54,56], sexual trauma [28], or natural disasters [60]. However, others did not specify the type of trauma experienced and included people with a multitude of difference experiences that could be potentially traumatic [36,37,39,42,43, 45,46,50,57-59,62]. Multimedia Appendix 1 provides further details of trauma characteristics, including time posttrauma.

Table 2. Quality assessment of RCTs of e-Mental Health interventions for treatment of symptoms of PTSD[a].

Study author (year) [ref]	Selection bias	Study design	Confounders	Blinding	Data collection methods	Withdrawals and dropouts	Global rating for design methods (A-F)
Beatty (2016) [26]	•	•••	•••	••	•••	•••	••
Beyer (unpublished) [27]	••	•••	•••	••	•••	•••	•••
Bomyea (2015) [28]	••	•••	•••	•••	•••	••	•••
Brief (2013) [29]	•	•••	•••	••	•••	•	•
Carpenter (2014) [30]	•	•••	•••	•	•••	•••	•
Cernvall (2015) [31]	••	•••	•••	•	•••	••	•
Cieslak (2016) [32]	•	•••	•••	••	•••	•	•
Cox (2010) [33]	••	•••	•••	•	•••	••	••
Eisma (2015) [34]	•	•••	•••	••	•••	••	••
Engel (2015) [35]	•	•••	•••	••	•••	•••	••
Hirai (2005) [36]	••	•••	•••	••	•••	•••	•••
Hirai (2012) [37]	••	•••	•••	••	•••	••	•••
Hobfoll (2015) [38]	•	•••	•••	••	•••	•••	••
Ivarsson (2014) [39]	•	•••	•••	••	•••	•••	••
Kersting (2011) [40]	•	•••	•••	••	•••	••	••
Kersting (2013) [41]	••	•••	•	••	•••	•••	••
Knaevelsrud (2007) [42]	•	•••	•••	•	•••	•••	•
Knaevelsrud (2015) [43]	•	•••	•••	••	•••	•	•
Krupnick (unpublished) [44]	••	•••	•	••	•••	•	•
Lange (2001) [45]	••	•••	•	••	•••	•••	••
Lange (2003) [46]	•	•••	••	••	•••	•	•
Litz (2007) [47]	•	•••	•••	••	•••	••	••
Litz (2014) [48]	••	•••	•••	••	•••	•••	•••
Marsac (2013) [49]	••	•••	••	••	••	••	••
Miner (2016) [50]	•	•••	•••	••	•••	•••	••
Mouthaan (2013) [51]	•	•••	•••	••	•••	•	•
Nieminen (2016) [52]	•	•••	•••	••	•••	•••	••
Owen (2005) [53]	••	•••	•••	•	•••	•••	••
Possemato (2010) [54]	•	•••	•••	••	•••	•••	••
Possemato (2011) [55]	••	•••	•••	••	•••	•••	•••
Sayer (2015) [56]	•	•••	•••	••	•••	•••	••
Schoorl (2013) [57]	••	•••	•••	•••	•••	••	•••
Spence (2011) [58]	•	•••	•••	•	•••	•••	•
Spence (2014) [59]	••	•••	•••	•	•••	•••	••
Steinmetz (2012) [60]	••	•••	••	•	•••	•••	••
Wagner (2006) [61]	•	•••	•••	••	•••	•••	••
Wang (2013) [62]	•	•••	•••	••	••	••	••
Winzelberg (2003) [63]	•	•••	•••	••	•••	•••	••
Zernicke (2014) [64]	•	•••	•••	••	•••	•••	••

[a]•Weak; ••Moderate; •••Strong.

Intervention Characteristics

Comparison Condition

Of the 39 RCTs included, 21 compared the e-Mental Health intervention with a waitlist control condition [29-31,33, 36,38,40-43,45,46,48,50,52,53,58,61-64]. See Multimedia Appendix 1 for further details on these studies.

The remaining studies compared to another active intervention, either instead of or as an additional arm to a waitlist control condition. Alternative active interventions included Web-based time management [27,54], Web-based factual writing [37,55,56], Web-based psychoeducation with [47] or without [26,32,60] supportive counseling, Web-based behavioral activation [34], Web-based weekly support, not specific to the traumatic event [39], an alternative computerized working memory capacity task [28], Web-based attention training [28,57], and treatment as usual within a clinical service [35,44,49,51,60].

One final study directly compared a version of a Web-based CBT intervention with and without exposure to the traumatic event [59]. Further details for all studies with an active comparison condition can be found in Multimedia Appendix 1.

Model of Therapy

The e-Mental Health interventions included in the meta-analysis incorporated a variety of therapeutic models. The interventions were grouped by similarities in theoretical methodologies as also described in Table 2 and Multimedia Appendix 1.

Trauma-Focused Cognitive Behavioral Therapy

We categorized 14 studies as TF-CBT [32,34,39-46, 52,58,59,61]. All of these interventions included exposure—be it indirect via imagery, written descriptions, or facilitated in vivo exercises—to the traumatic event and support to reappraise reactions. They also included additional CBT techniques such as psychoeducation about PTSD, self-monitoring of symptoms, behavioral activation, problem solving, goal setting, coping skills training (eg, relaxation), and cognitive restructuring. Half of these studies trialed the same Web-based intervention program: "Interapy" [40-43,45,46,61]. This Web-based intervention comprised three treatment phases: (1) self-confrontation where participants were required to write about the trauma focusing on the sensory perceptions in the present tense and in the first person, (2) cognitive reappraisal where participants were instructed to write a supportive and encouraging letter to a hypothetical friend who has been through a similar trauma with guidance on challenging unhelpful thinking and behavioral patterns, and (3) social sharing where, again, participants were asked to write a letter to another person but this time focusing on outlining difficult memories and reflecting on how they will cope with difficulties in the future.

Non Trauma-Focused Cognitive Behavioral Therapy

We grouped 16 studies as non-TF-CBT approaches that included CBT techniques, as detailed above, but did not include an element of exposure to the traumatic event and support to reappraise reactions [26,29-31,33,35,36,38,47-51,53,60,62]. Some incorporated other psychotherapeutic approaches, for example, motivational interviewing [29] or parenting guidance [33,49], in addition to CBT techniques. Others included

additional elements of expressive writing, sometimes about a stressful event or trauma, but did not state that they supported participants to cognitively reappraise their reactions or provide any further therapeutic instruction focused on the trauma [30,31,36,47,51].

Other e-Mental Health Interventions

Nine studies trialed other types of e-Mental Health interventions including attentional bias modification [57], a working memory capacity task [28], expressive writing based on models of emotional disclosure without any additional CBT techniques [27,37,54-56], semistructured peer support only [63], and Mindfulness-Based Stress Reduction [64].

Guidance

In addition to this, interventions were further categorized into those that offered additional guidance. Some studies employed a combination of strategies to support completion. One study directly compared a Web-based intervention condition with and without guidance [27]. This study also compared two methods of providing guidance: delayed and immediate individual tailored feedback. The remaining studies were grouped as described in Table 2.

Individual Tailored Feedback

In addition to the study carried out by Beyer [27], a further 17 studies provided participants completing e-Mental Health interventions with individual tailored feedback [29,31,34,39-48, 52,58,59,61]. Seven of these studies stated that feedback was provided by either a licensed clinician (clinical psychologist, psychotherapist, psychiatrist) or clinician in training as a clinical psychologist or occupational therapist [31,34,39,42,43,58,61]. A further five studies reported that feedback was provided from graduates of clinical psychology courses who, in some cases, received additional training and clinical supervision but whose practicing status was not specified [45,46,48,59] or a nonclinical person such as a doctoral student who also received additional training and supervision from a licensed clinical psychologist [27]. The six remaining studies did not provide any details about the clinical experience of the person providing feedback [29,40,41,44,47,52]. Most of the individual tailored feedback was provided at a delay after the participants had completed a Web- or mobile-based module. However, one study in addition to the Beyer [27] study provided immediate individual tailored feedback through an instant messenger service [58] and another provided an initial session via telephone with a therapist at the start of the intervention [48].

Individual Technical Support

Two studies included intervention conditions where participants received individualized technical support but no tailored therapeutic guidance was offered [32,62].

Online Discussion Forum

Six studies included an online discussion forum where participants could interact with a licensed clinical psychologist or other mental health professional [58,63] or trained peer coach [38] or access self-guided peer support [30,51,53]. One of these studies provided additional automated guidance in the form of

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video-based vignettes of clinicians and cancer survivors [30], and another provided contact details for technical support [51].

Automated Feedback Only

One study provided only automated feedback on participants' performance on a test of mastery [36].

Group Feedback Via Video-Conferencing

One study provided immediate feedback from both a behavioral medicine specialist and a group of peers completing the intervention live via video-conferencing technology [64].

No Guidance

A total of 12 studies reported on e-Mental Health interventions where participants were given no additional guidance [26,28,33,35,37,49,50,54-57,60].

Measurement Tools

Tables 3 and 4 detail the outcomes of the studies included in this review for each of the standardized measures of PTSD employed.

The most commonly employed outcome measure of PTSD-related symptoms was the Impact of Events Scale (including the original IES, revised IES-R, and Dutch IES-D versions), which was administered in 16 studies [27,30,33,36,37,39-42,45,46,51-53,59,61]. The second most common measure was the PTSD Checklist (including the brief PCL-5, military PCL-M, and civilian PCL-C versions), which was administered in 13 studies [29,31,35,38,44,48-50, 54-56,58,63]. Other measures included the Posttraumatic Diagnostic Scale [39,43,62]; the Posttraumatic Stress Scale-Self Report version [26,34,47,59,63]; the Clinician Administered PTSD Scale [28,57]; the Secondary Traumatic Stress Scale [32]; the Self-Rating Inventory for Posttraumatic Stress Disorder [57]; the Modified PTSD Symptom Scale [60]; the Traumatic Event Scale [52]; and the Calgary Symptoms of Stress Inventory [64]. Four of the studies administered two measures of PTSD symptoms [36,39,52,57,59,63], while the remaining majority of studies administered only one.

Studies Included in the Meta-Analysis

Six papers did not include sufficient information to be included in the meta-analysis (including a total score on the measure of PTSD), and their authors did not respond to our request for further information. Therefore, 33 papers were included in the final meta-analysis. Where studies included multiple condition groups (≥3), these were included in the analyses as separate comparisons. The sample size was adjusted in these analyses to account for multiple comparisons (eg, the total sample size was halved if a comparison of the same active intervention was made to two independent control condition groups). In total, 5405 participants were included in the studies. Data from 3832 participants contributed to the meta-analyses.

Risk of Bias

Results of the quality assessment for risk of bias performed on the studies included in this systematic review can be found in

Table 2. Seven of the studies (17.9%) demonstrated the highest possible overall rating for quality of the design [27,28,36,37,48,54,57]. Marks were most frequently lost for methods of sampling bias, with a large proportion of studies recruiting via a relatively unsystematic and opportunistic method [26,29,30,32,34,35,38-40,42,43,46,47,50-52, 55,56,58,61-64]. Strict criteria for blinding of participants and assessors were met in only two studies [27,57]. For clarification, when reviewing the quality of blinding across the RCTs, it was not always possible to identify with certainty that participants or outcome assessors were blind to the conditions of the study if it was not explicitly stated by the authors. Therefore, it was agreed that cases of ambiguity were given the benefit of the doubt and rated for blinding as moderate rather than weak according to the quality of evidence tool. However, this means that studies that did clearly state that conditions were not blinded may have been awarded a lower rating than those that omitted this information. Retention of participants in the studies was relatively good, with 23 of the studies (59.0%) retaining over 80% of participants throughout the intervention and through to postcompletion assessment [26,27,30,35,36,38,39,41,42,45,48, 50,52-56,58-61,63,64]. Only six studies (15.4%) failed to control for at least 90% of potential confounders in the analysis [41,44-46,49,60] [49,62] employed only standardized measured to assess outcomes, highlighting a further relative strength in the design of studies conducted within this area.

Treatment Effects

Impact of the Interventions on Posttraumatic Stress Disorder

A meta-analysis on the between-group difference for end-point scores on measures of PTSD demonstrated a significant effect in favor of the treatment group (SMD -0.35, 95% CI -0.45 to -0.25, $P<.001$). However, there was considerable heterogeneity between the study comparisons made (I^2=81%).

Of the six studies that were not included in the meta-analysis, four studies found a significant difference on all subscales representing dimensional symptoms of PTSD, including intrusions, avoidance, and hyperarousal, in favor of the treatment intervention [42,45,46,61]. Sayer et al [56] found a significant between-group difference on total PTSD scores favoring an active intervention of expressive writing compared to a no writing control condition. Another study reported no significant between-group difference on a clinician-rated measure of PTSD [54].

Sensitivity Analyses

The planned sensitivity analyses (Table 3) demonstrated that the outcomes for PTSD were relatively stable. The exclusion of studies with a high risk of bias increased the effect size slightly in comparison to the primary analysis, whereas the excluded studies without PTSD as a primary outcome slightly increased the effect size compared to the primary analysis. For all analyses, the heterogeneity of the studies remained considerably high.

Table 3. Impact of Web-based interventions on PTSD: sensitivity analyses.

Analysis	Comparisons, n	Participants, n	SMD[a] (95% CI)	P	I² statistic, %
Primary analysis	38	3832	-0.35 (-0.45 to -0.25)	<.001	81
Excluding studies with high risk of bias	30	2340	-0.36 (-0.50 to -0.21)	<.001	81
Excluding studies without PTSD as a primary outcome	35	3551	-0.34 (-0.44 to -0.24)	<.001	80

[a]SMD >0 favors control, and SMD <0 favors active intervention.

Subgroup Analyses

The first planned subgroup analysis involved separating studies into those that compared an active intervention to another active comparison condition and those that compared to either a waitlist control or treatment as usual. Figure 2 shows the impact of e-Mental Health interventions on end-point outcomes for PTSD, split by comparison group. A significant effect in favor of the treatment group remained for both subgroups of studies that compared to another active intervention condition (SMD -0.27, 95% CI -0.43 to -0.11, P<.001, I²=52%) and either a waitlist or TAU control condition (SMD -0.41, 95% CI -0.69 to -0.14, P<.001, I²=89%), with effect sizes slightly greater for the latter subgroup. However, the heterogeneity of the studies was improved for studies compared to another active intervention condition. Table 4 compares this subgroup analysis to other planned subgroup analyses including the model of therapy and the type of guidance received.

Table 4. Impact of Web-based interventions on PTSD: subgroup analyses.

Analysis	Subgroups	Comparisons, n	Participants, n	SMD[a] (95% CI)	P	I² statistic, %
Primary analysis		38	3832	-0.35 (-0.45 to -0.25)	<.001	81
Comparison group						
	Active	18	1533	-0.27 (-0.43 to -0.11)	<.001	52
	Waitlist or TAU	20	2352	-0.41 (-0.69 to -0.14)	<.001	89
Model of therapy						
	TF-CBT	11	997	-0.34 (-0.48 to -0.21)	<.001	92
	Interapy	3	465	-10.24 (-12.32 to -8.15)	<.001	0
	Other	8	532	-0.30 (-0.44 to -0.16)	<.001	77
	Non-TF-CBT	18	2227	-0.36 (-0.50 to -0.22)	<.001	62
	Expressive writing	5	346	-0.04 (-0.88 to 0.79)	.92	0
	Attention bias modification	1	102	—	—	—
	Working memory capacity task	1	42	—	—	—
	Semistructured peer support	1	72	—	—	—
	Mindfulness-based stress reduction	1	62	—	—	—
Guidance						
	Individual tailored feedback	16	1743	-0.52 (-0.76 to -0.28)	<.001	90
	Individual technical support	2	261	-0.27 (-0.40 to -0.14)	<.001	0
	Online discussion forum	6	913	-0.26 (-0.53 to 0.01)	.06	72
	Automated feedback only	1	27	—	—	—
	Live group feedback	1	62	—	—	—
	No guidance	13	927	-0.50 (-0.76 to -0.24)	<.001	13

[a]SMD > 0 favors control, and SMD < 0 favors active intervention.

The additional subgroup analyses showed that studies grouped together as following TF-CBT protocols were not only significantly effective compared to controls but were as effective as studies grouped together as following non-TF-CBT protocols. The heterogeneity of TF-CBT was high, falling within the substantial range. A subgroup analysis grouping together only those studies that trialed the intervention package, Interapy, demonstrated an unimportant le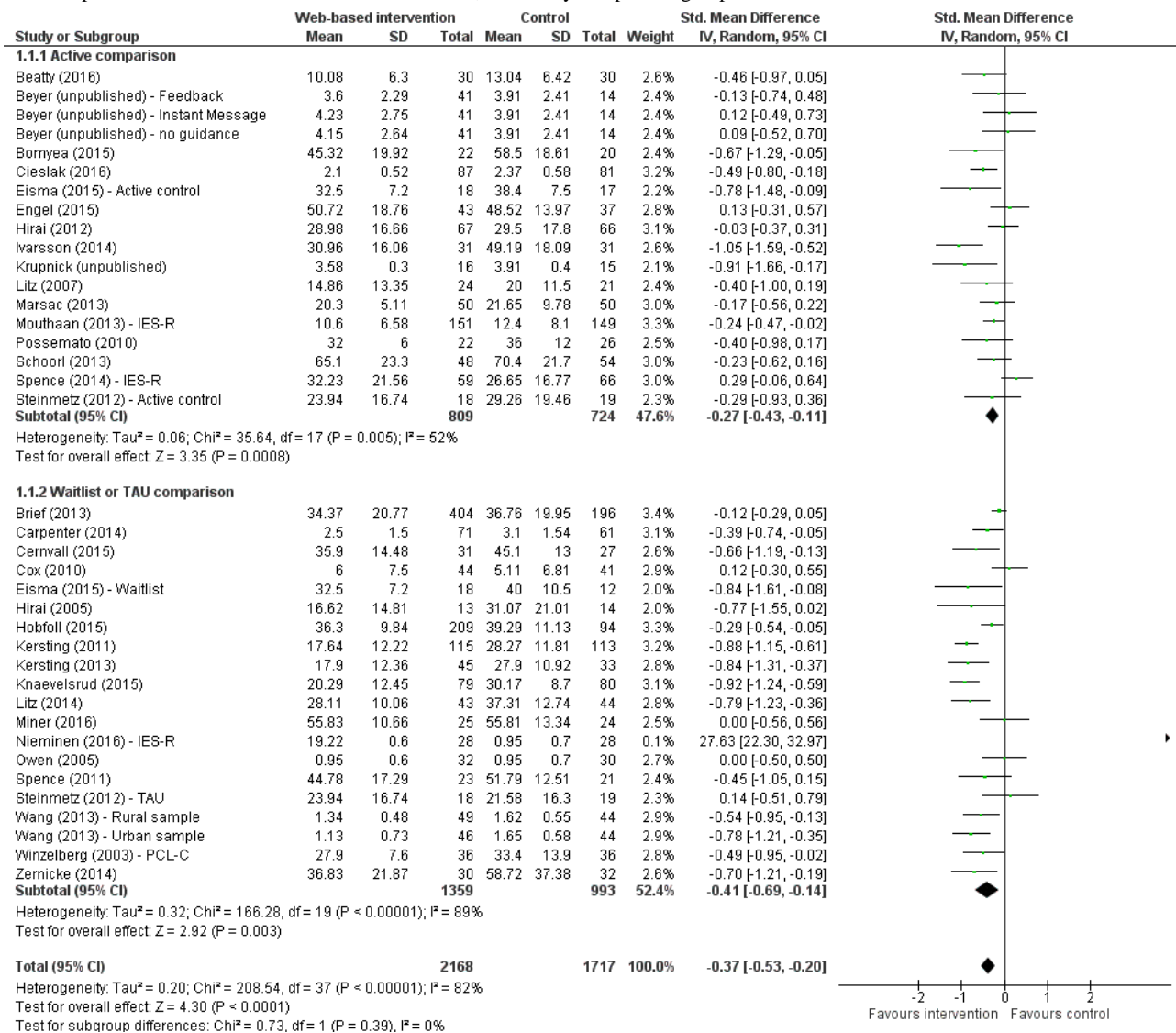vel of heterogeneity, while retaining a significant between-group difference. The large variation in heterogeneity can be accounted for the other studies grouped together as TF-CBT interventions. Web-based expressive writing interventions did not significantly differ from their control conditions but demonstrated an unimportant level of heterogeneity suggesting that these interventions were more

comparable. In terms of the single studies that could not be included in the meta-analysis, the attention bias modification training was reported to be equally effective at reducing symptoms of PTSD and an active control condition [57]. The working memory capacity training was found to be significantly effective at reducing the re-experiencing of symptoms over and above an active control condition, but no significant interaction effects were found on other dimensions of PTSD symptoms including avoidance and arousal [28]. The Web-based mindfulness-based stress reduction intervention resulted in significant improvements in PTSD symptoms relative to a waitlist control condition [64].

For the subgroup analysis of guidance, groups of studies demonstrated a significant between-group difference regardless of whether guidance was provided in the form of individual tailored feedback during the therapeutic intervention, as individual technical support only or if no guidance was provided at all. The heterogeneity of studies included in the subgroup

analysis was the lowest for no guidance group. Both the individual tailored feedback group and the individual technical support group demonstrated at least a substantial degree of heterogeneity. The only subgroup that did not show a significant between-group difference included the studies that had only an online discussion forum. A meta-analysis could not be carried out on the two remaining groups: automated feedback only and live group feedback, given that only a single study included this method in each case. However, in terms of the results described in these papers, Hirai and Clum [36] found that participants who received an 8-week Web-based program for traumatic event-related consequences with only automated feedback reported a significant decrease in avoidance behavior and frequency of intrusive symptoms as compared to participants on a waiting list. As previously reported Zernicke [64], who used live group feedback via videoconferencing technology, demonstrated significant improvements in PTSD symptoms relative to a waitlist control condition.

Figure 2. Impact of e-Mental Health interventions on PTSD, divided by comparison group.

Study or Subgroup	Web-based intervention Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI
1.1.1 Active comparison								
Beatty (2016)	10.08	6.3	30	13.04	6.42	30	2.6%	-0.46 [-0.97, 0.05]
Beyer (unpublished) - Feedback	3.6	2.29	41	3.91	2.41	14	2.4%	-0.13 [-0.74, 0.48]
Beyer (unpublished) - Instant Message	4.23	2.75	41	3.91	2.41	14	2.4%	0.12 [-0.49, 0.73]
Beyer (unpublished) - no guidance	4.15	2.64	41	3.91	2.41	14	2.4%	0.09 [-0.52, 0.70]
Bomyea (2015)	45.32	19.92	22	58.5	18.61	20	2.4%	-0.67 [-1.29, -0.05]
Cieslak (2016)	2.1	0.52	87	2.37	0.58	81	3.2%	-0.49 [-0.80, -0.18]
Eisma (2015) - Active control	32.5	7.2	18	38.4	7.5	17	2.2%	-0.78 [-1.48, -0.09]
Engel (2015)	50.72	18.76	43	48.52	13.97	37	2.8%	0.13 [-0.31, 0.57]
Hirai (2012)	28.98	16.66	67	29.5	17.8	66	3.1%	-0.03 [-0.37, 0.31]
Ivarsson (2014)	30.96	16.06	31	49.19	18.09	31	2.6%	-1.05 [-1.59, -0.52]
Krupnick (unpublished)	3.58	0.3	16	3.91	0.4	15	2.1%	-0.91 [-1.66, -0.17]
Litz (2007)	14.86	13.35	24	20	11.5	21	2.4%	-0.40 [-1.00, 0.19]
Marsac (2013)	20.3	5.11	50	21.65	9.78	50	3.0%	-0.17 [-0.56, 0.22]
Mouthaan (2013) - IES-R	10.6	6.58	151	12.4	8.1	149	3.3%	-0.24 [-0.47, -0.02]
Possemato (2010)	32	6	22	36	12	26	2.5%	-0.40 [-0.98, 0.17]
Schoorl (2013)	65.1	23.3	48	70.4	21.7	54	3.0%	-0.23 [-0.62, 0.16]
Spence (2014) - IES-R	32.23	21.56	59	26.65	16.77	66	3.0%	0.29 [-0.06, 0.64]
Steinmetz (2012) - Active control	23.94	16.74	18	29.26	19.46	19	2.3%	-0.29 [-0.93, 0.36]
Subtotal (95% CI)			**809**			**724**	**47.6%**	**-0.27 [-0.43, -0.11]**
Heterogeneity: Tau² = 0.06; Chi² = 35.64, df = 17 (P = 0.005); I² = 52%								
Test for overall effect: Z = 3.35 (P = 0.0008)								
1.1.2 Waitlist or TAU comparison								
Brief (2013)	34.37	20.77	404	36.76	19.95	196	3.4%	-0.12 [-0.29, 0.05]
Carpenter (2014)	2.5	1.5	71	3.1	1.54	61	3.1%	-0.39 [-0.74, -0.05]
Cernvall (2015)	35.9	14.48	31	45.1	13	27	2.6%	-0.66 [-1.19, -0.13]
Cox (2010)	6	7.5	44	5.11	6.81	41	2.9%	0.12 [-0.30, 0.55]
Eisma (2015) - Waitlist	32.5	7.2	18	40	10.5	12	2.0%	-0.84 [-1.61, -0.08]
Hirai (2005)	16.62	14.81	13	31.07	21.01	14	2.0%	-0.77 [-1.55, 0.02]
Hobfoll (2015)	36.3	9.84	209	39.29	11.13	94	3.3%	-0.29 [-0.54, -0.05]
Kersting (2011)	17.64	12.22	115	28.27	11.81	113	3.2%	-0.88 [-1.15, -0.61]
Kersting (2013)	17.9	12.36	45	27.9	10.92	33	2.8%	-0.84 [-1.31, -0.37]
Knaevelsrud (2015)	20.29	12.45	79	30.17	8.7	80	3.1%	-0.92 [-1.24, -0.59]
Litz (2014)	28.11	10.06	43	37.31	12.74	44	2.8%	-0.79 [-1.23, -0.36]
Miner (2016)	55.83	10.66	25	55.81	13.34	24	2.5%	0.00 [-0.56, 0.56]
Nieminen (2016) - IES-R	19.22	0.6	28	0.95	0.7	28	0.1%	27.63 [22.30, 32.97]
Owen (2005)	0.95	0.6	32	0.95	0.7	30	2.7%	0.00 [-0.50, 0.50]
Spence (2011)	44.78	17.29	23	51.79	12.51	21	2.4%	-0.45 [-1.05, 0.15]
Steinmetz (2012) - TAU	23.94	16.74	18	21.58	16.3	19	2.3%	0.14 [-0.51, 0.79]
Wang (2013) - Rural sample	1.34	0.48	49	1.62	0.55	44	2.9%	-0.54 [-0.95, -0.13]
Wang (2013) - Urban sample	1.13	0.73	46	1.65	0.58	44	2.9%	-0.78 [-1.21, -0.35]
Winzelberg (2003) - PCL-C	27.9	7.6	36	33.4	13.9	36	2.8%	-0.49 [-0.95, -0.02]
Zernicke (2014)	36.83	21.87	30	58.72	37.38	32	2.6%	-0.70 [-1.21, -0.19]
Subtotal (95% CI)			**1359**			**993**	**52.4%**	**-0.41 [-0.69, -0.14]**
Heterogeneity: Tau² = 0.32; Chi² = 166.28, df = 19 (P < 0.00001); I² = 89%								
Test for overall effect: Z = 2.92 (P = 0.003)								
Total (95% CI)			**2168**			**1717**	**100.0%**	**-0.37 [-0.53, -0.20]**
Heterogeneity: Tau² = 0.20; Chi² = 208.54, df = 37 (P < 0.00001); I² = 82%								
Test for overall effect: Z = 4.30 (P < 0.0001)								
Test for subgroup differences: Chi² = 0.73, df = 1 (P = 0.39), I² = 0%								

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Discussion

Principal Findings

This systematic review and meta-analysis summarizes the results of RCTs designed to assess the impact of e-Mental Health interventions on symptoms of PTSD. There is some evidence to suggest that these e-Mental Health treatments are effective at reducing PTSD-related distress over and above a variety of control conditions. Results from the primary meta-analysis of endpoint data showed a medium and significant between-group difference in PTSD symptoms, in favor of the active intervention conditions. However, there was considerable heterogeneity between the studies included in this review, raising some concerns about how meaningful it is to make direct comparisons between the studies included in this meta-analysis. The results remained similar when removing studies that were found to present a high risk of bias, suggesting that factors other than those contributing the quality assessment scores may have accounted for the high level of heterogeneity between studies.

When dividing studies by the characteristics of the condition to which they were compared, the results became slightly clearer. A medium and significant between-group difference was found for studies compared to either a waitlist control or TAU condition, favoring the active intervention. While still favoring the active intervention, only a small significant between-group difference was found for studies compared to another active condition. Studies compared to an active intervention were much less heterogeneous, providing some further confidence to support the reliability of these estimated effects. This evidence suggests that not only is there some good evidence emerging to support the efficacy of e-Mental Health treatments for PTSD but that these interventions contain an active component that is stronger than other Web- or mobile-based activities including psychoeducation, behavioral activation, weekly non-specific support, and factual writing about a traumatic event.

In a further subgroup meta-analysis, we explored the impact of different models of therapy. A medium and significant between-group difference favoring the active intervention was found for both studies categorized as employing TF-CBT techniques and non-TF-CBT techniques. The main difference between these interventions was that the former required participants to take part in exercises that encouraged them to re-engage with the trauma and work on reappraising the cognitive and physical consequences of the event, while the latter included CBT techniques with a more general focus on anxiety and stress management. From this analysis, there appears to be little difference between the two groups, with both being as effective as the other at reducing symptoms of PTSD. However, it is still important to note that these two subgroups of studies still demonstrated a high degree of heterogeneity, suggesting some qualitative differences between studies included in the analysis. CBT is a broad term, encompassing a wide range of therapeutic techniques. In addition to this, some studies reported incorporating techniques from alternative models of therapy, such as motivational interviewing, alongside CBT techniques. It is possible that some of the heterogeneity between

studies could be accounted for by differences in the therapeutic techniques employed. When comparing studies that used the same Web-based treatment program (Interapy), the results were much less heterogeneous and remained significant and in favor of the active intervention condition. However, the between-group difference reduced to a small effect. This result was limited by the exclusion of four additional studies that trialed the efficacy of the Interapy program, as total PTSD scores could not be gathered from all the authors.

In relation to the alternative models of therapy trialed in previous RCTs for treatment of PTSD, as yet, there is little evidence to support the use of Web-based attentional bias modification paradigms, and only some emerging evidence to support a working memory capacity paradigm and mindfulness-based stress reduction techniques from single studies alone. A meta-analysis of expressive writing, without any additional CBT techniques, showed a nonsignificant difference between active intervention and control groups. There is scope to explore some of these alternative therapy models in greater depth. Face-to-face mindfulness-based approaches have been gathering evidence for treatment of recurrent and chronic depression, anxiety, and stress [65]. However, there currently is a far greater body of evidence in favor of CBT-based techniques presented through e-Mental Health sources for treatment of PTSD.

For the final subgroup analysis, we explored the impact of the type of guidance or support that participants received while completing e-Mental Health interventions. Medium-sized, significant group-differences, favoring the active interventions were found regardless of whether participants received individual tailored feedback or no guidance. Studies that provided participants with merely technical support demonstrated a small significant between-group difference in favor of the active intervention. This suggests that while previous studies have indicated that guidance improves outcomes for e-Mental Health interventions [12], this was not the finding of a meta-analysis of studies trialing e-Mental Health interventions for treatment of PTSD. It is important to mention that the type of individual tailored feedback varied greatly between the studies, specifically in terms of the qualifications and experience of the person providing feedback, which sometimes was reported to vary even within single studies. The impact of this was not explicitly tested in the analysis conducted here and could be an avenue for future research.

The only subgroup that did not demonstrate a significant between-group difference consisted of studies that had facilitated support with the e-Mental Health intervention via an online discussion forum. This was the only group-based means of providing feedback included in the meta-analysis. Emotions such as shame, guilt, and fear of negative evaluation from others are commonly associated with PTSD [66-68] and can present barriers for open communication about the impact of trauma. Arguably, the added anonymity of Web-based or mobile resources may provide some advantage over therapist-delivered treatments. However, research is needed to test the empirical validity of this hypothesis, especially when using online discussion forums between groups of people. Interestingly, the study employing mindfulness-based stress reduction techniques via an online forum, which reported a significant between-group

difference in favor of the active intervention, included live group interaction via video-conferencing technology. Further research would be required to establish whether this positive effect on reducing symptoms of PTSD was facilitated by the model of therapy or type of guidance employed.

Strengths and Limitations

This review considered RCTs of e-Mental Health resources for treatment of PTSD-related symptoms, including TF-CBT, non-TF-CBT, and other psychological therapies. It encompassed research on trauma spanning different countries, including people with different experiences in terms of the characteristics of the trauma and severity of PTSD-related symptoms. Many of the studies demonstrated strengths in design, assessment, and analysis of results. The results are consistent with but also extend previous findings; this study reports a significant between-group difference when comparing active interventions to active control conditions as well as more passive waitlist or TAU control conditions [21]. This is also consistent with the previous meta-analysis in that guidance was not found to moderate treatment outcomes. However, there are a number of limitations to this review.

This review did not consider acceptability of the interventions. Quality assessment indicated that studies varied in terms of participant retention, and it may be worthwhile to perform an analysis of dropout rates in an addition to the outcomes already assessed in this review. As people may be given access to e-Mental Health resources in their own homes without direct supervision, it is paramount that the risks and potential adverse effects associated with completing these type of interventions are thoroughly investigated. Finally, there were variations between studies in terms of treatment adherence, that is, the level of engagement necessary to constitute an episode of treatment. Some studies required submission of a set number of essays by participants, whereas others were monitored simply by the frequency of logging in to the intervention. For future research, determining the optimal level of engagement for therapeutic benefit of online treatments needs to be investigated in order to establish model fidelity of interventions and permit consistent clinical application.

This review focused on the use of e-Mental Health resources for treatment of PTSD. Only one study reported an RCT of a mobile-based treatment for PTSD. With the development of new mobile-based treatments, it is likely that future reviews may be able to make comparisons between Web-based and mobile-based technologies. Also missing from the scientific literature at present are studies that compare the relative efficacy of Web- or mobile-based and face-to-face therapist-delivered interventions for treatment of PTSD. In addition, there are limited follow-up data to assess the long-term benefits of interventions trialed. The review highlighted a number of weaknesses in the design of past studies particularly in relation to sample methods, the most notable being the unequal gender balance seen in most studies to date.

Conclusions

Research in this field is developing at a fast pace with creation of new technologies ever increasing. Future studies need to focus on maintaining a high quality of assessment of the efficacy and acceptability of these technologies in the face of these rapid developments. Assessment of side effects and risks should not be overlooked, despite the potential for interventions being more readily accessible. Replications of findings are needed to investigate the use of similar e-Mental Health interventions across diagnostics groups and health settings and could benefit from research to better understand which specific intervention packages or components work best and for whom. Related to this is the issue of gaining a better understanding of more practical factors influencing outcome such as an individual's technological literacy, the ease of use given graphical interface designs, and the mode of delivery (eg, via computers or apps on mobile and tablet devices). There is scope for developing more user-friendly tools. Collaborations between software engineers and designers, who have the ability to build the technology; psychologists, who have the theoretical knowledge of evidence-based therapeutic interventions; and individuals trialing prototypes, who have a unique expertise in their implementation, will be very important for creating user-friendly and effective resources. There is far to go in terms of gathering the same level of evidence base as therapist-delivered approaches. However, the results presented in this systematic review take a small step forward in understanding how technology such as e-Mental Health resources may offer additional opportunities for increasing access to effective psychological support for people suffering from PTSD, to improve well-being.

Conflicts of Interest

None declared.

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Multimedia Appendix 1

Characteristics of studies.

[PDF File (Adobe PDF File), 125KB - mental_v4i2e14_app1.pdf]

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Abbreviations

CBT: cognitive behavioral therapy
cCBT: computerized cognitive behavioral therapy
CI: confidence interval
DSM: Diagnostic and Statistical Manual of Mental Disorders
EMDR: Eye Movement Desentitization Reprocessing Therapy
EPHPP: Effective Public Health Practice Project
IES: Impact of Events Scale
IES-D: Impact of Events Scale-Dutch version
IES-R: Impact of Events Scale-revised
Non-TF-CBT: non trauma-focused cognitive behavioral therapy
PCL-5: PTSD Checklist-5
PCL-C: PTSD Checklist-Civilian Version
PCL-M: PTSD Checklist-Military Version
PTSD: posttraumatic stress disorder
RCT: randomized controlled trial
SMD: standardized mean differences
TAU: treatment as usual
TF-CBT: trauma-focused cognitive behavioral therapy

Original Paper

Internet Addiction Through the Phase of Adolescence: A Questionnaire Study

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Abstract

Background: Adolescents increasingly use the Internet for communication, education, entertainment, and other purposes in varying degrees. Given their vulnerable age, they may be prone to Internet addiction.

Objective: Our aim was to identify possible differences in the purpose of Internet use among adolescents with respect to age subgroup, country of residence, and gender and the distribution of Internet addiction across age subgroups. Another aim was to determine if there is a correlation between the purpose of Internet use and age and if this interaction influences the level of addiction to the Internet.

Methods: The study included a simple random sample of 1078 adolescents—534 boys and 525 girls—aged 11-18 years attending elementary and grammar schools in Croatia, Finland, and Poland. Adolescents were asked to complete an anonymous questionnaire and provide data on age, gender, country of residence, and purpose of Internet use (ie, school/work or entertainment). Collected data were analyzed with the chi-square test for correlations.

Results: Adolescents mostly used the Internet for entertainment (905/1078, 84.00%). More female than male adolescents used it for school/work (105/525, 20.0% vs 64/534, 12.0%, respectively). Internet for the purpose of school/work was mostly used by Polish adolescents (71/296, 24.0%), followed by Croatian (78/486, 16.0%) and Finnish (24/296, 8.0%) adolescents. The level of Internet addiction was the highest among the 15-16-year-old age subgroup and was lowest in the 11-12-year-old age subgroup. There was a weak but positive correlation between Internet addiction and age subgroup (P=.004). Male adolescents mostly contributed to the correlation between the age subgroup and level of addiction to the Internet (P=.001).

Conclusions: Adolescents aged 15-16 years, especially male adolescents, are the most prone to the development of Internet addiction, whereas adolescents aged 11-12 years show the lowest level of Internet addiction.

Introduction

Adolescence can be defined as the period between puberty and adulthood, usually between the ages of 11 and 18 years. Events during this period greatly influence a person's development and can determine their attitudes and behavior in later life [1]. Adolescence can be divided into three substages: early, middle, and late [2]. One of the most important functions of adolescence is to find one's own identity and view of life, without inner conflict and the need to always act within acceptable moral standards, abide by parental authority, or meet peer expectations [3]. Because teenagers are often in conflict with authority and cultural and moral norms of society, certain developmental effects can trigger a series of defense mechanisms [2]. During adolescence, there is an increased risk of emotional crises, often accompanied by mood changes and periods of anxiety and depressive behavior, which adolescents attempt to fight through withdrawal, avoidance of any extensive social contact, aggressive reactions, and addictive behavior [4,5]. Adolescents

are exceptionally vulnerable and receptive during this period and can become drawn to the Internet as a form of release. Over time, this can lead to an addiction. Adolescents are especially attracted to new technological methods of communication, which offer interaction with others and at the same time provide anonymity, impression of belonging to a community, and a sense of social acceptability. The Internet as a global network connects millions of people throughout the world and enables users to exchange information, which remains available at any time and any place [6]. However, as the most popular and sophisticated mass communication medium today, the Internet also poses perils for the children using the Internet without adult control, especially for the adolescents with free access to the content that is inappropriate for their age and stage of development [7]. Unlimited access to information on the Internet can be a source of amusement and generator of new interests [8], but it can also be a source of new and unknown threats. Recently, Internet addiction has attracted great interest from the public and scientists alike [9]. Some authors point out that excessive Internet use leads to social isolation [10]. Other authors emphasize the physical aspects of addiction [11,12], while others underscore psychological signs and symptoms indicative of Internet addiction [11,13,14]. An addiction is often the result of social crisis, lack of self-confidence, a need to conform, boredom, and the availability of an interesting and amusing pastime [15]. Scientists still debate whether Internet addiction should be included in the Diagnostic and Statistical Manual of Mental Disorders (DSM). In the fifth edition of the DSM, Internet addiction is equated with the addiction to Internet games [16]. However, the scientific community has not yet reached a consensus on whether Internet addiction and addiction to Internet games should be viewed together or separately. Some research shows that they should be viewed as separate entities [17,18]. Griffiths strongly argues that there is a fundamental difference between Internet addiction and addiction to the Internet. He claims that most people who are considered to be addicted to the Internet are Internet addicts (ie, they use the Internet as a tool for other addictions) [16,19,20]. A recent study pointed out numerous advantages of Internet use for students, such as wide access to literature, e-learning, online courses, and webinars [21]. However, frequent visits to websites such as online chat rooms, game websites, and similar sites can easily cause addiction and negatively impact student health and standards of learning. Children easily abandon traditional pastimes and replace them with time spent surfing the Internet. This can lead to late bedtime with subsequent sleep loss. In addition, children often consider life without the Internet boring, which can lead to a strong feeling of loneliness [21]. Adolescents need time to solve identity crises, affirm their attitudes, and establish social links and professional aims [22]. A previous study revealed that university students showed varying degrees of Internet addiction, psychological distress, and depression with respect to sex, age, year of study, and residential status [23]. Adolescents are most open to the various addictive temptations that the Internet presents during the period of adjustment. Emotional intelligence as a mediator can influence the degree of Internet addiction and predict such kind of activity [24]. Adolescents tend to be more prone to risky behavior and can indulge in addictive practices in order to cope with anxiety, frustration, and failure or because of the need for excitement, unrealistic optimism in relation to the feeling of invulnerability, or even the need to achieve their goals as a part of their transition into adult age [25]. The overuse of the Internet in this age group may be considered a risky behavior because it may lead to Internet addiction. The objectives of our study were to identify possible differences in the purpose of Internet use among adolescents with respect to age subgroup, country of residence, and gender and to determine the distribution of Internet addiction across different adolescent age subgroups. We tested the hypothesis that there is a correlation between the purpose of Internet use and age and that their interaction influences the level of addiction to the Internet.

Methods

Sample Selection

Study participants were 11- to 18-year-old students who attended regular public schools. They comprised a simple random representative sample of adolescents. Using a table of random samples, we selected the city of Split in Croatia, the town of Pakość in Poland, and the city of Turku in Finland. To select schools, we used the method of random numbers, always respecting the structure of education. In Split, four schools per 100 students were randomly selected, while two schools per 100 students were randomly selected in each of Pakość and Turku (see Table 1). All randomly selected schools had access to the Internet.

Table 1. Elementary and high schools in Croatia, Poland, and Finland randomly selected for the study.

School location	School name and address
Split, Croatia	
	Poljišani Elementary School, Viška 12
	Blatine-Škrape Elementary School, Kržice 2
	Third Gymnasium *S* chool, Matice Hrvatske 11
	First Gymnasium School, Teslina 10
Pakość, Poland	
	Szkoła Podstawową im. Powstańców Wielkopolskich w Pakości, Błonie 2
	Gimnazjum im.Ewarysta Estkowskiego w Pakości, ul.Szkolna 44
Turku, Finland	
	Raunistulan koulu, Teräsrautelan koulu /Suikkilan yksikkö, Talinkorventie 16
	Turun suomalaisen yhteiskoulun lukio, Kauppiaskatu 17

The study was approved by respective ministries of education in Croatia, Poland, and Finland and ethics committees of the schools. The schools were sent an invitation to participate in the study, with the assurance of complete student privacy protection. Informed consent was obtained from each student and their parents or guardians.

Survey Approach

The questionnaire was developed in Google Docs format and sent to schools in an electronic form along with instructions and contact information of the researchers. The title page instructed the students to fill out the questionnaire fully and truthfully. They were informed that their participation was anonymous and voluntary and that the data would be used for research purposes only. General and particular importance of the research was also explained. Furthermore, the students were notified of the type and duration of the procedures used and informed of the confidentiality of the data gathered and the protection of privacy of the participants. The students were free to refuse participation or to withdraw from the study at any time without explanation. Having been notified of all the particulars, they proceeded to fill out the questionnaire.

Our research systematically analyzed all significant variables necessary for scientific research. The survey consisted of three parts. A standardized procedure of double translation was applied to each part for each country and its language. The initial step was defined by taking the general data and demographic measures. Demographic parameters used in the research included age, gender (1=female, 2=male), country of residence, and purpose of Internet use (eg, school/work or entertainment). Participants were asked to appraise whether they use the Internet more often for entertainment or educational purposes.

Internet Addiction Questionnaire

Specific aspects that have been included in a more detailed analysis of research on Internet addiction have been assessed in previous studies. These include assessing Internet addiction using Young's Internet Addiction Test (IAT) [26], also known as Young's Internet Addiction Scale. The scale contains 20 questions based on the criteria for pathological gambling. These questions reflect typical addictive behavior. The scale reflects six dimensions of Internet addiction: salient preoccupation, overuse of the Internet, neglecting work responsibilities, expectation, lack of self-control, and neglecting social life. The authors have found that the factors of saliency and overuse are connected with a more intensive use, while neglecting work is only correlated with age and in a negative way. The conclusion drawn by the authors is that the IAT "does measure some of the key aspects of Internet addiction" [27]. In our study, the level of addiction was rated on a scale ranging from 20 to 100—normal (20-49), moderate addiction (50-79), and serious addiction (80-100). A 5-point Likert scale was used and answers to each question resulted in a score from 1 to 5 points—very rarely (1), rarely (2), often (3), very often (4), and always (5). The scale demonstrated excellent internal consistency with an alpha coefficient of .93 in this study.

Statistical Analysis

For statistical analysis, SPSS Statistics for Windows version 17.0 (SPSS Inc) was used. For data analysis, three groups of methods were used: descriptive statistical analysis (ie, relative numbers, median, and measures of dispersion), inferential statistical analysis (ie, chi-square test, t test, and analysis of variance), and multivariate analysis (ie, reliability factor analysis). Correlations were tested at different levels of significance (ie, 5%, 1%, and 0.1%).

Figure 1. Distribution of adolescents (pooled data) with respect to gender, age, country of residence, and purpose of Internet use (in percentages).
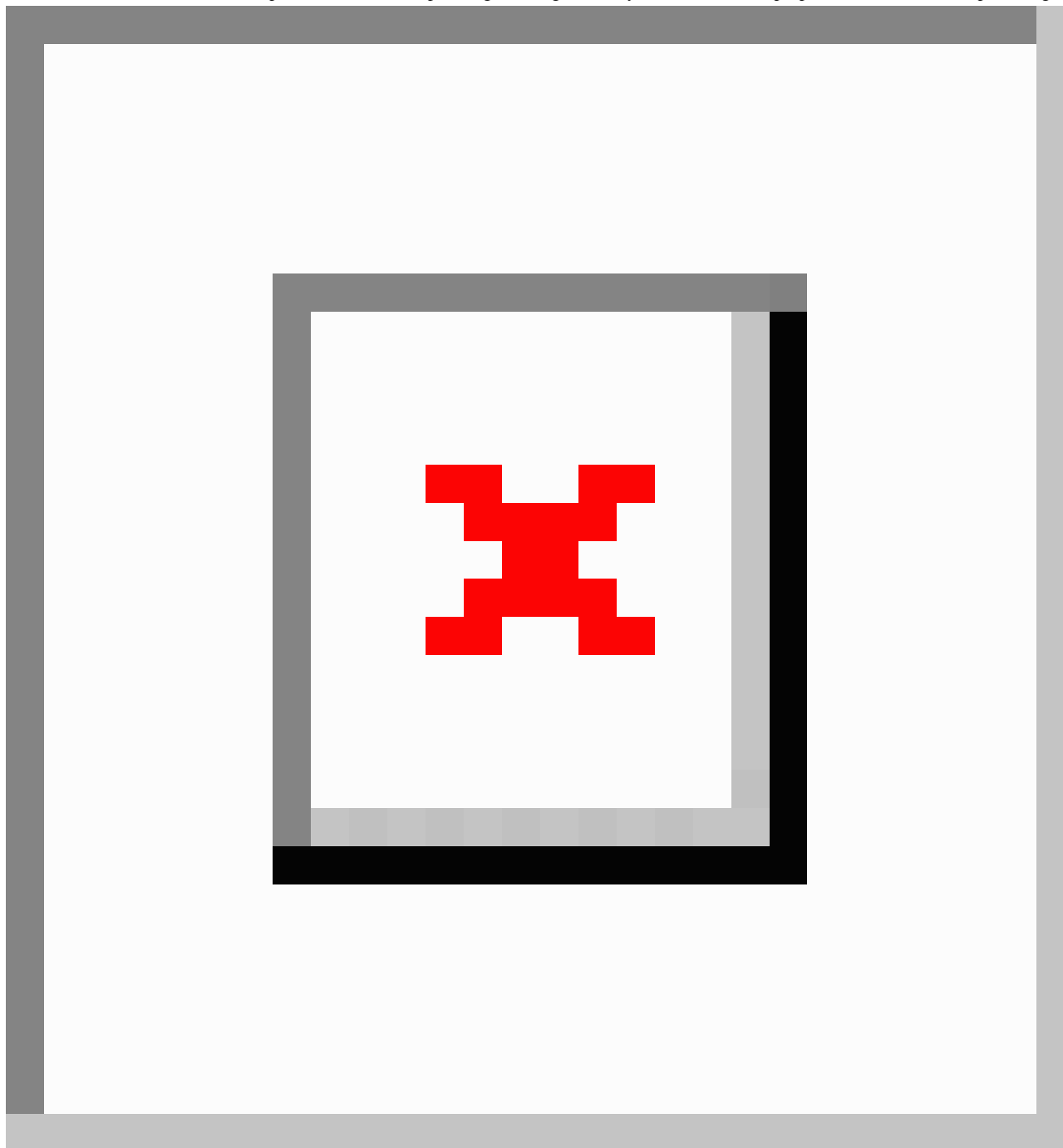
Results

The Purpose of Using the Internet

A total of 1078 adolescents from Croatia, Poland, and Finland participated in the research (see Figure 1).

The representative sample included 534 boys and 525 girls; gender was unknown for 19 participants. The average age of participants was 14.9 years (SD 1.9, range 11-18), with an average discrepancy of 1.9 years, which is a small dispersion (variance coefficient 13%). Since participants were predominantly 15-year-olds, both the median and mode values were 15 years. There were more participants from Croatia than from either of the other two countries. A large majority of

participants used the Internet for entertainment purposes (905/1078, 84.00%), whereas only a small proportion used it for school/work (172/1078, 16.00%).

Internet Use and Gender

We found a statistically significant relationship between the purpose of Internet use and gender ($\chi^2_1=11.3$; n=1042; $P=.001$) (see Table 2).

Female participants used the Internet for school- or work-related purposes (105/525, 20.0%) much more than their male counterparts (64/534, 12.0%). However, when the analyses of this correlation between gender and the purpose of Internet use were carried out separately for each country, the results became more revealing (see Table 3).

A statistically significant relationship was found for Croatian participants (χ^2_1=26.8; n=476; P<.001), but not for the Finnish (χ^2_1=0.2; n=275; P=.63) and Polish (χ^2_1=0.2; n=291; P=.65) participants. Therefore, the Croatian participants contributed to the statistically significant correlation between gender and the purpose of Internet use for the entire sample.

Internet Use and Country of Residence

We found a statistically significant correlation between the country of residence and the purpose of Internet use (χ^2_2= 27.3; n=1048; P<.001) (see Table 4). The use of the Internet for school/work was less frequent among Croatian (78/486, 16.0%) participants than among Polish (71/296, 24.0%) participants, and it was only 8.0% (24/296) among Finnish participants.

Table 2. Number of interviewed adolescent participants according to gender and purpose of Internet use (n=1042).

		Purpose of Internet use, n		
		Entertainment	School/work	Total
Gender				
	Male	459	65	524
	Female	414	104	518
Total		873	169	1042

Table 3. Correlation between gender and purpose of Internet use for each country.

Country	χ^2	df	n	P
Croatia	26.8	1	476	<.001
Poland	0.2	1	291	.65
Finland	0.2	1	275	.63

Table 4. Number of interviewed adolescent participants according to their country of residence and purpose of Internet use (n=1048).

		Purpose of Internet use, n		
		Entertainment	School/work	Total
Country				
	Croatia	400	78	478
	Poland	225	70	295
	Finland	254	21	275
Total		879	169	1048

Correlation Between Age and Internet Addiction

There was a statistically significant correlation between age and the level of Internet addiction (χ^2_6=19.7; n=919; P=.003). Using the contingency table, we calculated that the percentage of moderate and serious addicts increased simultaneously with the participants' age as follows: youngest (aged 11-12 years), 6%; slightly older (aged 13-14 years), 12%; older (aged 15-16 years), 19%; and the oldest (aged 17-18 years), 13%. The results showed a correlation between age and Internet addiction (χ^2_3= 13.5; n=919; P=.004). This correlation was further broken down

by gender, country, and the purpose of Internet use. Thus, we could determine whether it was the male or female demographic that contributed to the correlation between age and Internet addiction. The same analysis was applied to the remaining two independent variables—country of residence and the purpose of Internet use. Due to the preciseness of tests, Internet addiction was expressed as normal addiction or moderate and serious addiction. Male participants and those who used the Internet mostly for entertainment purposes contributed the most to the correlation between the age of adolescents and Internet addiction (see Table 5).

Table 5. Contingency table (4 × 2 format) showing correlation between age of adolescent participants and Internet addiction.

Variables	Analyzed group	n	χ^2	df	P
Age of adolescents (4 groups) Internet addiction (2 groups)	Male participants	469	16.9	3	.001
Age of adolescents (4 groups) Internet addiction (2 groups)	Female participants	447	0.5	3	.93
Age of adolescents (4 groups) Internet addiction (2 groups)	Participants from Croatia	397	5.8	3	.12
Age of adolescents (4 groups) Internet addiction (2 groups)	Participants from Poland	270	3.8	3	.29
Age of adolescents (4 groups) Internet addiction (2 groups)	Participants from Finland	252	1.1	3	.81
Age of adolescents (4 groups) Internet addiction (2 groups)	Participants who used the Internet for school/work	145	7.4	3	.06
Age of adolescents (4 groups) Internet addiction (2 groups)	Participants who used the Internet for entertainment	760	8.4	3	.04

In a correlation analysis, age was considered as a continuous independent variable and Internet addiction as a dependent ordinal variable. A nonparametric method was used to calculate the Spearman coefficient of correlation of .08 for n=1033 and with P=.01, showing that the correlation between the age of adolescents and Internet addiction was weak, but positive and statistically significant. We carried out a two-factor variance analysis. The dependent quantitative variable was Internet addiction (expressed in points); this variable was formed as a sum of scores of the answers to the 20 questions on Internet use. The first independent categorical variable was the purpose of Internet use (factor 1) with two modalities: school/work and entertainment. The second independent categorical variable was the age group (factor 2) with four modalities: 11-12, 13-14, 15-16, and 17-18 years.

Influence of the Purpose of Internet Use on the Level of Internet Addiction

In describing the analysis data obtained through the described model, the Levene test of variance equality has to be mentioned first, as it has established that variances were not homogenous (P<.001) for the analyzed sample of participants.

The obtained results (see Table 6) showed that there was no significant influence of the purpose of Internet use on the level of Internet addiction, disregarding the age of participants (P=.22). In addition, there was a statistically important influence of the age of participants on the level of Internet addiction,

disregarding the purpose of Internet use (P<.001). Finally, there was a statistically significant interaction between the purpose of Internet use and age regarding the level of Internet addiction (P=.001).

Age and the Level of Internet Addiction

Comparing the eight mean values among themselves, we are able to determine the lowest and the highest level of Internet addiction. The lowest level of Internet addiction was found among the youngest age group who used the Internet for school, whereas adolescents between the ages of 15 and 16 years who used the Internet for school had the highest level of Internet addiction (see Table 7).

A single-factor variance analysis (F test) was used to compare the average values of Internet addiction in adolescents of different ages; points for average values were calculated based on the answers to the 20 questions in the questionnaire (see Table 8).

The average overall score was 37.8 (SD 12.3). There was a statistically significant difference between the four averages (F_3=14.5; n=919; P<.001). A post hoc test according to Bonferroni yielded five statistically significant P values out of six possible values (see Table 9).

Adolescents aged 15-16 years who also used the Internet for school had the highest level of Internet addiction (see Figure 2).

Table 6. The analysis data obtained through the described model.

Source variation	The sum of squares	df	The middle square	F	P
Factor 1: the purpose of Internet use	220.152	1	220.152	1.54	.22
Factor 2: age	6686.400	3	2228.800	15.61	<.001
Interaction: the purpose of Internet use x age	2286.327	3	762.109	5.33	.001

Table 7. Summary results of descriptive statistical analysis with analysis of variance.

Age group (years)	Purpose of Internet use	Mean (SD)
11-12		
	School/work	32.5 (9.5)
	Entertainment	32.8 (9.4)
13-14		
	School/work	34.8 (9.1)
	Entertainment	38.2 (10.9)
15-16		
	School/work	46.5 (20.2)
	Entertainment	39.3 (11.9)
17-18		
	School/work	38.2 (11.1)
	Entertainment	35.9 (11.9)

Table 8. Results of the F test comparing the arithmetic means of Internet addiction (summary variable).

Age group (years)	n	Internet addiction, mean (SD)	F	P
11-12	115	32.4 (9.5)		
13-14	267	37.6 (10.7)		
15-16	323	40.4 (13.9)		
17-18	205	36.4 (12.0)	14.46	.001[a]

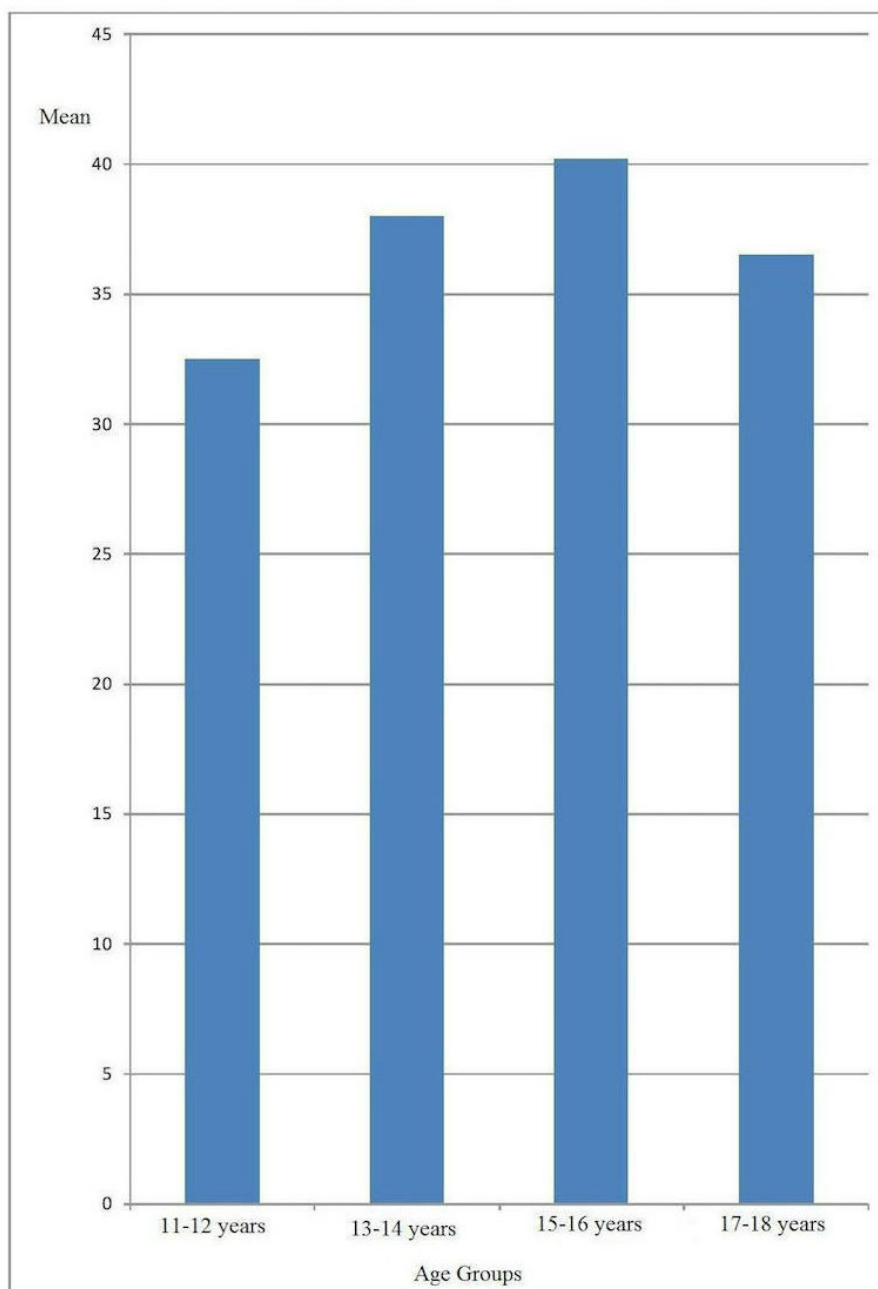[a]Statistical significance at 0.1%.

Table 9. Results of the Bonferroni post hoc test (P values).

Age group (years)	Age group (years), P		
	13-14	15-16	17-18
11-12	.001[a]	<.001[a]	.03[b]
13-14		.004[b]	>.99
15-16			.001[a]

[a]Statistical significance at 0.1%.

[b]Statistical significance at 5%.

Figure 2. Comparison of the average values (points) of Internet addiction in adolescent participants of different age.

Discussion

Principal Findings

The objective of our study was to investigate if there were differences among adolescents in Croatia, Poland, and Finland regarding the purpose of their Internet use with respect to their age subgroup and gender. Our findings showed that a majority of adolescents used the Internet for entertainment and only one-sixth of them used it for school/work. Female adolescents used the Internet for school/work significantly more than did their male counterparts. The use of the Internet for school was most frequent among Polish adolescents, followed by Croatian

adolescents, and least common among Finnish adolescents. Lenhart and Madden found similar results in their study, reporting that male adolescents in America use the Internet for functional and entertainment activities much more than female adolescents who use it for educational and social activities to a much higher degree [28]. Furthermore, similar results were also obtained by Tsai and Lin [29]. They concluded that Taiwanese boys use the Internet to elevate their mood, while Taiwanese girls have a more practical view of the Internet. Programs and activities on the Internet offer younger generations new dimensions of social activities, so the use of the Internet can expand and reinforce their connection with friends and

colleagues [29]. One study reported that some adolescents were so preoccupied with their activities on the Internet that they were displaying signs of addiction [30]. In accordance with the correlations of risky forms of behavior and the developmental stages of adolescence, it seems that different stages of adolescence show a different percentage of Internet addicts. We also found a weak but positive correlation between the age of adolescents and Internet addiction. The greatest contributors to this correlation were male adolescents and those who used the Internet predominately for entertainment. Those aged 15-16 years demonstrated the highest degree of addiction, possibly because at this age they have achieved a greater level of independence and their free time and social activities are less controlled by their parents. Online communication has a strong influence on the developmental stages of adolescence. Adolescents share their experience through new forms of communication; they seek their own position within a group and report their friends as being a great source of social support, even greater than their parents [31]. According to our results, there is no statistically significant influence of the purpose of Internet use on the level of Internet addiction, while there is a statistically significant influence of the age of adolescents on the level of Internet addiction. In addition, there is a statistically significant interaction between the purpose of Internet use and age with regard to the level of Internet addiction. We established that the lowest level of addiction occurred among the youngest group aged 11-12 years who use the Internet for school. They were also the ones who used the Internet for entertainment the least. The highest level of Internet addiction was found among the adolescents aged 15-16 years. They used the Internet for school as well as for entertainment more than other age groups of adolescents in our study. Those aged 13-14 years used the Internet more for entertainment and less for school, similar to those in the 17-18-year-old age group. Our results also showed that Internet addiction was highest among the adolescents aged 15-16 years.

Limitations

Our study did not manage to clarify the relationship between the different developmental phases of adolescence and the growing number of Internet addicts. Another limitation of this study is that we have no specific clinical criteria to determine which children aged 15-16 years are the most sensitive and most vulnerable to Internet addiction. Thus, the current findings increase our understanding of the relationships between Internet addiction and different developmental phases of adolescence.

Conclusions

The primary purpose of Internet use among the 1078 participants was entertainment (905/1078, 84.00%) while the secondary purpose was school/work (172/1078, 16.00%). A total of 20.0% (105/525) of female adolescents used the Internet for school/work, which was significantly more than the males (64/534, 12.0%). Croatian participants (78/486, 16.0%) used the Internet for school/work significantly less than did the Polish participants (71/296, 24.0%); the Finnish participants used it for school/work the least (24/296, 8.0%). The percentage of moderate and serious Internet addicts increased with age. Most adolescent Internet addicts were in the middle stage of adolescence (ie, the 15-16-year-old age group). Furthermore, the purpose of Internet use had no effect on the level of Internet addiction. Age was a significant predictor of the level of Internet addiction as was the interaction between the purpose of Internet use and age. After comparing the eight mean values between themselves, we learned that the level of Internet addiction was the lowest among the youngest group (11-12 years) that used the Internet for school. They also had the lowest rate of Internet use for entertainment. The highest level of Internet addiction was found among the group of 15-16-year-olds. This group had the highest rate of Internet use for school, but also for entertainment. In the 13-14-year-old age group, 38.2% (116/303) of adolescents used the Internet for school and 34.2% (104/303) for entertainment. In the 17-18-year-old age group, 38.2% (91/237) of adolescents used the Internet for school/work and 35.9% (85/237) used it for entertainment.

Conflicts of Interest

None declared.

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Abbreviations

DSM: Diagnostic and Statistical Manual of Mental Disorders

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Original Paper

A Mixed-Methods Study Using a Nonclinical Sample to Measure Feasibility of Ostrich Community: A Web-Based Cognitive Behavioral Therapy Program for Individuals With Debt and Associated Stress

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Abstract

Background: There are increasing concerns about the health and well-being of individuals facing financial troubles. For instance, in the United Kingdom, the relationship between debt and mental health difficulties is becoming more evident due to the economic downturn and welfare reform. Access to debt counseling services is limited and individuals may be reluctant to access services due to stigma. In addition, most of these services may not be appropriately resourced to address the psychological impact of debt. This study describes outcomes from an Internet-based cognitive behavioral therapy (ICBT) program, Ostrich Community (OC), which was developed to provide support to those struggling with debt and associated psychological distress.

Objective: The aim of this feasibility study was to assess the suitability and acceptability of the OC program in a nonclinical sample and examine mental health and well-being outcomes from using the program.

Methods: A total of 15 participants (who were not suffering from severe financial difficulty) were assisted in working through the 8-week ICBT program. Participants rated usability and satisfaction with the program, and after completion 7 participants took part in a semistructured interview to provide further feedback. Before the first session and after the final session all participants completed questionnaires to measure well-being and levels of depression, stress, and anxiety and pre- and postscores were compared.

Results: Satisfaction was high and themes emerging from the interviews indicate that the program has the potential to promote effective financial behaviors and improve financial and global psychosocial well-being. When postcompletion scores were compared with those taken before the program, significant improvements were identified on psychometric measures of well-being, stress, and anxiety.

Conclusions: The OC program is the first ICBT program that targets poor mental health associated with financial difficulty. This feasibility study indicates that OC may be an effective intervention for increasing financial resilience, supporting individuals to become financially independent, and promoting positive financial and global well-being. Further work with individuals suffering from debt and associated emotional difficulties will help to examine clinical effectiveness more closely.

(JMIR Ment Health 2017;4(2):e12) doi:10.2196/mental.6809

KEYWORDS

cognitive behavioral therapy; computer-assisted therapy; psychological stress; economic recession; mental health

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Introduction

Internet-Based Cognitive Behavioral Therapy

Cognitive behavioral therapy (CBT) [1,2] is an effective treatment for depression and anxiety recommended by the National Institute for Health and Care Excellence (NICE). It is based on the assumption that most behavioral and emotional reactions are learnt and focuses on the interrelated components of emotions, behaviors, and thoughts [3]. A key advantage of CBT is that it adapts to computerization [4], with Internet-based cognitive behavioral therapy (ICBT) programs tailored to the needs of the individual. There are a range of ICBT programs adapted for different health issues, psychological disorders, and lifestyle choices such as substance misuse [5-8], insomnia [9,10], mild to moderate depression [11,12], pathological gambling [13], and perfectionist-related issues [14]. This feasibility study explores the acceptability and usability of an ICBT program that has been designed for people experiencing mental health problems due to difficult financial circumstances.

In the midst of a recession and with the continuing move by the UK government to implement austerity measures, vulnerable members of society are suffering the consequences of an economic contraction [15]. One of the adverse outcomes of the recession is the so-called "credit crunch" whereby individuals are struggling to cope with debt and the consequences of this on mental health and well-being [16-19]. Individuals in financial distress (especially those experiencing unemployment and impoverishment) manifest a range of illnesses including depression, anxiety, and alcohol use disorders [20,21], with greater austerity measures increasing the severity of such mental health issues [22,23]. Indeed, a survey by Rethink [24] revealed that almost 9 out of 10 of those in debt felt that their financial difficulties had made their mental health problems worse.

Mental Health Problems and Debt

A further negative consequence of the imposed austerity measures is the continuing erosion of access to mental health services [24,25]. Financial institutions, such as the Citizens Advice Bureau, are not able to support those experiencing financial difficulties and associated mental health problems [26]. Due to limited access to appropriate support and intervention, individuals may therefore be less able to resolve their financial problems or access help, and subsequently, may find themselves sinking deeper into debt.

In light of the detrimental effects that debt may have on well-being, and the lack of evidence-based services that offer both financial and emotional advice, government and financial institutions now recognize that considerable work needs to be done to address this gap in services [27,28]. However, although the optimal treatment for debt and mental health is still being sought, there is good reason to assume that ICBT can be adapted to the specific issues associated with the burden of debt. ICBT may be appealing in that it may reduce concerns an individual has about stigma associated with seeking face-to-face help for debt and mental health issues [29]. Indeed, most of those who experience financial difficulty also experience feelings of shame, self-disgust, and secretiveness [30]. This means that individuals in debt can suffer in silence when confidential services that assure anonymity are lacking [31].

Therefore, this study was conducted to assess the usability and acceptability of a novel ICBT treatment program, Ostrich Community (OC), which is designed to help individuals with their financial difficulties while supporting them to overcome any associated mental health problems. The program aims to promote development of positive behaviors, increase financial knowledge, and improve self-efficacy with regards to financial management. The study adopted a mixed-methods approach as recommended by the Medical Research Council (MRC) guidance around the development and evaluation of complex, multicomponent psychosocial interventions [32,33]. This MRC guidance recommends that before examining clinical effectiveness of complex interventions via approaches such as randomized controlled trials (RCTs), feasibility and piloting work should be conducted in order to ascertain initial acceptability and usability of any novel intervention. This may be particularly important when developing digital interventions that can be perceived as "disruptive" to the status quo within an existing health or social care system [34,35].

In line with the MRC guidance, it was important to conduct a feasibility study to explore acceptability and usability in a group of participants experiencing only moderate financial difficulties, before examining effectiveness in the target population, that is, service users accessing support for financial and mental health difficulties. This approach is important to gain insights into improvements that could be made to the program before evaluating it more formally with a group who may have more complex needs [36]. Small-scale feasibility studies can also reveal insights into acceptability of novel treatment approaches, which can be used to facilitate engagement during formal piloting and effectiveness studies [37-40].

Methods

Design

This was a mixed-methods feasibility study, incorporating semistructured qualitative interviews and quantitative satisfaction measures, alongside psychometric measures of stress and well-being. These measures were taken to explore acceptability and usability of the OC program.

Description of the OC Program

The OC ICBT program provides practical advice about management of finances and psychological well-being and clinically validated evidence-based psychosocial intervention strategies that are grounded in the theoretical underpinnings of the CBT model [3]. Each module provides psychoeducation, cognitive-behavioral worksheets or strategies, and money management stories and quotes to help increase motivation. The program moves beyond information-giving and is the very first intervention program that is evidence-based and tailored to address issues surrounding financial and associated psychological distress.

The program comprises a 2-min introductory video, followed by 8 Web-based sessions at weekly intervals. Each session lasts approximately 30 min, with approximately 30 additional min

per week spent practicing away from the computer (eg, keeping problem diaries, thought records, and completing behavioral experiments) in order to encourage the user to practice the skills taught throughout the program. The program contains information delivered by video and audio to enhance engagement and accessibility. See Table 1 for more detail of the content of individual modules and topics covered by the program.

The OC program is best suited to users who are experiencing mild to moderate stress or depression and anxiety symptoms, and who need information and guidance about money management. Participants with more serious mental health symptoms and debt issues are introduced to content on the home page and there is a toolbox that provides information on more intensive mental health and debt advice services that are more appropriate to their needs.

Table 1. Content of the Ostrich Community (OC) program.

Module	Topic	Summary of activities
1	What are stress, fear, and anxiety?	Provides information to give awareness and understanding of stress and how it can be prevented and managed. The module introduces the purpose of the program (ie, to support users to develop skills to cope with financial stress), and helps the user to understand the links between financial difficulties and stress (Figure 1).
2	The Ostrich model—therapeutic interventions	Introduces cognitive behavioral therapy and self-help techniques to help the user understand why they feel as they do, and learn strategies for changing the way they think, feel, and act. It uses videos, text, and exercises that focus on generic knowledge and skills to help the individual apply these methods in their own lives, with a specific focus on applying these skills to coping with difficult financial situations.
3	Thinking patterns	Provides information, videos, and exercises to help the user identify and challenge negative thoughts and learn to think in a more accurate and realistic way toward their financial situation (Figure 2). Uses cognitive restructuring and other cognitive change techniques to encourage accurate appraisal of financial difficulties.
4	Problem solving	Builds on the cognitive techniques provided in session 3 to support users to utilize their new, realistic insights into their financial situation to solve identified difficulties. The problem solving approaches are underpinned by a goal-setting strategy, to encourage the user to set realistic, achievable goals. Mind mapping exercises are used to identify possible solutions to barriers to goal attainment. Promotes help seeking behaviors (seeking debt advice, talking to creditors).
5	Incorporating positive actions	Helps to identify unhelpful and unhealthy behaviors, particularly around finances, and provides guidance on changing these into healthier behaviors. Provides techniques to increase coping skills and effective communication skills to assist the user in talking to other agencies about their debt, for example. This session also includes completion of an activity monitoring and scheduling planner, to enable the user to organize days and times that they will carry out problem-solving activities related to their debt.
6	Taking action	Provides practical information and resources directly related to financial issues, such as budgeting exercises, and guides the user through a step-by-step exercise to become more financially competent.
7	Stress management and relaxation methods	Provides more general exercises, information, and videos of wider stress management techniques, including relaxation training, progressive muscle relaxation, visualization, and gentle exercise, to help promote relaxation and enhance ability to cope with financial stress.
8	Recap	This module recaps on prior learning and information covered in the program to help consolidate and reinforce learning and the practical skills taught.

Figure 1. A screenshot from Module 1 that focuses on educating the user about stress and anxiety.
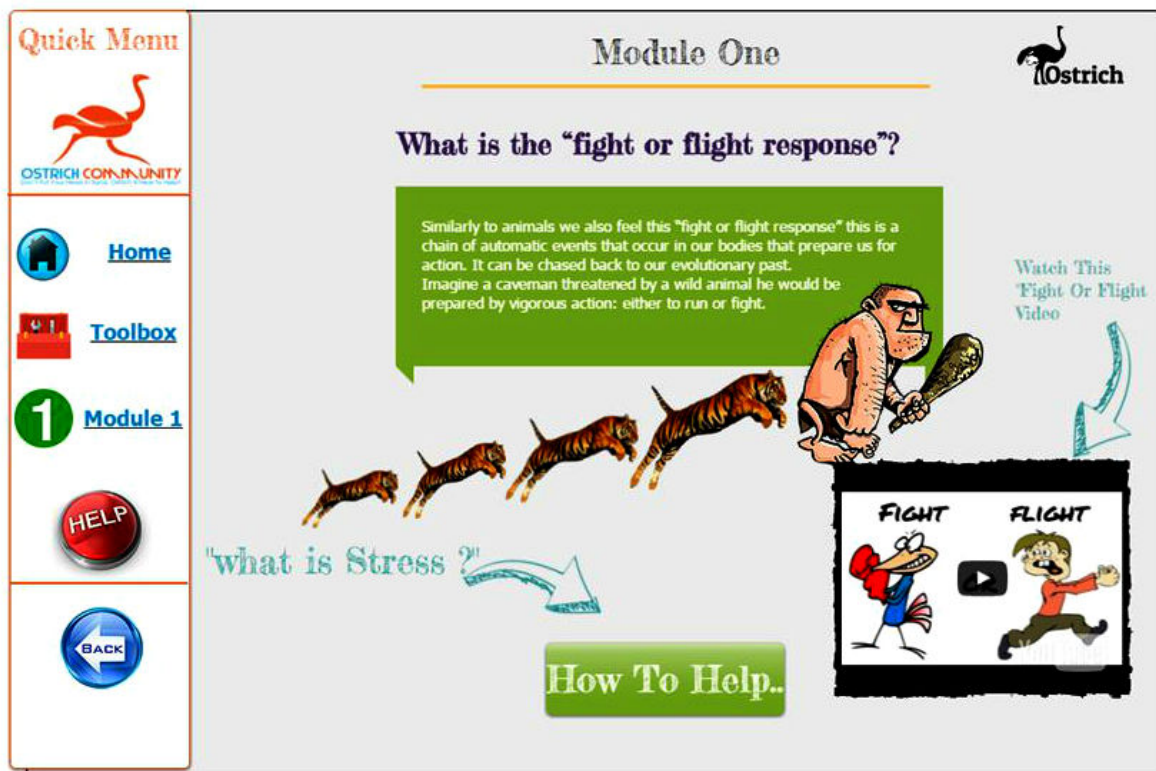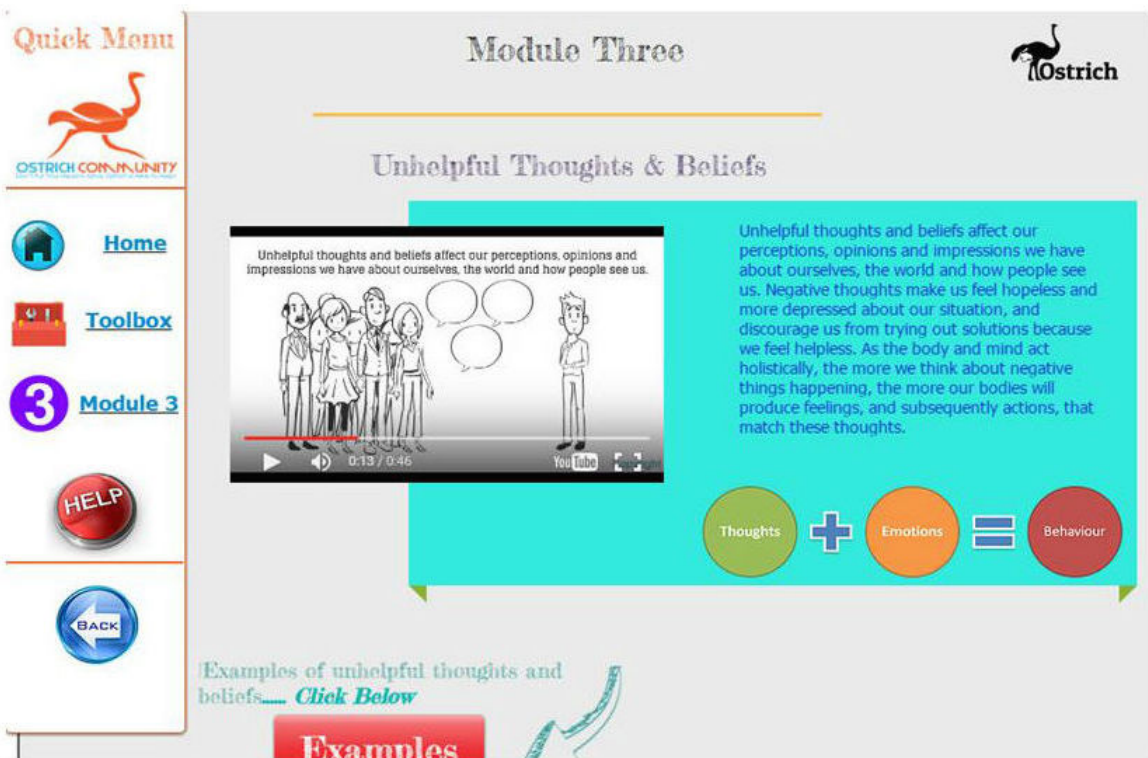

Figure 2. A screenshot from Module 3. This activity encourages users to challenge their beliefs and thought patterns.

Participants

The sample consisted of 17 students from the University of Salford, who were not in significant financial distress, but were coping with the demands of a further education course of study, alongside the low income and financial difficulties many students experience. This group was selected as it was considered important to explore acceptability and usability of the program in a group without significant financial and emotional difficulties, before testing individuals with more complex needs that are facing real financial and emotional difficulties. All participants were studying full-time and some were also working to supplement their income. Table 2 provides demographic information on the sample.

**Table 2.** Participant demographics for those who volunteered for the program (N=17).

Demographic characteristics	n (%)
Sex	
Female	11 (65)
Male	6 (35)
Age range (years)	
18-24	7 (41)
25-34	8 (47)
35-44	2 (12)
Marital status	
Single	14 (82)
Married	2 (12)
Separated	1 (6)
Employment status (alongside being a student)	
Working (full-time)	4 (24)
Working (part-time)	3 (18)
Student only (no full- or part-time work)	10 (59)
Living arrangements	
Home owner	3 (18)
Renting a property	9 (53)
Living with parents (not paying rent)	5 (29)

Procedure

Participants who consented to take part subscribed to the program by activating a Web-based account, providing an email address, and creating a password. They received a welcome message together with login details via email. Of the 17 consenting participants, 15 activated an account.

Participants worked through the modules sequentially, with a new module released each week for 8 weeks together with an email reminder. Following completion of all modules, participants were invited to take part in a semistructured interview exploring acceptability and usability of the program (7 took part). Before module 1 and after module 8, participants completed two standardized psychometric assessments, measuring stress and well-being (with a total of 13 participants providing these data). The flowchart depicted in Figure 3 demonstrates the sequence of events during the study, from initial recruitment to completion of qualitative interviews, and shows attrition rates at each stage.

Figure 3. Flowchart depicting study stages and participant attrition.
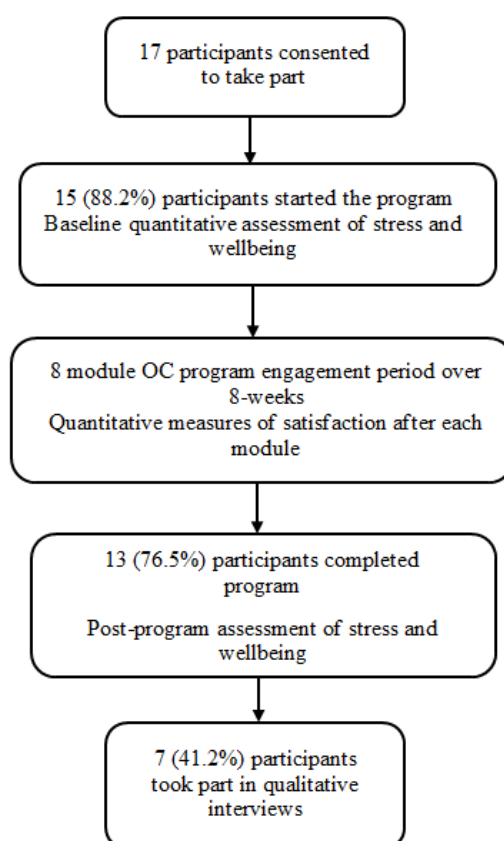
Measures

Three separate methods were used to examine (1) acceptability and usability of the program, (2) participant satisfaction, and (3) stress and well-being outcomes.

Feasibility Study: Qualitative Interviews to Assess Acceptability and Usability

On completion of the program, participants were offered the opportunity to take part in an interview. Interviews were conducted on a one-to-one basis with the lead author (DS) and explored participants' views of the OC program. Open-ended questions allowed participants to elaborate on their answers. Interviews lasted approximately 30 min and were recorded using a digital Dictaphone.

The interviews were transcribed and entered into NVivo qualitative data analysis software version 10 (QSR International Pty, Ltd), and thematic analysis (TA) was used to analyze the transcripts. Published guidelines around the process of TA in psychological research were followed [41], with transcripts initially being read by the lead author (DS) to identify quotes relevant to the study aims. Connections were made between quotes and were used to develop overarching themes, which were examined and refined to ensure that they accurately described themes common to all transcripts. These were reviewed by the second author (SE), to increase reliability, and any discrepancies were discussed until an agreement was

reached. The themes were named and defined to ensure that they were discrete.

Feasibility Study: Quantitative Measures to Assess Satisfaction

This stage of the study measured satisfaction with the program using the 8-item Client Satisfaction Questionnaire (CSQ-8) [42]. The CSQ-8 total score ranges from 8 to 32, with higher scores indicating higher satisfaction. Participants completed this at the end of every session and at the end of the program. A short questionnaire developed by the lead author was also used to gain additional information around satisfaction and usability specific to the OC program, and this was completed after each module. This was a 5-item questionnaire with a Likert scale ranging from 0 ("not at all") to 7 ("very much") and participants were asked to state how much they agreed with statements such as "How useful did you find the new topic introduced today?" Data were analyzed using Microsoft Excel and Statistical Package for the Social Sciences (SPSS).

Clinical Outcomes: Quantitative Psychometric Measures of Stress and Well-Being

Participants completed the Warwick and Edinburgh Mental Well-Being Scale (WEMWBS) [43] and the short version of the Depression Anxiety Stress Scale (DASS-21) [44] to monitor any changes in well-being and stress as a result of engaging with the program. The WEMWBS is a scale of 14 positively worded items for assessing mental well-being. Each statement

asks for a response on a Likert scale that ranges from 1 ("None of the time") to 5 ("All of the time"). The scores on the questionnaire range from 14 to 70 with higher scores indicating greater well-being. The DASS is a 21-item self-report questionnaire designed to measure the severity of a range of symptoms common to depression, anxiety, and stress with 7 items for each scale. Each item is scored on a 4-point scale from 0 ("Did not apply to me at all") to 3 ("Applied to me very much or most of the time") indicating how often the respondent experienced each state in the past week. The questionnaire provides 3 scores (one for each state) with higher scores indicating that respondents had suffered from a particular state in the last week.

In order to determine stress and well-being outcomes, pre- and postintervention scores on the DASS [44] and WEMWBS [43] were subjected to statistical analyses. Nonparametric Wilcoxon Signed-Ranks tests were used to examine changes in scores at the beginning and end of the program.

Results

As three methods were used to address three independent aims, findings from each of these are reported separately.

Feasibility Study: Qualitative Interviews to Assess Acceptability and Usability

Three themes were identified relating to (1) enhancing engagement with the OC program, (2) acceptability of program content, and (3) the programs' potential to benefit the target population.

Theme 1: Enhancing Engagement

Participants reported a number of features of the program that enhanced engagement, including presentation of modules in a sequential and progressive manner with each one building on knowledge gained from the previous session:

> it was organized in a way that you can do it, in a step-by-step process. [Participant 1]

Participants also liked that the program content was delivered via interactive Web-based multimedia including video and audio, although one participant did suggest that a purely Web-based program may not be suitable for everyone:

> I think...the way the website was very visual, and you did a blend of different ways (to) suit people's needs in terms of their learning style (but) I think it needs to be maybe classroom based...there's a tutor or someone taking them through it bit by bit then taking them back to apply it. [Participant 6]

Theme 2: Acceptability and Accessibility of Content

In general, participants were positive about the content of the program, and while there was acknowledgment from participants that the content was informed by academic theory, this did not make it difficult to access or understand:

> I liked that there was a good balance between the theory, the information provided, and activities...it was nothing too strenuous. [Participant 7]

Positive reinforcement within the program was also perceived as helpful and played an important part in supporting users to achieve the goals they set:

> I like the positive quotes and encouraging words that were throughout the program, I liked how rewarding it was...which made you feel like you've done some progress. [Participant 4]

Theme 3: Potential to Benefit the Target Population

On the whole, participants reported that they understood the concept of the program, even though a Web-based financial capability program was a new idea:

> it was a new concept that I haven't explored in other programs. It's a financial capability program so its specialized and it's good that its specialized to help people with financial difficulties in that sense. [Participant 1]

The opinion among participants was that the program offered practical advice and solutions to financial difficulties and would support individuals to develop the tools necessary to overcome their financial difficulties:

> it was practical, there was so many things you provided in the tool box, which is a good thing because the program didn't just talk about stuff it actually provided the tools to help people. [Participant 3]

Feasibility Study: Quantitative Measures to Assess Satisfaction

All 13 participants completed the usability questionnaire after each module and the CSQ-8 [42] at the end of the program. Data from the usability questionnaire (Table 3) demonstrated mean experience across the 8 sessions was favorable, with participants rating the usefulness of each topic and the benefits of each session as high. Following each session participants felt less stressed compared with how they felt at the beginning, with none reporting distress from any of the sessions.

Table 3. Perception of the sessions based on scores from the usability questionnaire completed after each module (N=13).

Questions	Mean (SD[a])
How stressed were you at the beginning of the session?	3.63 (0.74)
How useful did you find the new topic introduced today?	6.13 (0.64)
How relaxed do you feel right now?	5.88 (0.35)
How beneficial did you find the session?	6 (0.53)
How tense do you feel right now?	2.25 (0.46)

[a]SD: standard deviation.

From the CSQ-8 data (Table 4), 92% (12/13) of participants rated the quality as good or excellent. All participants received the service they wanted, and 92% (12/13) reported that the program met most or all of their needs and that they were satisfied with the amount of help provided. All would recommend the program to a friend in need of financial help and 92% (12/13) said that they would come back to the program if they needed help in the future. When asked how satisfied they were with the program overall, 69% (9/13) were "very satisfied" and 30% (4/13) were "mostly satisfied."

Table 4. Satisfaction with the overall program based on the 8-item Client Satisfaction Questionnaire (CSQ-8; N=13).

Questions		n (%)
How would you rate the quality of service you have received?	Excellent	6 (46)
	Good	6 (46)
	Fair	1 (8)
	Poor	0 (0)
Did you get the kind of service you wanted?	Yes, definitely	8 (62)
	Yes, generally	5 (38)
	No, not really	0 (0)
	No, definitely not	0 (0)
To what extent has the program met your needs?	Almost all of my needs have been met	7 (54)
	Most of my needs have been met	5 (38)
	Only a few of my needs have been met	1 (8)
	None of my needs have been met	0 (0)
If a friend were in need of similar help would you recommend the program?	Yes, definitely	9 (69)
	Yes, I think so	4 (31)
	No, I don't think so	0 (0)
	No, definitely not	0 (0)
How satisfied are you with the amount of help you have received?	Very satisfied	11 (84)
	Mostly satisfied	1 (8)
	Indifferent or mildly dissatisfied	1 (8)
	Quite dissatisfied	0 (0)
Have the services you have received helped you to deal more effectively with your problems?	Yes, they helped a great deal	6 (46)
	Yes, they helped	6 (46)
	No, they seemed to make things worse	0 (0)
	No, they really did not	1 (8)
In an overall, general sense, how satisfied are you with the service you have received?	Very satisfied	9 (69)
	Mostly satisfied	4 (31)
	Indifferent or mildly dissatisfied	0 (0)
	Quite dissatisfied	0 (0)
If you were to seek help in the future would you come back to the program?	Yes, definitely	8 (62)
	Yes, I think so	4 (31)
	No, I do not think so	1 (8)
	No, definitely not	0 (0)

Clinical Outcomes: Quantitative Measures of Stress and Well-Being

Participants reported higher levels of anxiety before the program (median 24) than at the end (median 16) and this difference was significant, $Z(13)=-2.006$, $P<.05$ There was also a significant difference in stress scores before and after (median scores of 32 and 26 respectively) with participants reporting lower levels of stress at the end of the program, $Z(13)=-2.814$, $P<.01$. There was no difference between levels of depression at the end of the program (median 22) compared with the beginning (median 26), $Z(13)=-0.393$, $P=.69$.

Scores on the WEMWBS were lower at the beginning of the program (median 45.00) compared with the end (median 51). Participants reported a significant increase in well-being from pre- to postprogram, $Z(13)=-2.275$, $P<.05$.

Discussion

Principal Findings

The continuing government austerity measures, coupled with a bleaker outlook on jobs, have resulted in more people experiencing debt [15]. This often takes a toll on a person's health and psychological well-being [16] and is exacerbated by

a shortage of services available to assist people experiencing financial hardship and associated mental health difficulties. Financial and other governmental institutions have limited resources to assist people in this situation and the waiting list of people needing help is expanding [45].

The OC program is an innovative ICBT program that aims to support individuals who are having financial difficulties that are affecting their emotional well-being. The focus of the program is to relieve psychological stress, anxiety, and depression while teaching positive financial behaviors and resilience. This initial feasibility study was conducted to explore acceptability and usability of the program.

Many participants said that they appreciated taking part in the study because it helped them to learn how to budget effectively and how to be prepared in terms of dealing with sudden financial changes. One of the benefits of this program is therefore that individuals can use it as a preventative tool regardless of their financial circumstances and in the absence of significant levels of debt [2,46]. Indeed, participants noted that the CBT principles in the program could be beneficial for anyone, even for those without any significant financial or psychological difficulties. In addition, after completing the program, participants reported a significant reduction in anxiety and stress, and improvements in well-being.

Participants found the program to be helpful and easy to use and there was high satisfaction with the financial information and emotional help provided. These findings support the high satisfaction with ICBT when addressing gambling [13], insomnia [10], mild-to-moderate depression [11], and drug and alcohol use [6,8]. Participants liked the interactive and multimedia, digital format of the program, reporting that they found it to be user-friendly, and the information easy to understand. Some observed that although the program allows for people to work independently, it may be too much for some who may benefit from "computer-assisted therapy" (CAT) rather than "self-help therapy."

CAT integrates therapeutic content delivered by an ICBT program with a human practitioner who may provide screening, supervision, and other support to the user [477], whereas self-help programs do not use practitioner monitoring or involvement [48]. Evidence suggests that people with higher levels of motivation, such as students, have improved outcomes from participation in this latter type of program. Students are generally driven by a desire to achieve [49] and are encouraged to be self-motivated autonomous learners [50]. This is a drawback with this sample as participants may have been more motivated than those in the general population suffering with debt problems. This is supported by the relatively low dropout rate compared with other studies of ICBT programs, some of which report high attrition rates [51]. In addition, as the students who participated in this study were not necessarily in debt, and

instead were coping with a relatively low income that is common among students, the sample is not representative of the target user groups.

A "blended" approach to facilitation of ICBT programs has been demonstrated to be helpful for those individuals experiencing mental health difficulties [52]. Therefore, further work will explore delivery of the program not as self-help, but as CAT. By delivering the program as CAT with practitioner support, this may lessen the attrition rate in the target population, and may provide vital additional therapeutic support for individuals experiencing significant financial hardship and mental health difficulties [51].

This study intended to explore initial feasibility and acceptability of the OC program with a small cohort of participants experiencing some financial difficulties. This was to gain insights into improvements that could be made to the program before evaluating it with a population of service users with more complex needs. Multiple digital health studies take this approach, including studies of mental health intervention programs [53] and alcohol misuse programs [36]. The sample size was limited, yet when examining feasibility of novel digital interventions such as the OC program, small-scale studies can reveal important insights regarding acceptability and clinical content. This can facilitate optimal engagement during formal piloting and effectiveness studies [37-40]. Future work will include a larger pilot study with the target population, that is, service users accessing support for their financial and mental health difficulties.

Conclusions

The aims of this feasibility study were to assess the acceptability and usability of a novel ICBT program for people experiencing poor mental health due to financial difficulties. A total of 15 participants worked through the program over a period of 8 weeks, and they reported satisfaction with the program and noted that it was easy to use. They also suggested that it made them consider their financial situation and gave them skills they could use beyond the immediate focus of finances. There was also a significant improvement in well-being, anxiety, and stress on completion of the program.

Some participants reported that it was difficult to work through the modules individually and so future work will explore the addition of support from a practitioner and potentially a moderated peer support forum. These implementation approaches may help to increase impact [51], increase engagement, and support completion. The sample was also limited to participants not in serious financial difficulties. Therefore, further research will include a larger sample of participants who come from the intended targeted population for the OC program; individuals experiencing significant financial difficulties and associated mental health difficulties.

Authors' Contributions

DS created the OC program, conceived and designed the study, analyzed the qualitative data, and drafted the manuscript. SE analyzed the qualitative data and drafted the manuscript. LDM provided advice on study design and ethical approval. CT designed the study, analyzed the quantitative data, and drafted the manuscript.

Conflicts of Interest

None declared.

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Abbreviations

CAT: computer-assisted therapy
CBT: cognitive behavioral therapy
CSQ: Client Satisfaction Questionnaire
DASS: Depression Anxiety Stress Scale
ICBT: Internet-based cognitive behavioral therapy
MRC: Medical Research Council
NHS: National Health Service
NICE: National Institute for Health and Care Excellence
OC: Ostrich Community
RCT: randomized controlled trial
SPSS: Statistical Package for the Social Sciences
TA: thematic analysis
WEMWBS: Warwick and Edinburgh Mental Well-Being Scale

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<u>Original Paper</u>

Computerized Cognitive Behavioral Therapy to Treat Emotional Distress After Stroke: A Feasibility Randomized Controlled Trial

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Abstract

Background: Depression and anxiety are common complications following stroke. Symptoms could be treatable with psychological therapy, but there is little research on its efficacy.

Objectives: The aim of this study was to investigate (1) the acceptability and feasibility of computerized cognitive behavioral therapy (cCBT) to treat symptoms of depression and anxiety and (2) a trial design for comparing the efficacy of cCBT compared with an active comparator.

Methods: Of the total 134 people screened for symptoms of depression and anxiety following stroke, 28 were cluster randomized in blocks with an allocation ratio 2:1 to cCBT (n=19) or an active comparator of computerized cognitive remediation therapy (cCRT, n=9). Qualitative and quantitative feedback was sought on the acceptability and feasibility of both interventions, alongside measuring levels of depression, anxiety, and activities of daily living before, immediately after, and 3 months post treatment.

Results: Both cCBT and cCRT groups were rated as near equally useful (mean = 6.4 vs 6.5, d=0.05), while cCBT was somewhat less relevant (mean = 5.5 vs 6.5, d=0.45) but somewhat easier to use (mean = 7.0 vs 6.3, d=0.31). Participants tolerated randomization and dropout rates were comparable with similar trials, with only 3 participants discontinuing due to potential adverse effects; however, dropout was higher from the cCBT arm (7/19, 37% vs 1/9, 11% for cCRT). The trial design required small alterations and highlighted that future-related studies should control for participants receiving antidepressant medication, which significantly differed between groups (P=.05). Descriptive statistics of the proposed outcome measures and qualitative feedback about the cCBT intervention are reported.

Conclusions: A pragmatic approach is required to deliver computerized interventions to accommodate individual needs. We report a preliminary investigation to inform the development of a full randomized controlled trial for testing the efficacy of computerized interventions for people with long-term neurological conditions such as stroke and conclude that this is a potentially promising way of improving accessibility of psychological support.

Introduction

Psychological Support Following Stroke

Emotional distress is a frequent complication following stroke. Approximately one-third of people report common mental health problems such as depression (33%) [1] or anxiety disorders (25%) [2] after experiencing a stroke. Longitudinal studies of poststroke depression and anxiety suggest that symptoms remain high throughout the acute and longer-term phases, for example, up to three years post stroke [3,4]. If left untreated, mental health problems have been found to significantly impact on functional recovery and quality of life [5].

Despite the clear need, it has been reported that relatively few people receive treatment for these commonly experienced mental health problems after stroke [1]. Stroke rehabilitation guidelines recommend routine clinical psychology input [6], but less than 40% of regions in the United Kingdom provide good access to psychological therapy [7]. This may in part be due to a relatively small evidence-base for treatment, especially psychological treatment, of depression and anxiety disorders following stroke [8,9]. Other barriers include the additional costs associated with providing psychological therapy and the difficulties service users may have in traveling to clinics for practical reasons such as physical and cognitive impairments, or lack of transport. This research sought to investigate the use of therapeutic technology, more specifically a computerized therapy package based on cognitive behavioral therapy (cCBT), as an accessible and, potentially, effective means of providing psychological treatment for common mental health problems following stroke.

Computerized Therapy Interventions

Across populations, there is a weight of evidence toward computerized versions of CBT being effective treatments of depression and anxiety disorders. Indeed, recent meta-analyses conclude that cCBT could be a very promising and efficacious treatment for depression within a diverse range of settings and clinical groups [10] and for some specific anxiety disorders, that is, panic disorder and specific phobia [11] across urban and remote rural communities [12]. Furthermore, research has shown that cCBT has the potential to be as effective as therapist-delivered CBT [11,13]. Currently, the United Kingdom's National Institute for Health and Clinical Excellence recommends cCBT as a possible treatment for depression among people with concurrent long-term physical health problems, such as neurological conditions including stroke [14]. However, there is a limited evidence-base for this recommendation.

In a review of the current research on the acceptability and feasibility of providing cCBT for people with a diagnosis of a neurological condition, including traumatic brain injury and multiple sclerosis, it was concluded that while cCBT has the potential to be of benefit, greater efforts are needed to improve the accessibility of such interventions to accommodate physical and cognitive difficulties [15]. This parallels research findings for the appropriateness of therapist-delivered CBT for clinical

groups where physical and cognitive difficulties are more prevalent, for example, in older adult populations. CBT has been found to be effective at reducing symptoms of depression and anxiety among older adults but often requires adaptation and augmentation to accommodate individuals with more complex needs such as physical and cognitive difficulties [16,17]. Evidence drawn from these studies, along with a systematic review of the evidence for use of cCBT with older adults [18], suggests that it may be necessary to provide users with a greater level of support to complete the cCBT programs. This is supported in the general literature on cCBT, which has concluded that "guided" cCBT yields better outcomes [10]. Further barriers for accessing cCBT and psychological support, in general, include the perceived social stigma attached to seeking support from mental health services [19] and associated additional immediate costs, despite potential long-term payoffs [20].

To summarize, the work here contributes to the goal of making psychological support for symptoms of depression and anxiety more accessible for people who have experienced a stroke. In particular, we explored the acceptability and feasibility of a particular intervention for symptoms of depression and anxiety, in preparation for testing its efficacy in a larger randomized controlled trial (RCT). We investigated the feasibility of providing access to computerized therapy interventions embedded within people's local communities. Furthermore, we report on a pilot RCT of a cCBT intervention (referred to throughout as the "active condition") as compared with an alternative ("control") condition. Both involved active engagement in structured activities via a computer. The alternative "control" activity was loosely based on a computerized cognitive remediation therapy (cCRT) approach and focused on practicing cognitive skills in a series of training exercises as opposed to addressing mood directly. An active comparator condition was designed to directly assess efficacy related to the content of the treatment intervention. This work followed guidelines for conducting and reporting on the feasibility of randomized pilot studies [21], with the view of progressing toward the design of a larger scale RCT to assess the effectiveness of the therapeutic technology, for example, cCBT, as an addition to current practice in community stroke and other neurorehabilitation services.

Methods

Participants

We recruited 134 people who had been medically assessed and diagnosed as having experienced a stroke within the last 5 years (from April 2011 to April 2012) and had not subsequently received a diagnosis of a neurodegenerative condition (eg, dementia) from three community-based neurorehabilitation services situated in a large county, consisting of a mix of rural and urban areas. All were screened for symptoms of depression and anxiety using the Beck Depression Inventory-II (BDI-II) [22] and Beck Anxiety Inventory (BAI) [23], and 28 people

scoring high on these measures (as detailed in Textbox 1) consented to take part in a pilot RCT. The full inclusion and exclusion criteria are shown in Textbox 1. Ethical approval was granted by the local National Health Service (NHS) Research Ethics Committee (reference no.: 10/H0311/62).

Interventions

Participants completed an eight-module course of either cCBT or an active comparison condition in addition to their usual care, which included general practitioner (GP) support and in some cases antidepressant medication.

cCBT condition: the first group completed a computerized package (also available in an Web-based format over the Internet) called "Beating the Blues" (formerly Ultrasis Plc), which was developed to treat symptoms of depression and anxiety following principals drawn from CBT. At the time of the study, this package had the best evidence base for treatment of symptoms of depression within primary care settings

compared with other computerized packages available [24], and following the success of a pilot clinical case study [25] the idea was to see whether it could also be a feasible and acceptable "off the shelf" intervention for people who had experienced a stroke.

Active comparison condition: the second group completed an intervention designed to be an active comparator for the cCBT condition using Web-based resources. This involved a series of training exercises aimed at rehearsing cognitive skills, including memory, attention, visuospatial, and executive functioning, considering compensatory strategies where possible. It was loosely based on CRT, defined by consensus as "a behavioural-training based intervention that aims to improve cognitive processes (attention, memory, executive function, social cognition, or metacognition) with the goal of durability and generalization" [26].

Specific details about the structure and content of the two interventions are provided in Multimedia Appendix 1.

Textbox 1. Participant inclusion and exclusion criteria.

Inclusion criteria

- Aged 18 years and over

- Experienced a stroke within the last year

- Mild or moderate depression or anxiety defined by the Beck Depression Inventory-II (BDI-II) [22] score >13 or the Beck Anxiety Inventory (BAI) [23] score >7 or endorsement of being often bothered by feeling down, depressed, or hopeless, and having little interest or pleasure in doing things in the last month

Exclusion criteria

- Unable to give full informed consent to participate in the research

- A diagnosis of a neurodegenerative condition (eg, vascular dementia) or a symptomatic acquired brain injury, other than stroke

- A visual or auditory problem that could not be corrected and would seriously interfere with the participation in the research study

- Unable to undergo a verbal interview due to impairment of comprehension (including severe receptive aphasia)

- Currently severely depressed or reporting active suicidal ideation defined by BDI-II score ≥29 or BDI-II item 9 (suicidal ideation) score ≥2

Currently receiving psychological therapy or antidepressant medication for treatment of a mood or anxiety disorder

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A number of common factors were shared between the way in which the two interventions were delivered. Where possible, participants completed one module per week, which lasted approximately one hour for a series of eight consecutive weeks. Each participant made use of a computer to administer the treatment and received guidance from a researcher with a master's level degree in neuropsychology and supervision from a clinical neuropsychologist to facilitate engagement in the scheduled computerized activity. Both interventions took place in community-based, nonclinical settings. Participants in both conditions were first encouraged to complete the interventions on computers provided in local libraries or laptops (one of four) provided by the researchers in other community-based settings, for example, village halls. Participants were invited to attend these sessions in small groups at a mutually convenient time. A professional was present at all times and participants worked independently on their own computer. The idea of small groups was primarily introduced as a means of improving the feasibility of delivery, for example, reducing the costs associated with providing psychological therapy. However, if this was not

possible, for example, where participants could not attend a community-based location, the researchers provided individualized support either remotely via telephone or email, or face-to-face within the participant's home, bringing a laptop where needed. All participants received a combination of telephone and email support in between computerized treatment sessions to further facilitate engagement in the treatment interventions.

Treatment Allocation

Participants were randomized in clusters into cCBT and active comparator conditions using a ratio of 2:1, that is, for every one cluster randomized into the control condition, two clusters were randomized into the cCBT condition. The use of this ratio allowed for analysis of the feasibility of a larger scale RCT in this area with a greater focus on assessing the appropriateness, acceptability, and relevance of the cCBT sintervention. Randomization blocks of three (1 × cCRT, 2 × cCBT), six (2 × cCRT, 4 × cCBT), and nine (3 × cCRT, 6 × cCBT) were applied in a randomly generated sequence to help balance the number

of participants receiving each of the two conditions. This allocation sequence was generated by a researcher external to the research team and saved in a location where it could not be accessed by any of the researchers involved in the study. In order to allocate a participant to a condition, a member of the research team had to send an email to the person with access to the allocation sequence, specifying a cluster number. The prespecified condition that corresponded to the cluster number was then returned via email.

Clustering was determined pragmatically, on the basis of the region or area in which the participant lived and the ease of attending a group at one of several localities. As soon as two people were available within the same region and they both provided consent to take part in the study, they were randomized into one of the two conditions. If more than two people within the same region became available at the same time, pairings were determined by assigning each person a number and allocating them to a cluster according to a randomly generated list of numbers (ie, the numbers that appeared first and second in the sequence were grouped together, the two numbers that appeared third and fourth in the sequence were grouped together).

Data Collection

In line with this being a pilot study, we focused on the feasibility and acceptability of the active intervention and the proposed study design. Acceptability was measured using ratings of appropriateness, usefulness, and ease of use for each computerized module on an 8-point scale with higher scores indicating a greater level of satisfaction with the intervention. Information on variables such as number of weeks spent in the intervention phase; number of treatment modules (out of a total of eight) completed; and the proportion of sessions completed in a group, in a community-based setting outside of their own home and with the additional face-to-face support of a clinical helper were collected to inform the feasibility of the current intervention design for this sample. Reasons for dropout were also gathered, where possible. Recruitment ended a year following commencement of data collection.

Participants also completed several quantitative outcome measures, including the BDI-II and BAI, as well as a measure of participation in activities of daily living (the Nottingham extended activities of daily living scale, NEADLS) [27]. The outcome measures were collected at baseline, just after completion of the last module (or when a participant decided to stop treatment early), and 3 months later.

Data Analysis

Feasibility and Acceptability

Analysis of feedback on the feasibility and acceptability of the interventions was descriptive, reporting on the means or median values, and standard deviations or interquartile ranges, and also involved *t* tests to assess group differences. This information was used to address the following questions.

For the feasibility of the research and intervention protocols, the questions were as follows:

- Recruitment: how many people were screened and enrolled each month?
- Adherence: were both treatment interventions able to be delivered as specified in the intervention and research protocol? This included following the intended length, setting, and format of the interventions, as well as following the randomization and assessment procedures specified.
- Differences between trial arms: were there any deviations from the research protocol that were specific to either of the intervention conditions? Were these differences statistically significant?

For the acceptability and relevance of the interventions, the questions were as follows:

- Subjective ratings: Did the majority of participants report that the interventions were relevant to their problems, easy to engage in, and useful?
- Reasons for dropout: How many people dropped out and did not complete the entire intervention? Did participants who dropped out report any adverse effects?

Self-Reported Symptom and Activity Outcomes

Descriptive statistics of the outcome measures (BDI, BAI, and NEADLS) from the three measurement points are also reported.

Results

Feasibility of the Research and Intervention Protocols

Recruitment

In the early stages of recruitment, it became clear that fewer people than expected met the rigorous inclusion criteria set out in Textbox 1. For example, the recruitment rate for the intervention ran on average at 0.31 of the expected rate (n=8 per month) during the first two months. In part, this was due to fewer than expected people being available for initial screening (recruitment rate = 0.32). Thus, two alterations were made: first, the recruitment procedure for screening was widened to include people who had experienced a stroke during the last *five* years (as opposed to within a year of stroke). Second, the eligibility criteria for the intervention phase were further relaxed to include people who were currently taking a stable dose of antidepressant medication (as opposed to only those using *no* antidepressant medication); stable was defined as no modification within the 8 weeks prior commencing participation. These changes highlighted an unmet need: while we set out to treat symptoms of depression, we ended up treating co-morbid problems with depression and anxiety up to five years post stroke, a proportion of whom were receiving medical intervention but no psychological input to treat mood before commencing participation in this study.

Figure 1. Flowchart of participants included in each phase of the study. n=number of individual participants, c=number of clusters, cCBT=computerized cognitive behavioural therapy, cCRT=computerized cognitive remediation therapy.
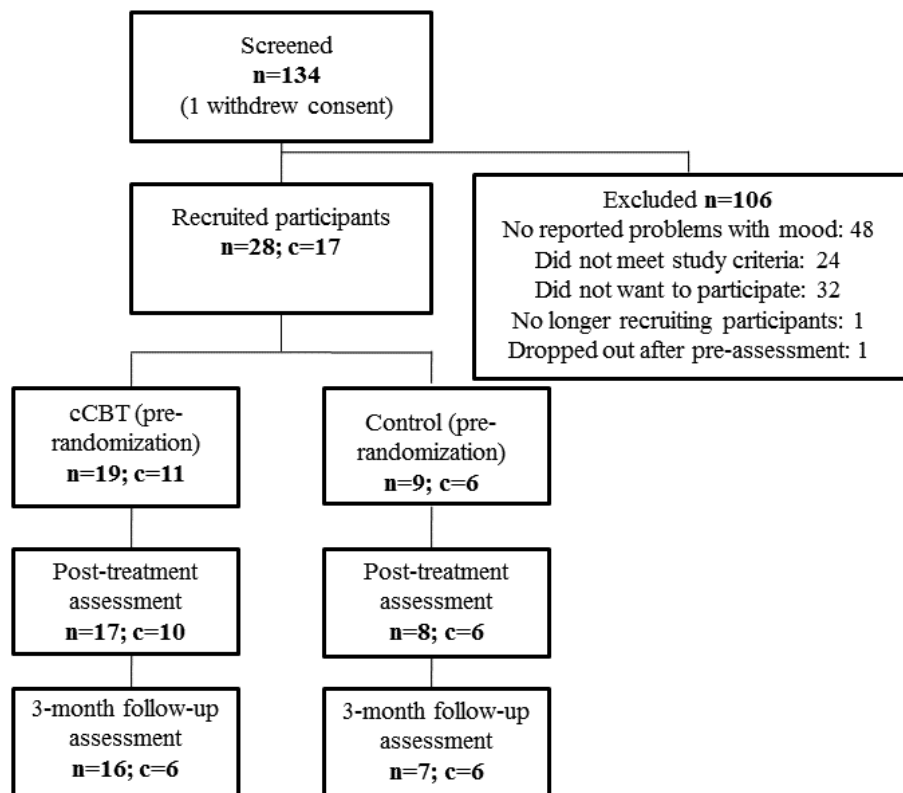
Adherence

Of the 134 screened potential participants, 28 met the inclusion criteria and were randomly allocated into the cCBT (n=19) or cCRT (n=9) intervention. Figure 1 details the number of participants who were recruited and assessed at baseline, immediately post treatment and at the 3-month follow-up time points for the two groups. Both treatment interventions were able to be delivered as intended, via a computer. However, while group comparisons were underpowered to detect statistically significant differences, effect size estimates suggested small differences in the delivery of the intervention with participants belonging to the cCBT group spending, on average, a greater number of weeks in the intervention and attending a larger number of sessions (see Table 1). However, participants allocated to the cCRT group completed the intervention within a time that was closer to the intended treatment protocol (8 weeks). This may be accounted for by the greater number of face-to-face sessions scheduled at regular weekly intervals by the researcher for participants in the cCRT group (9/9, 100%) as compared with the cCBT group (16/19, 84%), which was accessible online and able to be completed independently.

In general, the complexity of both of the interventions and the heterogeneous needs of the sample in relation to cognitive, functional, and physical functioning, as well as familiarity with use of computers, meant that there was a fairly high degree of variation in how the research protocol was applied between participants. Of note was the difference in time from discontinuation of treatment and administration of the post-assessment between the two groups (cCBT: mean 31 days [SD 31 days]; cCRT: mean 8 days [SD 6 days]).

Some individuals needed more support (eg, face-to-face technical assistance) to complete the computerized interventions. For example, a proportion of participants found it difficult to remember to do the homework tasks; some were able to do tasks between sessions if a carer prompted them to complete the exercises; others reported that they could remember to do the homework tasks but felt unmotivated or unable to do so.

Furthermore, although it had been initially intended that participants would complete the computerized intervention in groups, the median group size was only two people, and this was only achieved for 40% of cCBT sessions completed and 32% of cCRT sessions completed. Several participants (cCBT: 6/19, 32%; cCRT: 5/9, 56%) completed the intervention in their own homes on their own computer or a computer that was provided by the research team.

Table 1. Raw (unadjusted) differences between baseline characteristics of participants included in the two treatment arms, separately.

Variable	cCBT[a]	Active control, cCRT[b]	Group differences
N	19	9	
Female, n (%)	9 (47)	1 (11)	Fisher exact test, $P=.10$ $OR=7.20$
Age, mean (SD[c])	62.1 (11.4)	64.6 (8.1)	Dif[d]$=2.5$ (95% CI -5.3 to 10.3), $P=.51$, D[e]$=0.27$
Time since stroke, median (IQR[f]: 25th-75th)	1.190 (0.5-1.1)	0.89 (0.6-4.1)	Kruskal-Wallis $\chi^2_1 = 2.2$, $P=.14$
GCSEs[g], n (%)	7 (37)	7 (78)	Fisher exact test, $P=.16$, OR[h]$=4.50$
A-levels, n (%)	9 (47)	2 (22)	
Bachelor's, n (%)	3 (16)	0 (0)	
Master's, n (%)	0 (0)	0 (0)	
PhD, n (%)	0 (0)	0 (0)	
Taking anti-depressants, n (%)	10 (53)	1 (11)	Fisher exact test, $P=.05$, $OR=8.89$
Baseline BDI-II[i], mean (SD)	19.1 (5.8)	13.4 (4.1)	Dif$=-5.6$ (95% CI-9.6 to -1.6), $P=.01$, $D=1.19$
Baseline BAI[j], mean (SD)	11.2 (7.6)	8.3 (6.2)	Dif$=-2.8$ (95% CI-8.5 to 2.8), $P=.31$, $D=0.42$
Baseline NEADL[k], mean (SD)	45.5 (14.6)	53.6 (12.5)	Dif$=8.0$ (95% CI-3.2 to 19.3), $P=.15$, $D=0.61$
Sessions attended, mean (SD)	6.3 (2.5)	7.2 (2.3)	Dif$=1.0$ (95% CI -1.1 to 3.0), $P=.34$, $D=0.40$
Weeks in intervention phase, mean (SD)	11.3 (7.7)	8.9 (3.3)	Dif$=-2.4$ (95% CI -6.7 to 1.8), $P=.25$, $D=0.47$

[a]cCBT: computerized cognitive behavioral therapy.

[b]cCRT: computerized cognitive remediation therapy.

[c]SD: standard deviation.

[d]Dif: difference.

[e]D: Cohen effect size measure.

[f]IQR: interquartile range (25-75).

[g]GCSE: General Certificate of Secondary Education.

[h]Odds ratio based on differences between controls and CBTs on just GCSEs and A-levels.

[i]BDI-II: Beck Depression Inventory-II [22].

[j]BAI: Beck Anxiety Inventory [23].

[k]NEADL: Nottingham extended activities of daily living [27].

Differences Between Trial Arms

There were also deviations to the research protocol in terms of the characteristics of participants allocated to the two intervention conditions. By design, as described in the methods, the cCBT arm had twice as many participants as in the active control arm. Significantly more ($P=.05$) of the cCBT group (10/19, 53%) were taking antidepression medication than in the control group (1/9, 11%), a large effect (odds ratio, OR=8.89). This may be linked with the significantly ($P=.008$) higher average level of baseline BDI-II score in the cCBT group (mean 19.1) than in the control group (mean 13.4). Raw unadjusted differences between the trial arms are shown in Table 1. Additional information on the characteristics of the participants included in the two trial arms in terms of their functional, cognitive, and estimated premorbid intelligence quotient abilities are provided in Table 2. Group comparisons were underpowered due to small sample sizes, and although none of the differences in Baseline BAI, Baseline NEADL, Sessions attended, and weeks in intervention phase between the two arms reached statistically significant differences, comparisons did still attain a moderate effect size as shown in Table 1.

Acceptability and Relevance of the Interventions

Subjective Ratings

Average ratings of the usefulness, relevancy, and the ease of use of each session of the two interventions are shown in Figure 2. These ratings ranged from 4 to 7 out of 8 for useful, relevant, and easy to use across participants for all sessions. Both cCBT and cCRT were rated as near equally useful (mean=6.4 vs 6.5, $d=0.05$), while cCBT was somewhat less relevant (mean=5.5 vs 6.5, $d=0.45$) but somewhat easier to use (mean=7.0 vs 6.3, $d=0.31$). Group comparisons were underpowered due to small sample sizes and none of these differences in the overall ratings between the two arms reached statistical significance (usefulness: $P=.93$; relevancy: $P=.38$; and the ease of use: $P=.13$).

Table 2. Functional ability, cognitive functioning, and estimated premorbid intelligence quotient (IQ) of participants included in the two intervention arms.

Functional Domain	cCBT[a] (n=19)	Active control, cCRT[b] (n=9)
Functional ability, raw scores on NEADLS: mean (SD[c]), min=0		
Mobility, max=9	6.26 (2.51)	7.11 (2.15)
Kitchen activities, max=7	5.68 (1.77)	6.78 (0.44)
Other domestic activities, max=6	3.42 (1.87)	4.46 (2.40)
Leisure activities, max=9	5.59 (2.17)	6.22 (2.49)
General cognitive functioning, raw scores on ACE-R[d] : mean (SD), min=0		
Attention/orientation, max=18	17.74 (0.56)	17.11 (2.03)
Memory, max=26	19.11 (6.00)	21.56 (3.71)
Verbal fluency, max=14	9.05 (3.44)	10.00 (3.87)
Visuospatial skills, max=16	14.21 (2.02)	14.78 (1.09)
Language, max=26	23.74 (1.33)	22.22 (4.29)
Overall cognition, max=100	84.21 (9.70)	84.21 (9.11)
Estimated premorbid IQ, from NART[e] raw scores: mean (SD), min=0	112.11 (4.46)	109.78 (7.58)

[a]cCBT: computerized cognitive behavioral therapy.

[b]cCRT: computerized cognitive remediation therapy.

[c]SD: standard deviation.

[d]ACE-R: Addenbrooke's cognitive examination [28].

[e]NART: National Adult Reading Test [29].

Reasons for Dropout

Across the course of the intervention, more participants dropped out of the cCBT (7/19, 37%) as compared with the comparison (1/9, 11%) condition as shown in Table 3. One participant dropped out before starting treatment due to improved mood. Due to other commitments, a participant from the cCRT group dropped out before posttreatment assessment. Posttreatment assessment data for two participants in the cCBT group were lost to follow-up (see Figure 1). Of most concern were those who dropped out due to potential adverse effects of the intervention, all of whom belonged to the cCBT condition. These individuals reported slightly worse mood or more anxiety as a consequence of commencing cCBT. No one reported additional risks (eg, thoughts to harm self) as a result of completing modules in the cCBT condition. Any potential adverse outcomes were notified to participants' GPs and, with permission, they were referred on to a clinical psychologist specializing in neurorehabilitation.

Descriptive Statistics for Self-Reported Symptoms and Activity Outcomes

Table 4 displays the descriptive scores across the three different time points for both groups. All groups demonstrated a decrease in symptoms of distress across time, but there was very little difference in terms of functional ability between pre- and postintervention measurement points. A larger sample of participants is needed to establish reliable magnitudes of change or to measure group differences.

Table 3. Number of people who dropped out from one or other of the treatment conditions and their reasons for this.

Reason for dropout	cCBT (n=19)	cCRT (n=9)
Other commitment, n (%)	2 (10.5)	1 (11.1)
Potential adverse effect, n (%)	3 (15.8)	0 (0)
Ineffective, n (%)	1 (5.3)	0 (0)
Deterioration not due to intervention, n (%)	1 (5.3)	0 (0)

Figure 2. Ratings of usefulness, relevancy, and the ease of use of each session and the courses overall for (1) computerized cognitive behavioral therapy (cCBT) and (2) computerized cognitive remediation therapy (cCRT) as a comparison condition.
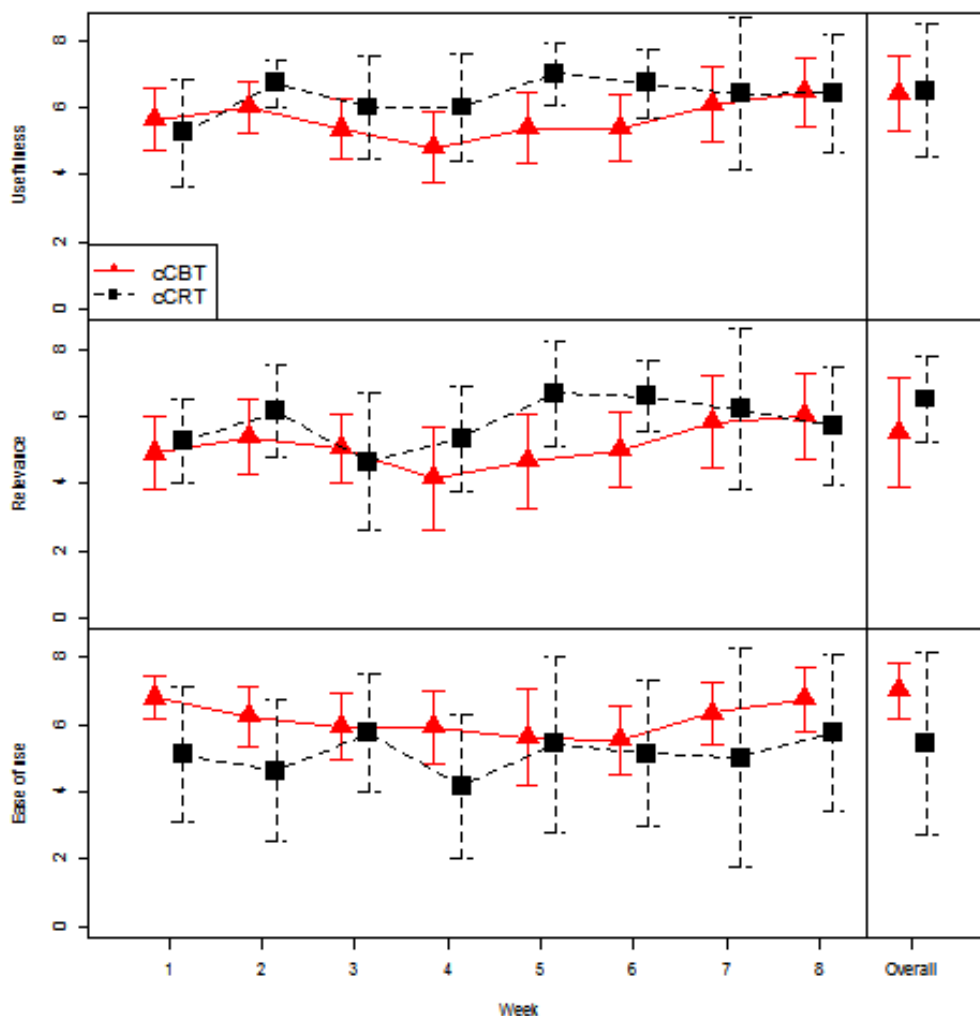

Table 4. Descriptive statistics for the three repeated measures at the three time points.

Time	Beck Depression Inventory (BDI-II)						Beck Anxiety Inventory (BAI)						Nottingham extended activities of daily living (NEADL)					
	cCBT[a]			cCRT[b]			cCBT			cCRT			cCBT			cCRT		
	N	Mean (SD[c])	95% CIs	N	Mean (SD)	95% CIs	N	Mean (SD)	95% CIs	N	Mean (SD)	95% CIs	N	Mean (SD)	95% CIs	N	Mean (SD)	95% CIs
Baseline	19	19.1 (5.8)	16.3-21.9	9	13.4 (4.1)	10.3-16.6	19	11.2 (7.6)	7.5-14.8	9	8.3 (6.2)	3.6-13.1	19	45.5 (14.6)	38.5-52.6	9	53.6 (12.5)	43.9-63.2
Postintervention	15	9.5 (8.1)	5.0-14.0	8	9.4 (5.6)	4.7-14.1	15	8.7 (9.0)	3.7-13.7	8	6.5 (6.1)	1.4-11.6	14	52.4 (12.0)	45.5-59.4	7	54.6 (13.5)	42.1-67.1
Three-month follow-up	15	7.9 (5.3)	4.9-10.8	7	11.1 (6.8)	4.8-17.4	16	9.3 (11.4)	3.2-15.4	7	6.1 (4.3)	2.2-10.1	15	49.1 (15.8)	40.3-57.8	6	53.5 (18.1)	34.5-72.5

[a]cCBT: computerized cognitive behavioral therapy.

[b]cCRT: computerized cognitive remediation therapy.

[d]SD: standard deviation.

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Discussion

This study reports on the feasibility and acceptability of a cCBT intervention compared with an alternative computerized therapy condition based on CRT. Overall, our protocol design was reasonable: both interventions were considered appropriate, accessible, and useful. However, a number of adaptations were required to the research protocol and it was clear that a pragmatic approach is required to deliver computerized interventions to accommodate individual needs, the specifics of which will be discussed.

Feasibility of the Research and Intervention Protocols

In terms of the feasibility of the research and treatment protocols, most aspects were followed, as planned. Indeed, all people who enrolled into the intervention phase were able to access the resources needed to engage in a computerized psychological intervention. This was achieved by a flexible and pragmatic approach to service provision, with participants using a combination of home-based and other community-based (eg, library) computers. However, some aspects of the intervention protocols required a greater level of flexibility; this included an extension to the length of time needed for participants to complete the intervention and allowing a proportion of participants to access the interventions independently. This was, in part, due to the geographically dispersed area over which the interventions were carried out and the heterogeneous needs of the population in terms of cognitive, communication, and physical abilities. Some of the deviations to the research protocol were in line with previous findings [30], in which a sample of people who had experienced a traumatic brain injury also took longer than expected to complete a course of cCBT. These authors suggest that this was a reflection of limitations posed by cognitive difficulties and that many people found it hard to access necessary computer and Internet resources. The cCBT intervention, which enabled participants to log on remotely, over the Internet, without the assistance of a researcher to facilitate this, made for greater accessibility. However, overall, participants in the cCBT group took longer to complete the intervention when they accessed the program independently with remote supervision. Although this meant that they also completed a greater number of sessions, there are implications for resources such as the length of time that online interventions are and remote supervision is made available to clients.

In terms of practical considerations, without access to a printer, participants needed to be provided with hard copies of materials, some of which were required in order to record completed tasks in daily-life between sessions. The need for "off-line" resources may have contributed to difficulties with adhering to this part of the intervention protocol, for example, completion of tasks between sessions. It suggests a benefit for interventions that can be completed entirely computerized or administered "online" via either a computer or mobile device. This suggestion will be important to consider when developing further resources. Although it is important to note that preferences for a "high-tech" treatment may naturally be more acceptable to some as compared with others, and perhaps relates to previous

familiarity with technology, this hypothesis was not formally assessed in this study.

The computerized control intervention worked well as a comparator intervention, but required a greater degree of technical facilitation and shared a number of "active components" with the cCBT intervention, such as therapeutic contact and activity scheduling, both of which could have a potential impact on mood, for example, behavioral activation has been shown to be an effective intervention for reducing symptoms of depression [31]. Future studies could consider including a "treatment as usual" condition, such as a waiting-list design. The differences in characteristics between the two trial arms is also important for the purpose of designing future experimental studies and clinical trials to test the efficacy of computerized or Web-based psychological resources, which was beyond the scope of this study. In a larger scale RCT, certain variables (eg, severity of symptoms at baseline) should be more balanced with a greater sample size. However, consideration of stratifying, for example, by antidepressant use, will be worth noting for the design of future RCTs.

It was intended that postintervention assessment would be carried out by someone who was blind to which intervention participants had received. Unfortunately, this did not prove to be feasible due to limited resources. Although, where possible, the postintervention assessments were sent to participants in the post (self-report measures only) and were completed without supervision from a researcher, in an attempt to reduce observer bias, this methodological issue should be considered in greater depth when designing a larger scale trial.

A final, interesting, and somewhat unexpected finding with regard to feasibility was the discovery of a significant minority of people who had ongoing problems with anxiety and depression beyond the first year following their stroke. These people were almost invariably not receiving any support from neurorehabilitation services and their management was being primarily overseen by their GP. This demonstrates a potential unmet need in current service provision for emotional support following a stroke, and it makes a case for longer availability of psychological input *and better collaboration between psychological services and primary care*.

Acceptability and Relevance of the Interventions

Quantitative ratings of usefulness, relevance, and ease of use of the treatment sessions and intervention conditions overall were a useful addition to this study over previous feasibility studies in this area [30,32]. They demonstrated that the majority of the content was deemed useful for the population. However, the cCBT was rated as somewhat less relevant but somewhat easier to use. There were also variations both across sessions and across participants that could be used to guide the development of future resources that could be targeted more to the needs of this specific clinical group.

It is encouraging to note that many of the participants in the cCBT condition provided very positive qualitative feedback about the package. In support of the quantitative ratings, people recognized the usefulness of the content; a participant fed-back that they "could see how it relates directly to time management,

i.e. identify tasks and priorities and set aside (a) date and time to complete them," which they self-identified as "something I have an issue with since I am at home 24/7 and as such feel I can do anything any time and struggle to be disciplined." A number of people commented that cCBT helped to improve their level of confidence, feel more positive about the future, and less frustrated. One participant commented:

> I do feel as if I have strategies for coping now. I just have to keep reminding myself to use them. The program did help me a lot and I believe it has helped me cope with a lot of the inner beliefs about myself that were not quite accurate.

Another participant, who particularly benefited from cCBT, expressed that:

> It's helped me come out of my comfort zone and face things, and that it helps you to understand yourself because you feel different.

Previously, this participant had described experiencing a stroke as "it's like an alien creeping in one side of you." The same participant told the facilitator that they had used the worksheets to help communicate how they were feeling with their family and friends. This was an unexpected positive finding.

The dropout rate in the present study for the cCBT intervention was almost identical to that reported in a previous study [30] (37% as compared to 38%, respectively) and is also comparable to findings reported in other studies of cCBT within the general population [24]. While some reasons for dropout were primarily practical, for example, other time commitments, again, in support of the results of the qualitative ratings, a degree of dissatisfaction related to the relevance of the content of the cCBT program was raised. One participant explained that:

> My anxiety, when it happens, is caused by frustration of not being able to do simple things easily and then getting angry over it; for me, depression is too strong a description for how I feel, but unhappy, angry and annoyed, definitely; I find the exercises difficult since I do not go through anxiety or depression which the course is aimed at.

Another participant mentioned that they thought that their difficulties related to low self-esteem, rather than depression or anxiety. It is worth highlighting that the dropout rate for the cCRT group was lower than for the cCBT group (11% as compared with 37%). The reason for this is unknown and may reflect differences in the method of delivery between the two groups with a larger proportion of participants in the cCRT group receiving face-to-face support in their own homes. However, it is also possible that this result indicates that the cCRT intervention was more acceptable to the participants who undertook it.

Despite some people responding well to the interventions trialed in this study, others reported feeling worse (ie, reported greater levels of anxiety and lower mood) as a consequence of starting to complete the computerized therapy courses, specifically in relation to the course of cCBT. In general, little was known about other life circumstances that may have contributed to an increase in psychological distress. Therefore, more information

is required before concluding whether or not participants reporting an increase in scores on the outcome measures experienced an adverse effect specific to the intervention received. Further follow-up, including more in-depth interviews, could be useful in answering this question. However, potential risks associated with any intervention must also be addressed. This highlights the need to consider the relevance of the clinical intervention recommended, given each person's individual situation and presenting problems, and for suitable procedures to be in place to allow for escalation beyond low intensity interventions such as cCBT to access a greater level of psychological support, where necessary. Variation in response could be accounted for by differences in cognitive abilities. Indeed, research has found that executive functioning moderates response to CBT for generalized anxiety within an older adult population [33]. Research suggests augmenting CBT interventions with techniques to promote internal motivation to make behavioral changes, directly addressing issues associated with grief and loss as well as accommodating to cognitive abilities so that they are individually tailored to a person's needs following a stroke [34].

Future Research and Conclusions

Further work is needed to target computerized or other Web-based self-help interventions such as cCBT to the right people. There is good evidence to support the effectiveness of cCBT for depression [10,35]. However, depression might not have been the primary problem for everyone. Indeed, it has already been mentioned that a mixed group of people displaying problems commonly associated with depression and/or anxiety were recruited to take part in this study, some of whom may have required greater, or different, support for anxiety. This study trialled the feasibility and acceptability of an "off the shelf" cCBT package to treat symptoms of depression and anxiety; there is scope to develop a Web-based intervention that is more targeted to the specific therapeutic needs of people post stroke, which also takes into account the practical limitations they may face, such as physical restrictions, and the need to rely on carers for transport. Similarly, people's ability to access and use the technology necessary to run the software should be considered. In this study, several people were guided to learn how to use a computer as part of the intervention, demonstrating that this is possible to achieve but requires adequate technical support.

From a broader perspective, it is important to consider barriers that impact the use of cCBT within health services. When exploring the infrastructure and information technology (IT) policies of the NHS in the United Kingdom, it was found that service users are limited by the number of computers they have access to [36]. It has also been highlighted that IT policies restricted the ability for NHS staff to provide ongoing guidance and support to potential cCBT users through, for example, contact via service user's personal email account. Moreover, for cCBT to be an effective alternative to face-to-face therapy, the perceptions of service providers must be considered. Although previous research has reported good general acceptance of Web-based psychotherapy [37], other evidence suggests that health care professionals hold negative perceptions of cCBT, and this could impact its uptake [38]. For cCBT to be

a viable and feasible intervention it is important that health services implement robust and streamlined IT infrastructures and provide information, training, and support to their staff so as not to cause additional clinical burden or interrupt therapeutic relationships [39]. These factors will be important for enabling generalization of findings reported in this study.

Despite these challenges, computerized therapy packages such as cCBT offer a promising means of making psychological support more accessible to people who have experienced a stroke. Further research, in an appropriately powered RCT, is needed to determine the efficacy of the cCBT interventions over and above other treatment options and the process of natural recovery. However, this study has demonstrated that guided cCBT is a feasible and appropriate intervention for many people who have experienced a stroke and, if found to be effective for treating symptoms of depression and/or anxiety, it could be a useful tool to add to the repertoire of neurorehabilitation services, increasing access to psychological support.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Summary of the structure and content included in the two interventions.

[PDF File (Adobe PDF File), 24KB - mental_v4i2e16_app1.pdf]

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Abbreviations

ACE-R: Addenbrooke's cognitive examination
BAI: Beck Anxiety Inventory
BDI-II: Beck Depression Inventory-II
cCBT: computerized cognitive behavioral therapy
cCRT: computerized cognitive remediation therapy
CLAHRC: Collaboration for Leadership in Applied Health Research and Care
EoE: East of England
GCSE: General Certificate of Secondary Education.
GP: general practitioner
IT: information technology
NART: National Adult Reading Test
NEADLS: Nottingham extended activities of daily living scale
NHS: National Health Service
NIHR: National Institute for Health Research
SD: standard deviation

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