Digital Mental Health Interventions for Older Adolescents: A Human-Centered Design Study

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Abstract

Background: Anxiety and depression are common in adolescents, but adolescents are often uninterested in formal mental health treatments or are unable to access them. Digital interventions can be delivered at scale to bridge critical gaps in mental health care but must address the needs and preferences of adolescents.

Objective: We recruited older adolescents (18 years of age) to participate in a series of human-centered design activities to inform both the design of digital mental health interventions for adolescents broadly as well as refinements to an automated text messaging intervention, Small Steps SMS, that was originally designed for young adults.

Methods: Non-treatment engaged 18-year-olds in the USA with experiences of depression and/or anxiety were recruited through social media advertising and online self-screeners hosted by Mental Health America, a mental health advocacy organization. Participants (N=12) answered researcher prompts and engaged with one another in an asynchronous online discussion group for 24 days, with a new discussion prompt released every 3 days. In parallel, participants used Small Steps SMS, an automated text messaging intervention which delivers daily interactive dialogues supporting mental health self-management. Questions in the discussion group asked about mental health challenges, help-seeking attitudes, perceptions of Small Steps SMS, and ways the program and other digital mental health interventions should be adapted to the needs of older adolescents. A subset of participants (N=4) also completed interviews to elaborate on their responses. Thematic analysis was applied to transcripts of the discussion group and interviews to characterize user needs and design priorities when making Small Steps SMS and similar interventions available to adolescents.

Results: Participants reported factors that contributed to their experience of mental health symptoms, including the transition from adolescence to adulthood, fears that the world is unstable and that their futures are uncertain, and ineffective use of social media for coping. Participants were proud of their generation's mental health acceptance, but also observed a generational divide in mental health stigma and literacy that could impede seeking help from parents and other adults. Participants appreciated that Small Steps SMS allowed them to pursue mental health self-management conveniently and independently. They suggested that the program address adolescent-specific challenges and facilitate inter-generational communication about mental health. They also recommended possible ways to increase engagement through peer-to-peer communication, gamification, and greater explanation of self-management strategies.

Conclusions: Major life transitions affect adolescents' mental health needs and their preferences for digital mental health tools. While interactive automated messaging programs have potential to support self-management in this population, program content and features should be adapted to adolescents.

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Keywords: depression; anxiety; adolescents; qualitative data; text messaging; digital mental health; user-centered design

Introduction

Background

Adolescence refers to the developmental stage between childhood and adulthood, defined by the World Health Organization as spanning 10 to 19 years of age [1]. Adolescence features unique biological developmental changes (i.e. puberty), high attunement to social information, heightened emotionality, and evolution of social roles and self-concept [2–4]. These changes make adolescents vulnerable to the emergence of mental health symptoms [5]. In addition, adolescent mental health has been affected by recent trends and events, including increases in screen time and social media use, and the COVID-19 pandemic and related lockdowns [6,7]. Prevalence of past-year major depressive episodes among 12–17-year-olds nearly doubled between 2005 and 2019, increasing from 8.7% to 15.7%, then further increased to 20.1% in 2021 [8–10]. In 2020, 20.5% of adolescents reported clinically elevated anxiety symptoms [11].

Despite high levels of mental health symptoms, few adolescents access mental health services. Typically, adolescents seek informal help from trusted friends and family members before turning to formal sources like medical professionals or school resources [12–14]. Among adolescents affected by recent major depressive episodes, only 40.6% received relevant treatment [10], and treatment rates for anxiety disorders were similarly low [15]. This reflects common barriers to help-seeking like stigma, which may be particularly salient to socially developing youth [4,16]. Other common barriers include costs, inadequate insurance, limited availability of services, low mental health literacy, negative beliefs about mental health services, and preferences for self-reliance [17–20]. Many states require parental consent for minors to pursue mental health treatment [21], which poses an additional barrier when adolescents anticipate or experience stigma from parents/guardians or prefer to pursue treatment independently [22,23].

There is a growing consensus that the unmet mental health needs of adolescents represent a public health crisis [24,25]. Untreated mental health symptoms in adolescence can lead to distress and suffering, and increase the risk of poor academic performance, non-completion of high school or college, psychiatric problems later in life, and suicide [26–29]. Early intervention can help adolescents manage symptoms and build coping skills, potentially changing the trajectory of mental health conditions into adulthood [30].

Digital mental health interventions (DMHIs) represent a potential solution to address the unmet mental health needs of adolescents. Most adolescents have access to and familiarity with digital devices, with 95% of US teens having access to a smartphone in 2022 [31]. DMHIs are generally well-received by adolescents, who report a preference for DMHIs that offer flexibility, self-reliance, opportunities for communication with others, and privacy [32]. Examples of existing DMHIs include mobile phone apps, therapeutic video games, and mental health focused web programs [32,33]. These DMHIs have employed many approaches, including coping skill education, mindfulness training, mental health coaching, self-monitoring and self-tracking, and social support [32,34,35]. Some DMHIs have been designed with scalability in mind, such as by delivering interventions in online spaces where adolescents seek mental health information and through communication channels that are already highly used by young people like messaging apps, texting, and social media [36–38].

Despite the potential alignment between DMHIs and the needs and preferences of adolescents, most DMHIs to date have focused on adults [39–41]. A systematic overview from Lehtimaki et al. (2021) concluded that DMHIs for adolescents demonstrate benefits for anxiety, depression, and stress when

compared to non-active control groups (receiving no treatment or waitlisted for treatment), but they did not find differences relative to active controls [32]. They also found that completion rates among the reviewed interventions varied widely, ranging between 10% and 94%. Low engagement and high attrition are common issues in trials of DMHIs [35], and these issues are even more pronounced in the real-world [42], reflecting the loss of structure and support outside of trials, and a less motivated population of users [43]. To meaningfully address adolescents' unmet mental health needs, there is a need for DMHIs that are effective as well as engaging in the context of adolescents' day-to-day lives.

Objectives for This Study

To ensure digital mental health tools have potential for real-world engagement, the digital mental health community increasingly employs human-centered design methods from the human-computer interaction field [43–45]. These methods engage end-users to understand their needs, elicit their design ideas, gather iterative feedback on DMHI prototypes, and establish usability, with the goal of creating tools that are engaging and useful to real-world users.

Consistent with such a focus, this paper applies a qualitative human-centered design approach to understand how DMHIs can better address the needs and preferences of older adolescents who are not in formal mental health treatment. We also seek to gather feedback on interactive automated text messaging interventions, and particularly Small Steps SMS, a program that was originally designed for young adults [46–48]. The content delivered via SMS provides psychoeducation and support relevant to several mental health self-management strategies, drawing on evidence-based psychotherapies such as cognitive behavioral therapy and acceptance and commitment therapy. Automated interventions delivered via communication channels regularly used by young people have the potential to expand access to mental health support at large scale and low cost. This study seeks to provide insight into the mental health challenges faced by older adolescents, how they approach help-seeking and self-management, and the content revisions and design features that may align automated mental health messaging tools like Small Steps SMS to their needs.

Methods

To facilitate participation in study activities despite the sensitive and stigmatized nature of mental health issues, we employed asynchronous remote community methods [49], which allow participants to share their thoughts, opinions, experiences, and preferences anonymously within a private discussion forum, and to build on one another's contributions. In parallel, participants used the Small Steps SMS program for 3 weeks, receiving daily interactive text messages to support mental health self-management. A subset of participants also completed semi-structured phone interviews.

Participants

Participants in our study were recruited through social media advertisements on Meta (Facebook and Instagram) and through free self-screening surveys for depression and anxiety (i.e., the 9-item patient health questionnaire (PHQ-9) [50] or 7-item Generalized Anxiety Disorder scale (GAD-7) [51]) hosted on the website of Mental Health America, a national mental health advocacy organization. Potential participants completed an eligibility survey and were invited to enroll in our study if they self-reported being US residents, having experienced depression or anxiety, sufficient English language ability to participate in study activities, access to a personal smartphone, and being 18 years old. This focus on 18-year-olds allowed us to capture challenges around the transition from high school into early adulthood, and to gather informed consent directly from participants who are legal adults. Exclusion criteria included being engaged in formal mental health treatment; visual, hearing,

or motor impairments that would restrict individuals in completing study activities; self-reported serious mental illness (psychotic disorder or bipolar disorder); or suicidal ideation with plan and intent. Potential participants were required to provide a valid US mobile phone number at which they could receive text messages. Of the 17 individuals who met eligibility criteria and provided informed consent, 14 completed the required steps to enroll in our study and, of these individuals, 12 engaged in the study's discussion group and are included in our analyses.

Reference Table 1 for participant demographics, treatment history, and symptom severity. Participants were mostly women, were racially and ethnically diverse, and half reported prior mental health treatment. Current symptoms of both anxiety and depression were moderate, on average.

Table 1: Participant demographics, mental health history, and symptom levels

	Characteristic	Discussion group (n = 12)	Interview (n = 4)
Gender, n (%)			
	Female	8 (67)	3 (75)
	Male	3 (25)	1 (25)
	Non-binary	1 (8)	0 (0)
Race, n (%)			
	White	3 (25)	1 (25)
	African American	3 (25)	2 (50)
	Asian	3 (25)	1 (25)
	More than one race	3 (25)	0 (0)
Ethnicity, n (%)			
	Hispanic/Latinx	4 (33)	1 (25)
	Not Hispanic/Latinx	8 (67)	3 (75)
Mental Health Treatment History, n (%)			
	Has previously seen a mental health professional	6 (50)	1 (25)
	Has previously been prescribed Rx for a mental health condition	3 (25)	1 (25)
Depression and			

anxiety symptoms, M (SD)			
	PHQ-9	13.42 (4.25)	13.00 (5.60)
	GAD-7	12.83 (3.79)	13.25 (5.06)

Procedure

All study procedures were approved by the Institutional Review Board at the authors' institution. Data were collected between August 2023 and September 2023.

Discussion Group

Participants were registered for an online discussion group based on asynchronous remote community methods [49]. The discussion group was hosted on the FocusGroupIt.com website. Participants were asked to submit text-based responses to prompts posted by the researchers every 3 days for 24 days (8 prompts total). Prompts asked about participants' mental health experiences, treatment and self-management needs, and perspectives on the design of digital tools for mental health. To encourage active dialogue and collaborative thinking, participants were also asked to reply to each other's responses.

Responses in the discussion group were visible to all study participants; however, participants were identified to one another only by generic pseudonyms that were automatically assigned upon registration to the website (i.e., "Participant 1", "Participant 2", etc.). Participants in the discussion group agreed to follow a code of conduct which advised them to engage others with respect and to avoid disclosing personally identifying information or details about methods of suicide or self-harm. Responses were monitored daily for compliance with the code of conduct. Text-based data from the discussion group were automatically saved by the website and downloaded by the researchers at the conclusion of the study.

Responding to each researcher-posted discussion prompt was compensated $7. For each prompt, responding to at least one other participant was compensated $2. Thus, participants could earn up to $9 per prompt and $72 total for participating in the discussion group, which was delivered in the form of a gift card upon completion of the study.

Small Steps SMS Program

Participants in our study were also enrolled in the Small Steps SMS program following the third discussion group prompt. They received messages for 3 weeks. Within the discussion group, participants were asked to reflect on their experiences with, impressions of, and suggestions for the Small Steps SMS program and similar programs.

Small Steps SMS is an automated text messaging intervention to support self-management of depression and anxiety symptoms [46–48,52]. Small Steps SMS was designed to sustain engagement through 1) delivering diverse interaction types (e.g., peer stories, reflection questions,

psychoeducation, action prompts) and 2) supporting low-stakes experimentation with a variety of evidence-based self-management strategies (e.g., thought challenging, behavioral activation, valued living, self-compassion). Dialogues are interactive, with a subset of messages asking participants to respond back with their feedback, choices, and experiences. The number of daily messages sent to each participant was dependent on user responses such that participants who were more engaged with the program received more messages. Participants were not required to respond to messages from Small Steps SMS and received no compensation for engaging with the program. They could send the word "STOP" at any time to end all messages.

Participants were invited to complete optional semi-structured interviews with researchers after discussion group activities concluded. The main purpose of the interviews was to allow participants to share detailed feedback on the researcher prompts and Small Steps SMS that may not have been covered in discussion group responses. Interviews lasted approximately 20-25 minutes and were conducted via the Zoom teleconferencing platform. Participants could turn their video on or off based on their preference. Interviews were audio recorded and transcribed. Participants could earn an additional $8 for completing an interview (in the form of a gift card).

Safety considerations

Individuals who completed screening or participated in the study were provided with a list of resources for accessing 24/7 mental health support, if needed (e.g., suicide prevention hotline, crisis text line). Across all activities, research staff had a risk management protocol in place, such that sharing any information signaling they were a risk to themselves or others would prompt the researcher to contact the participant to administer risk assessments and provide resources, if needed. No such risks emerged and therefore no follow-up was conducted.

Data analysis

Discussion group and interview data were subject to thematic analysis [53]. Four coders, who are authors of this paper, first became familiar with the data by reading the discussion group and interview transcripts. They performed open coding to identify preliminary codes and met to discuss and prioritize these codes, guided by each code's relevance to the research questions. Prioritized codes and their definitions were captured in a shared codebook. The coders then applied the codebook to overlapping transcripts using the qualitative data analysis software Dedoose, and subsequently met to discuss and resolve coding discrepancies and to refine and consolidate the codebook. Approximately four overlapping coding rounds were completed before discussions ceased to yield codebook revisions. Three of the coders then divided the uncoded transcripts and applied the final codebook. Key themes were identified that encompassed the coded data, and excerpts were selected to illustrate each theme.

Results

Overview

Our study included adolescents with any prior experiences of depression or anxiety; however, most participants reported mental health symptoms that were current. Participants' symptoms varied in duration – some had experienced chronic and persistent symptoms lasting months or years, while for others, symptoms had only manifested recently. Participants identified several key factors that they associated with their mental health challenges, including the life transition from adolescence to young adulthood, uncertainty in their own future, and the belief that the world is unstable.

Participants also shared their perspectives on the influence of technology in mental health, including how technology can be both helpful and harmful for mental health, and its impact on mental health literacy and stigma. Finally, participants shared their perspectives on DMHIs and how these tools can be optimized to address the mental health challenges they face.

Factors Influencing Mental Health in Late Adolescence

Participants reported experiencing a major life transition in late adolescence, and shared that certain factors encountered during this transition may have contributed to the worsening of their mental health. One factor highlighted was the pressure to manage an overwhelming number of tasks all at once, which included school-related responsibilities, commitments to extracurriculars, and employment. This was described by P6:

> “I feel like things that affect this generation is like stress, mainly I feel like there is a lot of expectations being pushed. And you try to do your very best, and sometimes people want to work, but we’re also expected to do that. And sometimes you have extracurriculars and so, you have to do all that.” (P. 6)

Participants also reported feeling overwhelmed by a growing number of responsibilities after graduating high school and transitioning to college, as stated by P7:

> “So, coming to college is a really big culture shock because you’re so – you’re responsible for everything. Everything’s on you now. Everything bad that happens, you have to ask yourself, oh, was it my fault? Did I miss something?” (P. 7)

Participants indicated feeling scared, exhausted, and unmotivated in response to changes in their daily routines, which they perceived as rapid and drastic. Overall, despite acknowledging that the transition from adolescence to adulthood is characterized by both positive and negative aspects, they described their own experiences to be jarring. P1 reflected,

> “I graduated this summer and now that it's almost fall I'm feeling weird about how life is going to be so different now because it was basically the same thing for so many years of my life. I wish I had more time to adjust to that before I'm shoved into "real life". It's kinda scary to be honest.” (P. 1)

Challenges in transitioning from adolescence to adulthood also extended to those who did not enroll in college, such as P2:

> “One of the biggest challenges I'm currently facing is with moving out to live on my own and whether or not I want to move on to college.” (P. 2)

Feeling socially excluded during the transition from adolescence to adulthood was identified as a significant trigger for symptoms of depression and anxiety, and many participants reported struggling with these types of social challenges, like P11:

> “The biggest challenge in my life is adjusting to university with a very much lively social scene I’m not used to. It’s hard adapting right now where everyone seemingly already have found their crowd of people to rely on.” (P. 11)

Similarly, P5 considered themself to have greater social challenges than their peers, in part because

they were a commuter student. They shared:

> "I feel pretty left out while everyone seems to be getting together really well. And that spiralled into me being sad and replaying a bunch of moments from last year that I still haven't moved on from yet…. I start feeling out of place, feeling very tired, and my body feels very irritable." (P. 5)

Many participants also identified uncertainty about the future as a factor that contributed to their experiences of anxiety and depression. Participants worried about their ability to successfully manage both short- and long-term goals, as stated by P1:

> "The biggest thing in life that's making me depressed and anxious is my future. I'm worried about what if I can't make it through my courses and I fail. Will I be able to make a living? ... Will I ever be able to actually find someone with the way dating culture is
> these days? Basically everything about the future and it's exhausting. I'd just like to be able to live my life in the moment and enjoy it instead of constantly worrying about basically everything and not feeling so tired and not like doing anything." (P. 1)

Finally, participants identified the belief that they were coming of age in an unpredictable world as a contributor to their mental health issues. For example, P9 shared:

> "With the state of the world these days, it's really hard to think positively about the future." (P. 9)

Participants' fears that the world is unpredictable were based, in part, on their experiences of growing up during the COVID-19 pandemic. They believed the pandemic had long-lasting effects on their mental health, disrupting the transition from adolescence to adulthood, as explained by P8:

> "...a lot of people in this young generation are stuck in their pre pandemic life where they were carefree and dependent on their parents. Counseling therapy should consider the fact that the teens from this generation need time to adjust to their new age and responsibilities" (P. 8)

Overall, participants perceived the transition from adolescence to adulthood to be highly overwhelming and disruptive to their mental health. They associated this transition with the experience of depressive and anxious symptoms. These challenges were further exacerbated by participants' perceptions of an unpredictable world and an uncertain future.

Adolescents' Perceptions of the Role of Technology in Mental Health

Participants perceived technology to be strongly embedded in their daily lives and often described it as a source of entertainment and distraction. For many participants, technology offered an escape from daily stressors and was considered a useful coping tool; however, some relayed that over-reliance on technology could reinforce negative habits (e.g., self-isolation) and worsen mental health symptoms. Despite reporting ambivalence regarding the impact of technology on mental health, participants believed that technology played a significant role in enhancing mental health awareness and reducing stigma, particularly within their own generation.

The Dual Impact of Technology on Mental Health: Helpful and Harmful

Participants reported relying on technology as a coping tool when dealing with acute mental health challenges. Their digital devices were described as a means of escape when they were feeling mentally unwell, allowing them to seek social support and connection. P2 shared:

> "Technology connects us to people all over the world and gives people a sense a community, which I think is important for mental health or even just for having people to reach out to when you need them." (P. 2)

Most participants discussed having used the Internet as a tool to learn more about their mental health symptoms and others' experiences. Some had also disclosed their experiences of depression and anxiety online to others, sought to understand available treatment and support options, or used mobile phone apps for mental health and wellbeing.

Some individuals also reported that social media, specifically, served as a useful coping tool for social anxiety, and attributed its usefulness to social norms that sanction the use of cell phones in public. P4 described:

> "It's a good distraction sometimes when you're, I guess, alone. Like, let's say you're in a public space, and you feel alone. You can just go on social media and just be in your own pot, and just scroll through it or whatever." (P. 4)

Many participants recognized that technology has a dual impact on mental health, noting that it has the potential to improve but also to worsen symptoms of depression and anxiety. Participants reported beliefs that using technology as a mental health coping tool could encourage avoidant behaviors and potentially exacerbate symptoms. P10 summarized this concern, sharing that they frequently turned to technology to escape their problems, but that technology did not address the root of the issues they faced. They summarized that technology "hurts me more than it helps, I end up spending too much time on reels and ignoring the issues completely." (P. 10)

Similarly, P7 described:

> "I think I fell victim to using technology as a distraction all the time. But even I know that technology, like social media doesn't fix everything and can even make it feel worse." (P. 7)

P7 also questioned whether using technology in place of traditional social engagement could have unintended negative consequences:

> "But then, on the other side, I think it can be very harmful because of the things that people use technology for. Social media can be very harmful. And I feel like some people can use technology as a way to avoid people." (P. 7)

While participants recognized that technology could temporarily help them escape their problems, they recognized its potential to serve as an unhealthy coping mechanism that could prevent them from addressing the root causes of their mental health issues and engaging in more effective treatment strategies.

Reducing Mental Health Stigma Using Technology

Participants strongly advocated for mental health awareness and resources, emphasizing that mental health concerns should be taken seriously and that access to treatment should be readily available. They reported observing a generational gap in mental health awareness, believing that younger generations possess greater understanding of mental health issues compared to older generations. P7 shared:

> "I think mental health issues are so normalized with younger people compared to older people... I think younger people are more understanding and open to talking about mental health issues because they've been exposed to it more often." (P. 7)

Participants attributed generational differences in mental health awareness largely to the rise of the internet, and specifically social media, as stated by P2:

> "People my age grew up with social media and the Internet as it was forming, so naturally we were a lot more exposed to mental health issues (both good and bad) than those who are older." (P. 2)

Thus, many participants felt that technology had benefited their generation by raising mental health awareness, which enabled them to openly discuss mental health issues with others and seek help when needed; however, many participants reported fears that their mental health issues would be dismissed or invalidated by members of older generations. P9 described:

> "Older generations, in my experience, tend to brush off any negative emotions or feelings as being weak or made up for attention. This has to do with the lack of research and widespread knowledge of mental health issues at the time. So, now, we see a lot of older people tend to say they're fake simply because it's newer information, and they still need time to adjust to it being the norm." (P. 9)

Similarly, P1 stated:

> "Younger people may just be told they're being dramatic or oversensitive or to just get over it or deal. Or that it will pass, you'll grow out of it etc." (P. 1)

Lower mental health awareness among older generations was perceived to be a barrier to mental health treatment by participants, in part because adolescents often must go through a parent, teacher, or other adult to access mental health resources. P4 shared some of their concerns about discussing mental health treatment with a parent:

> "Well, personally, I would feel uncomfortable because my dad would be like, why are you doing that? What do you need it for? He's just gonna ask a lot of questions that I'm just gonna pause it, and don't know the answer to any of it." (P. 4)

Some participants viewed technology as an opportunity to bridge gaps in mental health awareness and to facilitate intergenerational conversations on mental health topics; however, those who lacked confidence in involving adults in their mental health decision-making were more likely to report an interest in seeking resources independently. Overall, participants were interested in mental health solutions that could help them treat symptoms of depression and anxiety without stigma or

judgement. Participants' preferences for how a digital tool might meet their needs are described in the next section.

Text messaging as a tool for mental health support

Adolescents in our study expressed interest in digital tools for mental health self-management and perceived the Small Steps SMS program positively, describing it as convenient, accessible, and familiar due to its employment of text messaging. P1 explained:

> "I definitely think the fact that it's a texting program is a factor that would make people my age sign up because it's low pressure and easy to fit in when you can." (P. 1)

Participants believed that Small Steps SMS could be easily integrated within their daily routine because they could engage with it on their own time and in their own space. Others shared that text messaging reduced some of the anxiety and vulnerability that can arise face-to-face. P3 stated:

> "It also feels like there's much less pressure because it's a texting program and not face to face/ physically talking to someone." (P. 3)

P7 also provided their perspective on the sense of privacy that texting provides:

> "I think a text service would be very helpful for when people are in public and they're dealing with a mental health issue or if they are in places where they don't want their mental health to be aired out for everyone to see." (P. 7)

Addressing adolescent-specific issues in program content

While participants held favorable perceptions of Small Steps SMS, they believed that the program could be improved for older adolescents. Participants thought that the program should tailor its content to the unique challenges that their age group faces, such as major life changes that act as significant sources of stress (e.g., including the transition to college, moving away from home, or joining the workforce). P12 stated:

> "... adding more content regarding the life changes some people in the group might be going through and how to get through the mental barriers they are going through with the changes." (P. 12)

Similarly, P7 emphasized the importance of including content tailored to the transition to college, which they identified as a particularly challenging life change:

> "I think it would be really helpful, especially in the first few months of college, when you're still trying to get to know people. You're still trying to figure out how to be an adult, how to be on your own, how to deal with homesickness, and stuff like that." (P. 7)

Aside from major life transitions, some participants highlighted how parents, teachers, and other adults can impact their ability to seek help for mental health symptoms and advocated for a program that could help them navigate these generational challenges. For example, P12 imagined a program that could help younger generations communicate their mental health needs to older generations:

> “For people my age, I feel like it would be more geared towards helping them find support and being comfortable talking about it with their parents.” (P. 12)

Re-imagining engagement strategies for adolescent users

In addition to adapting the content within text messages, participants identified ways that Small Steps SMS could improve the user experience and increase engagement among adolescents. These suggestions included gamification, opportunities for peer-to-peer communication, and more scaffolding of self-management strategies.

Several participants thought that Small Steps SMS and similar interventions could benefit from the inclusion of game-like components. For example, P3 stated:

> “I think a fun and interactive way to make a tool for people my age (if I had the skill to make it haha) would be a mobile game where you do tasks to get points and earn rewards... After a certain amount of points, you get to pick a charity to donate some money to. It could also do e-gift cards as rewards as well.” (P. 3)

Participants theorized that the addition of more tangible rewards would increase engagement among adolescents, and one participant provided additional guidance on how these types of rewards could be incorporated within programs focused on self-management:

> “I think a tool that people my age would like would be an app or game that interests them and gives them in-game rewards for different things they do. This would be able to ask them different prompts about how they're feeling while not making it all about mental health. With this, it can give them the opportunity to be honest with how they're feeling while also making sure that the thing that they're using isn't fully about how they're feeling.” (P. 12)

Overall, the possible addition of gamified elements was identified as an opportunity for DMHIs to incorporate an element of fun and allow individuals to see beyond their mental health issues, while also addressing symptoms.

Participants also thought the program could benefit from the addition of peer-to-peer communication. Many participants indicated a strong interest in using Small Steps SMS to communicate with other adolescents who experienced similar challenges. P12 explained:

> “I think that people my age would like being in a program like Small Steps because they can talk with people near their age going through the same life changes as they are and can experience it together and we can help each other through the mental health part of things.” (P. 12)

Participants particularly valued opportunities to connect around similar hobbies and interests. They saw these connections as an opportunity to build community and reduce stigma of mental health issues.

Finally, some participants thought that digital interventions like Small Steps SMS should incorporate more technical guidance, as well as detailed instructions breaking down how to use the psychological strategies introduced in the text messages. P1 stated:

> “[mental health interventions] should have an easy-to-use interface with clear directions on

> how to use it… I'd add in videos or something that would give step by step guides to some of the techniques." (P. 1)

Similarly, P6 shared:

> "I agree with adding more direction to the messages. I feel the messages could be a bit more substantial." (P. 6)

Thus, presenting program content in gamified tasks, integrating peer-to-peer communication, and greater support for learning psychological strategies were seen as ways to increase engagement and satisfaction among these older adolescents.

Discussion

Principal Results

This study sought to inform the design of digital tools that can address the mental health needs of older adolescents. Through an online discussion group and series of interviews with non-treatment engaged 18-year-olds, we identified key mental health challenges as well as barriers to effective coping that are tied to the transition from adolescence to young adulthood. The transition from high school to college or the workforce was regarded as highly influential for participants' mental health. Participants also viewed their mental health symptoms as related not only to being young, but also to being young in the present moment, pointing to the perception that the world is becoming increasingly unstable and inhospitable. They also highlighted the complex influence of technology and social media on young people, contending that the impact of these tools on an individual's mental health depends on how they are used, making them either beneficial or harmful. Participants further believed that social networks had facilitated rapid change in their own mental health knowledge and awareness, as well as that of others. They perceived this increased knowledge and awareness to be empowering; however, they also find common ground with and receive validation from adults in older generations, who they found to be less aware of and informed on mental health topics. This generational divide discouraged some participants from engaging in mental health support-seeking behaviors, particularly in relation to their parents and adults belonging to older generations.

Our study deployed an automated text messaging program, Small Steps SMS, to participants to gather their feedback on messaging-based approaches to mental health challenges, as well as specific feedback on the self-management content and interactions within the program. Participants endorsed Small Steps SMS as a helpful tool, describing its automated approach to be a non-stigmatizing and low-burden way to learn self-management strategies. They noted that the program allowed them to bypass face-to-face help-seeking. Participants particularly emphasized their appreciation for the program's usability, which they attributed to the convenient and familiar nature of text messaging as a medium. Participants also suggested several changes to the program, which may also be useful for SMS mental health interventions generally, like tailored content or changing how content is delivered over time to sustain engagement. Participants highlighted that digital tools should address the specific challenges faced by older adolescents, including the disruption of transitioning out of high school and navigating inter-generational conversations about mental health. They also thought that the program could be structured to further engage them through game-like elements, peer-to-peer contact, and more detailed guidance on self-management practices.

Limitations

Adolescence spans an age range from 10 to 19 [1] and adolescents typically progress through profound changes in physical maturity, social roles, sense of self and identity, and emotional and intellectual development [2–5,54,55]. Our study focused on a relatively narrow subgroup of older adolescents: those who are 18 years old. We prioritized direct access to participants who are legal adults since parental involvement (e.g., parental consent) can act as a barrier to help-seeking and potentially to mental health research participation [22,23]. Consequently, our study is limited in what we can conclude about the needs of younger adolescents. While we asked participants to reflect on their recent experiences in high school and to comment on how younger adolescents may receive the Small Steps SMS program, we note the importance of further research prioritizing those under 18 years of age.

Additionally, although sample sizes are often small in human-centered design work [56], and small group sizes for online discussion groups are recommended to increase participants' comfort and engagement [57], we acknowledge that using additional methods and recruiting a larger sample may be helpful to triangulate these findings. Furthermore, while we recruited a diverse group of participants in regard to race/ethnicity, their recruitment online and the study's focus on technology-based solutions may have contributed to over-representing those with interest in and access to technologies.

Comparison with Prior Work

Given the extent of unmet mental health needs in the US across demographic groups, many DMHIs are designed to be suitable across various individuals in need [39–41]; however, it is increasingly recognized that programs may be more appealing and potentially more effective when designed to address the needs of narrower segments of the population [58,59]. This can be achieved either through programs that are targeted (i.e. making them available to certain segments of the population) or tailored (i.e. where content or components are delivered based on users' assessed characteristics) [59]. When targeting and tailoring DMHIs, designers must weigh the potential benefits of focusing on particular constituent groups against the resources required to do so [60]. Past work has developed programs aligned with the needs of racial/ethnic minoritized groups [59], those with limited resources or specific challenges (e.g., homelessness, trauma) [61,62], and age ranges [32], among other differences.

For young people, past work has focused on developing programs that reflect their distinct mental health needs, including through considerations of mental health literacy, differences in technology use, and settings for disseminating and implementing digital mental health tools (e.g., schools, pediatric care, or public services like libraries) [41,63,64]. Our findings build on this work, suggesting the importance of addressing the specific concerns and challenges faced by older adolescents in program content, particularly the disruption they experience while transitioning out of high school and their generation's unique relationship with technology. These findings are consistent with prior literature on older adolescence that has described the rapid and disorienting transitions in social standing and from familial dependence to independence [3,54]. Prior literature has also supported some of the engagement strategies endorsed by our participants, particularly peer-to-peer communication and gamification [32,33,65].

Our findings also highlight the importance of considering how adolescents access DMHIs. Problems may emerge when adolescents depend on parents/guardians for access, as many participants feared

or had experienced stigma and invalidation that discouraged help-seeking. Notably, some recent work has proposed a "prevalence inflation hypothesis," wherein exposure to well-intended mental health awareness campaigns on social media, in schools, and in other settings, could drive young people's inaccurate self-diagnoses or potentially exacerbate their symptoms [66]. While our findings cannot speak to the validity of this hypothesis, they do suggest that young people perceive concerns about prevalence inflation to be widespread, and they find such views invalidating and stigmatizing. Participants often thought that their mental health problems would be trivialized because of their age. To avoid unsupportive responses to mental health disclosures, they were interested in accessing treatment on their own, although some also wanted support in raising or discussing mental health issues with parents/guardians. Some work has explored technology as a tool for brokering inter-generational communication, including facilitating parent-child shared experiences, encouraging adolescents to initiate conversations about contraceptives or other health topics with parents, and self-monitoring family functioning [67]. Potential opportunities may also include dyadic interventions (i.e., that help the adolescent while also offering parallel guidance for the parent in how to support their child with a mental health issue), providing opportunities to rehearse mental health disclosure and build communication skills, and educational approaches that target parents' mental health stigma.

Our findings also suggest that these participants see their generation's acceptance of mental health issues as an important strength. In this regard, strength-based interventions, which are conceived to emphasize and understand the experiences, values, perspectives, and strengths of systemically marginalized people [68], may be useful for adolescents – who tend to identify closely with their generation. Participants noted that they are united not just as young people but as young people coming of age post-pandemic, who are witnessing historic levels of social and technological change as they enter adulthood. Some strength-based interventions focus on individuals' strengths, such as one digital tool designed for transition age youth on the autism spectrum that supports users in identifying their strengths and provides practice in expressing those strengths to others [69]. Other strength-based approaches can build an empowering collective narrative (e.g., around experiences as refugees) [70]. Helping adolescents to claim and take pride in shared traits like openness and acceptance may be a way to support adolescents through a sense of community and collective action. This may be particularly important given that participants felt their age group was misunderstood and disparaged.

Our data also speak to the deep enmeshment of technology in older adolescents' daily lives, and the dual role of technology in mental health. Potential negative effects of technology on the mental health of adolescents have been of great public concern, with the US Surgeon General recently issuing a warning about negative effects of social media use in adolescence [71]. The extent and nature of these effects has been debated, as the research literature has yielded complex and sometimes contradictory findings [72–74]. However, less work has examined how adolescents themselves perceive and balance the potential benefits and harms of technology. Our findings suggest considerable nuance in how older adolescents think about and use technology. Among our participants, technology was often used as a coping tool, sometimes successfully. Many participants also described how much they had benefited from the social awareness and de-stigmatization that the Internet had fostered related to mental health. Their regular use of mobile phones was also key to achieving continuous reach through the text messaging program, facilitating engagement in mental health self-management. However, adolescents also recognized important harms of technology, particularly social media. Often used to cope with mental health symptoms, this use could backfire and lead to lost productivity, avoidance, and isolation. Importantly, participants did not view all uses of technology as harmful but acknowledged variability across types of technology (e.g., social media versus texting) and motivations for use (e.g., avoidance versus seeking mental health information).

This is consistent with past work describing distinctions between passive use of social media (e.g., browsing feeds), which may have negative effects on mental health, whereas more active and targeted use (e.g., direct communication with close ties) may have benefits [75,76].

Conclusions

Adolescents experience high rates of mental health issues but have limited access to treatment. We engaged older adolescents to better understand their mental health challenges and priorities for the design of digital mental health tools. Participants emphasized that their mental health had been negatively and severely impacted by stressful life transitions and expressed pessimism about the future. They characterized a complex role played by technology, with both negative and positive effects on mental health. Technology, especially social media, could contribute to mental health issues, but the Internet was also seen as a potential avenue for seeking support and reducing stigma among people of their generation. Given their regular use of smartphones and texting, participants were receptive toward Small Steps SMS, an automated text messaging program for mental health self-management. They appreciated that it provided a low-burden way to access support without a need to disclose their mental health issues to others, such as parents. Participants recommended that Small Steps SMS include more content relevant to the challenges of late adolescent life transitions (e.g. high school to college, high school to workforce, familial dependence to independence), and voiced desires for game-like engagement features and opportunities to communicate with peers. Scalable digital mental health tools like Small Steps SMS may help to alleviate the mental health treatment gap for adolescents if designed to meet adolescents' unique needs.

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