

Effectiveness of Anonymous, On-Demand, Real-time Moderated Peer Support in Medicaid-Plan-Sponsored Teens: A Retrospective Analysis of Emotional Relief and Sentiment Change

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Effectiveness of Anonymous, On-Demand, Real-time Moderated Peer Support in Medicaid-Plan-Sponsored Teens: A Retrospective Analysis of Emotional Relief and Sentiment Change

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Abstract

Background: Teens from low socioeconomic status (SES) households have a higher risk for emotional distress and less access to support. Emotional distress increases the risk of mental health and other downstream chronic conditions. Today, all teens, including those from low SES households use technology pervasively. Real-time moderated digital peer support presents an opportunity to connect low income teens to a safe, evidence-based support resource in real time.

Objective: The current study focuses on Medicaid-plan-sponsored teens who were given no-cost access to a 24/7, on-demand, anonymous, real-time moderated digital peer support service to better understand the dynamics of how sentiment and emotional states changed throughout the chat conversations.

Methods: Using OpenAI's LLM model, GPT-4o-mini, employing a few-shot learning approach, 1005 conversations were evaluated for non-clinical emotional distress variables including sadness, stress, insecurity, loneliness, anger, and anxiety.

Results: Consistent, statistically significant improvement was observed in all emotional states throughout the conversations, with the greatest reductions seen for anger (46.94%, Wilcoxon signed-rank test $P = 2.265 \times 10^{-12}$), loneliness (31.99%, $P = 9.968 \times 10^{-22}$), and stress (31.02%, Wilcoxon signed-rank test $P = 2.394 \times 10^{-22}$). There were also smaller reductions in anxiety, sadness, and insecurity over the course of the conversations and a corresponding improvement in overall sentiment (196.78% increase, Wilcoxon signed-rank test $P = 1.954 \times 10^{-12}$).

Conclusions: Among a cohort of Medicaid-plan-sponsored teens, use of an anonymous, synchronous, real-time moderated digital peer support service was associated with significant reductions in sadness, stress, insecurity, loneliness, anger, and anxiety and a corresponding improvement in optimism by the end of the conversations. These marked reductions in distressing emotions continued as the conversations progressed, reinforcing the potential value of conversation-based engagement on emotional regulation and overall emotional well-being. Teens from low income households face higher incidence of mental health conditions. Digital peer support could be instrumental in easing such emotional distress and addressing the larger teen mental health crisis. Clinical Trial: N/A

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Original Manuscript

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Abstract

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The current study focuses on Medicaid-plan-sponsored teens who were given no-cost access to a 24/7, on-demand, anonymous, real-time moderated digital peer support service to better understand the dynamics of how sentiment and emotional states changed throughout the chat conversations.

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Using OpenAI's LLM model, GPT-4o-mini, employing a few-shot learning approach, 1005 conversations were evaluated for non-clinical emotional distress variables including sadness, stress, insecurity, loneliness, anger, and anxiety.

Results

Consistent, statistically significant improvement was observed in all emotional states throughout the conversations, with the greatest reductions seen for anger (46.94%, Wilcoxon signed-rank test $P = 2.265 \times 10^{-17}$), loneliness (31.99%, $P = 9.968 \times 10^{-20}$), and stress (31.02%, Wilcoxon signed-rank test $P = 2.394 \times 10^{-25}$). There were also smaller reductions in anxiety, sadness, and insecurity over the course of the conversations and a corresponding improvement in overall sentiment (196.78%

increase, Wilcoxon signed-rank test $P = 1.954 \times 10^{-19}$).

Conclusions

Among a cohort of Medicaid-plan-sponsored teens, use of an anonymous, synchronous, real-time moderated digital peer support service was associated with significant reductions in sadness, stress, insecurity, loneliness, anger, and anxiety and a corresponding improvement in optimism by the end of the conversations. These marked reductions in distressing emotions continued as the conversations progressed, reinforcing the potential value of conversation-based engagement on emotional regulation and overall emotional well-being. Teens from low income households face higher incidence of mental health conditions. Digital peer support could be instrumental in easing such emotional distress and addressing the larger teen mental health crisis.

Introduction

Background

It is widely accepted that there is a direct and causal inverse association between low socioeconomic status (SES) and health for chronic and mental health conditions.[1,2] Low-income households have greater exposure to chronic stressors such as food insecurity, lack of stable housing, and exposure to environmental stressors, such as substance use and violence.[1,2] The youth living in these households have no way to avoid exposure to these familial stresses at home and as such, the impact on children and teens tend to persist across generations.

As a whole, U.S. teens have faced heightened challenges navigating adolescence since the COVID-19 pandemic, resulting in a rise of a range of emotional conditions such as subclinical anxiety and depression, inattention, and hyperactivity.[3,4] Emotional distress, such as feeling sad, worried, bored, or frustrated also increased.[3] Across numerous studies of varying global teen populations, there were consistent reports of high levels of psycho-emotional disturbance, especially stress, sadness, and loneliness as a result of the pandemic.[3] Loneliness is also increasing generally among U.S. based and teens worldwide and is correlated with increased internet, cell phone and social media use.[5,6] Emotional distress levels are even higher for lower income teens compared to those living with higher income.[7] This correlates with well-documented evidence demonstrating that adolescents' mental health issues increase as SES decreases.[8] Further adding to the burden of factors contributing to emotional distress, poverty is also linked to an increased risk of obesity and behavioral issues, and a decrease in vocabulary and reading skills.[9,10]

In addition to emotional distress, there was already an existing pre-pandemic mental health crisis among low-income teens. Adolescents from households with low SES are estimated as having a 2-3 times higher risk of developing a mental health condition than their high socioeconomic peers.[8,11] As well, the prevalence of mental health conditions is estimated to be 21% among this group and as high as 50% among youth on welfare [12] as compared to 13% to 20% of teens worldwide.[13–15] Several more recent studies show that the rates of depression and suicidal ideation in teens from all

social strata continue to steadily climb since the pandemic.[16]

The rising rates of emotional distress may be explained by social baseline theory.[17] Social baseline theory states that humans rely on social support as a way to perceive the world as less threatening. [17] When social support is available, emotions become less distressing and perceived threats are less remarkable. When social support is limited or missing, the perceived threat increases.[17] The pandemic provided an acute experience of low social support but continued digital advancements, including teens spending majority of their time online, have contributed to increased rates of loneliness.

Per social baseline theory, direct access to social support may help reduce such distress, however, adolescents face a myriad of barriers to accessing appropriate emotional and health care when needed but these access barriers are higher in low income groups. It is estimated that half or more of children ages 17 years and younger with a known mental health condition are not receiving treatment [18] due to such barriers as mental health stigma, unsupportive family belief systems, low mental health literacy, and difficulty accessing services.[19] Access to treatment is even lower among teens with low SES [11] and the estimates jump to as high as 85% of youth on welfare lacking access to care.[12]

Given these barriers to care, there is a critical need for alternatives to address mental health needs among all teens but especially those from lower income settings. Access to care is often considered through the lens of the framework introduced in 1981 by Pechansky and Thomas; most notably, they introduced the idea that access to care is multi-dimensional and related to the following categories (known as the 5 A's): *availability*, *accessibility*, *accommodation*, *affordability* and *acceptability*. [20] Given the sheer volume of teens facing inadequate access to mental health care and emotional support, solutions are needed to address every facet of access and at every level of illness severity, from those with subclinical emotional distress to those with severe mental illness. *Availability*, defined as the relationship between the amount of care available and the amount of care needed, and *accessibility*, traditionally defined as the distance between where a patient lives and where care is provided [21], are both access variables that can be positively impacted by effective population health interventions. Population level solutions are especially helpful in targeting those groups at lowest risk and present an opportunity to focus on increasing broad based support for teens experiencing emotional distress or those with rising risk for mental illness. Population solutions can also be helpful to those with untreated mental illness, as not every teen is ready or willing to engage in mental health care but may be amenable to alternatives that help bridge them to services. As well, alternative resources may help to flag emotional distress among teens that left unrecognized and untreated, will undoubtedly advance to clinical mental illness.

It is known that adolescence is a time of heightened emotional expression often in response to developing independence and hormonal changes. As well, it is a particular time of heightened focus on forming and managing social relationships. The nature of how teens achieve social connection is also shifting from solely in-person to primarily digital or a mix of digital and in-person interactions. [22] All of these changes result in an expected, healthy expression of some amount of negative emotions among teens such as sadness, anxiety, anger, and insecurity.[23] Stress can be both positive or negative and is also a normal part of development for teens as they learn to navigate their lives. [24] Feelings of loneliness can be real or perceived deficits in social relationships and connectedness. [22] All of these emotions, when transient and addressed through mature emotional regulation, are developmentally normal and expected in adolescence. When one or more of these emotions become persistent or heightened and are not met with appropriate emotional regulation, this can be an early

sign of greater concern.[25] Other factors such as trauma, bullying or violence place teens at greater risk and can lead to downstream physical and/or mental illness.[26]

With this in mind, we aim to introduce and evaluate an alternative intervention for low income teens who struggle with increased emotional distress but may not yet meet clinical criteria for a mental health condition. Supportiv delivers real-time 24/7 anonymous, digital peer-to-peer small group, professionally moderated chats for every mental, emotional, and social support topic that impacts daily life. Supportiv uses multi-patented Artificial Intelligence/Natural Language Processing (AI/NLP) capabilities to precision-match peers, using just a few words, instantly into live, synchronous, human-moderated, small groups chats. During the chats, users are comforted, uplifted, and guided through collaborative problem solving, which includes real-time links and referrals to personalized resources. As Supportiv is a safe space offering the opportunity for teens to feel connected and understood, it presents a digital population-based alternative to reach low income teens who are struggling or experiencing emotional distress.

This study examines the role of Supportiv, a digital peer support intervention, in impacting emotional distress and access resources for Medicaid-sponsored teens. Specifically, we aim to:

- 1) Assess Supportiv's effectiveness in reducing emotional distress by providing an innovative and moderated source of social support.
- 2) Evaluate Supportiv's role in expanding emotional health access.

Peer Support

Peer support interventions are defined as those which combine persons with similar struggles or conditions to create an environment of mutual support, [27] introducing the opportunity for connection and building empathy around shared life experiences. Peer support can take many different forms, such as convening groups that meet in-person or virtually. The conversation can be structured or more free flowing, and these groups can be led formally by trained peer support workers or informally by members of the group.[28] In contrast to receiving mental health treatment from trained professionals, peer support is a different, often more easily-accessed approach that provides an opportunity for connection, validation, and empathy around the shared experiences of living with a similar struggle. This shared lived experience of peer support is key to forming connection and healing.

Though the extent of the impact has not been consistently established given the wide variation in delivery of peer support modalities, the evidence suggests a tendency toward positive benefits on clinical mental health diagnoses.[29, 30] For example, a study of persons with severe mental illness found that the peer interventions increased their satisfaction with life and the perception that they have control to make life changes.[31] Another study demonstrated that adults with a mental illness noted an increase in positive self-assessment of their mental health as a result of an online peer support intervention.[32] Peer support has shown effectiveness among young adults in improving mental health outcomes such as reducing loneliness and improving self-esteem.[33]

The beneficial effects of peer support apply as well to younger persons. One study of a free, anonymous, UK-based, online forum offering emotional support to youth and young adults ages 11 to 25 years demonstrated benefit from discussing emotional and mental health issues in this way. The

majority of online peer interactions were emotional and involved the sharing of a similar personal experience. Other responses were informational and provided specific guidance or advice.[30] A systematic review examining the impact of peer support on anxiety and depression in youth and young adults noted a trend supporting reduction in mental health symptoms. The mean age across the studies reviewed was 14 to 24 years. The extent of the impact varied by study, with fewer showing significant impact on anxiety and depression but the majority showing a reduction of negative affect. [29]

While peer support is not a standalone replacement for clinical mental health care, data show that it provides valuable adjunctive benefits, enhancing overall support and well-being.[28] For example, a 2018 randomized controlled trial of adolescents with mental health conditions demonstrated positive effects on decreasing stigma-related stress around disclosure of their diagnoses to others.[34] Another Australian study showed improved shared decision-making among participants aged 13-17 years receiving an intervention supported by youth peer workers.[35] A study among adolescents with schizophrenia also showed positive impact of digital peer support on improving self-efficacy and decreasing self-reported depressive symptoms.[36]

In addition to the well documented reasons given for not accessing care, such as mental health stigma and unsupportive family members [19], there is also consistent evidence suggesting that teens are more likely to seek help from peers before doing so from the medical system.[29] Therefore, it is important to consider whether these interactions will have the desired effect that the teen is seeking. With the landscape of today's teens immersed so heavily in digital technologies and social media use, this population is ripe for consideration of what type of digital peer support interventions may be most impactful and which modalities have the ability to serve as a bridge to accessing higher level mental health services. To ensure that it is plausible that low income teens would be able to access a digital solution, we first examine the current state of access to and usage patterns of digital devices among teens.

Technology

Exposure to technology has become the new normal for all teens, as Generation Z teens (i.e. persons born between 1995 and 2012) and Generation Alpha (i.e., persons born between 2013 and 2025) are guaranteed to be immersed in technology and online resources over the course of their childhoods, with 95% of teens ages 13 to 18 years reporting having a smartphone.[37] In the past, the difference between those who can and cannot access and understand digital technology, known as the *digital divide*, has been much wider in both urban and rural geographies.[38] Considering Penchansky and Thomas' access framework in the age of digital care delivery, availability and accessibility are dependent upon access to digital devices as well as the ability to effectively use technology.[20] The latest data signals that the digital divide appears to be closing for teens as with low income teens reporting similar smartphone access as teens in higher income households, though they remain less likely to have a computer or tablet at home.[39]

Teenagers today are faced with the complexities of navigating their social interactions in these digital environments.[40, 41] A Pew Research Center 2024 survey revealed that 96% of U.S. teens ages 13 to 17 years report daily internet activity and 46% of teens report being online "almost constantly," which is double from the prior decade.[42] There appear to only be minor differences in the use of

technology between low income teens and their peers in higher socioeconomic groups, with lower income teens more likely to use social media to communicate with friends while texting is more common among higher income teens.[42] An earlier 2015 Pew Research survey of teens ages 13 to 17 years explored the ways in which teens form and sustain social relationships.[42] Although school remains an important venue for connecting with friends, online interactions have become increasingly common. Having a smartphone is associated with an increased use of text messaging for communicating with close friends. Digital options, such as social media and online gaming, are commonly used both for meeting new friends and interacting with friends. Use of both appears to increase feelings of connectedness, and it is commonplace for teens to use their digital technology as the way to maintain connection to their “offline” friends.[43, 44] A 2023 Common Sense analysis of 203 teens notes that digital interactions are co-occurring with in person settings such as school with the 97% of students surveyed reporting use of their smartphone during the school day, most commonly on social media and gaming apps. Given that so much of teens’ attention, social interactions, and relationships have now gone digital, in order to assess the potential benefit of a digital peer support offering across a population of teens, it is important to explore the research on empathy development in modern teens and whether teens have the same capacity to demonstrate empathy in digital social interactions as compared to in-person interactions.

Digital Empathy

Online interactions provide a way for teens to connect with and provide emotional support to one another, but some teens struggle to find spaces where they can express themselves safely and receive empathetic responses. Social media plays an important role both in supporting teens through their personal challenges but can also have a negative impact, with 21% of teens in one Pew Research survey reporting social media use making them “feel worse about their own life”.[42]

Overall, research suggests that empathy is increasing among young people after a previous decline.[45] Empathy appears to be stronger for one’s perceived “in-group” compared to those not perceived to belong to the same group, or “outgroup” [46]. The data is mixed on the impact of social media use on empathy, with earlier analyses suggesting that social media use has a negative impact on empathy. However, more recent studies suggest that social media has positive effects in teens, increasing the ability to both recognize and share another’s emotions.[43], [47] Additionally, it appears the ability to express emotions does not vary between online and in person settings.[48]

However, empathy burnout (i.e., compassion fatigue), or becoming less empathetic to another’s struggle due to prolonged exposure to distressing social issues, is also documented among social media and technology users.[49, 50] Empathy fatigue accelerated during the COVID-19 pandemic, with survey data showing an average decrease of 14% in self-reported empathy in 2022 as compared to 2019, though the smallest decrease was seen among Gen Z. As well, 57% of respondents cited social media use as a cause of their worsening empathy fatigue, though the effect changes depending on which social media platform app is used. It is not clear whether this finding is persistent or is transient as a result of a specific major societal event such as the pandemic.[49]

Peer Support and Self-Determination Theory

The effectiveness of peer support interventions may be understood in the framework of self-determination theory, as delineated in 1985 by Deci and Ryan.[51] According to this theory, three fundamental factors—autonomy, competence, and relatedness—facilitate individuals’ progression

toward emotional change.[52] Autonomy pertains to an individual's inclination to self-direct and exert control over their actions, while competence reflects the desire to acquire and master new skills before integrating them into behavior. Relatedness encompasses the need for interpersonal connections.[52] In peer support settings, as emotional struggles are processed, teens may feel more autonomous because there is no mental health professional or adult to serve as the expert guide, competence may be reinforced through mirroring and highlighting past coping skills, and participation in the peer community may inherently normalize the faced struggles because the person is connected to the community based on their unique struggle.[53] It is hypothesized that these dynamics within peer support settings positively correlate with improved mental health and well-being.[53] By harnessing the principles of autonomy, competence, and relatedness, peer support interventions offer a unique and potentially transformative and more accessible approach to addressing emotional difficulties and promoting individuals' overall psychological resilience. With the rise of digital peer support, opportunities to extend the reach and impact of peer support interventions have expanded and numerous studies have explored the effectiveness of digital peer support interventions, often in combination with evidence-based practices, in addressing mental health needs.[36,54–61][62]

Real-time Moderated Peer Support

There are many elements of peer support that are known to lead to enhancing both the process and the impact of a peer intervention, with moderation being one of the most impactful. Introducing live, real-time moderation to peer interventions, either by trained professionals or peers themselves, has a demonstrable positive effect on user outcomes, including increased engagement and perceived effectiveness compared to non-moderated support.[63,64] Moderated peer interventions allow for users to establish trust and a higher level of safety.[65] At the extreme, moderation also protects against acute harm such as hostility or direct attack and also prevents the spread of misinformation.[66] This is especially important in peer support aimed at helping those with emotional distress as users may be more susceptible to harm if the conversation is not evidence-based. Moderators have also been found to keep chatters engaged in conversations longer, to maintain civility and positivity in chat rooms, prevent topic changes for longer periods, and to engender better cohesion between chatters.[65]

Given the digital immersion of today's teens, further research is needed to understand how safe, moderated online environments can counterbalance the negative dynamics of their digital landscape to foster empathy and emotional resilience. To address this, we evaluated the effectiveness of an anonymous, chat-based digital peer support solution in adolescents that provides chat-based conversational support to its users and features trained human moderators who facilitate constructive discussions while ensuring a safe and respectful environment. In a previous study, we evaluated the impact of digital peer support on elderly adults and found significant reductions in momentary loneliness and increases in optimism after just a few minutes of chat engagement.[67] The current study focuses on Medicaid-plan-sponsored teens in Nevada (Clark County) and Kansas (Sedgwick and Saline Counties) who were given no-cost access to the same anonymous, real-time moderated digital peer support service. We will describe how emotional states changed throughout the chat conversations to better understand the dynamics of these digital peer support interactions among the youth studied on categories of non-clinical emotional distress including sadness, stress, insecurity, loneliness, anger, and anxiety.

Methods

Supportiv Service Model

Supportiv is an anonymous, peer-to-peer service providing mental, emotional, and social support through real-time moderated synchronous small group chats available 24/7. Users begin their session at Supportiv with the prompt, “What’s your struggle?” where they share a free text description of their real-time concern. Using AI-driven Natural Language Processing (NLP), the users are matched with others facing similar issues, forming small groups of no more than five people, each guided by a trained human moderator. We implemented a transformer-based language classifier to identify whether an incoming message was authored by a teenager. When a message is classified as teen-authored, the system restricts peer matching to other teen users to enhance age-appropriate support and promote relatable peer interactions.. Users are auto-selected, not self-selected, into either a moderator-led small group or a one-on-one chat with a moderator.

Trained human moderators facilitate discussions, ensure a psychologically safe environment by enforcing chat rules and lead problem-solving efforts. Another key role of the moderators is to identify and exclude individuals who intentionally disrupt conversations with inflammatory or off-topic remarks, herein defined as “trolls”, ensuring that the space remains supportive and constructive. Moderators have all completed formal training and have demonstrated competence in skills such as asking facilitative questions, providing an empathetic experience, sharing relevant resources, and, when necessary, connecting users to crisis services. Moderators are also regularly monitored for their handling of crises and additional service delivery quality. Supportiv has documented referral protocols to address concerns, including medical emergencies, physical danger (suicide risk, domestic violence, sexual assault, and elder abuse), and panic attacks. Because Supportiv is fully anonymous, there is no collection of name, email address, or other personally identifying information. The lack of such registration steps supports expedient connection to the service, allowing users to access immediate support with minimal barriers. We use state-of-the-art security measures (such as at-rest and in-transit encryption) to minimize potential privacy and security risks in handling users’ data. In addition, to ensure user safety,

Study Design and Population

This observational, retrospective study analyzes Medicaid-plan-sponsored teens ages 13 to 20 years who had direct access to the service at no cost between March 1, 2024, and December 31, 2025, through either their Medicaid health plan provider or their school district. Only chat sessions containing at least three messages from users were included in the analysis. We decided to filter out any sessions shorter than three messages because a person who only sent one or two messages has not engaged with the intervention in a meaningful way and it does not allow for any measurable impact. Conversations involving users identified as trolls by moderators were excluded. We excluded these conversations as they did not reflect genuine emotional expression or authentic engagement with the group, and could distort analyses of sentiment change and peer support dynamics.

Conversation Setting

Once users articulated typed a few words describing their struggle, they were auto-matched (average time: 29.784 seconds, median time: 13.388 seconds) ~~within 1 minute~~ either into an existing live chat with a small group speaking on the same topic or to a one-on-one chat with a moderator, where they could later be joined by other concurrent users auto-matched for experiencing similar struggles. Newly joined participants received a short narrative summary of the ongoing discussion to ensure continuity and context. Moderators play a central role in facilitating these conversations by posing open-ended questions, guiding discussions, and fostering engagement among participants. Additionally, moderators share relevant resources tailored to the issues discussed, including practical

advice articles and informational materials aimed at enhancing users' understanding of their struggles. At the conclusion of the conversation, users are given the opportunity to provide feedback. (Representative feedback examples included in the Results).

Emotion Analysis

We evaluated different emotions using OpenAI's LLM model, GPT-4o-mini, employing a few-shot learning approach.[68] The few-shot learning approach refers to a method in which a model is provided with a small number of labeled examples (or "shots") within the prompt to guide its responses. Instead of requiring extensive fine-tuning on large labeled datasets, the model learns from these provided examples in real time, allowing it to generalize and perform the desired task effectively. To enhance performance, the model was given examples of manually selected and rated messages as references. In our prior work, we demonstrated that this approach is comparable to or superior to state-of-the-art models.[67] The following emotions were evaluated: sadness, stress, insecurity, loneliness, anger, and anxiety. For the evaluation of each emotion, the model was provided with the user's message along with the context of the preceding conversation, which included all messages since the previous message of the user in question. The model then assigned a score to each emotion on a scale from 1 to 10, with 1 representing the minimum and 10 the maximum level of expressed emotion. The 1-10 scale provides a reasonable level of granularity to capture and evaluate shifts in emotional expression. This allows us to distinguish between subtle variations in intensity while maintaining interpretability. To ensure the scale effectively represents real-world emotion dynamics, we carefully selected examples from real data that span the full range of expression, from the most subtle to the most intense. This approach enhances the robustness of the model's scoring and its applicability to diverse emotional contexts. Examples for the scores 1, 5, and 10 are given in Textbox 1. In addition to this, we evaluated the overall sentiment as belonging in one of 3 categories: positive (marked as 1), negative (marked as -1) and neutral (marked as 0). Examples provided for the different sentiment categories are given in Textbox 2.

Textbox 1. Examples provided to interpret emotion intensities in a few-shot manner.**A. Insecurity****Score 1 (low levels of insecurity):**

"I love the person I became I am more happier and more importantly mindful of what I do"

Score 5 (medium levels of insecurity):

"Yes, I don't think too highly of myself. I think that I'm a little on the chubby side. I need to work out a little bit. Which I have been getting into."

Score 10 (highest levels of insecurity):

"sometimes i feel like a husk. other times i feel gross and not worthy of perception. i hate my body."

B. Stress**Score 1 (low levels of stress):**

"life is actually going pretty good lately, just wanting to talk to someone so someone can care about how good my life is going."

Score 5 (medium levels of stress):

"My boyfriend and I have been together for like 5 years, but there's been so many new things and changes and situations that keeps coming up"

Score 10 (highest levels of stress):

"The whole experience of this stress anxiety and depression have been riding on my back for so long and its been awful like being forced to wear literal tons of weights on your back"

C. Sadness**Score 1 (low levels of sadness):**

"i'm feeling okay today, just want to chat a bit"

Score 5 (medium levels of sadness):

"It's just sad to me that he won't even give me a chance"

Score 10 (highest levels of sadness):

"I feel alone and depressed and very dark and invisible. My life has been terrible for years and I never knew what it was like to receive care."

D. Anger**Score 1 (low levels of anger):**

"Well you're really calmed me down, I feel much better now"

Score 5 (medium levels of anger):

"Yeah it annoyed me because I would never do this to them.. and when I express those emotions I get called the mean and fake friend"

Score 10 (highest levels of anger):

"I feel anger a lot of anger like at myself my family all the people that could have helped me but chose not to"

E. Anxiety**Score 1 (low levels of anxiety):**

"The other alternatives I have explored is drawing, Music, and Talking to my Mom that I only trust to talk to and even I hug her too!"

Score 5 (medium levels of anxiety):

"its kind of a lot and i might be overreacting it but its just the stress of keeping up grades and getting frustrated with myself"

Score 10 (highest levels of anxiety):

"so intense that i can hear my heart racing and my fingers sweating and i get the chills in my spine"

F. Loneliness**Score 1 (low levels of loneliness):**

"My best friend is the person I usually go to when I'm ranting and she rants back. We go to each other all the time for advice or for a pick me up"

Score 5 (medium levels of loneliness):

"I was alone a lot at in-person things like school or clubs, but I had online friends. I can deal with my own issues alone most of the time but sometimes I do crave interaction or social support."

Score 10 (highest levels of loneliness):

"My mom abandoned me when I was around five I lived what my grandmother she never let us leave the house other than going to school so I didn't have much of a social life and I didn't really know how to talk to other kids my age so I got bullied a lot"

Textbox 2. Examples provided to interpret sentiment intensities in a few-shot manner.**Score -1 (negative sentiment):**

"I am alone and scared. I don't feel like myself. I want to cry all the time"

Score 0 (neutral sentiment):

"I've been feeling okay lately, neither good nor bad."

Score 1 (positive sentiment):

"I had a really good day today. Managed to go for a walk and spend time with friends."

Importantly, some messages did not allow inference of the emotional state because they were not related to the teenagers sharing their problem (for example, users asking moderators "Are you a human?" or saying something unrelated to the conversation like "My dad is calling me"). In cases where there was not enough information to evaluate the emotion, the model within the same few-shot learning approach was instructed to not assign any score to avoid introducing noise or misclassifications due to uncertainty.

To assess changes in emotional state over the course of the peer support chat, we analyzed emotion scores as the conversation progressed. We used linear interpolation to map the conversation from 0 to 100% progression, ensuring that all conversations were scaled to a common reference frame regardless of length.

Because we were specifically interested in the effect of peer support on negative emotional states, we restricted our analysis to conversations where the emotions in question were negative at the start. To identify these conversations, we took the maximal value of the emotion scores from the first three messages and selected the conversations with a score of 5 or more. This approach accounted for the possibility that initial messages might contain polite greetings or neutral introductions before transitioning to the core issue, which typically reflects the emotional state of concern. By using the maximum value within this window, we aimed to capture the strongest negative emotion expressed early in the conversation while mitigating the impact of neutral or non-representative opening statements. This approach ensured that we were tracking meaningful emotional shifts over the course of a conversation, rather than including cases where the emotion of interest was minimal or absent to begin with. By focusing on conversations where a given emotion was salient, we aimed to better capture relevant improvements or changes.

Since this thresholding method was applied separately for each emotion, different subsets of conversations were used depending on the specific emotion being analyzed. This allowed us to focus on cases where the emotion in question was initially present at a meaningful level, ensuring a more targeted assessment of how peer support influenced emotional trajectories throughout the conversation. We noted that the first 10% and last 10% of the conversations included opening and closing phrases with lower negative emotion intensities. These introductory and concluding messages often included greetings, introductions, expressions of gratitude, or formalities that do not necessarily reflect the core emotional trajectory of the conversation. To mitigate this bias, we discarded the first and last 10% of each conversation and focused on the remaining central portion for trend analysis.

Within this core segment, we fitted a linear model to the emotion scores and used the slope of this fitted line as an indicator of emotional improvement. A negative slope suggests a decrease in emotional distress over the course of the conversation, while a flatter or positive slope may indicate stability or worsening of the initial emotional state. This method allowed us to quantify the overall effect of peer support on emotional trajectories in a way that minimizes the influence of structural artifacts in the conversation flow.

We used a non-parametric Wilcoxon signed-rank test, with the assumption of having non-normal distribution, to evaluate whether the effects were significantly different from zero and computed effect size using rank-biserial correlation. Additionally, we conducted a separate comparison of emotional states at the beginning and end of the conversation by calculating the mean emotion score of the first three and last three messages. Our data suggest that adolescents often do not articulate their concerns clearly in their initial description of “struggle” or may provide non-informative inputs like “I need to talk”, or even simple greetings (e.g., “Hello”), which do not allow for an accurate assessment of their initial emotional state. However, by considering the first three messages, we generally obtain sufficient information to capture the emotional context. Based on this observation, we conducted a comparative analysis between the emotion scores of the first and last three messages in each conversation.

To assess the significance of these changes, we employed the Wilcoxon signed-rank test, a non-parametric statistical method suitable for paired data, and calculated the rank-biserial correlation (effect size) to quantify the magnitude of the observed differences.

Topic modeling

We employed a topic modeling framework using LLM-based categorization to efficiently assign topics and subtopics to text data. A list of topics was manually selected after reviewing conversations. The texts were processed using GPT-3.5, using a structured prompt to categorize them into predefined topics and subtopics. We have manually verified the accuracy of the classification. We selected this approach because it achieved a balance between user control, efficiency, and consistency.

Time of day and device type

We recorded the user's join time and converted it to local time to account for time zone differences. Additionally, we collected data on the type of device used to access the service, allowing for a more comprehensive analysis of user digital engagement and interaction patterns.

Results

A total of 1,005 conversations met the inclusion criteria and were used for the final analysis. 1.3% conversations were removed due to being categorized by moderators as including “trolling”. Of the conversations that met inclusion criteria, the duration varied, with a mean duration of 29.15 minutes (SD = 30.71) and a median duration of 18.19 minutes, indicating a positively skewed distribution (Figure 1). The majority of interactions (781 conversations or 77.7%) occurred in one-on-one settings with a peer support-moderator, while the remaining conversations took place in moderated small group discussions with peers and moderators.

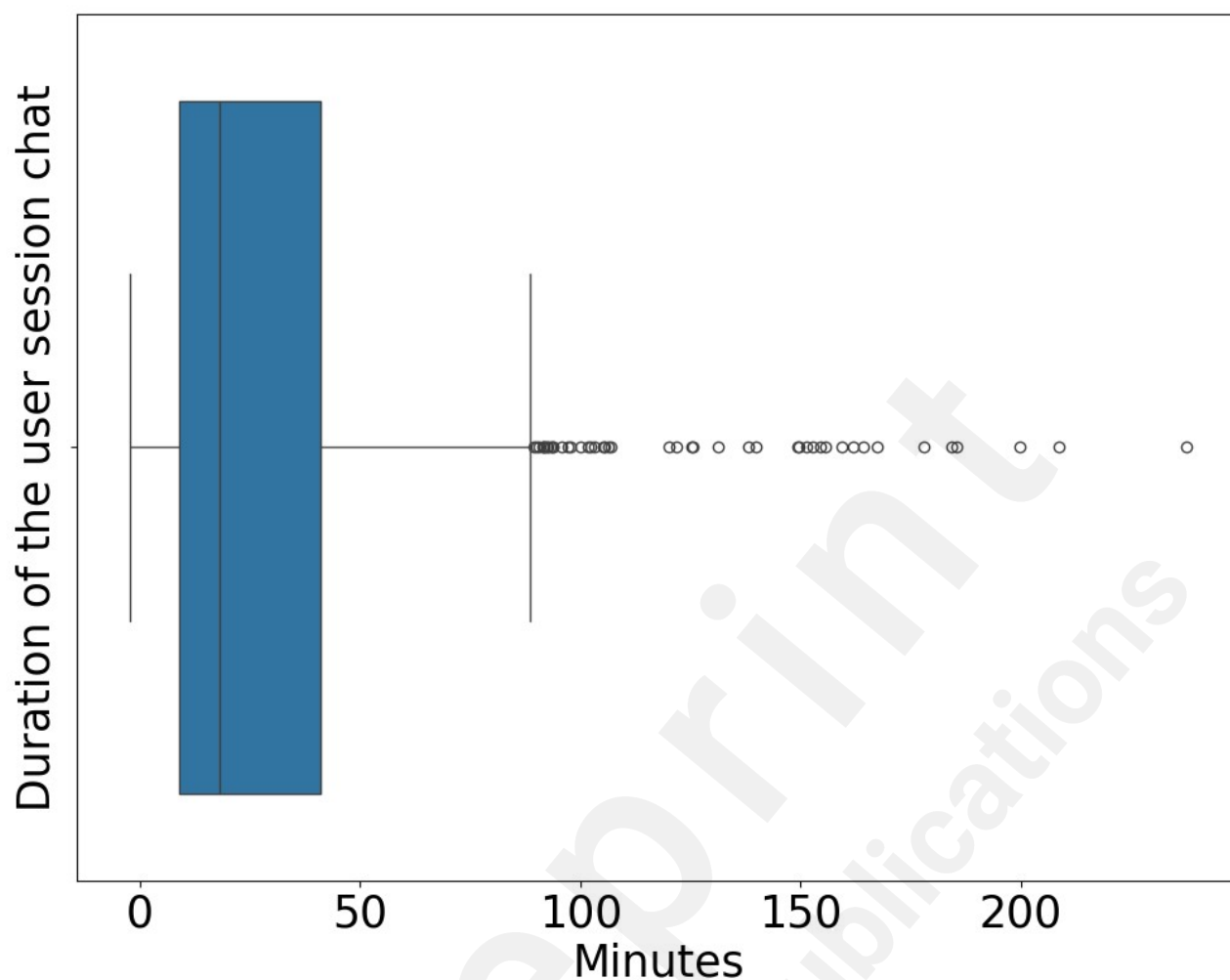


Figure 1. Average duration of the user session chat for all 1005 participants, 29.15 minutes (SD = 30.71) and a median duration of 18.19 minutes.

With regard to the characteristics of each conversation, the distribution of the number of messages and word count is shown on Figure 2, which demonstrates that most conversations tended to contain less than a thousand words (median number of words 698, median number of messages 12). The majority of conversations were conducted via mobile devices, which accounted for 80.89% of interactions. Desktop computers were used in 18.47% of cases, while tablets were the least common, representing only 0.65% of interactions.

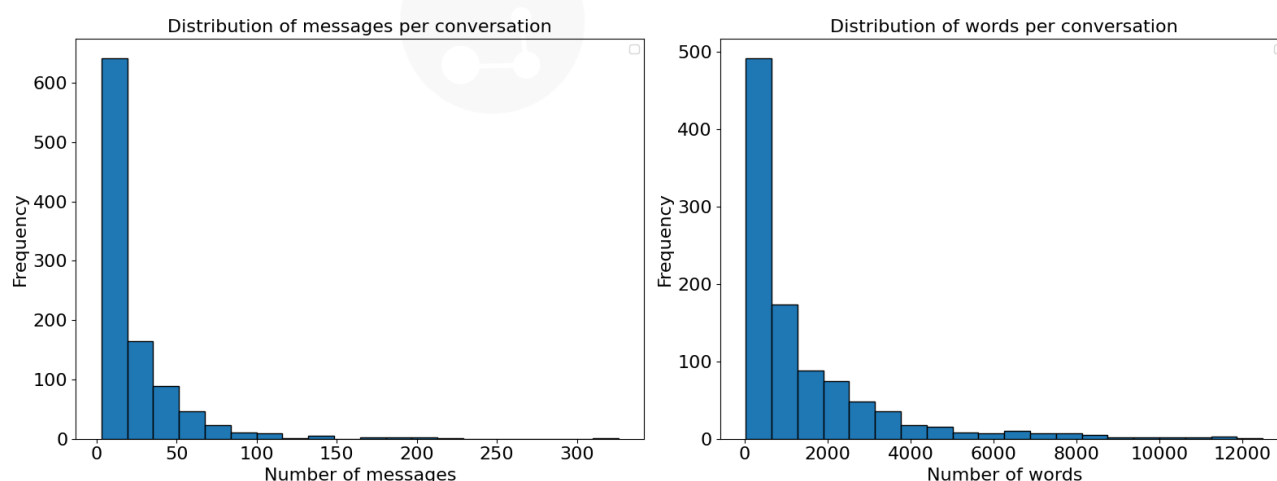


Figure 2. Distribution of the numbers of messages and word count in the conversations.

The temporal analysis of service usage revealed distinct patterns in when adolescents engaged in conversations. As illustrated in Figure 3, there was a peak in usage between 1:00 and 2:00 PM, with the most substantial and sustained surge in conversations occurring in the evening, beginning around 7:00 PM and continuing steadily until midnight.

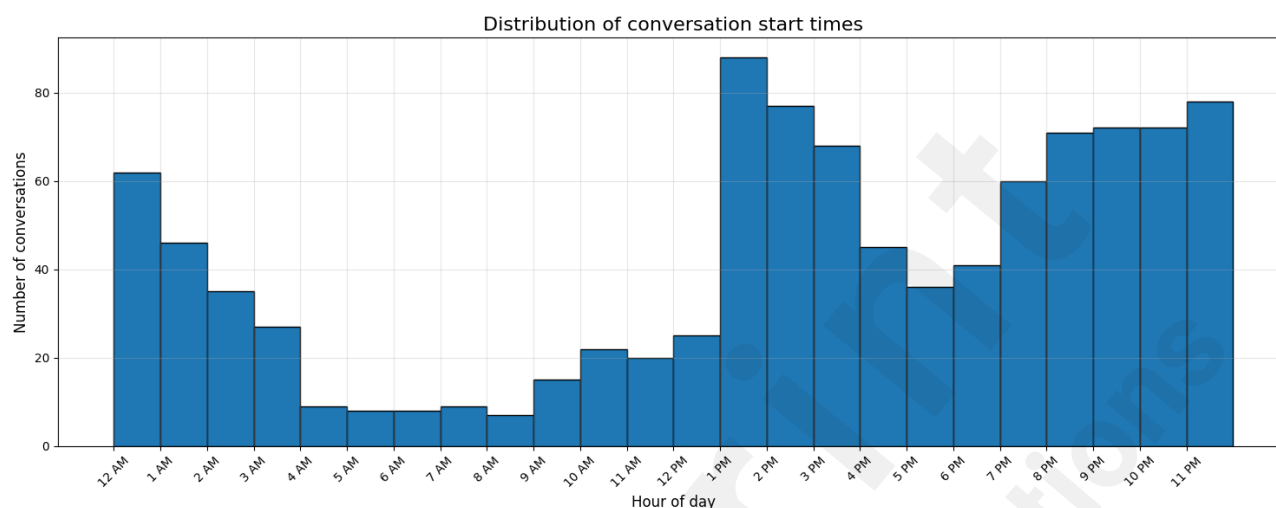


Figure 3. Distribution of conversation start times. This histogram shows the timing of conversation initiations throughout the day. Two peaks are evident: an early afternoon surge around 1:00–2:00 PM and a major evening increase starting at 7:00 PM, peaking between 9:00 PM and midnight.

In terms of conversation topics, the most frequently discussed theme was social connection (39.84%), followed by mental health conditions (27.26%), loneliness (9.86%), stress (9.15%), and identity (3.92%). Other topics, including productivity/work, financial concerns, physical health, and burnout, were discussed less frequently, each comprising less than 3% of the dataset. Within the overarching topic of social connection, the most prominent subcategories were relationships (80.56%), followed by family (11.36%), breakups (3.03%), and communication (2.78%). Examples of struggle descriptions for the top 5 topics are given in the Textbox 3.

Textbox 3. Examples of user's struggles for the most common topics.

A. Social connection

"The guy I'm talking to is giving me mixed signals and I don't know what to do"

B. Mental health conditions

"I have problems with anxiety, I may have ADHD and I don't know if I am depressed but I also may have problems with my feelings and emotions."

C. Loneliness

"I'm really lonely because I have no friends and I can't actually do anything about it to fix how I feel"

D. Stress

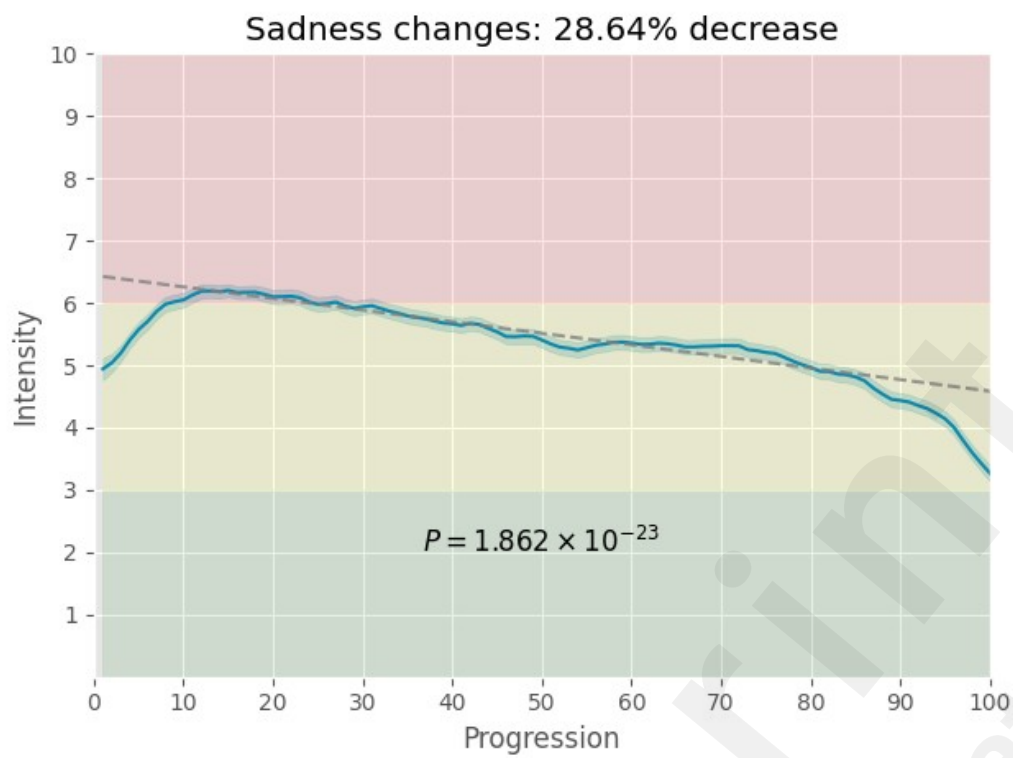
“Life makes me feel stressful with inadequate solutions to find peace”

E. Identity

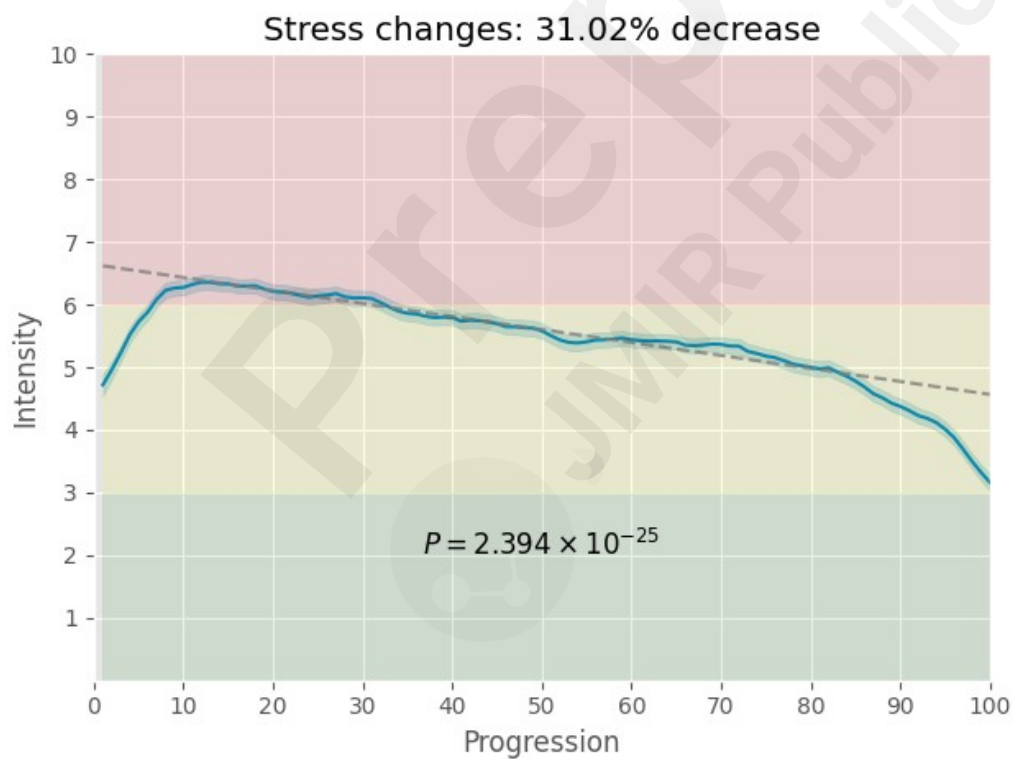
“I’m sad because I can’t do hockey as a girl it really makes me depressed”

Regarding the progression of emotional states throughout the conversations, we observed a consistent improvement across all measured emotional states, as shown in Figure 4. Specifically, there was a significant decrease in all of the negative emotions studied, with the greatest reductions seen for anger (46.94% (Wilcoxon signed-rank test $P = 2.265 \times 10^{-17}$, effect size: 0.87), loneliness (31.99% (Wilcoxon signed-rank test $P = 9.968 \times 10^{-20}$, effect size: 0.79), and stress (31.02% (Wilcoxon signed-rank test $P = 2.394 \times 10^{-25}$, effect size: 0.82). There were also reductions in anxiety 29.81% (Wilcoxon signed-rank test $P = 9.201 \times 10^{-19}$, effect size: 0.79), sadness (28.64% (Wilcoxon signed-rank test $P = 1.862 \times 10^{-23}$, effect size: 0.81), and insecurity (24.17% (Wilcoxon signed-rank test $P = 6.212 \times 10^{-17}$, effect size: 0.75) over the course of the conversation. There was a corresponding significant increase in overall sentiment, showing a 196.78% improvement (Wilcoxon signed-rank test $P = 1.954 \times 10^{-19}$, effect size: 0.80).

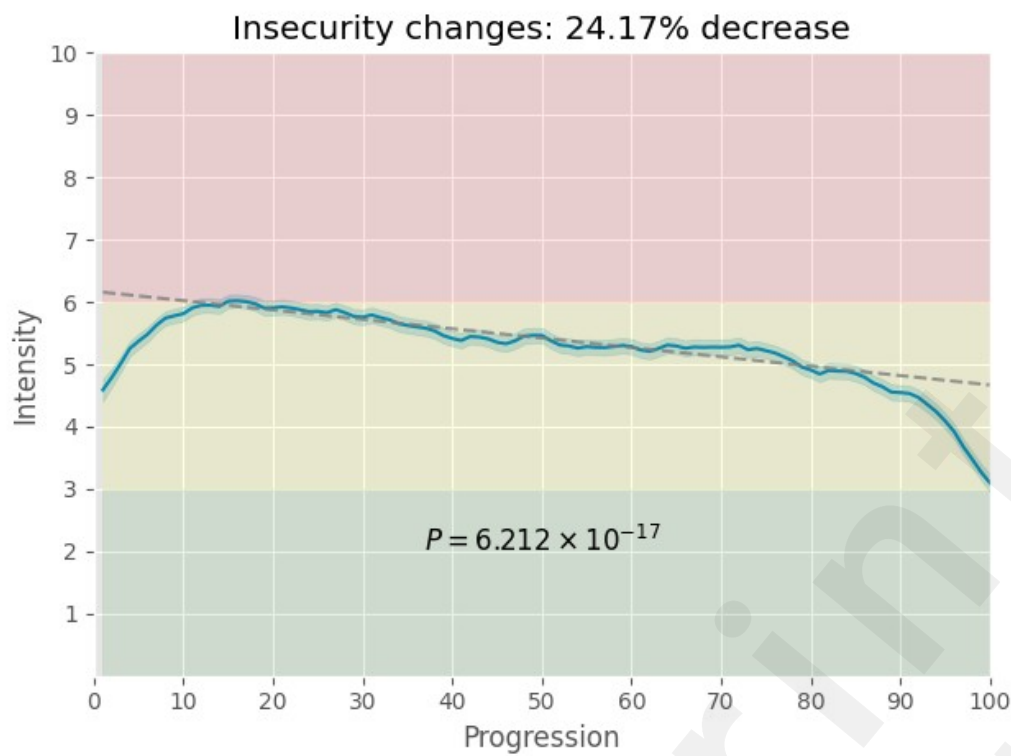
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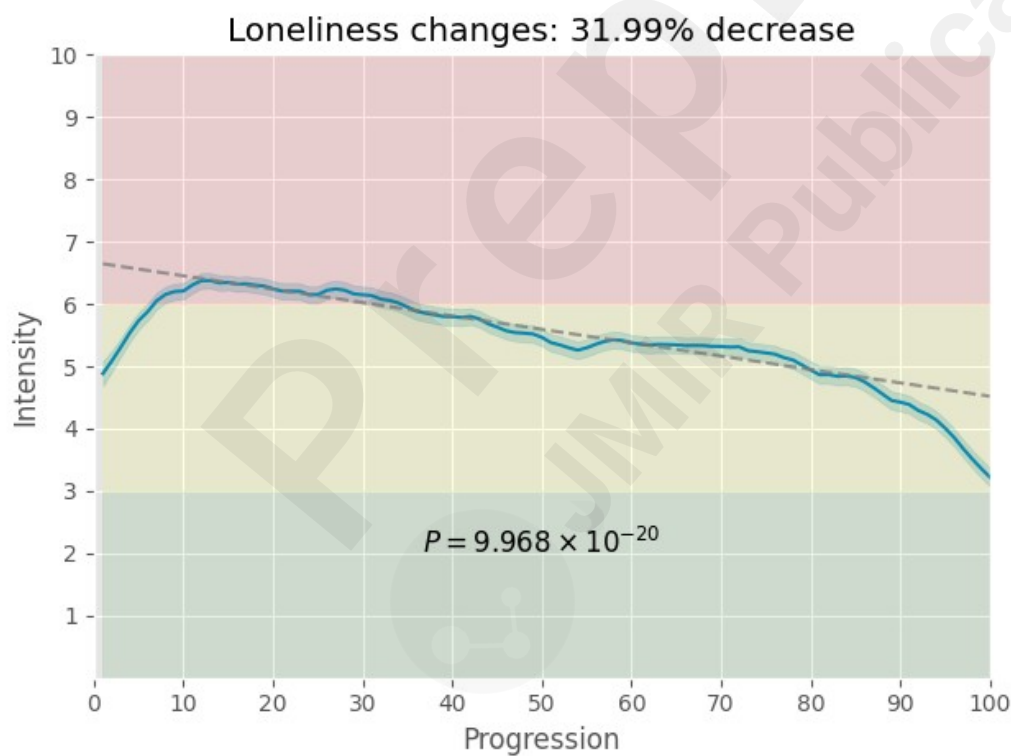
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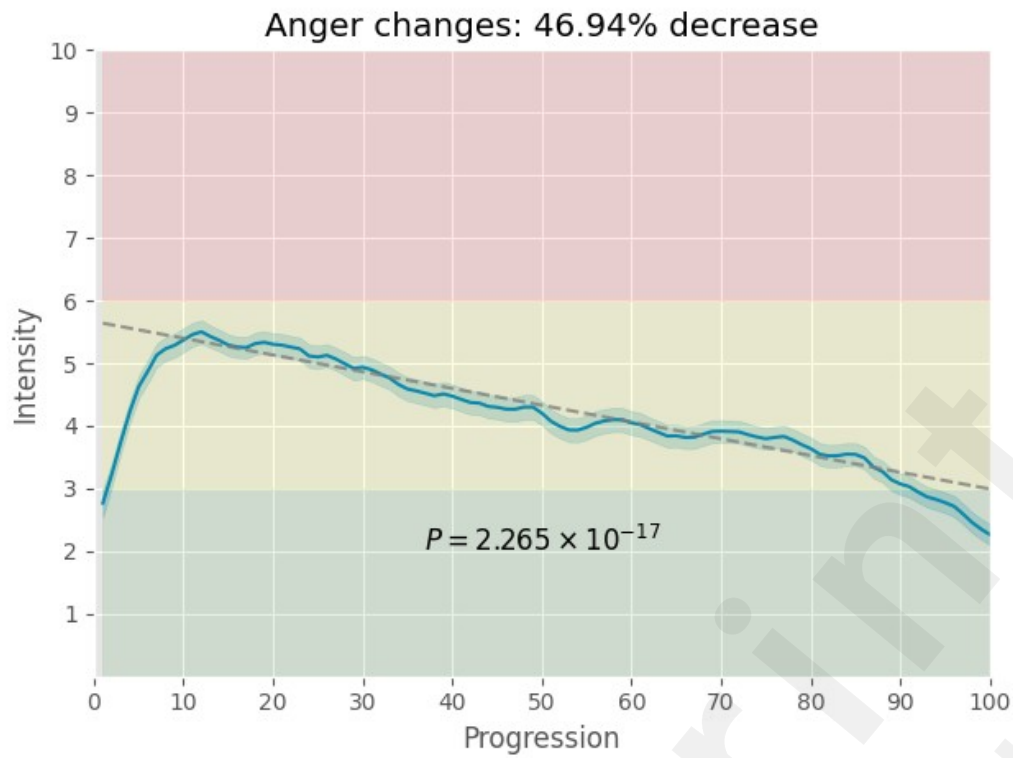
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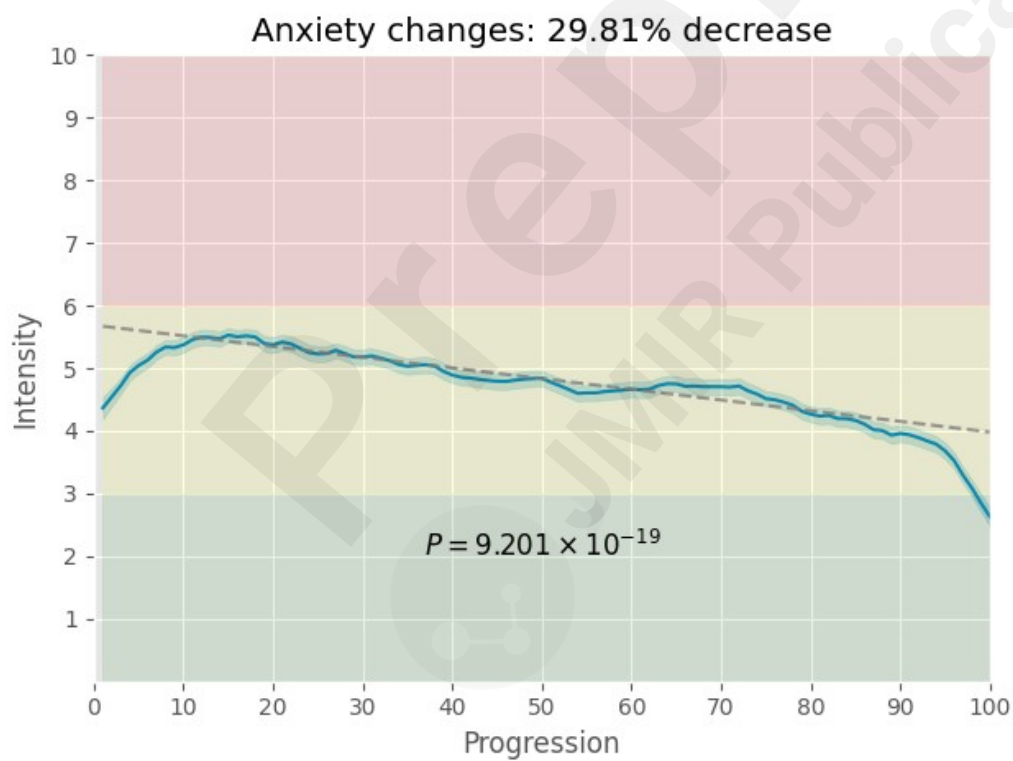
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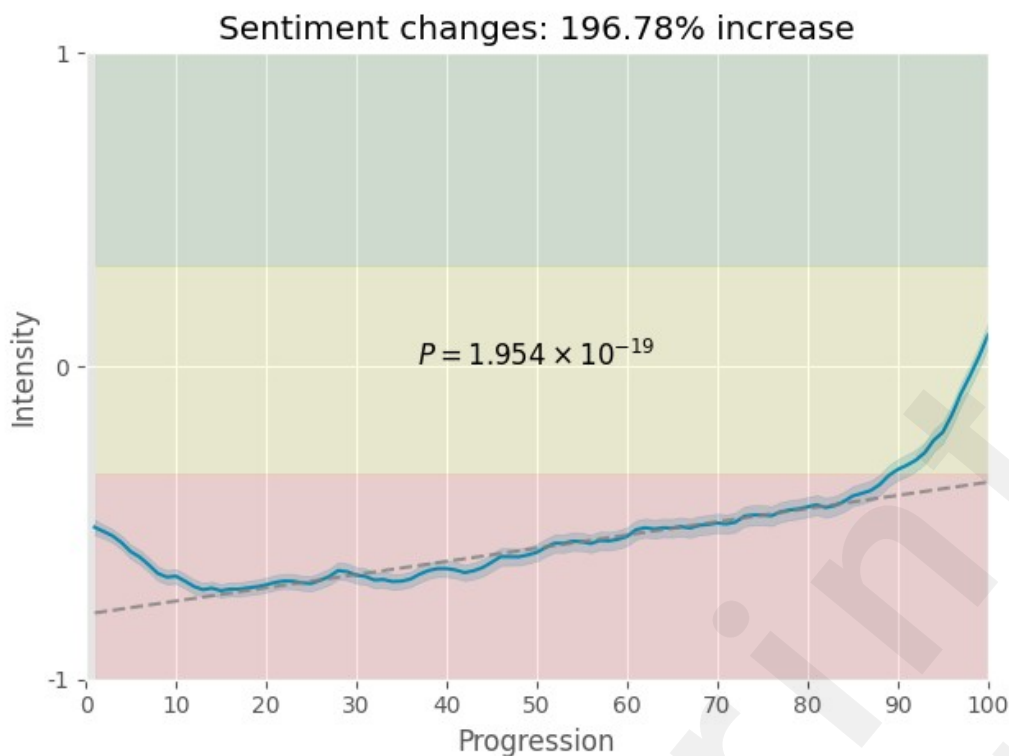


Figure 4. Emotion trends throughout conversation progression. Emotional changes were observed as conversations progressed. Shaded area represents standard error of mean. A-F. The green area (1–4) represents “low” levels of emotion, yellow (4–7) signifies “moderate” levels, and red (7–10) indicates “high” momentary emotion. G. The red area represents negative overall sentiment (-1 to -0.33 score), yellow area represents neutral values (-0.33 to 0.33), and green area represents positive range (0.33 to 1). Sentiment values below 0 are classified as “negative,” those above 0 as “positive”.

Comparing the beginning and the end of the conversation, we see a significant improvement in all the emotions, as shown in Figure 5. Because we applied the thresholding criteria to include only conversations with higher negative scores, the number of conversations analyzed varied by emotion. The most pronounced reduction was observed in anger, where scores declined from 6.58 to 4.72 over 191 conversations (Wilcoxon signed-rank test $P = 1.762 \times 10^{-4}$, effect size: 0.88). Anxiety levels also significantly decreased, with 513 conversations showing a drop from 6.43 to 5.11 (Wilcoxon signed-rank test $P = 2.636 \times 10^{-14}$, effect size: 0.84). Loneliness exhibited a comparable trend, with 482 conversations analyzed. The mean score decreased from 7.18 to 5.49 (Wilcoxon signed-rank test $P = 1.231 \times 10^{-11}$, effect size: 0.83), suggesting that engagement in conversations might have mitigated feelings of isolation. Insecurity showed a notable decline in mean scores from 6.68 in the first three messages to 5.4 in the last three messages (Wilcoxon signed-rank test $P = 2.623 \times 10^{-15}$, effect size: 0.82) across 656 conversations. Similarly, stress levels were evaluated in 542 conversations, showing a drop from 6.83 to 5.39 (Wilcoxon signed-rank test $P = 6.096 \times 10^{-15}$, effect size: 0.78), indicating a meaningful decrease in stress expression. The results from this targeted comparison of the beginning and end of the conversations further support the findings of emotional improvement across all emotion types throughout the conversations.

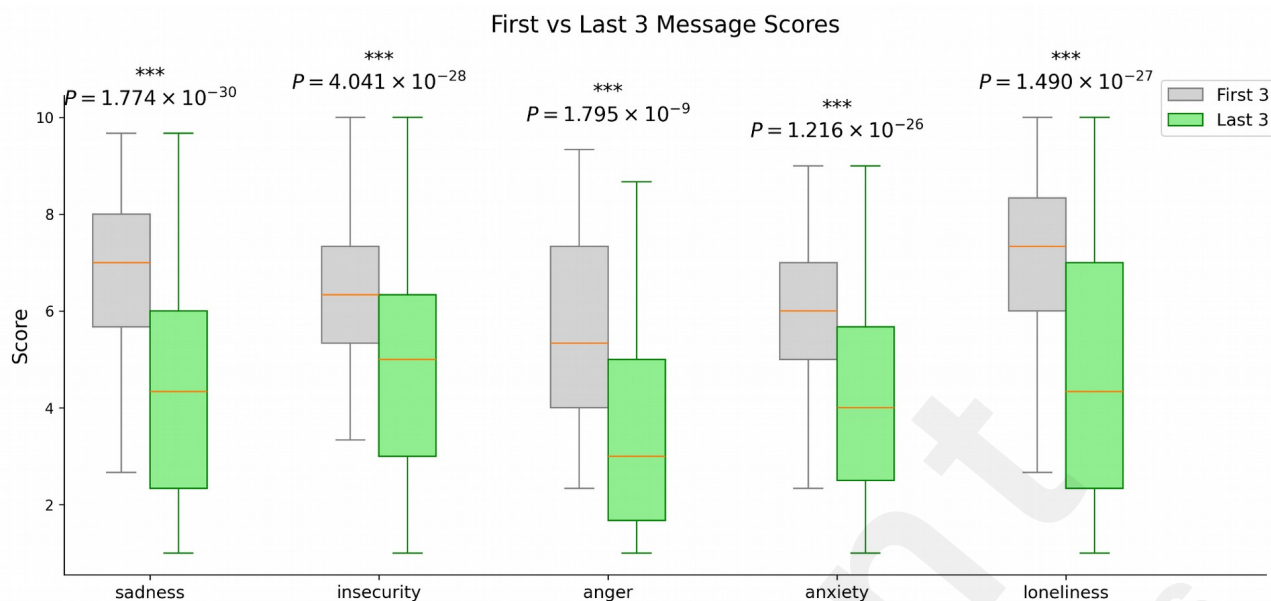


Figure 5. Comparison of the initial emotional state and the final emotional state across conversations. For each emotion, the first 3 scores (grey) and last 3 scores (green) were averaged per conversation and compared. The filled box plots display the distribution of these scores, with the central orange line representing the median, the box edges denoting the interquartile range (IQR), and the whiskers extending to 1.5 times the IQR.

Lastly, we analyzed the reviews and identified several common themes in user experiences. One key theme was feeling heard and understood, with many users appreciating being listened to without judgment (see Textbox 4A). Another major theme was emotional relief; users often mentioned that the chats helped them process their emotions and feel lighter (see Textbox 4B), clearly highlighting the comfort these conversations provided. We also observed that some users enjoyed helping others, finding value in both supporting peers and reflecting on their own experiences (see Textbox 4C). Additionally, praise and gratitude for specific moderators were frequent, with users commending their kindness, patience, and understanding (see Textbox 4D). Together, these themes underscore the positive impact of the interactions, fostering both emotional relief and a strong sense of community.

Textbox 4. Examples of user reviews highlighting common themes.**A. Feeling heard and understood**

“I feel less anxious now that I’ve talked about my thoughts and feelings. I felt heard and they gave me good advice. I was able to say anything without any judgment or hesitation.”

B. Emotional relief

“i do feel a bit better, like some weight was lifted off my chest & shoulders :)”

C. Enjoyment of helping others

“I love helping people with their thoughts, it was lovely! <3”

D. Praise and gratitude towards moderators

“[moderator] was a very good moderator, understood my feeling and provided helpful resources, is very kind and understanding about what you have to say, no matter the topic.”

Discussion

Principal Findings

Among this cohort of Medicaid-plan-sponsored teens, use of an anonymous, synchronous, real-time moderated digital peer support service was associated with significant reductions in all six emotions studied (sadness, stress, insecurity, loneliness, anger, and anxiety) with a nearly 47% reduction in anger and over 30% reductions in loneliness and stress. A 24-30% reduction was seen for the remaining negative emotions of anxiety, sadness, and insecurity. Consistent with the reduction in negative emotions, there was a corresponding improvement in optimism by the end of the conversations. These marked reductions in distressing emotions continued as the conversations progressed. These findings were replicated when examining just the beginning and end of the conversations, highlighting a consistent reduction in negative emotional expression from peer interaction, reinforcing the potential value of conversation-based engagement on emotional regulation and overall emotional well-being.

These are promising findings which indicate that real-time moderated digital peer support may be beneficial in multiple domains related to teen’s emotional distress. Mechanisms for impacting these common emotions in teens are valuable as these may be early indicators of more serious mental illness, allowing for earlier intervention, recognition of rising risk, and prevention of serious life threatening consequences such as suicidal ideation. For instance, anger has been found to decrease general wellbeing in adolescents age 12-14 years old.[69] Chronic loneliness can negatively impact adolescents’ emotional regulation in social interactions and also decreases the willingness to engage in social situations.[70] Adolescents who face chronic stress may also be at risk for having negative neurological changes to the amygdala, hippocampus, and prefrontal cortex along with physiological issues related to their metabolic function and timing of puberty.[71,72] Sadness in teens has been

linked to deficits in multiple positive life domains such as family, friends, and education.[73]

Though we did not directly measure empathy, our findings of improved optimism and reduction in negative emotional states through a digital interaction do suggest a potential relationship with the findings from current literature on empathy that suggest social media usage may increase empathy. [43] It may be the case that direct peer support also cultivates an empathy-enhanced environment where positive social interactions have the power to decrease the emotional and psychological pressures that teens are facing. This would be of great value as higher empathy has been consistently linked to increases in prosocial behaviors and wellbeing.[74–76] It is also the case that usage of digital applications is continuously growing and is much more the modern norm for socializing, especially for teenagers.[39,42] In the past few decades, social media and messaging applications have become central components in the majority of teenager's social lives. Thus, these digital forms of communication are an integral part of current teenage social systems and not simply alternative ones.

Much can also be gleaned from the topics discussed during a conversation with peers. The five primary topics accounting for the majority of conversations included social connection, mental health conditions, loneliness, stress and identity, reflecting a strong emphasis on conversations related to emotional and psychological well-being. As well, interpersonal relationships were a central focus for teenagers seeking help, with discussions primarily revolving around romantic and social connections, followed by family dynamics and challenges related to communication. This highlights the significance of multiple relationships in teenagers' social system and the role they play in their development and mental health as these findings align with the relevant literature on how important interpersonal relationships are for teenagers in protecting and affecting their emotional well-being. [77–79] The consistency of these topics in the conversations could also suggest that teens face difficulty in expressing their interpersonal issues offline, and thus find comfort in an online space where anonymity and a lack of conflict are features.

Our findings mirror the national data on devices owned and used by low-income teens.[39] The majority of conversations were conducted via mobile devices while tablets were the least common. The predominance of mobile device usage suggests that adolescents primarily engage in conversations in flexible, on-the-go contexts, which may influence the way they express their emotions and articulate their concerns. The peaks in usage in the early afternoon suggest that a notable number of users reached out during early afternoon hours, possibly around school breaks or lunch period with the most activity occurring in the late evening to middle of the night. This sustained increase in engagement during late hours aligns with the time when adolescents may experience heightened emotional distress or have more privacy to seek support. These findings highlight the importance of ensuring service availability during peak hours, particularly in the evening, when demand is at its highest.

Potential Applications

Cyberbullying

Given its relative ease of use and accessibility, as well as the anonymity provided, there are additional concerns for which real-time moderated, anonymous digital peer support such as that provided by the Supportiv service can potentially be a solution. For instance, the rise of cyberbullying has become an increasing concern for teens, with prevalence estimates ranging from 20-40% of both young males and females having experienced cyberbullying with youth ages 12 to 14 years most at risk.[80] It is thought that the rise of cyberbullying is partly due to digital social

media environments allowing cyberbullies to evade supervision generally implied with traditional face-to-face, school-based bullying activities. Teenage victims of cyberbullying can experience many negative consequences, including adverse psychological effects and increased mental health conditions. Depression, social anxiety, low self-esteem, loneliness, sleep disturbance, and suicidal ideation are all reported to be increased as a result of severe cyberbullying.[80, 81] Help-seeking is also reduced among victims as teens are unlikely to share their experience with adults.[81]

Expanded access to real-time moderated digital peer support would allow teens the option to receive support to work through their experiences in a safe, anonymous setting that does not expose them to further victimization. There is potentially great utility for school and community-based organizations to apply this type of intervention as a way to address the downstream consequences of cyberbullying.

Self-esteem

Given the relationship between low self-esteem and emotional distress [82], the statistically significant decrease in negative emotions suggests that digital peer support also has applicability to combat the decrease in self-esteem found among cyberbully victims.[80, 81] The potential benefit is applicable far beyond those teens experiencing cyberbullying, as improvements in self-esteem has also been found to be beneficial in myriad domains related to mental health such as relationships, education, occupations, physical fitness, and antisocial behavior.[83] Additionally, there is evidence to suggest that self-esteem decreases excessive social media usage in Spanish teenagers [84] and British university students [85], which may be due to an increased ability to better control addictive tendencies. Thus, this may be an area for future research with American teenagers as investigating this relationship could indicate that digital peer support can improve positive social media behaviors and general mental health.

Safety of Online Environments

Social media platforms battling criticism and increasing pressure to protect the health of teens could consider integration of objective, third party services such as anonymous, real-time moderated digital peer support, especially since there are findings indicating that increased social media usage is linked to decreased self-esteem.[86] For instance, while social media provides a space for healthy social engagement for users, there is no constantly active moderator available to prevent negative social interactions. While certain algorithmic content moderation systems are programmed to automatically identify and censor certain words and phrases, many of the negative comments must be flagged by other users to then be placed under review at a later time [87]. Further, anonymity allows for users to feel safer about engaging in personal information relating to their sensitive health information.[88,89]

Study Limitations

Since Supportiv is designed for a digitized peer support as opposed to offering clinical diagnosis and treatment, it purposely anonymizes its users to mitigate any drawbacks or hesitations from requirements to share personal and private information. From a research standpoint, the anonymous nature of the service prevents tracking users over time which makes it difficult to track emotional and psychological states prior to and after utilizing the service as well as trends in emotional state over repeated peer interactions by the returning users. Moreover, the lack of demographic information prevents further understanding of potential variations in digital peer support effectiveness such as changes in outcomes based on a teen's SES, race, or gender/gender identity. It is also unknown if the population of Medicaid-plan-sponsored teens who used the Supportiv service are significantly different than those in the same plans who did not choose to use digital peer support. The larger group of conversations studied were from teens who had a direct chat with a peer support

moderator. Though not a larger peer group, moderators, though trained in moderating peer support interactions, are not mental health experts or professional mental health workers, so are still considered peers in the context of overall peer support interventions. Further research is needed to confirm that emotional distress levels respond similarly for larger group conversations with peers and a moderator.

Additionally, the external validity of these results cannot be fully known as our sample was composed of Medicaid-plan-sponsored teens in specific counties of Nevada and Kansas, and thus, we are not able to calculate the change in emotion and sentiment among teens not enrolled in a Medicaid plan or from other communities in the U.S. However, given the similar patterns in use of digital technologies and the high incidence of mental health conditions across all socioeconomic strata and geographies, we hypothesize that the results would be similar. That is an area for future study.

Conclusion

In conclusion, real-time moderated, anonymous digital peer support appears to be a promising method for teenagers to decrease key areas of emotional and psychological distress such as anxiety, anger, insecurity, loneliness, sadness, and stress. Digital peer support provides an easily-accessed and safe digital environment for teens to engage in healthy, personal discussions and substantially alleviate their emotional distress at any time. Our findings support the potential for digital peer support to be explored as a population level intervention to expand the availability and accessibility of digital supports for emotional distress. Given the higher incidence of mental health conditions and access barriers faced by teens from low income households, this type of sponsored, no-cost-to-end-user digital service may be of particular value in addressing the emotional distress contributing to the larger mental health crisis among this especially vulnerable group of young people.

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