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Authors

Haro-Ramos, Alein Y
Rodriguez, Hector P
Aguilera, Adrian

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Effectiveness and implementation of a text messaging intervention to reduce depression and anxiety symptoms among Latinx and Non-Latinx white users during the COVID-19 pandemic

Alein Y. Haro-Ramos^a, Hector P. Rodriguez^a, Adrian Aguilera^{b,c,*}

^a School of Public Health, University of California, Berkeley, Berkeley, CA, USA

^b Digital Health Equity and Access Lab, School of Social Welfare, University of California, Berkeley, Berkeley, CA, USA

^c Department of Psychiatry and Behavioral Sciences, University of California, San Francisco, San Francisco, CA, USA

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ABSTRACT

Text messaging interventions are increasingly used to help people manage depression and anxiety. However, little is known about the effectiveness and implementation of these interventions among U.S. Latinxs, who often face barriers to using mental health tools. The StayWell at Home (StayWell) intervention, a 60-day text messaging program based on cognitive behavioral therapy (CBT), was developed to help adults cope with depressive and anxiety symptoms during the COVID-19 pandemic. StayWell users ($n = 398$) received daily mood inquiries and automated skills-based text messages delivering CBT-informed coping strategies from an investigator-generated message bank. We conduct a Hybrid Type 1 mixed-methods study to compare the effectiveness and implementation of StayWell for Latinx and Non-Latinx White (NLW) adults using the Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) framework. Effectiveness was measured using the PHQ-8 depression and GAD-7 anxiety scales, assessed before starting and after completing StayWell. Guided by RE-AIM, we conducted a thematic text analysis of responses to an open-ended question about user experiences to help contextualize quantitative findings. Approximately 65.8% ($n = 262$) of StayWell users completed pre-and-post surveys. On average, depressive (-1.48 , $p = 0.001$) and anxiety (-1.38 , $p = 0.001$) symptoms decreased from pre-to-post StayWell. Compared to NLW users ($n = 192$), Latinx users ($n = 70$) reported an additional -1.45 point ($p < 0.05$) decline in depressive symptoms, adjusting for demographics. Although Latinxs reported StayWell as relatively less useable (76.8 vs. 83.9, $p = 0.001$) than NLWs, they were more interested in continuing the program (7.5 vs. 6.2 out of 10, $p = 0.001$) and recommending it to a family member/friend (7.8 vs. 7.0 out of 10, $p = 0.01$). Based on the thematic analysis, both Latinx and NLW users enjoyed responding to mood inquiries and sought bi-directional, personalized text messages and texts with links to more information to resources. Only NLW users stated that StayWell provided no new information than they already knew from therapy or other sources. In contrast, Latinx users suggested that engagement with a behavioral provider through text or support groups would be beneficial, highlighting this group's unmet need for behavioral health care. mHealth interventions like StayWell are well-positioned to address population-level disparities by serving those with the greatest unmet needs if they are culturally adapted and actively disseminated to marginalized groups.

Trial registration: ClinicalTrials.gov Identifier: NCT04473599.

1. Introduction

Mobile health (mHealth) interventions (medical or public health programs supported by mobile devices (WHO Global Observatory for eHealth, 2011)), such as those using short messaging service (SMS) text,

are increasingly used to facilitate access to health services and educational health resources (Berrouiguet et al., 2016; Rathbone & Prescott, 2017). These digital tools can efficiently deliver population-wide interventions (Anderson-Lewis et al., 2018), are scalable (Terry, 2008), cost-effective (Guerrero et al., 2013), and can be used to support care

* Corresponding author. School of Social Welfare, University of California, Berkeley, 120 Haviland Hall, MC7400, Berkeley, CA, 94720, USA.

E-mail address: aguila@berkeley.edu (A. Aguilera).

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management across clinical areas, including depression, chronic disease management, and alcohol use disorder (Kumar et al., 2013). The COVID-19 pandemic has accelerated the use of SMS interventions globally to mitigate the negative impact of social isolation on mental health (Agyapong et al., 2020; Agyapong, Hrabok, et al., 2021; Agyapong, Shalaby, et al., 2021; Strudwick et al., 2021; Torous & Keshavan, 2020). In sum, scalable mHealth interventions, like SMS mental health interventions, can potentially reduce access gaps and unmet mental health needs (Ramos & Chavira, 2022).

Despite the advances associated with mHealth interventions, and their increasingly widespread adoption, a paucity of research focuses on the use, effectiveness, and implementation-related factors of SMS mHealth among underserved and disadvantaged groups, such as Latinxs (Friis-Healy et al., 2021; Khoong et al., 2021; Schueller et al., 2019). Most digital health tools are created for a “general” population which typically defaults to advantaged, English-speaking, and highly educated end-users, even during the COVID-19 crisis (Blacklow et al., 2021; Lyles et al., 2021). A lack of sociocultural and racial/ethnic representation in the development and implementation of supportive SMS mHealth interventions may inadvertently perpetuate health disparities by improving mental health among advantaged populations while less-advantaged populations do not benefit (Brewer et al., 2020). Because users interact with mHealth programs in manners influenced by their resources, sociocultural background, and circumstances (Moore et al., 2014), the limited attention to the unique experiences of Latinx users could jeopardize the feasibility and effectiveness of mHealth interventions among this group by inadvertently “alienating” users with marginalized identities (Ramos et al., 2021; Valdez et al., 2012). In the United States (U.S.), Latinxs experience an array of social factors that limit their use of traditional behavioral health care, which can potentially translate to barriers to using mHealth interventions. For example, Latinxs are more likely to have limited English proficiency (Himmelstein et al., 2021; Language Spoken at Home: American Community Survey, 2019: ACS 1-Year Estimates Subject Tables, 2019), lower health insurance rates (Artiga et al., 2020), and unequal access to mental health providers and culturally competent services (Cummings et al., 2017; Leong & Kalibatseva, 2011). Such structural barriers result in Latinxs underutilizing treatment for mental health conditions compared to their Non-Latinx White (NLW) counterparts, despite the groups’ similar rates of mental illnesses (SAMHSA., 2018, 2020, p. 7).

Evidence-based mHealth interventions are a viable tool to improve population-level mental health because they can reduce logistic barriers, decrease costs associated with traditional behavioral health care use, and overcome the mental health provider shortage (Kazdin, 2015). To achieve this, however, these interventions need to be widely available to and made for underrepresented users with a high unmet need for behavioral health tools. Achieving digital health equity involves designing, implementing, and evaluating digital health tools with a broad range of end-users in mind (Lyles et al., 2021). Considering marginalized and underrepresented populations as the end-users during the deployment and evaluation of text-based interventions can provide critical information to tailor mHealth programs for those with the greatest unmet need (Schueller et al., 2019). For example, previous work has found cultural differences in how Latinx and NLW users engage with a mHealth text intervention (Aguilera & Berridge, 2014), yet evidence remains limited (Ramos & Chavira, 2022). Given the inadequate understanding of the barriers and facilitators of SMS interventions among Latinxs, their increased use of mobile devices (Lopez et al., 2013), and receptiveness to using digital health tools (Ramirez et al., 2016), a window of opportunity exists to examine the effectiveness and implementation-related factors of SMS interventions among Latinxs; doing so can provide critical information on how to adapt novel interventions to be effective among Latinx and other disadvantaged groups. Further, assessing whether differences in implementation-related factors exist between Latinx and more traditional users can inform the tailoring of SMS interventions and identify implementation strategies to improve their

uptake among Latinxs.

Simultaneously examining the effectiveness and implementation of SMS interventions necessitate novel and flexible designs that overcome the staged, lengthy approach of the traditional research route focused on efficacy (Landes et al., 2019). The Hybrid Type 1 study design offers an opportunity to study the effectiveness of an intervention while simultaneously examining information on implementation to speed the translation of research findings to practice (Curran et al., 2012; Landes et al., 2019). This study design supports the timely translation of research findings into practical tools that can benefit underserved communities and maximize positive health outcomes by learning directly from current users. Further, the Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) framework provides a structured manner of evaluating an intervention’s impact and informing future program implementation and adaptation through an iterative process (Glasgow et al., 1999). RE-AIM has been used extensively to monitor and evaluate evidence-based interventions by considering the dimensions most relevant to real-world implementation, such as the capacity to reach underserved populations (Glasgow et al., 2019). Together, a Hybrid Type 1 design and the RE-AIM framework facilitate an iterative user-centered approach to adapting interventions to fit the needs of culturally diverse users. Assessing RE-AIM domains can help improve mental health outcomes and address behavioral health care access disparities by better understanding the needs of Latinx users (Lyles et al., 2021).

In this Hybrid Type 1 study, we examine the effectiveness and implementation outcomes of the StayWell at Home intervention (StayWell), a 60-day text messaging program aiming to help people cope with depressive and anxiety symptoms during the pandemic. StayWell messages are based on cognitive behavioral therapy (CBT), which aids users in challenging unhelpful thoughts and understanding the relationship between behaviors and mood. A previous study found that StayWell improved depressive symptoms across all users (Aguilera et al., 2021). This mixed-methods study uses a new sample of intervention participants, and it expands on our previous work by testing whether heterogeneity in treatment effect exists across Latinx and NLW users and, if so, the implementation factors that may help explain it (Curran et al., 2012; Landes et al., 2019). We employ simultaneous collection and analysis of quantitative and qualitative data in a complementary fashion, using quantitative data to evaluate the intervention and implementation outcomes and qualitative data to evaluate the implementation process (Palinkas et al., 2011).

Specifically, our primary research aim is to i) examine whether the effectiveness of StayWell is consistent among Latinx and NLW users. Our secondary aim is to better understand the implementation process of participating in StayWell by ii) quantifying subgroup differences in implementation-related factors organized according to the RE-AIM Framework and iii) elaborating on quantitative findings using a thematic analysis of user feedback related to barriers, facilitators, and suggestions. Based on the primary aim, we hypothesize that we will find differential effects of StayWell on depressive and anxiety symptoms across Latinx and NLW users. We expect that, on average, Latinx users will exhibit greater improvement in depression and anxiety due to the high unmet behavioral health care needs. Our secondary aim is explorative and meant to help contextualize our primary findings.

2. Methods

2.1. StayWell background

StayWell is a one-way text messaging intervention aiming to help people cope with anxiety and depressive symptoms during the COVID-19 pandemic. Users receive two messages daily for 60 days: one CBT-informed skills-based message (i.e., focused on behavioral activation, psychoeducation-based coping skills, or social support) and one inquiring about their mood (Aguilera et al., 2021) for a total of 120

messages during the study period. Skills-based text message templates were developed from previous work by a research team member (A.A.) and based on CBT skills to help improve coping with the worries and stress caused by the uncertainties and lifestyle changes of the pandemic, promote behavior change, and encourage social connections. Social support messages were integrated during this second StayWell phase, as Latinx participants have endorsed these as beneficial in previous work (Aguilera & Berridge, 2014). First, a skills-based text message was randomly sent daily between 9 a.m. and 6 p.m. from the investigator-generated message bank; each user had an equal probability of receiving a skills-based message focused on behavioral activation, coping skills, or social support. A message asking users to rate their mood on a scale of 1–9, with 9 being the best mood, was sent 3 h after the skills-based message. Importantly, the content is pre-established, not sent by a live therapist, and not tailored to each user. More information on the study protocol can be found in previous work (Figueroa et al., 2021).

All messages were translated and culturally adapted to Spanish. Bilingual and bicultural staff and clinicians with extensive experience working with Latinx individuals focused on translating the messages, retaining constructs, and conveying content in language that is easy to understand and informed by sociocultural contexts (Marf3n3ez-Lora et al., 2016). This approach is considered more culturally adaptive than strict direct translation approaches since it allows us to maintain content equivalency while attaining cultural relevance (Alegria et al., 2004). The following are examples of the messages that were sent.

Example 1: Keeping a routine is key. Set a time to work and time to take breaks.

Example 2: Every difficult situation also brings some positive things. Can you think of any positives for you?

Example 3: Self-soothe is an important skill for coping with distress. What are two ways that you can use your senses (e.g., smell, taste, touch) that will be calming?

2.2. Study design

This Hybrid Type I study is a follow-up to the first phase of the Staywell text messaging intervention with a purposeful targeting of Latinx individuals (Aguilera et al., 2021; Curran et al., 2012). We analyzed an independent sample of StayWell users during a baseline period between December 2020 to April 2021 (T1) and a follow-up period between February and June 2021 (T2). It is important to note that the first StayWell study protocol was pre-registered [ClinicalTrials.gov: NCT04473599], and the current study includes a post hoc, secondary analysis, testing whether we would find differences in the extent to which a new sample of Latinx and NLW users benefit from StayWell on depressive and anxiety outcomes. We pre-specified the primary subgroup analyses prior to examining the data to ensure our analyses were not biased by multiple comparisons.

We recruited program users in two manners. The first recruitment method was an online approach in which users signed up via Facebook ads created using user-centered design methods, general Craigslist ads, and ClinicalTrials.gov. This recruitment method was used in the first phase of StayWell, and more information can be found in previous work (Aguilera et al., 2021). The second recruitment method was a community-based, multipronged approach collaborating with community health centers and nonprofit organizations. First, established adult patients from eight community health center sites in Northern California were recruited; the clinic organization's Director of Behavioral Health encouraged behavioral health providers at each of the eight sites to share StayWell enrollment information with other clinicians and patients. Secondly, the intervention information was shared with immigrant rights organizations and school community liaisons working with Latinx communities in Northern California. Lastly, we used internal/-external listservs to disseminate program information and recruit Latinx,

immigrant, and Spanish-speaking users. Throughout the study period, a research team member was available to answer questions related to StayWell from any of the organizations' members or listserv users to facilitate trust-building. This recruitment strategy aimed to disseminate information about the intervention to marginalized individuals under-represented in mobile health interventions and clinical trials (Clark et al., 2019; Nebeker et al., 2017).

Users enrolled in the StayWell by texting the word "WELL" ("BIEN" in Spanish) to a phone number linked to the HealthySMS platform—an automated text messaging platform developed by author A.A. (<https://staywell.healthysms.org>) (Aguilera et al., 2017). Pre-intervention and post-intervention assessments of clinical data were supplemented with user measures derived from the program's software. Enrollment occurred on a rolling basis, and the intervention began the day after completing the pre-intervention assessment. The post-intervention assessment was administered on day 61 upon finalizing the 60 days of skills-based text messages and mood inquiries. Eligibility criteria included being 18 or older, online consent, and mobile phone ownership. All users could exit the intervention and stop receiving any text messages by sending the word "STOP" ("PARAR" in Spanish). Responses at T1 and T2 were linked to users' cellphone numbers and validated with a unique user ID created upon enrollment. The Checklist for Reporting of Survey Studies guided the reporting of our quantitative methods and results (Sharma et al., 2021).

2.3. Outcome measures

Outcome measures were organized into elements of the RE-AIM framework (Glasgow et al., 1999, 2019). We described the process of reaching users in the different recruitment samples (online vs. community approaches) as the indicator for *reach*. We present the *reach process* as we cannot estimate the degree to which we reached the target populations due to the lack of the denominator (total eligible individuals informed of StayWell). *Effectiveness* included adjusted differences in depressive symptoms, measured by Patient Health Questionnaire Depression Scale (PHQ-8), and anxiety symptoms, measured by the Generalized Anxiety Disorder Scale (GAD-7). The PHQ-8 and GAD-7 are valid diagnostic and severity measures for depression and anxiety in the general population (Kroenke et al., 2009; Plummer et al., 2016) and have been culturally validated among Latinx groups (Alpizar et al., 2018; Mills et al., 2014). The in-sample Cronbach alpha for PHQ-8 was $\alpha = 0.89$ and for the GAD-7 was $\alpha = 0.91$.

Adoption was assessed via user *engagement* as measured by the share of responses to the 60 daily mood inquiries (i.e., response rates). *Implementation* was measured quantitatively using (1) feedback on the number of messages and times messages were sent; (2) reasons why the time in which the support text message was sent may have been inconvenient; and (3) the 10-item System Usability Scale (SUS) to determine users' views on the usability of StayWell (i.e., the extent to which the program can be used to achieve its primary goal of helping users cope with depression and anxiety). The SUS is a validated instrument with established psychometrics (Brook et al., 1996) and has been extensively used within and outside mHealth (Bangor et al., 2008). The in-sample Cronbach alpha for the 10-item SUS was $\alpha = 0.80$. *Maintenance* indicators include the likelihood of continuing with the program, the degree of difficulty in using the program for six months, and the likelihood of recommending the program.

2.4. Quantitative analysis

We compared participant demographic variables and baseline measures for Latinx and NLW users using a *t*-test for continuous variables and a *chi-2* test for categorical variables (Table 1). Except for the descriptive baseline analysis, we restricted all subsequent analyses to a cohort of users who completed both the baseline and exit assessments ($n = 262$). The completion rate was not statistically different ($p = 0.77$) for

Table 1
User demographic and clinical characteristics by Latinx and Non-Latinx White (N = 398).

Characteristics		Latinx (n = 109)	NLW (n = 289)	Total N (%)	P value
		N (%)	N (%)	N (%)	
Age	Mean (SD)	31.6 (10.7)	39.8 (12.3)	37.5 (12.5)	<0.001
Gender	Female	88 (80.7)	242 (83.7)	330 (82.9)	0.575
	Male	21 (19.3)	47 (16.3)	68 (17.1)	
Native Language	English	63 (57.8)	285 (98.6)	348 (87.4)	<0.001
	Spanish	46 (42.2)	4 (1.4)	50 (12.6)	
Nativity	Foreign born	46 (42.2)	11 (3.8)	57 (14.3)	<0.001
Education	Highschool or less	18 (16.5)	25 (8.7)	43 (10.8)	0.11
	Somecollege	32 (29.4)	80 (27.7)	112 (28.1)	
	College	34 (31.2)	114 (39.4)	148 (37.2)	
	Graduatedegree	25 (22.9)	70 (24.2)	95 (23.9)	
Self-Rated Health	Excellent	15 (13.8)	35 (12.1)	50 (12.6)	0.88
	Verygood	40 (36.7)	111 (38.4)	151 (37.9)	
	Good	40 (36.7)	100 (34.6)	140 (35.2)	
	Fair	12 (11.0)	40 (13.8)	52 (13.1)	
	Poor	2 (1.8)	3 (1.0)	5 (1.3)	
Stress Frequency	Not at all	0 (0)	13 (4.5)	13 (3.3)	0.05
	A little bit	14 (12.8)	55 (19.0)	69 (17.3)	
	Quite a bit	44 (40.4)	89 (30.8)	133 (33.4)	
	Somewhat	26 (23.9)	90 (31.1)	116 (29.1)	
	Very much	25 (22.9)	42 (14.5)	67 (16.8)	
Baseline PHQ-8	Mean (SD)	9.3 (5.4)	7.9 (5.7)	8.3 (5.6)	0.028
Depression Clinical Categories	None (0–4)	23 (21.1)	87 (30.1)	110 (27.6)	0.025
	Mild (5–9)	32 (29.4)	105 (36.3)	137 (34.4)	
	Moderate (10–14)	37 (33.9)	55 (19.0)	92 (23.1)	
	Moderately severe (15–19)	11 (10.1)	28 (9.7)	39 (9.8)	
	Severe (20–24)	6 (5.5)	14 (4.8)	20 (5.0)	
	PHQ-8 Clinical Cut-off	PHQ-8 ≥ 10	54 (49.5)	97 (33.6)	
Baseline GAD-7	Mean (SD)	8.7 (5.0)	7.6 (5.5)	7.9 (5.4)	0.083
Anxiety Clinical Categories	None (0–4)	22 (20.2)	96 (33.2)	118 (29.6)	0.027
	Mild (5–9)	50 (45.9)	98 (33.9)	148 (37.2)	
	Moderate (10–14)	19 (17.4)	60 (20.8)	79 (19.8)	
	Severe (15–21)	18 (16.5)	35 (12.1)	53 (13.3)	
GAD-7 Clinical Cut-off	GAD-7 ≥ 10	37 (33.9)	95 (32.9)	132 (33.2)	0.84
Stopped Intervention	Mean (SD)	1.8 (1.2)	5.2 (1.3)	3.4 (1.8)	0.14
Somewhat difficult to use phone without help	Mean (SD)	0.9 (0.01)	2.1 (0.01)	1.8 (0.01)	0.43

Latinx (64.22%, 70/109) and NLW (66.44%, 192/289) users. Continuous variables were reported as means (SD). Statistically significant differences in values between the two groups, if present, were noted. A two-tailed $p < 0.05$ was considered statistically significant. Because our study’s hypotheses and primary outcomes were pre-specified, we do not need to adjust for Bonferroni correction (Streiner, 2015).

To evaluate StayWell’s effectiveness, we first calculated the change in PHQ-8 and GAD-7 scores for Latinx and NLW users separately using a paired t -test (Table 2). We also compared the differences in score changes from baseline to endline for the two groups using two-sample t -tests. Then, we used mixed-effects linear regressions (i.e., two repeated observations per user in the cohort) to examine differential changes in PHQ-8 and GAD-7 scores from baseline to 60 days between Latinx and NLW users, adjusting for age and gender (Table 3). A negative coefficient signifies a reduction in depression and anxiety symptoms over time. Models 1a and 1b estimate PHQ-8 and GAD-7, respectively, as a function of a pre-post intervention indicator (0 = pre-treatment and 1 = post-treatment), self-reported ethnicity (0 = NLW and 1 = Latinx), and an interaction between pre-post and ethnicity to model the differential effect of the StayWell intervention on PHQ-8 and GAD-7, respectively. Models 2a and 2b adjust for age and gender. Quantitative RE-AIM indicators were assessed using a t -test for continuous outcomes and a chi^2 test for categorical outcomes (Table 4).

As part of the sensitivity analyses, we include two models identical to 2a and 2b that also control for the recruitment method and user engagement to determine whether our findings were robust to the inclusion of these variables on which the groups varied. Our second sensitivity analysis was to determine whether our findings were clinically significant using clinical diagnostic categories for depressive disorder and generalized anxiety disorder (GAD) based on the corresponding PHQ-8 and GAD-7 scores. Here, we examined the within-group pre-post changes in the proportion of users in 1) each clinical diagnostic category (i.e., none/minimal, mild, moderate, moderately severe, and severe depression; and none, mild, moderate, and severe GAD) and also based on 2) the clinical cut-point of ≥ 10 for identifying probable cases of depressive disorder and GAD (Kroenke et al., 2009). We use Fisher’s Exact statistic for within-group pre-post changes in the distribution of depression and GAD categories since some cells have fewer than five observations. These results are presented in the Appendix. All quantitative analyses were conducted in Stata 17 and R.

2.5. Qualitative analysis

We apply a qualitative design centered on a constructivist paradigm to explore users’ perspectives of StayWell and understand the process of participating in the program. We used a constructivist paradigm because it focuses on the assumption that knowledge about a phenomenon is subjective, socially constructed, and formed by collecting perceptions of individuals who experience it (Angen, 2000). To understand StayWell users’ experiences, we aimed to generate themes that emerged from feedback that users provided after their participation.

All responses to the open-ended question on the exit assessment were analyzed using Braun and Clarke’s Six Step Framework for Thematic Analysis, including familiarization with the data, creating initial codes, theme search, theme review, defining/naming themes, and report production (Braun & Clarke, 2006). The open-ended question asked: “Do you have any other thoughts about the messages/program?” Among the cohort, 51.4% (36/70) of Latinx users and 53.1% (102/192) of NLW responded to the question. Using a two-sample test of proportions, we found no significant statistical differences in the share of Latinx and NLW users who responded to the open-ended question ($p = 0.4$). Upon excluding one-word responses (e.g., “positive” or “helpful”) and messages displaying gratitude to the research team (e.g., “This was an enjoyable study, and I appreciate the opportunity to participate in your research” or “Thanks for the opportunity”) from the analysis, we used 77.8% (28/36) of responses Latinx users provided compared to 77.5%

Table 2
Unadjusted changes in PHQ-8 and GAD-7 scores for participation, Latinx vs. Non-Latinx White (N = 262).

Measure		Scores					t statistic (df)	P value
		Baseline score, mean (SD)	60-day score, mean (SD)	Change from baseline, %	Mean difference (95% CI)			
PHQ-8	Latinx (n = 70)	9.86 (5.51)	7.31 (4.73)	-25.86%	-2.54 (-3.70, -1.39)	-4.40 (69)	<.001	
	NLW (n = 192)	7.99 (5.86)	6.89 (5.22)	-13.77%	-1.10 (-1.68, -0.52)	-3.76 (191)	<.001	
	All (n = 262)	8.49 (5.81)	7.00 (5.09)	-17.55%	-1.48 (-2.01, -0.96)	-5.57 (261)	<.001	
GAD-7	Latinx (n = 70)	8.84 (5.05)	6.97 (4.20)	-21.15%	-1.87 (-2.84, -0.90)	-3.84 (69)	<.001	
	NLW (n = 192)	7.56 (5.40)	6.36 (4.99)	-15.87%	-1.12 (-1.74, -0.66)	-4.36 (191)	<.001	
	All (n = 262)	7.90 (5.50)	6.52 (5.24)	-17.47%	-1.38 (-1.85, -0.91)	-5.74 (261)	<.001	

Note: Among users who completed the baseline and 60-day exit assessment; df = degrees of freedom, SD = standard deviation, CI = Confidence intervals, NLW= Non-Latinx White.

Table 3
Adjusted Analyses: Differential Changes in PHQ-8 and GAD-7 scores from pre-to post-intervention for Latinx and Non-Latinx White Users, n = 262.

Variables	PHQ-8		GAD-7	
	(1a)	(2a)	(1b)	(2b)
Latinx (Ref. NLW)	1.87* (0.76)	1.37 (0.89)	1.29+ (0.72)	0.80 (0.75)
Post-intervention (Ref. Pre-intervention)	-1.09*** (0.31)	-1.09*** (0.31)	-1.20*** (0.28)	-1.20*** (0.28)
Post#Latinx	-1.45* (0.60)	-1.45* (0.60)	-0.67 (0.54)	-0.67 (0.54)
Age (years)		-0.06* (0.03)		-0.07** (0.02)
Male (Ref. Female)		-1.50+ (0.82)		-1.93* (0.80)
Another Gender		6.11+ (3.50)		2.00 (3.40)
Constant	7.99*** (0.39)	10.58*** (1.13)	7.56*** (0.37)	10.59*** (1.09)

Standard errors in parentheses, ***p < 0.001, **p < 0.01, *p < 0.05, + p < 0.1; NLW = Non-Latinx White.

(79/102) NLW provided (p = 0.97). We considered each user’s response a data item in the thematic analysis.

We used a multi-stage process of categorizing and coding data items. In the first stage, each data item was deductively organized into meaningful groups, or codes, that capture user experiences. Then, we sorted all codes into the overarching themes of *facilitators* and *barriers*, which were derived from the research question and implementation science theory. In the second stage, we refined the themes, with the emergence of sub-themes and an additional theme, *user suggestions*, which was created inductively based on users’ feedback. We re-coded the entire data and analyzed it based on the final, more elaborate category system, and codes within each broader theme were further reviewed. We reviewed the themes multiple times to warrant a valid representation of the dataset. Finally, we appraised compiled passages assigned to each of the three main themes to ensure we did not misclassify any codes within each theme and to warrant internal homogeneity within themes. Re-coding stopped when refinements did not add anything substantial to the analysis.

All themes were categorized separately for Latinx and NLW users to find broad differences and similarities in responses between the groups. Notably, our exploratory qualitative analysis is not meant to reveal universal facts about the experiences of all StayWell users, especially because respondents who are more interested in the topic of an open-ended question are more likely to answer than those who are not as interested (Geer, 1991). As such, frequency counts may overrepresent the interested users and leave a proportion of all StayWell users with different impressions of the intervention underrepresented in the results. Instead, we highlight “differences” between Latinx and NLW based on the substantive significance and consistency of subthemes within and between the groups (Maguire & Delahunt, 2017).

One researcher (A.Y.H.R.) analyzed the text data because the coding

scheme contains three specific and well-defined themes (i.e., facilitators, barriers, and suggestions). The coding author is a self-identified Latina, a 1.5-generation immigrant, and holds a doctoral candidacy in population health from a major university. This coder has significant experience working with underrepresented, racialized groups and community-based organizations. All qualitative analyses were conducted using Dedoose software.

3. Results

Table 1 summarizes the demographic and clinical characteristics of Latinx (n = 109) and NLW (n = 289) users who subscribed to the second phase of StayWell. Most respondents were female (82.9%) and spoke English (87.4%). Latinx respondents reported higher average baseline PHQ-8 scores (9.3 vs. 7.9, p = 0.028) than NLW users; the distribution of clinical depression categories between the groups also varied at baseline (p = 0.025), and a greater share of Latinx respondents had a PHQ-8 score above the clinical cut-off of 10 (p = 0.003). Compared to NLW users, on average, Latinx were more likely to be foreign-born (42.2% vs. 3.8%, p < 0.001), were younger (31.6 years (SD = 10.6) vs. 39.8 years (SD = 12.3), p < 0.001), and were more likely to report Spanish as their native language (42.2% vs. 1.4%, p < 0.001). Seventeen (4.3%) users dropped out of the study by texting “STOP” to the server; among these, two were Latinx, and 15 were NLW users (p = 0.14). We did not find statistically significant differences in education (p = 0.11), gender (p = 0.58), self-rated health (p = 0.88), baseline average GAD-7 scores (p = 0.08) or the share of respondents with a GAD-7 score greater than 10 (p = 0.84), and users’ difficulty using their cellphone without someone’s help (p = 0.43) between the groups. It is important to note that the distribution of GAD clinical categories based on GAD-7 scores varied at baseline (p = 0.027).

Table 2 displays the unadjusted average depression (PHQ-8) and anxiety (GAD-7) scores and the change in scores at 60 days from baseline for the cohort who completed the exit assessment (n = 262). The cohort’s average PHQ-8 and GAD-7 scores decreased significantly from baseline to the end of the study. On average, PHQ-8 and GAD-7 scores decreased by 17.6% (from 8.49 to 7.00, p < 0.001) and 17.5% (from 7.9 to 6.52, p < 0.001), respectively. By the end of StayWell, Latinx users reported an improvement in depression symptoms, as measured by PHQ-8 scores (25.9% reduction, 9.86 to 7.31, p < 0.001) and anxiety symptoms, as measured by GAD-7 scores (21.2% reduction, 8.84 to 6.97, p < 0.001). Among NLW users, the average decrease of PHQ-8 and GAD-7 scores was 13.8% (from 7.99 to 6.89, p < 0.001) and 15.9% (from 7.56 to 6.36, p < 0.001), respectively. Based on the two-sample t-test, the mean difference in the change of PHQ-8 scores among Latinx and NLW individuals is statistically significant (mean diff. = -1.45, t = -2.4283, df = 260, p = 0.008), with an average decline in 2.54 points among Latinx users from baseline to endline compared to 1.09-point decline among NLW users. We did not find differences in the decline of GAD-7 scores between the groups (mean diff. = -0.67, t = -1.2436, df = 260, p = 0.107).

Results from the sensitivity analyses in which we examine the

Table 4
Differences in RE-AIM components between Latinx and Non-Latinx White adults (n = 262).

RE-AIM Constructs	Categories	Latinx (n = 70) n (%)	NLW (n = 192) n (%)	Total n (%)	P value		
Reach							
Recruitment	Online Sample	11 (15.7)	144 (75.0)	155 (59.2)	<0.001		
	Community Sample	59 (84.3)	48 (25.0)	107 (40.8)			
Adoption							
Engagement (0-60)	Mean (SD)	47.79 (13.0)	54.28 (10.6)	52.53 (11.6)	<0.001		
Implementation							
End Time Works	Always	12 (17.1)	29 (15.1)	41 (15.6)	0.456		
	Usually	34 (48.6)	105 (54.7)	139 (53.1)			
	Sometimes	24 (34.3)	54 (28.1)	78 (29.8)			
	Rarely	0 (0)	4 (2.1)	4 (1.5)			
	No. of Messages	Far too many	2 (2.9)	3 (1.6)		5 (1.9)	0.661
		Too many	6 (8.6)	24 (12.5)		30 (11.5)	
	Reasons Why Time Was Inconvenient	Just right	58 (82.9)	158 (82.3)		216 (82.4)	0.989
		Too few	4 (5.7)	6 (3.1)		10 (3.8)	
Far too few		0 (0)	1 (0.5)	1 (0.4)			
I don't have my phone with me		9 (12.9)	26 (13.5)	35 (13.4)			
I'm busy		45 (64.3)	124 (64.6)	169 (64.5)			
Multiple reasons		10 (14.3)	23 (12.0)	33 (12.6)			
Missing		1 (1.4)	5 (2.6)	6 (2.3)			
Too early in the day		2 (2.9)	5 (2.6)	7 (2.7)			
System Usability Scale Score (0-100)	Too late in the day	3 (4.3)	9 (4.7)	12 (4.6)	<0.001		
	Mean (SD)	76.8 (12.2)	83.9 (11.0)	82.0 (11.7)			
Maintenance							
Likelihood of Continuing (1-10)	Mean (SD)	7.5 (2.6)	6.2 (2.8)	6.6 (2.8)	0.001		
Degree of Difficulty to Continue Program for 6 Months	Extremely easy	23 (32.9)	82 (42.7)	105 (40.1)	0.001		
	Moderately easy	15 (21.4)	64 (33.3)	79 (30.2)			
	Slightly easy	15 (21.4)	16 (8.3)	31 (11.8)			
	Neither easy nor difficult	15 (21.4)	15 (7.8)	30 (11.5)			
	Slightly difficult	2 (2.9)	13 (6.8)	15 (5.7)			
	Moderately difficult	0 (0)	2 (1.0)	2 (0.8)			
	Likelihood of Recommending to a Friend/Family (1-10)	Mean (SD)	7.8 (2.2)	7.0 (2.3)		7.2 (2.3)	0.013

within-group pre-post changes in 1) the proportion of users in each clinical category for depression and GAD and 2) based on the clinical cut-point of ≥ 10 on the PHQ-8 and GAD-7 are consistent with our main analysis (see Appendix Table 1). We did not find a significant ($p = 0.08$) decline in the share of NLW users with probable depressive disorders ($\text{PHQ-8} \geq 10$) at baseline (T1) and endline (T2). However, the share of Latinx users with probable depressive disorder decreased from 54.3% at T1 to 23% at T2 ($p < 0.001$). To better illustrate the within-user clinical

changes, Figs. 1 and 2 include the share of Latinx and NLW users that improved or worsened at least one clinical category (e.g., changed from moderate to mild depression) or remained in the same category of depressive disorder and GAD at T1 and T2. At T2, 54% and 37% of Latinxs improved at least one clinical category of depressive disorder and GAD, respectively, compared to 30% and 31% of NLW who improved at least one clinical category of depressive disorder and GAD. Figs. 3 and 4 display the proportion of users who experienced no change, improvement, or worsening based on the clinical cut-point for identifying probable cases of depressive disorder ($\text{PHQ-8} \geq 10$) and GAD ($\text{GAD-7} \geq 10$). Those who experienced no change remained in the same clinical category at T1 and T2; users who improved had a score of ≥ 10 at T1 and < 10 at T2, and users who worsened had a score of < 10 at T1 and ≥ 10 at T2. Based on the probable depression cut-off, 36% of Latinx users improved compared to 13% of NLW users (Fig. 3). Regarding GAD, 16% of Latinx users improved compared to 11% of NLW users (Fig. 4).

Table 3 displays the results from the adjusted random-effects linear models examining the differential changes in PHQ-8 and GAD-7 scores from baseline to 60 days for Latinx and NLW users, adjusting for important demographics. Model 1a demonstrates that consistent with unadjusted findings, at the end of the intervention, Latinx respondents had an additional -1.45 -point ($p < 0.05$) reduction in PHQ-8 scores than their NLW counterparts (as assessed by the post*Latinx interaction). This differential effect of StayWell on depressive symptoms remained robust to the adjustment of gender and age in Model 2a. The joint test (*testparm*) of the interaction was statistically significant ($p = 0.02$), confirming that this sample of Latinxs had a greater reduction in depressive symptoms than NLW users. Regarding anxiety symptoms, Model 1b demonstrates that at the end of the intervention, the average GAD-7 score declined by -1.20 points ($p < 0.001$) across all users. We did not find a differential decline in GAD-7 scores between Latinx and NLW users ($-0.67, p > 0.05$). We find that results remain robust to the adjustment of sample method and user engagement (see Table 2 in Appendix).

3.1. RE-AIM implementation components

Table 4 displays the RE-AIM dimensions of reach, adoption, implementation, and maintenance among the cohort of users who completed the exit survey. Most Latinx users (84.3%, $n = 109$) were enlisted through the community-engagement approach, in which the study team collaborated with community/nonprofit organizations, federally qualified health centers, and internal/external list-serve emails to

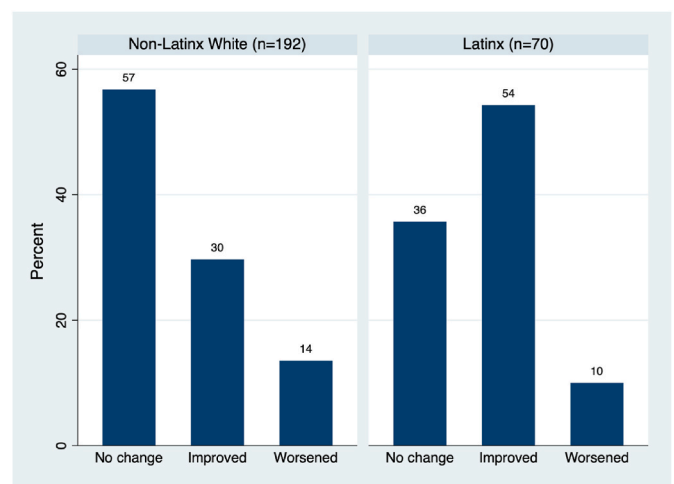


Fig. 1. Change in at least one clinical significance category of depression based on PHQ-8 clinical cut-points among users who completed the baseline and 60-day exit assessment (n = 262).

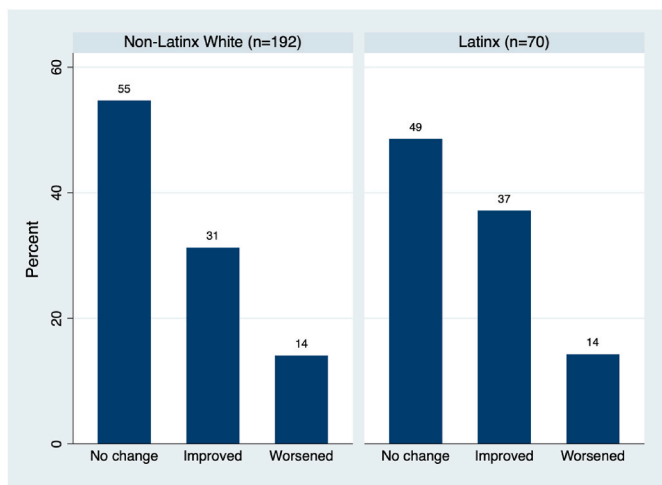


Fig. 2. Change in at least one clinical significance category of generalized anxiety disorder based on GAD-7 clinical cut-points among users who completed the baseline and 60-day exit assessment (n = 262).

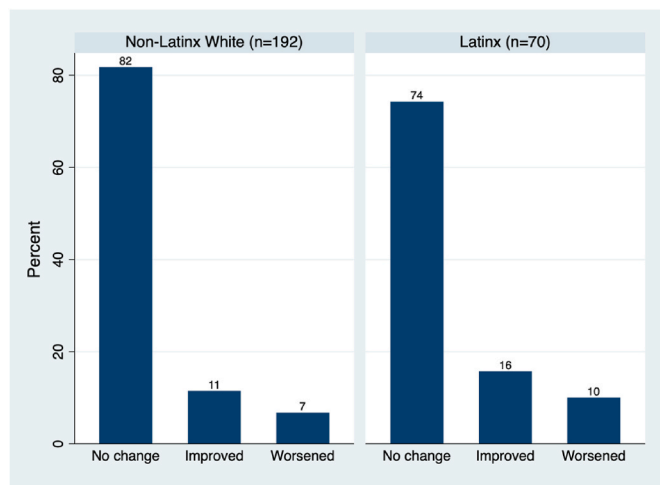


Fig. 4. Change in generalized anxiety disorder clinical significance categories based on GAD-7 (≥ 10) clinical cut-point for identifying probable cases of generalized anxiety disorder among users who completed the baseline and 60-day exit assessment (n=262). Individuals in the “no change” category remained in the same category at pre (T1) and post (T2) intervention, i.e., in the “generalized anxiety disorder” category (GAD-7 <10) at T1 and T2 or “no GAD” (GAD-7 ≥ 10) category at T1 and T2. Individuals in the “improved” category were in the “GAD” category (GAD-7 ≥ 10) at T1 and in the “no GAD” category (GAD-7 <10) at T2. Individuals in the “worsened” category were in the “no GAD” category (GAD-7 <10) at T1 and the “GAD” category (GAD-7 ≥ 10) at T2.

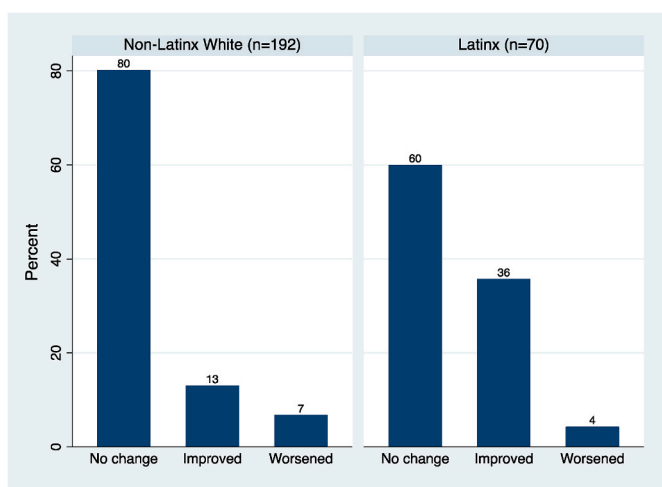


Fig. 3. Change in clinical significance categories of depression based on PHQ-8 (≥ 10) clinical cut-point for identifying probable cases of depressive disorder among users who completed the baseline and 60-day exit assessment (n=262). Individuals in the “no change” category remained in the same category at pre (T1) and post (T2) intervention, i.e., in the “depressive disorder” category (PHQ-8 <10) at T1 and T2 or “no depressive disorder” (PHQ-8 ≥ 10) category at T1 and T2. Individuals in the “improved” category were in the “depressive disorder” category (PHQ-8 ≥ 10) at T1 and in the “no depressive disorder” category (PHQ-8 <10) at T2. Individuals in the “worsened” category were in the “no depressive disorder” category (PHQ-8 <10) at T1 and the “depressive disorder” category (PHQ-8 ≥ 10) at T2.

disseminate information about StayWell. Approximately 25% of NLW users were recruited through the community-engagement approach, and the remaining were recruited through Facebook ads, Craigslist, and [ClinicalTrials.gov](https://www.clinicaltrials.gov). We compared baseline clinical characteristics between the community and online recruitment groups to determine whether either subsample had a higher clinical need or symptomatology and found no significant differences between the groups in PHQ-8 (community: 8.31 vs. online 8.28, $p = 0.97$) and GAD-7 (community: 8.26 vs. online: 7.58, $p = 0.21$) scores.

The average number of responses to mood inquiry texts among Latinxs was 47.8 (SD = 13.0, $rr = 79.7\%$) and 54.3 (SD = 10.6, $rr = 90.5\%$) among NLW users in the cohort, which were significantly different ($p < 0.01$). As measured by SUS scores, we also found

statistically significant ($p < 0.001$) differences in usability between Latinx and NLW users. On average, Latinx users reported lower usability of StayWell (76.8, SD = 12.2) than NLW users (83.9, SD = 11.0). Scores above 70 are considered “acceptable,” and scores above 85 are deemed “excellent” (Bangor et al., 2009). No statistically significant differences were detected between Latinx and NLW users for perceptions about the number of messages sent ($p = 0.66$) and convenience of message timing ($p = 0.46$). Among all users, 82.4% endorsed that the number of messages received was “just right,” and 68.7% reported that messages were “always” or “usually” sent at a convenient time. Latinx and NLW users identified similar reasons why the message timing was inconvenient ($p = 0.989$); “being busy” when users received the message was the most endorsed (62.1%) response for inconvenient message time across the cohort.

Regarding maintenance, we found statistically significant differences in the ease of continuing with Staywell for six months between Latinx and NLW users. Among NLWs, 42.7% said it would be “extremely easy” to continue the program compared to 32.9% of Latinx users ($p < 0.001$). On a scale of 1–10, NLW users were less likely to report they would use StayWell in the future than Latinx (6.2 vs. 7.5, $p = 0.001$). We also found that Latinx users were more likely to report willingness to recommend the program to family/friends than their counterparts (7.8 vs. 7.2, $p = 0.013$).

3.1.1. Qualitative implementation results

Identified themes centered around the implementation outcomes of *facilitators* and *barriers* to participating in StayWell, and *user suggestions* to improve the uptake and effectiveness of the program. Table 5 lists illustrative quotes representative of these major themes and subthemes. Differences surfaced between the subthemes reported by Latinx and NLW respondents.

Theme 1: Facilitators of StayWell

Facilitators were defined as any positive factors that may facilitate the use of StayWell or lead to users deciding to sustain the intervention. The

Table 5
Study themes, subthemes, and illustrative quotes from users on StayWell implementation facilitators, barriers, and suggestions.

Themes and Subthemes	Illustrative Quotations			
THEME 1: FACILITATORS				
	Latinx	Non-Latinx White		
Preference for reflecting on mood	<p>"I love the rating my mood feature. It made me reflect on my day and made me think of what I was grateful for. But it also made me reflect on the negative things that happen and somehow, it made me worry less. This feature was really nice and hope maybe one more feature like this could be added." [Community]</p> <p>"This program helped me reflect on my mood throughout each day more than I usually would have (by rating my mood)." [Community]</p>	<p>"I liked the mood tracking element much more than the actual messages. Looking back over previous days and seeing the trends was interesting. Being told to breathe deeply or use zoom was much less interesting and usually ignored." [Online]</p> <p>"While the intent of the messages was good and reinforced what I already know, in many ways they were unnecessary. The daily mood check-in did see help me see a pattern. This gave me help in recognizing when I might need a pick up and this helped me plan ahead." [Community]</p> <p>"I liked that I reflected on my mood every night- it helped myself monitor and reflect on my trends. Thinking back, I think the self-reflection was the most helpful aspect for me. The advice was nice but the reflection required me to stop and think and participate." [Community]</p> <p>"I like to check in with myself and my day so I loved the number scale." [Community]</p> <p>"I really liked the messages and several of them came on days when I really needed the personal encouragement, and they were exactly what I needed to hear at the moment. I enjoyed the personal messages far more than the "what is your mood 1-9" texts." [Online]</p>	<p>were helpful in one way or another." [Online]</p> <p>"Even when I didn't respond, I appreciated them. I think this is a really helpful program. Honestly, not so much for the content, but for the consistency. I will miss having the reminder to stop and take a moment. I think it's a useful habit." [Online]</p> <p>"I liked this program. Many of the texts were right on time. Like you were in my brain in a good way. Great timing each day." [Online]</p> <p>"Your little messages and self-reflection I did because of the program were small, unobtrusive, and weren't what I would say meant to create great changes or help. But I think maybe that's why they helped. They didn't increase my horrible mood to a 9, but they did raise it to a 3 or 4 when it otherwise would have been a 1 or 2. It definitely made a difference for me." [Online]</p> <p>"I loved receiving tips. Sometimes it was nice just to have a text message to read as it helped me feel more connected to the world during this time." [Online]</p> <p>"It was a really great way to be reminded that although I'm physically alone sometimes, there are people out there who care, even if it's just an automated message." [Online]</p>	
	Message content	<p>"I think more positive activities could have been sent my way." [Community]</p> <p>"Deberian dirigirse realmente a la persona con un mensaje positivo como por ejemplo, 'si es ahora que vuelas hazlo, tu puedes'" [Community]</p> <p>"I enjoyed receiving the random thoughtful messages." [Community]</p> <p>"It was nice to receive positive messages during the weeks." [Online]</p>	<p>"I liked the messages and how they were action-oriented rather than just ideas." [Online]</p> <p>"I did not find the inspirational messages helpful. I preferred the concrete skills messages." [Community]</p> <p>"I thought the messages about how to cope and different things you could do were great. Sometimes we just need a little reminder to get out of our own head space." [Online]</p> <p>"I really liked it. It was a quick and simple way to put something positive into my day. Almost all of the tips</p>	

Table 5 (continued)

Themes and Subthemes	Illustrative Quotations		
THEME 1: FACILITATORS			
	Latinx	Non-Latinx White	
Timing-related (i.e., Consistency)	<p>"Great positive messages helped lift my spirits." [Community]</p> <p>"I liked having the text sent every day. I looked forward to what kind of uplifting messages I would receive." [Online]</p> <p>"I did have times when the messages really did impact me and were precisely sent at the time, I was experiencing something difficult." [Community].</p>		
Feeling a sense of support/connection			
Bilingual			
THEME 2: BARRIERS			
	Latinx	Non-Latinx White	
Confusion regarding responding to messages	<p>"It was unclear on whether or how I was supposed to report my daily average or not. I recorded my mood level at the moment I responded to the text but that could have been higher or lower depending on the time I</p>		<p>"I was confused by the texts that included questions at first because it made me think this program was bidirectional." [Community]</p> <p>"If it was offered more yes, I would continue. I enjoyed receiving the text. At times I</p>

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Table 5 (continued)

Themes and Subthemes	Illustrative Quotations	
THEME 1: FACILITATORS		
	Latinx	Non-Latinx White
	received the message.” [Community]	found myself looking for them. And on occasion I responded to the suggestion. I could not remember if I was supposed to or not.” [Online]
Disliked that StayWell was not bi-directional	<p>“The messages were annoying on the days I was feeling most low. It’s easy to ignore the text messages because it’s not connected to any real follow up. This kind of thing maybe works for mild depression/anxiety when someone needs a reminder.” [Community]</p> <p>“It’s hard for your average person struggling with depression to be committed to this program without other ways to buy in like getting responses from a person and more personalized messages tied to my individual goals. It just didn’t do anything for me and was more annoying than helpful. The messages were often disconnected from what I needed or what I could do. It’s too surface level.” [Online]</p>	<p>“I was confused about whether I was supposed to respond to support messages.” [Community]</p> <p>“I feel like it felt too impersonal. I understand that there is no real way to tailor the message, but I feel like sometimes it can reinforce a feeling of loneliness. I would hear my phone go off and think someone had reached out, but it was just an automated message.” [Community]</p> <p>“Knowing it was not a real person texting me made it less effective for me.” [Online]</p>
No novel information		<p>“Sometimes the messages would make me laugh! But I was already using all the coping mechanisms so it didn’t feel particularly effectual.” [Community]</p> <p>“I personally did not find any of tips helpful as they are things I’ve already been trying to do to improve my mood.” [Community]</p> <p>“I had a lot of therapy in my younger years and already employed most of these strategies during Covid, and believe they have really helped me to get through it. Had I never been exposed to these ideas, I believe they would have been especially helpful so I think you are on the right track.” [Community]</p> <p>“They were nice to get but a lot of them didn’t apply to my circumstances or are things that I try to do already.” [Online]</p> <p>“It didn’t necessarily tell me anything I didn’t already know, use, etc.” [Online]</p>
Timing/quantity of messages		<p>“The messages were helpful, but there were times that I was too busy to really act on them, perhaps a way to also search for ideas when</p>

Table 5 (continued)

Themes and Subthemes	Illustrative Quotations	
THEME 1: FACILITATORS		
	Latinx	Non-Latinx White
		needed would be helpful.” [Online]
		“It just began to feel like too many messages. They were nice messages, but too many.” [Community]
		“How helpful the messages were depended on when I got them. Sometimes I’d be distracted or busy going about my day, get a message about COVID coping skills, be reminded of everything I was worrying about, and feel worse. Alternatively, sometimes I would feel lonely or stuck and get a message prompting me to call a friend- and I would do that and feel better.” [Community]
		“I wish the messages came at a more consistent time - I put my phone down for the night at a certain time so it would have been nice to know when I was getting the message.” [Online]
		“Do not assume all people sleep your hours. Do not assume all people carry phones. Do not assume people my age type on phones.” [Online]
Repetitive content	<p>“I began to tune out the messages since they were repetitive, maybe switching up the verbiage or content may help.” [Community]</p> <p>“Repetitivos al extremo de hacer perder el interes a l@s participantes (<i>Repetitive to the point of making the participants lose interest</i>).” [Community]</p>	
THEME 3: USER SUGGESTIONS		
	Latinx	Non-Latinx White
Links to more information	<p>“I think a good idea would be to link to resources as well that people didn’t click on. The stuff like aside from mental health you could do food resources or something.” [Community]</p> <p>“I think it would be helpful for certain messages with tips/recommendations/suggestions to have links for more information, such as videos, resources, etc. that can help strengthen the message and can help build a certain skill or further shape a positive mindset.” [Community]</p>	<p>“Having links in the messages that lead to articles or videos about the advice suggested would be a great resource for people who are struggling.” [Online]</p> <p>“Perhaps a way to also search for ideas when needed would be helpful.” [Online]</p>
Tailoring content	<p>“Perhaps some pictures or imagery would help.” [Online]</p>	<p>“I felt the messages were just right. There could be a separate option for more religious people to receive more spiritual uplifting texts.” [Online]</p>

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Table 5 (continued)

Themes and Subthemes	Illustrative Quotations	
THEME 1: FACILITATORS		
	Latinx	Non-Latinx White
Tailoring timing	<p>"I think it's hard for your average person struggling with depression to be committed to this program without other ways to buy in like getting responses from a person and more personalized messages tied to my individual goals." [Online]</p> <p>"Great program, more support on social life would be great." [Online]</p>	<p>"If messages could have felt a little more personalized and words of encouragement plus an activity to do that would have been more supportive in my eyes." [Online]</p> <p>"Would have liked more activity ideas and less feel-good quotes." [Community]</p> <p>"It would be great to be able to schedule a time for the messages to have something to look forward to." [Online]</p> <p>"If I were to continue using it, I would like a set time to get the messages." [Online]</p> <p>"I think this program would have been more effective with several texts a day, at various times." [Community]</p> <p>"Perhaps have an option to increase or decrease the number of messages per day." [Online]</p> <p>Message or theme to work on should come first part of the day. A second message should come later in day to inquire about mood level. Maybe have two of those. One in morning also to inquire about mood level." [Community]</p> <p>"More consistent times of sending messages." [Online]</p>
	Support groups/ engagement with person	<p>"Estaria bien si hubiera grupos de apoyo (<i>It would be nice if there were support groups</i>)." [Community]</p> <p>"Si se tuviera de ves en cuando contacto con alguna persona por mensaje creo que ayudaria a mejorar el programa (<i>If I had contact with a person from time to time by message, I think it would help improve the program</i>)." [Community]</p>

five subthemes we identified within *facilitators* include (1) reflecting on mood, (2) message content, (3) consistency of messages, (4) sense of support, and (5) availability of a bilingual intervention.

We found that Latinx and NLW users who provided feedback shared similar *facilitators* to using StayWell. Most users expressed an overall preference and inclination for the mood inquiry text over skills text messages. For instance, a NLW user said that the mood reflection helped them "*monitor and reflect on mood trends ... [and] the self-reflection was the most helpful aspect.*" Another NLW participant mentioned their liking for tracking their mood throughout the 60 days of the program, saying,

"I liked the mood-tracking element much more than the actual messages. Looking back over previous days and seeing the trends was interesting. Being told to breathe deeply or use Zoom [to connect with others] was much less interesting and usually ignored."

Similarly, a Latinx user mentioned their appreciation of the mood inquiry, which facilitated introspection, saying,

"I love the rating my mood feature. It made me reflect on my day and made me think of what I was grateful for. But it also made me reflect on the negative things that happen, and somehow, it made me worry less."

Both groups enjoyed the consistency of the messages. Various users mentioned they enjoyed receiving messages every day, even when they did not respond to them, and looked forward to the reminder to stop and "take a breather." For instance, a Latinx user mentioned they "*liked having the text sent every day. [They] looked forward to what kind of uplifting messages [they] would receive.*" Similarly, a NLW user found the program helpful, "*not so much for the content, but for the consistency.*"

Users in both groups mentioned aspects of the message content that they liked. For example, some NLW users noted that they preferred "*concrete skills messages*" and "*action-oriented*" messages over "*feel-good quotes*" or "*ideas.*" Another Latinx user mentioned they sought "more positive activities." Both groups also enjoyed the "random thoughtful," and "positive" messages.

As one Latinx user mentioned, texts included "*great positive messages helped lift [their] spirits*" and they "*enjoyed receiving the random thoughtful messages.*" Another Latinx participant reiterated that texts should keep sending the user positive messages, saying, "*deberían dirigirse realmente a la persona con un mensaje positivo como por ejemplo, 'si es ahora de que vuelas, hazlo, tu puedes'*" ("*[texts] should really address the person with a positive message such as 'if it's time to fly, do it, you can'*").

In the last two subthemes, we found that only NLW users explicitly mentioned feeling connectedness, and only Latinx users mentioned aspects of the bilingual intervention. For example, a NLW endorsed feeling a sense of support/connection when receiving text messages. As one NLW user said, "*Sometimes it was nice just to have a text message to read as it helped me feel more connected to the world during this time.*" Echoing these feelings, another NLW user mentioned,

"It was a really great way to be reminded that although I'm physically alone sometimes, there are people out there who care, even if it's just an automated message."

Further, only Latinx users mentioned that they appreciated the availability of a bilingual program, which facilitated their participation by fostering engagement with Spanish-speaking family members on what they learned from StayWell. A Latinx user mentioned, "*I love that [StayWell] was bilingual, my dad and I would talk about the messages and tips; it made it more of a family initiative.*"

Theme 2: Barriers to using StayWell

Barriers were defined as any negative features that may result in users abandoning or declining future use of StayWell. We identified five subthemes within the main theme of *barriers*: (1) confusion regarding whether to respond to support messages, (2) lack of bi-directionality, (3) no novel information, (4) timing or quantity of messages, and (5) repetitive content.

Both Latinx and NLW users expressed confusion over whether they should respond to skills text messages as these sometimes posed questions and how to report their mood. A NLW user mentioned, "*I was confused by the texts that included questions at first because it made me think this program was bidirectional.*" A Latinx user also mentioned that "*it was unclear on whether or how*" they were "*supposed to report [their] daily average score.*"

Similarly, an additional shared barrier was related to the lack of bidirectionality of the intervention. A Latinx user said that the lack of "*any real follow-up*" made StayWell "*too surface level,*" and they found that lack of "*buy-in, like getting responses from a person,*" made it difficult to commit to the program. NLW users also endorsed this barrier, saying,

"I feel like it felt too impersonal. I understand that there is no real way to tailor the message, but I feel like sometimes it can reinforce a feeling of loneliness. I would hear my phone go off and think someone had reached out, but it was just an automated message."

Unlike Latinxs, NLW users mentioned that the program provided no new information or skills, as they were already familiar with the coping skills that StayWell aimed to cultivate amongst users. NLW users mentioned that the skills-based messages provided information they were already applying to their daily life to improve their mood. For instance, a NLW user mentioned they *"did not find any tips helpful as they are things [they've] already been trying to improve my mood."* Another said that while the messages made them laugh, they were *"already using all the coping mechanisms, so it didn't feel particularly effectual."* Similarly, a NLW user mentioned they already had the skills StayWell encouraged:

"I had a lot of therapy in my younger years and already employed most of these strategies during Covid, and believe they have really helped me get through it. Had I never been exposed to these ideas; I believe the [messages] would have been especially helpful, so I think you are on the right track."

NLW users, unlike any Latinx users, also endorsed the timing and quantity of messages as problematic. The times in which they received the messages were sometimes inconvenient because they were *"too busy to really act on them"* or *"distracted."* For instance, a NLW user mentioned that the timing in which they received the messages was challenging,

"How helpful the messages were depended on when I got them. Sometimes I'd be distracted or busy going about my day, [and I'd] get a message about COVID coping skills, be reminded of everything I was worrying about, and [would] feel worse. Alternatively, sometimes I would feel lonely or stuck and get a message prompting me to call a friend- and I would do that and feel better." *"I began to tune out the messages since they were repetitive, maybe switching up the verbiage or content may help."*

On the other hand, Latinx were the only ones to endorse that repetitive content were barriers to engaging with StayWell. For example, one Latinx user mentioned that the messages were *"Repetitivos al extremo de hacer perder el interes a l@s participantes (Repetitive to the point of making the participants lose interest)."* Another mentioned they became disengaged with the repetitive messaged, saying

Theme 3: User Suggestions to Improve StayWell

User suggestions were defined as any factors that may improve engagement and uptake of StayWell. Four dimensions of user suggestions emerged from the data: (1) links to more information, (2) tailoring message content, (3) tailoring timing, and (4) availability of support groups or engaging with a person via text.

Both groups reported similar suggestions for StayWell, including receiving links to educational material and information on improving social conditions associated with mental health. A NLW user reiterated that *"having links in the messages that lead to articles or videos about the advice suggested would be a great resource for people who are struggling."* A Latinx user said,

"I think it would be helpful for certain messages with tips/ recommendations/ suggestions to have links for more information, such as videos, resources, etc., that can help strengthen the message and can help build a certain skill or further shape a positive mindset."

A comparable suggestion between the groups was to make the content more *"personalized."* A NLW user suggested *"having a separate option for more religious people to receive more spiritual uplifting texts,"* while a Latinx user suggested *"switching up the verbiage"* or including *"pictures or imagery."* Similarly, a NLW user felt that *"a little more personalized and words of encouragement plus an activity to do that would have been more*

supportive." A Latinx user, for example, suggested *"more support on social life would be great,"* and another Latinx user suggested that *"more personalized messages tied to [their] individual goals"* would lead to *"buy in."*

The main difference in suggestions between the groups relates to tailoring timing and preferences for the availability of support groups. While no Latinx users suggested they would like to tailor message timing and quantity, various NLW users suggested allowing the tailoring of message timing and quantity. For example, a NLW user reported that being able to *"schedule a time for the messages would give [them] something to look forward to";* another mentioned that *"this program would have been more effective with several texts a day, at various times,"* while another would like the *"option to increase or decrease the number of messages per day."* On the other hand, Latinx users endorsed that having support groups or engaging with a person would result in a more effective intervention. For instance, a Latinx user said, *"Si se tuviera de ves en cuando contacto con alguna persona por mensaje creo que ayudaria a mejorar el programa (If I had contact with a person from time to time by message, I think it would help improve the program)."*

4. Discussion

Our Hybrid Type 1 study aimed to evaluate the effectiveness of the StayWell intervention in reducing anxiety and depressive symptoms among Latinx and NLW users, quantify subgroup differences in implementation-related outcomes, and elaborate on quantitative findings using a thematic analysis of user feedback to understand the process of participating in StayWell. The mixed-method design we used allowed us to evaluate outcomes and processes while using qualitative findings to elaborate on quantitative results (Palinkas et al., 2011). Our hypothesis that Latinx users would yield better outcomes than NLW was partially supported. While all users, on average, experienced a reduction in their depressive and anxiety symptoms, Latinxs had a greater reduction in depressive symptoms (but not anxiety symptoms) than NLWs, as measured by the decline in PHQ-8 scores. Results from the thematic analysis helped elaborate why Latinx users may have benefited more from StayWell on depressive symptoms.

We found that after participating in StayWell, Latinxs had a greater reduction in PHQ-8 scores (−2.54 points) than NLW users (−1.10 points). Our sensitivity analysis also suggests clinically significant changes in depression, with the share of Latinx users with probable depressive disorder decreasing from 54.3% at baseline to 23% at endline. What may help explain Latinxs' greater reduction in depressive symptoms? In the U.S., Latinx individuals experience similar rates of depressive disorders as NLW but are less likely to receive mental health care services (9.7% vs. 19.8%) than NLW adults (SAMHSA, 2020). These trends remain even during the COVID-19 pandemic, where the mental health of Latinx individuals worsened to a greater extent than that of NLWs, and higher levels of unmet mental health needs among Latinxs remained (Thomeer et al., 2023). Consistent with these findings, in the thematic analysis, NLW reported that the intervention provided no new information they had already learned from therapy in the past. On the other hand, this subtheme was not present among Latinxs; instead, we found that Latinxs suggested other forms of behavioral health care, such as support groups or texting with a therapist, to improve the intervention. Our qualitative findings are consistent with our pre-post analysis and highlight that StayWell may have helped narrow the gap in depressive symptomology between Latinx and NLW users, whereby Latinx's greater severity level in PHQ-8 scores at baseline converged with NLW's endline scores. Given the underutilization of behavioral health care and a greater propensity for depression among Latinxs, StayWell may be filling in the unmet need for culturally-relevant mental health tools during a period marked by increased isolation. These findings are consistent with previous studies, which have found that the population health impacts of interventions across various outcomes tend to be greater for more vulnerable groups

with lower resources and greater unmet need at baseline (Matthay et al., 2021).

While the average reduction in depressive symptoms is modest, the population health impact of this low-intensity, universal intervention can be practically meaningful if a significant share of the population receives the intervention. As a *population-level* health intervention, StayWell is a scalable solution to provide evidence-based behavioral health care tools to all communities—it is free, only requires a cellphone that can receive SMS texts, and helps overcome transportation, insurance, and cost barriers. StayWell has the potential to reach high-need individuals and may have a larger treatment effect on this subgroup's behavioral health outcomes due to greater need and greater severity of symptoms before starting the intervention. Although our average effect size is small, we offer valuable evidence to improve population health if our intervention is implemented broadly.

Regarding implementation outcomes, Latinxs were more likely to recommend the program to a family member or friend and report that they would continue using it than NLW users. Despite being more receptive to maintaining the use of StayWell, Latinx users reported a lower usability score and responded to fewer mood inquiries than NLWs, suggesting we can improve the program to increase the ease with which Latinxs engage with StayWell. Regarding the factors that may help explain why Latinxs may be more receptive to continue using StayWell, a central explanation may be Latinx populations' reliance on their cellphone. Racial minorities are more likely to be cellphone-dependent than their NLW counterparts, with a cellphone being the only device they own to access the internet (Tsetsi & Rains, 2017). Simultaneously, racial minorities were more likely to use their phones for social activities than NLWs, who performed more news and information activity (Tsetsi & Rains, 2017), which may help explain the lower interest in the future use of StayWell among NLW users.

Our analyses of user experiences revealed several key findings related to implementation processes (i.e., barriers, facilitators, and suggestions) across all users to help improve future StayWell iterations. First, a facilitator of StayWell among Latinx and NLW users was responding to the daily mood inquiry text. Mood ratings can be a valuable proxy for depression by capturing negative and positive affect (Aguilera et al., 2015). It may be that StayWell users enjoyed self-monitoring their daily affective experiences as a form of emotional awareness, a key feature of CBT. Both groups also stated that the consistency of the messages was critical in engaging with the content delivered. Second, regarding barriers, both groups mentioned needing clarification about whether they were expected to respond to support messages and what factors to consider when reporting their mood. Another barrier was the dislike for automated messages, which made it “impersonal” for some and “ineffective” for others. This finding is consistent with previous user experience research, which has found that tailoring mHealth design features, such as peer-to-peer communication, can enhance user engagement (Wei et al., 2020). Third, shared suggestions included sending links to resources and educational material on behavioral health via messages and personalizing message content. Another possibility for personalization is implementing machine learning algorithms that change message content based on user behavior and responses (Aguilera et al., 2020).

Despite similarities in implementation processes across the groups, we also found critical differences between Latinx and NLW users. First, repetitive content made some Latinx users lose interest, helping explain the lower response rates in mood responses. Second, Latinx users endorsed that having a support group or interaction with a therapist via text would improve the program, which may reflect the group's lower behavioral health care access levels (“Mental Health Care Health Professional Shortage Areas (HPSAs),” 2021). Third, Latinxs reported that a bilingual intervention increased accessibility to non-English speaking users. This last point highlights the importance of making evidence-based interventions available for individuals who do not speak English (Lyles et al., 2023; Ramos & Chavira, 2022).

An underexplored area of work has been the assessment of SMS text interventions' effectiveness and implementation-related factors among underrepresented groups. This study aims to fill this gap by examining heterogeneity in treatment effects between Latinxs, an underrepresented group in mHealth interventions, and their NLW counterparts while contextualizing quantitative differences with user experience data. We found a more diverse sample of users enrolled in the program when collaborating with trusted organizations by disseminating program information (Jackson et al., 2022). Along these lines, our overall low retention rate and relatively lower engagement with the program among Latinxs demonstrate that it is not enough to inform marginalized communities of the availability of mHealth interventions; instead, researchers need to support underrepresented groups throughout their program participation to retain and sustain engagement. Examining the implementability (i.e., features that predict the relative ease of implementing programs) of text-based interventions for mental health can help researchers tailor interventions to improve their reach, engage, and support Latinx and other disadvantaged populations.

Engaging diverse users when evaluating and implementing mHealth programs is pivotal to advancing health equity. As the field of digital health continues to evolve, conceptualizing and identifying barriers that minority populations experience in adopting novel technologies is the first step to preventing the exacerbation of health disparities. Our study highlights that mHealth interventions can reach a high-need population when culturally adapted and disseminated through adequate venues, which may reduce disparities in behavioral health outcomes at the population level.

5. Limitations

The study results should be considered in the context of certain limitations. First, the data were collected from a convenience sample of users not representative of the general Latinx or NLW population. For example, 54.1% of Latinx users in our sample have at least a college degree, higher than the 16% national average (Educational Attainment of Hispanic Population in the U.S., 2019). The generalizability of our results may be limited to more educated Latinxs. Unlike the first phase of StayWell, the program was open to individuals who did not want to participate in the research study; and Latinxs with lower educational levels or of more vulnerable positions (i.e., immigrants, monolingual Spanish speakers) may have been more likely to sign up for StayWell without having to share baseline and endline data with the research team. Second, the share of individuals who completed the exit questionnaire was relatively low. Still, the completion rate did not differ by group, and we did not find differences in the baseline clinical characteristics between those who completed the exit survey and users who did not. Third, while we found no significant difference in the share of Latinx and NLW users who responded to the open-ended exit question, this data may generally overrepresent users more interested in providing feedback. As such, findings from the qualitative analysis may only be generalizable to some StayWell users. For instance, users with higher education or familiarity with mHealth programs may have been more likely to respond, leading to self-selection. It is also possible that we are not capturing the experiences of certain users underrepresented in the open-ended text responses. However, given that our qualitative analysis is exploratory, our findings are not meant to reveal universal objective facts about the experiences of all underrepresented groups in mHealth, but rather to help contextualize our quantitative conclusions and examine the implementation process. Finally, we cannot establish causal relationships given the lack of randomization, and we could not control for some potential confounders. Including a previous mental health diagnosis, annual income, or concurrent access to mental health services could alter the results. The analyses, however, controlled for important demographics and were robust to the adjustment of recruitment samples and engagement in the sensitivity analysis.

6. Conclusion

StayWell, a text-based intervention program based on CBT principles, helped reduced depression and anxiety symptoms in our sample of users, highlighting the potential for assisting diverse populations manage their mental health symptoms and remain connected during extended emergencies like the COVID-19 pandemic. Even if the intervention effect size was small, StayWell is well-posed to be broadly implemented at the population level at a low cost. The evidence of relatively more significant reductions in PHQ-8 scores among Latinxs provides promising evidence that text-based mental health interventions can address widening disparities in depression management. Latinx users recommended maintaining the availability of bilingual programs and providing behavioral health group sessions or contact with a professional via text. The latter point illustrates the overall need for health professionals that can provide culturally competent care and mHealth program creators that can design digital health tools for Latinx patients. The Biden Administration announced a national mental health strategy to transform the behavioral services infrastructure to address mental health holistically, including investing in training and loan repayment programs to increase the behavioral health workforce's supply, cultural competency, and diversity ([President Biden to Announce Strategy to Address Our National Mental Health Crisis, 2022](#)). Along with structural changes, digital health interventions, such as StayWell, can play an essential role in diminishing unmet mental health needs and addressing the treatment gap at the population level.

Appendix

Table 1
Unadjusted share of Latinx & Non-Latinx White users in each clinical diagnostic category based on PHQ-8 and GAD-7 score cut-offs, pre-post (n = 262)

<i>Non-Latinx White</i> (n = 192)			
PHQ-8	Pre [N (%)]	Post [N (%)]	P value
None/Minimal depression (0–4)	58 (30.2)	79 (41.1)	0.052
Mild depression (5–9)	69 (35.9)	60 (31.2)	
Moderate depression (10–14)	36 (18.8)	33 (17.2)	
Moderately severe depression (15–19)	17 (8.9)	17 (8.9)	
Severe depression (20–24)	12 (6.2)	3 (1.6)	
Depression clinical significance (≥10)	65 (33.9)	53 (27.6)	0.18
GAD-7			
	Pre	Post	P value
None (0–4)	65 (33.9)	86 (44.8)	0.135
Mild anxiety (5–9)	66 (34.4)	54 (28.1)	
Moderate anxiety (10–14)	40 (20.8)	38 (19.8)	
Severe anxiety (15–21)	21 (10.9)	14 (7.3)	
Anxiety clinical significance (≥10)	61 (31.8)	52 (27.1)	
<i>Latinx</i> (n = 70)			
PHQ-8	Pre	Post	P value
None/Minimal depression (0–4)	12 (17.1)	24 (34.3)	0.003
Mild depression (5–9)	20 (28.6)	30 (42.9)	
Moderate depression (10–14)	23 (32.9)	10 (14.3)	
Moderately severe depression (15–19)	11 (15.7)	3 (4.3)	
Severe depression (20–24)	4 (5.7)	3 (4.3)	
Depression clinical significance (≥10)	38 (54.3)	16 (22.9)	<0.001
GAD-7			
	Pre	Post	P value
None (0–4)	11 (15.7)	21 (30.0)	0.041
Mild anxiety (5–9)	35 (50.0)	29 (41.4)	
Moderate anxiety (10–14)	12 (17.1)	16 (22.9)	
Severe anxiety (15–21)	12 (17.1)	4 (5.7)	
Anxiety clinical significance (≥10)	24 (34.3)	20 (28.6)	
<i>All</i> (N = 262)			
PHQ-8	Pre	Post	P value
None/Minimal depression (0–4)	70 (26.7)	103 (39.3)	0.005
Mild depression (5–9)	89 (34.0)	90 (34.4)	

(continued on next page)

CRedit authorship contribution statement

Alein Y. Haro-Ramos: Conceptualization, Analysis, Writing – original draft. **Hector P. Rodriguez:** Writing – review & editing. **Adrian Aguilera:** Conceptualization, Funding acquisition, Writing – review & editing.

Declaration of competing interest

AA is the creator and owner of HealthySMS.

Data availability

Data will be made available on request.

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Table 1 (continued)

Non-Latinx White (n = 192)			
PHQ-8	Pre [N (%)]	Post [N (%)]	P value
Moderate depression (10–14)	59 (22.5)	43 (16.4)	
Moderately severe depression (15–19)	28 (10.7)	20 (7.6)	
Severe depression (20–24)	16 (6.1)	6 (2.3)	
Depression clinical significance (≥ 10)	103 (39.3)	69 (26.3)	0.002
GAD-7			
	Pre	Post	P value
None (0–4)	76 (29.0)	107 (40.8)	0.009
Mild anxiety (5–9)	101 (38.5)	83 (31.7)	
Moderate anxiety (10–14)	52 (19.8)	54 (20.6)	
Severe anxiety (15–21)	33 (12.6)	18 (6.9)	
Anxiety clinical significance (≥ 10)	85 (32.4)	72 (27.5)	0.22

Table 2

Adjusted Analyses: Differential Changes in PHQ-8 and GAD-7 scores from pre-to post-intervention for Latinx and Non-Latinx White Users, n = 262

Variables	PHQ-8	GAD-7
Latinx (Ref. NLW)	1.32 (0.88)	0.56 (0.85)
Post-intervention (Ref. Pre-intervention)	-1.09*** (0.31)	-1.20*** (0.28)
Post#Latinx	-1.45* (0.6)	-0.67 (0.54)
Age (years)	-0.06* (0.03)	-0.07** (0.02)
Male (Ref. Female)	-1.58+ (0.82)	-1.93* (0.8)
Another Gender	6.14+ (3.53)	2.00 (3.4)
Community Sample Method (Ref. Online)	0.45 (0.79)	-0.25 (0.76)
Engagement	-0.78 (0.48)	-0.29 (0.47)
Constant	10.62*** (1.21)	10.82*** (1.16)

Standard errors in parentheses.

***p < 0.001, **p < 0.01, *p < 0.05, + p < 0.1; NLW = Non-Latinx White.

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