

ORIGINAL RESEARCH ARTICLE

The impact of a stress, emotional regulation, and support mobile health intervention in millennial family caregivers: A pilot study

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Abstract

Millennial family caregivers are a growing and unique population, with specific needs related to their life stage and generational experiences. Many are navigating careers, family building, and the impact of multiple economic recessions, in addition to family caregiving responsibilities. Therefore, the purpose of this study was to conduct pilot feasibility and acceptability testing of an app-based stress, emotional regulation, and support intervention that was informed by both the stress process model and the dynamic fit model. Participants were recruited using online recruitment strategies, and a rigorous fraud protocol was used to identify fraudulent participants. Following consent and randomization, participants in the treatment group received an app-based intervention with mindfulness, journaling, and support resources, and were instructed to use these interventions daily. The control group received similar, abbreviated content in the form of written education. Caregiver burden, stress, positive affect and well-being, and social support were measured at baseline and 6 weeks. Twenty-one caregivers completed the 6-week post-intervention measurement ($n = 9$ intervention; $n = 12$ control). Recruitment, retention, and adherence rates were adequate, and acceptability was high. There were no between-group differences, but the intervention group had statistically significant improvements in positive affect, well-being, and social support. This study highlights the potential of a mobile health stress, emotional regulation, and support intervention for millennial family caregivers.

Keywords: Mobile health; Family caregiver; Millennials; Stress; Emotional regulation; Social support

1. Introduction

Caregiving is a crucial but often overlooked responsibility that significantly impacts caregivers' social, emotional, and financial well-being. In the United States, millennial

caregivers—defined as individuals born between 1981 and 1996 (ages 28–43 in 2024)—now make up one-quarter of the caregiving population.^{1,2} Unlike previous generations, millennials are more likely to provide care not only for aging family members but also for friends, neighbors, and chosen family members with chronic health conditions.^{1,3,4} As the demand for caregiving continues to rise due to an aging population, understanding the unique challenges faced by millennial caregivers is essential.⁵

Millennial caregivers are more demographically diverse than older caregiving generations, with distinct intersectional experiences related to gender identity, race/ethnicity, sexual orientation, and socioeconomic status.² Among this group, 44% identify as White, 27% as Hispanic/Latino, 18% as African American/Black, and 8% as Asian American/Pacific Islander.¹ Additionally, 12% of millennial family caregivers identify as lesbian, gay, bisexual, transgender, and queer (LGBTQ+), compared to 8% of non-millennial family caregivers.¹ Their caregiving experiences are also shaped by their social values and behaviors, which emphasize collaboration, digital networking, and non-traditional support systems.⁶ Notably, millennials often rely on “families of choice”—close social networks outside of biological relatives—for emotional and caregiving support.^{2,3}

Despite these strengths, millennial caregivers face unique stressors compared to their predecessors, primarily due to their life stage. Many millennials are in the midst of establishing their careers, pursuing education, building relationships, and achieving financial independence while simultaneously managing caregiving duties.^{1,2,7,8} This dual burden often leads to career disruptions, financial instability, and social isolation, exacerbating stress and emotional strain. Research indicates that millennial caregivers are more likely to experience economic hardship, including unpaid bills, borrowing money, and struggling to afford necessities due to the financial demands of caregiving.^{9–12} In addition, millennials are reaching traditional adult milestones, such as homeownership, marriage, and parenthood, at a later age, partly due to these caregiving responsibilities.¹ For millennial caregivers, the intersection of economic strain, emotional burden, and work–life imbalance can erode their sense of mastery and self-esteem, increasing their risk of developing anxiety, depression, and loneliness.^{13,14}

However, despite these challenges, millennial caregivers exhibit resilience and adaptability in navigating their caregiving roles. At higher rates than previous generations, they leverage digital resources, online communities, and telehealth services to access emotional support, financial guidance, and caregiving strategies.^{15,16} The use

of innovative technologies in supporting the health and well-being of millennial family caregivers is increasingly important as the aging population grows, the resources within the health system continue to be stretched, and millennial health is threatened by the demands of family caregiving.^{2,3,17} The strong digital networking skills of millennial caregivers allow them to create alternative support systems beyond traditional family structures, enabling them to share caregiving responsibilities in innovative ways.^{1,3,6}

As the number of millennial caregivers continues to grow, recognizing their unique caregiving experiences, intersectional challenges, and innovative coping mechanisms becomes increasingly important.¹⁸ With millennials having greater uptake of technology than older generations of family caregivers,¹⁵ mobile health (mHealth) interventions may be an essential source of targeted and accessible technological interventions to enhance the stress management, emotional regulation, and support of millennial caregivers while ensuring sustainable and effective caregiving for those in need. Importantly, mHealth interventions can extend support for millennial family caregivers beyond the walls of the clinic and hospital, which may better align with the busy schedules of these caregivers who are navigating work, childcare, and other responsibilities along with family caregiving.¹² With prior research with this family caregiving group, we found that these caregivers wanted support and strategies to manage stress and needed this to be accessible.¹²

Therefore, the purpose of this study was to conduct pilot feasibility and acceptability testing of an app-based stress, emotional regulation, and support intervention that was informed by both the stress process model and the dynamic fit model (Table 1).^{19,20} The stress process model highlights the sources of stress, such as family caregiving responsibilities, other family relationships, work conflicts, economic challenges, social isolation, and mediators that can affect stress outcomes, such as depression and anxiety. These mediators include coping and social support.¹⁹ The dynamic fit model presents a framework for coping with stress through in-the-moment responses and sustained responses to stress.²⁰ In our intervention, mindfulness exercises are leveraged as in-the-moment responses to stress, while journaling is a sustained response to stress.^{20,21} Through a user-informed process for intervention and app adaptation, caregivers reported wanting social support resources along with coping, which aligns well with the Stress process model. Online resources were added to the app and reviewed with caregivers for appropriateness. This was then followed by app usability testing to identify major

Table 1. Intervention components

Intervention component	Description
Mindfulness activities	Step-by-step or audio instructions for: mountain meditation, loving kindness meditation, STOP (Stop, Take, Observe, Proceed), and mindful breathing meditation
Journaling activities	Journal prompts: What was one good event today? Realize that if you played a role, you can most likely cause this to happen again. If you had no role, remember to express gratitude for this gift. What was your role in the event? What was one challenge you experienced today?
Emotion checklist	How did you feel? (amazed, amused, excited, happy, peaceful, satisfied, anxious, ashamed, confused, sad, scared, upset)
Stress rating scale	On a scale of 1–10, please rate your level of stress at this moment: 1=low, 10=high
Caregiver support plan	Caregiver fills out this plan: Warning signs of stress or burden Activities I can do to help with stress People I can call for help Ways that people can help me My personal strengths that can help me Numbers I can call in a crisis
Resources	Advance care planning Disease-focused information Caregivers of veterans Caregiver well-being Caregiving, culture, and faith Creating a medication list/medication education Community resource guide Employment and caregiving Family meetings Finances and caregiving Hospital discharge planning Insurance Long-distance and sandwich caregiving Physical care tips Preparing for a healthcare appointment Prescription assistance programs Safety Social support State-by-state resources
Scheduled reminder	Participants can opt for a reminder for intervention activities at a time that works best for them

functionality issues.²²

2. Materials and methods

2.1. Materials

An mHealth app, UpLode, was used to deliver the stress, emotional regulation, and support intervention. Paid access to this app was provided for each participant through Senda, LLC (United States). Prior app usability

testing was conducted, and major functionality issues were addressed in collaboration with Senda, LLC.²² No member of the research team received any monetary or in-kind compensation for this collaboration.

2.2. Study design

This was a pilot feasibility and acceptability study to test the delivery of an app-based stress, emotional regulation, and support intervention over 4 weeks for millennial family caregivers. A concurrent pilot study was conducted with Latinx millennial family caregivers (<https://osf.io/b62nh/overview>). A wait-list, attention-control design was used to ensure that all participants eventually received access to the intervention. Surveys were collected at baseline (pre-intervention), 2, 4, and 6 weeks (post-intervention). Only findings from the pre-intervention and post-intervention surveys are reported. Additional surveys were collected to determine the feasibility of the interim data collection. Participants in the wait-list attention control group initially received an informational packet about stress management, mindfulness, and support resources as part of attention control procedures. This group subsequently received access to the app-based intervention after intervention testing procedures at the 6-week data collection time point.

2.3. Sample and setting

Participants were self-identified family caregivers (family, friends, and neighbors) of individuals with chronic illnesses or disabilities who were recruited nationally in the United States. While the study was carried out by researchers at a university in Texas and a university in Utah, the recruitment and delivery of the intervention occurred virtually, with interactions through Zoom, social media, the UpLode app for intervention delivery, and email. Recruitment occurred with support from TrialFacts, a research recruitment company. TrialFacts assisted the research team with the development of advertising materials consistent with the goals of the study and approved by the research team and the Institutional Review Board before distribution. Advertising materials were then distributed on social media and other advertising sites, including Facebook, Instagram, TrialFacts email database, and potentially YouTube, Craigslist, TikTok, and Google. Eligible caregivers (those who were born between 1981 and 1996, providing care for a family member, neighbor, or friend with a chronic illness/disability >10 h/week, able to speak English/Spanish, and have technology access for study procedures) completed pre-screening surveys and were then contacted by the research staff for a study intake interview through Health Insurance Portability and Accountability Act-compliant Zoom. This two-step process was to protect against fraudulent data due to

online recruitment strategies (Appendix 1). During the study intake interview, participants were screened for study inclusion and provided education about the study using the consent form (Appendix 2). After study consent forms were signed, participants were randomized into the treatment or control group using a computer-based random number generator (<https://www.randomizer.org/>) for group randomization. Participants were assigned numbers sequentially from the generated number list, with participants with odd numbers being assigned to the intervention group and participants with even numbers being assigned to the control group. Participants were blinded to their group assignment, but the study team was not. Participants were assigned a study ID number and given a link to a REDCap (<https://project-redcap.org>) survey, which included demographics and measures for caregiver burden, perceived stress, well-being, and perceived social support. Surveys were available in English.

2.4. Instruments

2.4.1. Demographics

We measured age (years), race and ethnicity, gender identity, relationship status, education, employment, annual income, and caregiving characteristics (time spent caregiving, relationship to care recipient, and care recipient age) of the participants.

2.4.2. Caregiver burden

The Zarit burden interview short form, a 12-item scale, measures caregiver burden related to caregiving, including questions about time, responsibilities, and relationships management, and emotional responses to caregiving.²³ Items are scored on a 5-point Likert scale. Scores range from 0 to 48, with higher scores meaning greater caregiver burden. Reliability has consistently been reported to be >0.70, with a clinical cut-off of 11 or greater.^{23,24}

2.4.3. Caregiver perceived stress

The perceived stress scale short form is a 10-item, five-point Likert scale (0 = never, 4 = very often) that measures thoughts and feelings associated with stress over a 1-month time period. Scores range from 0 to 40, with scores of 0–13 considered low stress, 14–26 considered moderate stress, and 27–40 regarded as high stress. Cronbach's alpha is 0.91.^{25,26}

2.4.4. Caregiver well-being

The Neuro-Quol Positive Affect and Well-Being short form is a nine-item, five-point Likert scale (1 = never, 5 = always) used to assess well-being, hope, purpose, meaning, and balance. Scores range from 9 to 45 and can be standardized to a T-score. For this study, a raw score was used. Higher

scores indicate greater well-being. Cronbach's alpha ranges from 0.94 to 0.95.²⁷

2.4.5. Caregiver perceived social support

Patient-Reported Outcomes Measurement Information System (PROMIS) emotional support short form and PROMIS informational support short form are both four-item, with five-point Likert scale (1 = never, 5 = always) questions. PROMIS emotional support assesses the availability of a support person for listening, confiding, feeling appreciated, and coping with bad days. PROMIS informational support assesses having a support person for advice during a crisis or for important things, guidance for handling problems, and the provision of needed information. For both measures, scores range from 4 to 20 and can be standardized to a T-score. For this study, raw scores were used. Higher scores indicate greater perceived emotional support. Cronbach's alpha is more than 0.88 for both measures.^{28,29}

2.5. Data collection

Survey data were collected using REDCap surveys at baseline (pre-intervention) and at weeks 2 (mid-intervention), 4 (post-intervention), and 6 (follow-up).^{30,31} With the 6-week survey, an acceptability survey was also included for the intervention group. The control group completed an acceptability survey after using the intervention for 4 weeks. The acceptability survey addressed seven facets of acceptability with Likert scale questions (0 = not true for me, 10 = very true for me): Affective attitude, intervention burden, ethicality, intervention coherence, opportunity costs, perceived effectiveness, and self-efficacy.³² There was one open-ended response question that allowed participants to share additional feedback. Feasibility data were collected throughout recruitment and data collection, including the number of participants screened (opting in and out), the number of participants recruited per week, exit surveys for participants dropping out (perceived barriers and reasons for leaving), adherence to the intervention (one mindfulness practice per day and response to three journal prompts per day), and study retention rates.³³

2.6. Statistical analysis

Acceptability surveys were analyzed descriptively, and counts and percentages were used to understand feasibility data. Due to the small sample size and limited responses to the open-ended response question, qualitative data are presented without additional analyses. Pre- and post-intervention survey data, including demographics data and study outcomes of burden, stress, well-being, and emotional and informational support, were analyzed

using descriptive statistics, frequencies, chi-square, and Mann–Whitney U tests for significant group differences in demographics. Wilcoxon signed-rank and rank-sum tests were used for within and between-group differences for study outcomes of burden, stress, well-being, and emotional and informational support. All analyses were conducted in IBM SPSS Statistics (version 25; IBM, USA), and $p < 0.05$ was considered statistically significant.

2.7. Ethical considerations

The study was approved by the University of Texas at Austin IRB (STUDY00002382), and participants provided written informed consent.

3. Results

3.1. Demographics

A total of 21 millennial caregivers completed baseline and 6-week surveys, with nine in the intervention group and 12 in the control group (Figure 1). The mean age of participants was 33 years (standard deviation [SD] = 4.98). Two-thirds of the sample identified as women (67%), and over half identified as Black/African American (52%), followed by

White (38%) and Asian (14%). Due to concurrent testing of the intervention with a Latino population, there were no Latino caregivers in this study. Nearly half of the participants were married or partnered (48%), while 38% were single. Educational attainment varied, with 43% holding a bachelor's degree and 33% a master's degree. The average annual income was US\$65,167 (SD = 28,005). Employment was common, with 57% working full-time. Care recipients were most commonly parents or in-laws (48%), followed by friends, neighbors, and grandparents. The average age of care recipients was 59 years (SD = 22), and caregivers reported providing an average of 41 h of care per week (SD = 47; Table 2). There were no significant demographic differences between the experimental and control groups.

3.2. Feasibility

Participant recruitment occurred virtually, with participants submitting a pre-screening questionnaire with study criteria to indicate their interest in study participation. During the two-phase screening process, the pre-screening questionnaire filtered out 84 of the 167 individuals who completed it and indicated interest

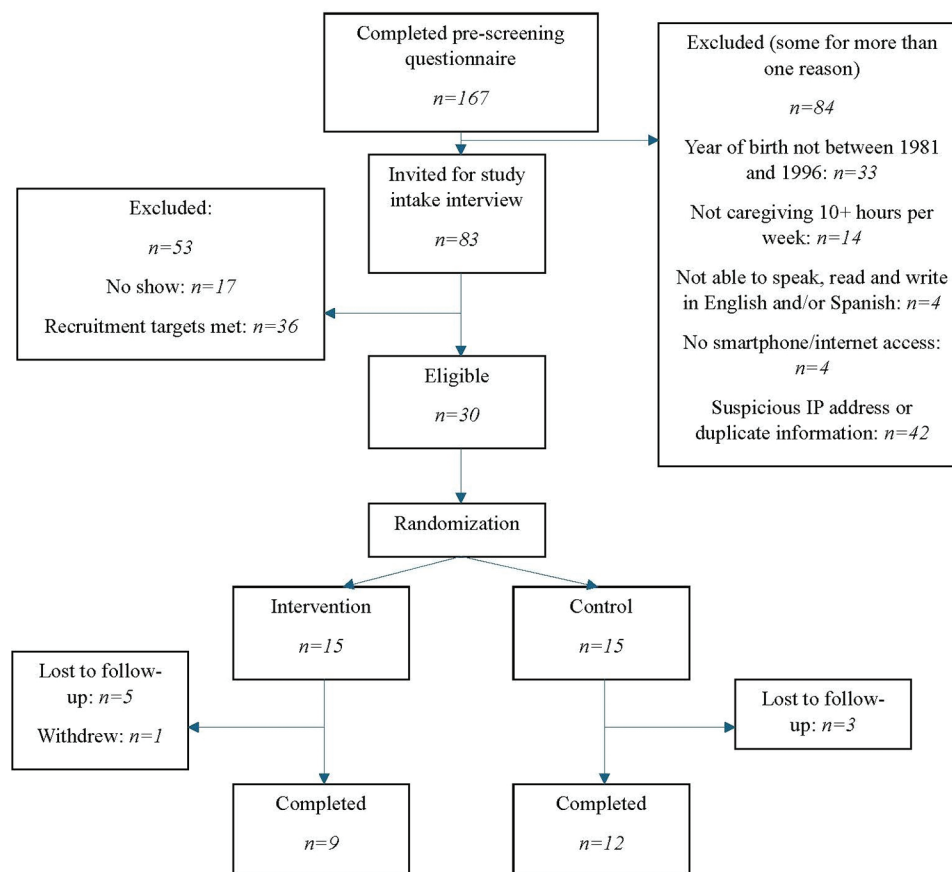


Figure 1. Study recruitment flow chart

Table 2. Millennial caregiver demographics

Demographic variable	Intervention (<i>n</i> =9)	Control (<i>n</i> =12)	Both (<i>n</i> =21)
Age (years), mean (SD)	33 (4.98)	33 (5.21)	33 (4.98)
Gender (%)			
Woman	6 (67)	8 (67)	14 (67)
Man	3 (33)	4 (33)	7 (33)
Race (%)			
Asian	1 (11)	2 (17)	3 (14)
Black/African American	5 (56)	6 (50)	11 (52)
White	3 (33)	5 (42)	8 (38)
Marital status			
Single	4 (44%)	4 (33%)	8 (38%)
Partnered/Married	4 (44%)	6 (50%)	10 (48%)
Divorced	1 (11%)	1 (8%)	2 (10%)
Widowed	0 (0%)	1 (8%)	1 (5%)
Annual income (US\$), mean (SD)	69,556 (24,920)	61,876 (30,769)	65,167 (28,005)
Educational attainment (%)			
High school/GED	0 (0)	1 (8)	1 (5)
Technical certificate	1 (11)	0 (0)	1 (5)
Some college	1 (11)	1 (8)	2 (10)
Associate's degree	1 (11)	0 (0)	1 (5)
Bachelor's degree	4 (44)	5 (42)	9 (43)
Master's degree	2 (22)	5 (42)	7 (33)
Employment (%)			
Full time	4 (44)	8 (67)	12 (57)
Part time	5 (56)	3 (25)	8 (38)
Not employed (providing family care)	0 (0)	1 (8)	1 (5)
Care recipient relationship			
Spouse/Partner	0 (0%)	2 (17%)	2 (10%)
Child	0 (0%)	1 (8%)	1 (5%)
Parent/In-law	5 (56%)	5 (42%)	10 (48%)
Grandparent	3 (33%)	0 (0%)	3 (14%)
Uncle/Aunt	0 (0%)	1 (8%)	1 (5%)
Friend/Neighbor	0 (0%)	3 (25%)	3 (15%)
Missing	1 (11%)	0 (0%)	1 (5%)
Care recipient age (years), mean (SD)	70 (9.93)	49.83 (25.56)	59 (22)
Time spent caregiving (hours/week), mean (SD)	32 (34.28)	48 (54.46)	41 (47)
ZBI, mean (SD)			
Baseline	21.89 (5.69)	22.67 (8.73)	22.33 (7.42)
6 weeks	18.89 (4.62)	18.33 (8.5)	18.57 (6.95)
PSS, mean (SD)			
Baseline	19.11 (4.76)	21.67 (4.29)	20.57 (4.57)
6 weeks	16.22 (3.70)	19.58 (6.01)	18.14 (5.31)

(Cont'd...)

Table 2. (Continued)

Demographic variable	Intervention (n=9)	Control (n=12)	Both (n=21)
PAW, mean (SD)			
Baseline	28.89 (6.01)	33.33 (6.18)	31.43 (6.37)
6 weeks	33.22 (4.18)	33.75 (5.58)	33.52 (4.92)
IS, mean (SD)			
Baseline	13.22 (4.32)	14.50 (3.78)	13.95 (3.97)
6 weeks	15.89 (3.59)	15.25 (3.70)	15.52 (3.57)
ES, mean (SD)			
Baseline	13.78 (4.49)	15 (3.13)	14.48 (3.72)
6 weeks	16.22 (3.15)	16.17 (3.33)	16.19 (3.17)

Note: Data presented as *n* (%), unless stated otherwise.

Abbreviations: ES: Emotional support; GED: General educational development; IS: Informational support; PAW: Positive affect and well-being; PSS: Perceived stress scale; SD: Standard deviation; ZBI: Zarit burden interview.

in study participation. Eighty-three participants were available for the study intake interview, 17 of whom were no-shows to the interview, and 36 were not included due to meeting recruitment targets before a study intake interview occurred (Figure 1). Recruitment of participants occurred at a rate of 1.88/day (13.10/week), with all 30 participants recruited in 16 days. Of the 30 participants who were recruited, eight were lost to follow-up (five from the intervention group; three from the control group), and one person withdrew from the study, citing it as “too overwhelming” (intervention group). In the intervention group, seven of nine individuals who completed the post-intervention measures (week 6) accessed the app at least once. Six individuals in the intervention group who did not complete the post-intervention measures accessed the app at least once. Of those seven individuals who completed post-intervention measures, all completed journal entries (range: 52–86 journal entries). Average use of journal entries was 89.88% of expected use (mean = 75.5, SD = 13.95; expected 84), indicating three journal responses every day for 4 weeks. Of those seven individuals who completed post-intervention measures, 6 of the 7 completed a mindfulness activity at least once (range: 7–146 mindfulness activities). Average use of the mindfulness activities was 270.25% of expected use (mean = 75.67, SD = 65.07; expected 28), suggesting one mindfulness activity every day for 4 weeks.

3.3. Acceptability

Overall, acceptability ratings for both mindfulness and journaling activities were favorable (Table 3), with mean scores ranging from 6.75 to 8 on a 10-point scale. Participants rated both activities as equally enjoyable (mean = 7.75), with mindfulness viewed as slightly more useful for managing stress (mean = 7.2) and more likely to

be used to manage stress (mean = 8.00, SD = 2.08). While the journaling activity was rated slightly lower in terms of appropriateness for stress management needs (mean = 6.75, SD = 2.67), it was seen as helpful (mean = 7.15, SD = 2.18) and easy to understand (mean = 7.75, SD = 2.15). Time burden scores remained low for both activities, with average ratings of 4.0 or less for perceived time demands.

Participants’ comments echoed these scores, with many describing both mindfulness and journaling as grounding and beneficial. One participant reflected, “The mindfulness activities helped to center me... I started doing the activity in my head at times of stress.” Others emphasized the value of journaling as a reminder to pause and reflect. However, a few participants noted barriers. Some found the number of mindfulness options overwhelming or disruptive, while one stated that journaling felt like “a way to further ruminate on negatives.”

3.4. Between and within-group outcomes

When examining changes in pre- and post-intervention measurements of caregiver burden, perceived stress, well-being, and informational and emotional support, there were no statistically significant between-group differences post-intervention. For example, post-intervention, the control group had lower perceived burden levels, although this was not statistically significant ($U = 56.50$; $z = 0.18$; $p = 0.86$). Perceived stress was lower in the control group, but this was not statistically significant ($U = 34$; $z = 1.43$; $p = 0.17$).

Overall, both groups demonstrated improvements across multiple outcomes, with greater statistically significant gains observed in emotional and informational support and well-being within the intervention group. Caregiver burden decreased over time in both groups, with the intervention group dropping from a baseline mean

Table 3. Acceptability (n=21)

Question	M (Standard deviation)
I liked the mindfulness activities	7.75 (2.22)
I liked the journaling activity	7.75 (1.45)
The mindfulness activities took too much time	4 (2.86)
The journaling activity took too much time	3.8 (2.86)
The mindfulness activities were appropriate for my stress management needs	7.55 (2.50)
The journaling activity was appropriate for my stress management needs	6.75 (2.67)
The mindfulness activities made sense to me	7.5 (2.63)
The journaling activity made sense to me	7.75 (2.15)
The mindfulness activities helped my stress	7.2 (2.63)
The journaling activity helped my stress	7.15 (2.18)
I feel like I can use the mindfulness activities to help my stress	8 (2.08)
I feel like I can use the journaling activity to help my stress	7.25 (2.55)
Please share any other feedback about the intervention	<p>Positive: “The mindfulness activities helped to center me. After the first few times, I started doing the activity in my head at times of stress. My job doesn’t allow me to pull out headphones when needed. Most of them were breathing and refocusing exercises. The journaling also helped me slow down and think. In my life, it is very hard to slow down to do that, but it was a needed reminder.” “It has been awesome and helpful.”</p> <p>Negative: “All of the mindfulness options were a little overwhelming to choose from, so I often didn’t attempt.” “I found the mindfulness activities to be an annoying interruption in my already burdened schedule, and the journaling activities seemed to be a way to further ruminate on negatives, even when addressing the positive events.”</p>

of 21.89 (SD = 5.69) to 18.89 (SD = 4.62), although this improvement was not statistically significant ($z = -1.32$; $p=0.19$). The control group changed from 22.67 (SD = 8.73) at baseline to 18.33 (SD = 8.50) at 6 weeks, and this was statistically significant ($z = -2.02$; $p=0.04$).

Stress scores also declined in both groups. In the intervention group, the PSS score decreased from 19.11 (SD = 4.76) to 16.22 (SD = 3.70), although this was not statistically significant ($z = -1.76$; $p=0.08$). In the control group, perceived stress decreased from 21.67 (SD = 4.29) to 19.58 (SD = 6.01), which was not statistically significant ($z = -1.26$; $p=0.21$).

Improvements in positive affect and well-being were observed across both groups. The intervention group had a statistically significant increase from 28.89 (SD = 6.01) to 33.22 (SD = 4.18; $z = -2.08$; $p=0.04$), while the control group rose slightly from 33.33 (SD = 6.18) to 33.75 (SD = 5.58) without statistical significance ($z = -0.27$; $p=0.79$).

Informational support also improved; intervention participants had a statistically significant increase from 13.22 (SD = 4.32) to 15.89 (SD = 3.59; $z = -1.97$;

$p=0.05$), while control participants showed a smaller, not statistically significant increase from 14.50 (SD = 3.78) to 15.25 (SD = 3.70; $z = -0.72$; $p=0.47$).

The intervention group had a statistically significant increase in emotional support from 13.78 (SD = 4.49) to 16.22 (SD = 3.15; $z = -2.21$; $p=0.03$). The control group’s emotional support scores increased from 15.00 (SD = 3.13) to 16.17 (SD = 3.33; $z = -1.28$; $p=0.20$), but the increase was not statistically significant.

4. Discussion

Our pilot study findings demonstrate a mixed picture regarding the feasibility, acceptability, and benefits of the stress, emotional regulation, and support intervention for millennial caregivers. This is one of the few caregiver interventions developed specifically for the millennial caregiving population, and while designed with user feedback and usability testing, there are ongoing gaps to address with further research.

Recruitment rates were rapid, and the overall study retention rate was acceptable, although lower for the

intervention group. One participant dropped out of the study, reporting that the intervention was too overwhelming. This highlights the need to balance intervention dose with intervention demands.³⁴ Millennial caregivers are juggling multiple responsibilities, so the lowest effective dose of the behavioral intervention needs to be identified to promote benefit without too much time or cost to caregivers.¹² For those who accessed the intervention components, intervention adherence was high, although there was wide variability in the use of the mindfulness activities and greater consistency in the use of the journaling activities. These insights are key, especially when considering future intervention iterations that are tailored to participants' individualized needs. This variability in mindfulness activity use may suggest that some caregivers need more in-the-moment responses to stress, while others may not feel this is of use to them. A future research adaptation could focus on tailoring the intervention components, such as mindfulness, based on stress-rating scales and/or biometric data, such as heart rate variability.¹⁷

Acceptability findings indicate that both the mindfulness and journaling components of the intervention were perceived as helpful and practical by the millennial caregivers. Participant-reported scores reflected high levels of enjoyment (mean = 7.75) and perceived relevance to stress management (range = 6.75–8.00), suggesting strong user engagement and alignment with participant needs. These findings are consistent with prior research on digital interventions targeting caregivers. For example, a mobile mindfulness app designed for caregivers of adults with cognitive impairment demonstrated high feasibility and acceptability, with usage linked to improvements in psychological well-being.^{35–37} Similarly, a telephone-delivered mindfulness program for rural African American dementia caregivers showed high retention (~86%) and positive ratings for usability and perceived benefit.^{38–40} In our study, participants also expressed confidence in their ability to continue using the mindfulness and journaling strategies beyond the intervention period, underscoring the flexibility and real-world applicability of these tools for stress regulation. Collectively, these results support the promise of brief, scalable behavioral interventions that integrate structured emotional regulation practices with flexible, user-centered delivery—particularly for millennial caregivers balancing multiple personal and professional demands.

Qualitative feedback in our study highlighted important nuances in acceptability, particularly regarding time burden and emotional discomfort—concerns that have also emerged in prior research. One participant described

the mindfulness activities as “annoying interruptions,” and another noted that journaling could exacerbate rumination. These experiences align with earlier work, which shows that some caregivers view structured mindfulness exercises as intrusive or emotionally challenging.³⁵ In addition, some participants found the variety of mindfulness options overwhelming, which may have deterred engagement. These findings highlight the importance of streamlining intervention components and offering customizable pathways that respect individual preferences and stress thresholds. Future research development should consider adaptive delivery formats that allow users to modulate the intensity and type of content based on real-time feedback or stress indicators, thereby preserving acceptability while enhancing user autonomy.

Despite the small sample size, the findings from this pilot study offer important preliminary insights into how millennial caregivers may respond to an app-based stress and well-being intervention. Although between-group differences were not statistically significant, notable within-group changes emerged, particularly among intervention participants. Caregiver burden decreased in both groups, with a statistically significant reduction observed in the control group. These findings suggest that even minimal interventions, such as informational packets, may provide short-term relief in perceived burden but may not be sufficient to reduce subjective stress. This pattern is partially consistent with prior literature. For example, the Mason CARES study, which tested a 9-week virtual stress management program for family caregivers of individuals with dementia, also reported reductions in caregiver burden using the Zarit burden interview. Across the full sample, mean burden scores decreased by 15%, with male caregivers showing a more pronounced reduction (from 22.5 to 15.9; $p < 0.01$) than female caregivers (from 24.4 to 21.4; $p < 0.01$).⁴¹ Compared to that study, our observed reductions were more modest, potentially due to differences in intervention dose, duration, or population characteristics. However, the direction of change in our study aligns with these findings and supports continued testing of this specific intervention in millennial family caregivers and exploration of technology-based stress reduction strategies tailored to diverse caregiving populations, including millennials.

Although neither group showed a statistically significant change in perceived stress, both experienced reductions in mean scores, with a greater decline in the intervention group. This trend suggests a modest positive effect of the app-based intervention. These findings are consistent with prior studies showing the effectiveness of structured support programs. For example, Hajisadeghian *et al.*⁴² reported significant stress reductions following a six-

session psychosocial program for caregivers of individuals with mental illness. Similarly, Hebdon *et al.*¹² found that millennial caregivers face substantial stress balancing caregiving, work, and family, and identified mental health support as a key unmet need. The observed decline in stress among our participants may reflect the relevance of mindfulness and journaling for this population, reinforcing the potential of this intervention and other tailored interventions to millennial caregivers' unique life contexts and support preferences.

Participants in the intervention group showed a statistically significant improvement in positive affect and well-being, suggesting that the mindfulness and journaling activities may have enhanced their emotional resilience. This finding aligns with recent literature indicating that positive affect plays a critical role in buffering stress responses. As reviewed by van Steenbergen *et al.*,⁴³ pleasant emotional states can dampen the physiological and cognitive impacts of both acute and chronic stress by modulating neural reward systems and activating endogenous opioids. Within the caregiving context, fostering positive affect may counterbalance the emotional strain associated with caregiving demands. The structured reflection and self-regulation strategies embedded in our intervention may have helped caregivers shift attention toward moments of gratitude, meaning, and emotional clarity, which are known to support psychological recovery and well-being.^{21,44} These findings support future testing of this intervention in millennial family caregivers and the integration of positive affect-enhancing components in future interventions targeting this population.

Caregivers in the intervention group demonstrated statistically significant improvements in perceived emotional and informational support. These findings align with prior research establishing these dimensions as core components of caregiver health-related quality of life. Raad *et al.*⁴⁵ emphasized that social health, comprising emotional and informational support, represents a distinct and essential domain of health-related quality of life for caregivers of individuals with traumatic brain injury. Their confirmatory factor analysis showed that these two forms of support cluster together as a unique latent construct, distinct from social participation and caregiver-specific emotional health. This reinforces the notion that targeted interventions, even when brief or app-based, can meaningfully influence caregivers' perceptions of their support networks. In our study, such gains may reflect the intervention's success in helping caregivers feel more equipped to access helpful information and emotionally process their experiences, elements especially valuable for millennial caregivers who often lack traditional sources of support.

While our pilot study yielded promising early results, there are important study limitations to consider. First, due to the nature of pilot testing, our sample size is small. Study findings related to intervention impact should therefore be interpreted in that light. Second, this study population did not include Latino millennial family caregivers (due to concurrent pilot testing in that population). There was a higher proportion of women and Black millennial family caregivers, which is not in line with population estimates of millennial family caregivers.² Therefore, the generalizability of the study findings is limited. Future research should seek balanced recruitment of study participants that aligns with population-level parameters for gender, race, and ethnicity within the United States. In addition to these considerations, there are opportunities for ongoing intervention adaptation and testing. For example, only six of nine participants who completed post-intervention surveys used the mindfulness intervention components, and seven of nine used the journaling components. There may be intervention access issues with the mobile app platform that need to be addressed through other intervention delivery modalities, such as a web-based option or enhanced education before provision of the app-based intervention. Participant preferences for the mindfulness and journaling intervention components may also need to be addressed with further tailoring to individualized needs. Future testing of this intervention will integrate the limitations identified in this study while maintaining the commitment to the brief and accessible intervention for this caregiver population.

5. Conclusion

This pilot study offers early evidence that an app-based intervention may support millennial caregivers by improving well-being and perceived support. While findings are preliminary, they highlight the potential of scalable, tech-enabled strategies to address millennial caregiver needs and inform future research.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

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Ethics approval and consent to participate

Ethics approval was obtained from the University of Texas at Austin IRB (STUDY00002382). Written informed consent was obtained from each participant for study participation.

Consent for publication

Written informed consent was obtained from each participant for publication of study findings.

Availability of data

Data are available from the corresponding author upon request.

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Appendices

Appendix 1: Fraudulent response protocol

1. Add a Captcha to the survey.
2. For screening questions, require text entry for all questions.
3. Review survey entries for the following characteristics:
 - a. Is over half of the survey incomplete? (1 point)
 - b. Is the email address provided unusual (e.g. long string of numbers or nonsense letters)? (1 point)
 - c. Did it take the participant <5 min to complete the survey? (1 point)
 - d. Does the email match or closely match a prior submission? (1 point)
 - e. Is there conflicting information in survey responses? (1 point)
 - f. Are responses to questions incongruent or unclear? (1 point)
4. If the score is 1, the participant receives an email listed as potentially fraudulent. If the score is 2 or greater, the participant receives an email labeled as fraudulent.

Appendix 2: Consent form

Consent to Participate in Research

Basic Study Information

Title of the Project: Cultural and Language Adaptation of a Stress, Emotional Regulation, and Support Intervention in Latinx Millennial Caregivers.

Principal Investigator: Megan Thomas Hebdon, PhD, DNP, RN, NP-c; University of Texas at Austin School of Nursing.

Invitation to be Part of a Research Study

You are invited to be part of our research study, *Cultural and Language Adaptation of a Stress, Emotional Regulation, and Support Intervention in Latinx Millennial Caregivers*. This consent form will help you choose whether or not to participate in the study. Feel free to ask if anything is not clear.

What is the study about, and why are we doing it?

The purpose of the study is to adapt an existing phone app and intervention for Millennial caregivers. We want to make changes so that it will meet the language, stress, support, and emotional needs of Latinx Millennial caregivers. Then, we want to test it in Latinx and non-Latinx Millennial caregivers.

What will happen if you take part in this study?

If you agree to take part in this study, you will be asked to do one of three, or possibly all three of the following things:

1. A focus group interview through Zoom or in person with other Latinx Millennial caregivers that will take no more than 90 min. The audio from the interview will be recorded and transcribed. Any identifying information about you will be removed.
2. Review an mHealth app for content and clarity through Zoom. Your feedback will be written down, but none of your personal information will be collected.
3. Participate in a 6- or 12-week intervention. You will be randomized to one of two groups to receive a stress, emotional regulation, and support intervention using a mobile health app. This should take no more than 30 min each day. You will be asked to complete a daily question (about 1 min) and surveys before the intervention starts and weeks 2, 4, and 6 (8, 10, and 12 depending on the study arm) through a mobile app. These surveys should take no more than 20 min.

How long will you be in this study, and how many people will be in the study?

Depending on which part(s) of the study you do, the number of people and the length of time will be different.

1. If you participate in the focus group interview, this will take no more than 90 min, including a short demographic survey at the beginning. Up to 30 people will participate in the focus group interviews.
2. If you review the mHealth app, this will take no more than 60 min. If you have not already completed a demographic survey, you will be asked to do this. Three people will participate in this step.
3. If you participate in the intervention, your participation may take 6 or 12 weeks, depending on the group you are randomized to. Up to 30 people will participate in this step. You will be asked to respond to a question in the UpLode app every day and participate in the intervention every day. The intervention should take no more than 20 min. You will be asked to complete surveys in the UpLode app before the intervention starts and at weeks 2, 4, and 6 (8, 10, and 12 depending on the study arm). These surveys should take no more than 20 min.

What risks and discomforts might you experience from being in this study?

If you participate in this study, you will experience no more risk than you would in daily life. You may experience distress when discussing your experiences as a family caregiver. If you do, you can stop answering questions or discontinue the study at any time.

How could you benefit from this study?

Although you will not directly benefit from being in this study, others might benefit because what you share about your experiences as a family caregiver will increase our understanding of Millennial Latinx caregivers. In addition, if you participate in the intervention, you will inform the process and delivery of the intervention for caregivers in the future.

What will happen to the data we collect from you?

As part of this study, we will collect data from an online demographic survey. Depending on your participation in other steps, we will record the audio from a focus group interview, take notes during feedback about an app and intervention, collect a daily question, and/or collect surveys every few days about stress, well-being, and social support. We will store this data securely, analyze it, and report any findings in a group format.

How will we protect your information?

To protect your privacy, we will collect information that could directly identify you for study communication purposes only, including name, phone, and/or email. We will protect your information by only collecting data that is necessary for our research, including emailing you a gift card or emailing/calling you to set up an interview. This information will be stored separately from other study data, including interviews or answers to questionnaires.

We will ask you if you are willing to be re-contacted for future studies by our research team. If you say yes, we will store your contact information (name, phone, and/or email) for future studies. If you say no, your contact information will be destroyed after study completion. Your contact information will be stored separately from your other data. All of your data will be stored in a password-protected file.

We plan to publish the results of this study. To protect your privacy, we will not include any information that could directly identify you. We will share your data or samples with other researchers for future research studies that may be similar to this study or may be very different. The data or samples shared with other researchers will not include information that can directly identify you.

If the research team sees or hears anything that indicates a child or elder is being abused, we are required by law to report such abuse.

What will happen to the information we collect about you after the study is over?

We will keep your research data to use for future analyses. Your contact information will be kept securely and stored separately from the research data collected as part of the project. We will destroy your contact information if you opt out of being re-contacted for future studies. Your contact information will be stored securely for future studies if you opt in to being re-contacted.

How will we compensate you for being part of the study?

You will be compensated differently depending on which parts of the study you do.

1. If you do the focus group interview, you will receive a \$70 Tango card after the interview. You must attend at least half of the focus group to receive compensation. If you do not, you will be offered the option to complete the questions with a subsequent focus group interview or one-on-one interview. To receive a \$70 Tango card, you must attend at least half of the one-on-one interview.
2. If you provide feedback about the app and intervention, you will receive a \$30 Tango card after providing feedback.
3. If you participate in the intervention, you will receive between \$5 and \$15 in compensation each week, depending on the survey length for that week. If you complete at least one daily question per week, you will receive \$5. You will receive \$15 for the baseline survey, and surveys at weeks 2, 4, and 6 (8, 10, and 12). Depending on the group you are assigned to, you will receive between \$70 and \$125 in total compensation through Tango cards.

Your Participation in this Study is Voluntary

It is totally up to you to decide to be in this research study. Participating in this study is voluntary. Your decision to participate will not affect your relationship with The University of Texas at Austin. You will not lose any benefits or rights you already have if you decide not to participate. Even if you decide to be part of the study now, you may change your mind and stop at any time. You do not have to answer any questions you do not want to answer.

Contact Information for the Study Team

If you have any questions about this research or feel you may have been harmed due to participation, you may contact:

Dr. Megan C. Thomas Hebdon

Phone: 512-475-9718

Email: megan.hebdon@nursing.utexas.edu

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the following:

The University of Texas at Austin Institutional Review Board

Phone: 512-232-1543

Email: irb@austin.utexas.edu

Please reference the protocol number found at the top of this document.

Your Consent

By signing this document, you are agreeing to be in this study. We will give you a copy of this document for your records. We will keep a copy of the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I would like to opt out of my contact information being saved for future studies. Yes No

I understand what the study is about, and my questions so far have been answered. I agree to take part in this study.

Printed Subject Name

Signature Date