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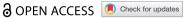
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ABSTRACT

Objectives: Farmers in the United States (U.S.) are exposed to myriad stressors and experience their negative effects, including higher rates of suicide than individuals in some other occupations. However, interventions to address mental health amongst farmers have faced barriers, such as farmers' perceived stigma regarding mental health, time constraints, and geographical isolation. Using text-messaging for intervention delivery may help to address some barriers, as text messages are private, delivered directly to one's phone, and require no travel. Our objective was to develop and assess the feasibility, acceptability, and initial efficacy of a text-messaging mental health literacy intervention tailored to U.S. farmers: Growing Resiliency in Tough Times (GRITT).

Methods: U.S. farmers ($N = 134$) were randomly assigned to an intervention group, who received 12 weeks of text messages regarding mental health literacy, or a control group, who received no treatment. Online pre-test and post-test surveys assessed mental health knowledge, familiarity with relevant mental health resources, self-efficacy to manage stress, and perceived stress. Feasibility was assessed via recruitment and retention data, and intervention group participants completed post-test measures to assess acceptability.

Results: Results indicate that intervention group participants were highly satisfied with the intervention and had higher post-test scores on multiple facets of mental health literacy and self-efficacy to manage farm stress than control group participants. The intervention group experienced a significant drop in perceived stress from pre-test to post-test. Participant retention was relatively high (84%). However, recruitment difficulties call into question intervention feasibility.

Conclusion: Though the intervention was efficacious in enhancing mental health literacy, improving stress management self-efficacy, and reducing stress, difficulties with participant recruitment indicate the need for continued intervention research in this context.

KEYWORDS

Farmer; mental health; intervention; text-messaging; mental health literacy

Introduction

Farmers in the United States (U.S.) face numerous sources of stress, such as adverse weather conditions, economic concerns, and heavy work demands.[1,2] Farmers' chronic (i.e., prolonged and overwhelming) stress is associated with mental illness, substance abuse, poor physical health, and greater risk of injury.[2–4] Farmers also experience higher rates of suicide than the general population.[5]

Unfortunately, for many farmers, discussing or seeking help for mental health is perceived to be stigmatized.[6] As such, some farmers avoid seeking support for chronic stress in a visible manner (e.g., visiting a therapist, talking openly with friends and family)[6–8] and may instead turn to maladaptive coping mechanisms such as substance abuse and social withdrawal.[2,9]

Interventions to address mental health in farm populations have been deployed worldwide.[10–13] However, most have not been rigorously evaluated.[14,15] A recent, systematic review of farmer mental health interventions concluded that "there is still a need for a stronger and broader evidence base in the field of farmer mental health interventions, which should focus on both holistic, multi-component programs and targeted approaches."[14(p1)] Researchers have also noted the need for mental health interventions for farmers that maintain their privacy and confidentiality.[16]

The goal of the present study is to develop a text-messaging mental health literacy intervention for United States (U.S.) farmers: Growing

Resilience in Tough Times (GRITT), and to assess GRITT's feasibility, acceptability, and preliminary efficacy in a pilot trial. GRITT Is designed to address lacuna in previous mental health interventions for farmers by delivering short bursts of tailored mental health information in a private manner. Before discussing the development of GRITT, we will review past farm mental health interventions.

Farm mental health interventions

A scoping review of farm mental health research[15] and a systematic review of farm mental health interventions[14] provide key insights into extant interventions. A farmer is defined as an individual who produces crops and/or raises livestock for commercial gain.[17] Mental health interventions involving farmers have most commonly been deployed outside of the U.S., and they often lack rigorous evaluation and/or do not include a control condition, making it difficult to ascertain their feasibility, acceptability, and/or efficacy.[14]

Prior U.S. interventions focused on farmers' mental health have included programs to increase farm families' awareness and use of community resources[18,19] and to create mental health services tailored to farmers.[6] Others have focused on increasing farmers' mental health literacy, which is the focus of the present intervention. Mental health literacy is defined as "knowledge and beliefs about mental disorders which aid their recognition, management and prevention".[20(p.182)] Greater mental health literacy is associated with outcomes including better mental health, increased self-efficacy, and reduced stigma against mental illness.[21–23]

Michigan State University Extension (MSU-E), recognizing farmers' desire for mental health information tailored to them, developed *Communicating with Farmers under Stress* (CFS), designed for audiences who interact with farmers under stress (e.g., agribusiness professionals).[16] A follow-up survey 9–12 months post-training revealed that nearly 90% of respondents reported increased mental health literacy after participating in CFS. MSU-E then modified CFS for farmers and their families with *Weathering the Storm* (WTS), a brief face-to-face program that also demonstrated success in increasing participants' mental health literacy.[16]

Text-messaging for mental health literacy intervention delivery

In developing and delivering CFS and WTS, MSU-E learned that participating farmers and those in farm communities desire delivery methods that do not require face-to-face interaction, expressing concerns about being seen by people they know when attending in-person workshops.[16] This finding corresponds with research on the perceived stigmatization of mental health topics in farm populations.[6] Farmers who *are* willing to seek help in a visible manner may live in isolated geographic locations, limiting their ability to access resources.[6–8] Finding time to physically seek out resources is another issue; farming is a round-the-clock job.

Some materials have been delivered online in past interventions for farmer mental health.[15,16] One intervention included a text messaging component. The Australian ifarmwell intervention is based in Acceptance and Commitment Therapy, with the majority of information delivered via online modules, accompanied by text-messaging reminders and supportive messages.[13] The ifarmwell intervention was found to be usable and effective in improving farmers' coping skills.[24]

Furthermore, reviews and meta-analyses of mental health text-messaging interventions in other adult populations suggest they are both feasible and acceptable.[25,26] One key feature of text-messaging is its inherent "alert" feature,[27] which means that recipients are alerted to the receipt of information by a notification on their phone. This feature may be particularly useful for farmers given their stoicism and reluctance to reach out or actively search for mental health information.[28] For end users, text messaging is relatively easy to use and access. Material can be delivered electronically in small segments to account for farmers' limited time. Text messaging is also private, as it may be accessed from a locked, handheld personal device.[22] Over time, text messaging interventions are relatively inexpensive to develop and allow for

long-term deployment with less maintenance, while maintaining interactive properties.[29]

Smartphone capabilities for mental health literacy interventions

The present intervention relies on smartphones for content delivery. When farmers access text messages via smartphones, they can easily be linked to additional web-based written, audio, and video resources. A 2023 report found that most farmers (82%) own a smartphone[30] and use them frequently to access resources related to their work, such as weather data and farm financial news.[31] Most (99%) farmers with smartphones report that they use them to send and/or receive text messages, indicating their familiarity and facility with this feature.[32]

A prior intervention that focused on education surrounding irrigation scheduling successfully used text messaging to reach farmers.[33] The use of smartphones and text messaging amongst farmers, as well as text messaging's features (e.g., private; alert capabilities) points to the potential feasibility, usability, and acceptability of a text-messaging mental health literacy intervention for this population.

The current study

Most farmers own a smartphone and use it for text messaging. Previous research indicates that text messaging is a viable channel for delivery of mental health information,[25,26] but no known research has examined the use of text messaging as the sole content delivery method in a farm population. The aim of this project was to develop a text messaging-based mental health literacy intervention for U.S. farmers and to test its feasibility and acceptability in a small pilot trial. This intervention, GRITT, offers an innovative way for farmers to learn about farm stress and its management. GRITT is specifically tailored to farmers and packaged in a format that seeks to address the barriers of cost, time, lack of privacy, and geographical isolation by delivering small doses of information to busy farmers on their private, easily accessible mobile devices.

In addition to examining the feasibility and acceptability of GRITT, we also examine its initial efficacy. Because GRITT was developed to enhance farmers' mental health literacy, we examine the extent to which their knowledge about farm stress, farm stress resources, and familiarity with general mental health resources increases after the intervention, and as compared to a control group. We also examine more distal effects of enhanced mental health literacy, including reduced levels of perceived stress and increased perceived self-efficacy to manage stress, outcomes that have been associated with greater mental health literacy in response to previous mental health literacy interventions in other populations.[34–36]

Methods

Intervention development

The authors' Institutional Review Board approved all phases of this project.

Initial survey. Research consistently indicates the importance of tailoring text-messaging intervention procedures and content to specific demographics.[27] To do so, we solicited farmers' responses to a brief survey focused on their interest in a text-messaging mental health literacy program as well as their preferences for message content and delivery. This information was used in developing the structure and content of GRITT.

Responding to this initial survey were 43 farmers. The survey was advertised on university extension websites in Michigan (MI). Just over half ($N = 22$) said they would either "probably" or "definitely" participate in a program in which they would receive text messages regarding farm stress management. Most who said they would not participate provided no reason. The most common types of media farmers reported accessing on their smartphones included websites, online articles and bulletins, and videos. Some key sources of stress for which farmers desired resources included extreme weather, commodity prices, and finance/farm management. They were also interested in broader stress-management topics including healthy diet and exercise, work/life balance, and maintaining healthy family

relationships. Finally, participants rated "2–3 times a week" as their most desired frequency for receiving such text messages.

Intervention length and content. A 12-week intervention period was chosen; it is the median length of prior effective mental health text-messaging interventions.[27,37] Based on our initial survey results, we elected to send three text messages per week.

Intervention content was adapted and expanded upon from MSU-E's CFS and WTS, which have demonstrated success in increasing knowledge about stress, warning signs of mental health and suicide, where to go for help, and stress management techniques.[16] Each week focused on a broad theme (see Table 1). Text messages used casual language per guidance from Gunn et al.[28] We addressed topics of key interest to this population, as determined from prior research and our initial survey.

During the intervention development phase, the COVID-19 pandemic emerged as a significant stressor worldwide. Farmers faced unique issues that impacted their mental health, such as supply-chain disruptions.[38] In response, some intervention content was modified and new content was added to address this distinct context.

Table 1. Example text message and resource info.

Week	Topic(s)	Example Text Message*	Linked Resource Info**
1	Orientation and introduction to farm stress	Do you ever feel like there's not much you can do about stress on the farm? You're not alone. Click this link to learn more.	Some stressors you can control and some you can't. MI State Representative Luke Meerman faced serious struggles on his farm. Watch this video to learn more about his perspective on farm stress and his own story and its connection to our study. *link*
2	Symptoms of farm stress	Did you know that about 20% of farmers suffer from frequent sadness or depression? Click here to learn the signs.	Some of the signs of depression are sneaky. Check here to see if you recognize them in yourself or your loved ones. *link*
3	Effects of farm stress	COVID-19 has had serious implications for farmers. Stay on top of the latest news! Click here for more.	Michigan State University Extension has compiled resources to help you navigate farming during the COVID-19 pandemic. Check out the resource here: *link*
4	Introduction to coping for farmers	This farmer is breaking negative attitudes toward mental health in his community. Learn more here.	He found a way to cope after attempting to take his own life. Now this farmer is working to break negative attitudes toward mental health in farm communities. Check out the video here: *link*
5	Problem-focused coping for farmers (part 1)	Tone, tighten, trim, and target your health in the tractor this season! Learn more here.	Just because you're in the tractor doesn't mean you can't get fit. Check out the resource, then click the next arrow to continue. *link*
6	Problem-focused coping for farmers (part 2)	Eating healthfully can be difficult. Identify your bad habits and learn little changes that can make a big difference here.	Do you recognize any of these unhealthy eating habits? Click here: *link*
7	Emotion-focused coping for farmers (part 1)	Feeling tense? Try a quick breathing exercise from the Navy SEALS! Click here.	When you start feeling anxious or stressed, step back and do this quick breathing exercise used by Navy SEALs to help you relax: *link*
8	Emotion-focused coping for farmers (part 2)	Stress doesn't just affect the mind, it affects the body, too.	Farmers have one of the highest rates of stress-related illnesses like heart disease and diabetes. To learn more watch this video. *link*
9	Farmers' social support networks	Who's got your back when times are tough? Click here and let us know!	Using your support system to talk about your feelings can help you cope. Who is a part of your support system? Click all that apply. *link*
10	Farm stress resources (part 1)	Need help with financial matters? Cooperative Extension can help!	Many land-grant institutions offer resources on farm management and finance through Cooperative Extension. Below you will find links to select resources based on regions across the United States. You can also contact your local Extension office for additional resources. *link*
11	Farm stress resources (part 2)	Stressed? Need someone to talk to? Find out more here.	For farmers who need to talk to someone directly (or someone who is worried about another farmer) - #FarmAid is there to listen 1–800-FARM-AID (M-F 9am – 5pm ET) *link*
12	Helping others in the farm family	Are the kids ok? Learn how to identify farm stress in kids here.	Kids can experience farm stress too. Learn the signs and how to help: *link*

*Text message refers to the text message delivered to participants. The text message provides a link to the linked resource info. **Linked resource info refers to information housed online that expands on the text's theme. From here, another link may lead to additional resources.

Each text message fit the length requirements of short messaging service (SMS; <140 characters). Most included a link to more information, typically in portable document format (PDF), video, or website (key sources for farmers according to our initial survey). Linked content was sourced from CFS, WTS, university extensions' materials, and other reputable sources. Occasional polls and results were included in text messages. See examples of text messages and linked resources in Table 1.

All text messages and linked materials were reviewed by two experts in farm stress and modified based on their feedback. Before intervention deployment, messages were tested for compatibility on iOS and Android devices.

Sample size, participant eligibility and recruitment

We sought a convenience sample of U.S. farmers, initially focusing on farmers in MI. Eligibility requirements specified that participants: (a) are at least 18 years old; (b) meet the definition of "farmer" per the United States Department of Agriculture[17]; (c) are literate in English; and (d) own a working smartphone for which they grant permission to receive texts from us. Eligibility was determined via a short online screening survey.

Using simple random assignment, we assigned participants to conditions using a 2:1 (intervention:control) allocation.[39] To detect medium-sized effects between groups (power = .80), power calculations indicated that a sample of 114 participants was required ($N = 76$ in the intervention group; $N = 38$ in the control group).[40] To account for attrition of 20%, we planned to recruit 137 participants.

Due to social distancing regulations issued in response to the COVID-19 pandemic during our recruitment period in Summer 2020, we were unable to recruit participants in person. Instead, we used online data collection methods. Initially, farmers were recruited via email, using a list purchased from U.S. Farm Data,[41] and the study was posted to relevant local Facebook groups (e.g., commodity groups), similar to the recruitment process employed by Gunn et al.[28] This method

yielded thousands of responses; unfortunately, many were determined to be fraudulent responses by bots, who pose an increasing threat to online survey data collection.[42]

At that point, though recruitment efforts still centered on MI farmers, eligibility was expanded to farmers across the U.S., and additional layers of screening were implemented to verify participant eligibility. The research team thoroughly reviewed responses for inconsistent answers; invalid GPS location (i.e., outside of the U.S); and/or ballot box stuffing (i.e., providing more than one response per participant). Participants who passed this level of screening were invited to a brief phone interview with a member of the research staff to further confirm eligibility.

Study procedure

Text messages were delivered using Qualtrics, an online survey platform, and EZ Texting, an SMS marketing platform. The intervention was deployed between September and December 2020. Participants in the intervention group received three text messages per week for 12 weeks; control group members did not receive any communication from the research staff during the intervention period. Participants in both groups completed an online survey before and after the intervention phase, which assessed farm stress knowledge, familiarity with farm stress and general mental health resources, stress management self-efficacy, and perceived stress. The intervention group also completed measures assessing intervention feasibility and acceptability at posttest. All participants were compensated with a $40 gift card to an online retailer for completion of both surveys.

Measures

Intervention feasibility and acceptability

Intervention feasibility was assessed, in part, using recruitment and retention data. Participants were also asked if they received all text messages and if they encountered any issues in accessing the text messages and/or linked information. To assess acceptability, a 5-item measure assessed satisfaction on

5-point Likert scales. This measure was slightly modified from the overall treatment satisfaction subscale of the Multi-Dimensional Treatment Satisfaction Scale,[43] which was developed to assess satisfaction with behavioral treatment interventions. Higher scores indicated greater satisfaction (e.g., "I liked the text-messaging program"), α = .86. Participants were also asked one closed-ended question about their satisfaction with each of these intervention features: number of text messages they received, the timing of text messages, and length of the program.

Preliminary efficacy outcomes

Preliminary efficacy outcomes were assessed at pre-test and post-test for the control and intervention groups. The perceived farm stress knowledge, familiarity with farm stress resources, and familiarity with general mental health resources measures were expanded upon from assessments of the effectiveness of CFS.[16]

Perceived farm stress knowledge. A 10-item measure assessed perceived knowledge about farm stress topics on 5-point scales, from 1 = nothing to 5 = a great deal (e.g., "How much do you know about causes of farm stress?"), pre-test α = .89; post-test α = .92.

Familiarity with farm stress resources. A seven-item measure assessed familiarity with coping resources related specifically to key farm stress topics. Participants were asked: "How familiar are you with knowing where to find resources for coping with stress related to each of these agricultural issues?" and responded on 5-point scales ranging from 1 = not at all familiar to 5 = extremely familiar for each item (e.g., farm finance resources, farm safety), pre-test α = .86; post-test α = .85.

Familiarity with general mental health resources. An eight-item measure assessed familiarity with general mental health coping resources. Participants were asked: "How familiar are you with knowing where to find each of the following resources for coping with stress?" and responded on 5-point scales ranging from 1 = not at all familiar to 5 = extremely familiar for each item (e.g., healthy diet, mental health crisis resources), pre-test α = .94; post-test α = .94.

Perceived farm stress management self-efficacy. A 10-item, published scale assessed perceived stress management self-efficacy.[44] Items were rated on 5-point Likert scales (e.g., "I feel confident in managing my stress well"), pre-test α = .90; post-test α = .92.

Perceived stress. Perceived stress over the previous month was assessed with Cohen and colleagues' 10-item Perceived Stress Scale.[45] Items were rated on 5-point scales ranging from 1 = never and 5 = very often (e.g., "In the last month, how often have you felt nervous and 'stressed'?"), pre-test α = .87; post-test α = .88.

Results

Participants

Difficulties in recruitment left us just short of our intended initial sample of 137. 134 verified participants were enrolled in the study and sent the pre-test survey. 129 participants completed the pre-test survey and were randomized into the control ($N = 56$) or experimental ($N = 73$) group. Of these 129 participants, 112 completed the post-test survey (control group, $N = 43$; intervention group, $N = 69$).

Most participants farmed in MI ($N = 112$, 86.8%); the remainder farmed in one of 15 other states ($N = 17$, 13.2%). Other demographic information and information about participants' farm operations can be found in Table 2.

The intervention and control groups were compared at pre-test on demographic characteristics. No differences between the two groups emerged in terms of sex, race, education level, marital status, number of children, farm type, farm acreage, or work outside the farm.

Feasibility and acceptability outcomes

Of the initial 134 verified participants, 83.6% were retained through the post-test survey. Participants who did not complete the second survey ($N = 22$) were significantly younger ($M = 41.41$, $SD = 11.77$) than those who did ($N = 112$, $M = 47.59$, $SD = 12.49$), $t(134) = 2.24$, $p = .03$. Non-completers were also significantly more likely to have been in the control group ($N = 13$) than the intervention group ($N = 4$), χ^2 (1, 129) = 8.71, $p = .003$. No other differences

Table 2. Participant demographic information.

Variable	Intervention Group N (%)	Control Group N (%)
Identified Sex		
Female	37 (50.7)	31 (55.4)
Male	36 (49.3)	25 (44.6)
Race/Ethnicity		
White	70 (95.9)	53 (94.6)
Hispanic/Latino	1 (1.4)	-
American Indian/Alaska Native	1 (1.4)	-
Multiple Races	1 (1.4)	2 (3.6)
Decline to respond	-	1 (1.8)
Relationship Status		
Single	12 (16.4)	7 (12.5)
Married	57 (78.1)	45 (80.4)
Divorced	3 (4.1)	3 (5.4)
Widowed	1 (1.4)	-
Declined to respond	-	1 (1.8)
Education Level		
Less than a high school degree	1 (1.4)	-
High school degree or GED	8 (11.0)	6 (10.7)
Some college, no degree	11(15.1)	18 (32.1)
Associates degree	4 (5.5)	3 (5.4)
Bachelor's degree	28 (38.4)	18 (32.1)
Postgraduate degree	21 (28.7)	11 (19.7)
Farm Type		
Crop	27 (37.0)	19 (33.9)
Livestock	11 (15.1)	10 (17.9)
Crop/Livestock	35 (47.9)	27 (48.2)
Acreage		
1–249	40 (54.8)	37 (66.1)
250–999	21 (28.8)	11 (19.6)
1000–4999	12 (16.4)	6 (10.7)
5000+	-	2 (3.6)
Off-Farm Work		
Yes	35 (47.9)	34 (60.7)
No	37 (50.7)	22 (39.3)
	1 (1.4)	-

	Intervention Group Mean (SD)	Control Group Mean (SD)
Age	46.59 (13.01)	46.48 (12.51)
Number children, total	2.04 (1.78)	1.96 (1.80)
Children at home	1.54 (1.75)	1.36 (1.36)

Intervention $N = 73$; control $N = 56$. Only categories with valid responses are reported.

between the groups emerged in demographic or farm characteristics.

Three intervention group participants opted out of receiving text messages mid-study by responding STOP to a study text message; another changed their phone number and did not alert us. When asked at post-test, 89.86% ($N = 62$) reported that they had no problems receiving study text messages or accessing linked information. The 10.14% ($N = 7$) who did report problems said they could not find linked material after having opened it initially or that they had other technological difficulties.

Satisfaction. Overall ratings of satisfaction with the intervention were significantly above the scale midpoint, $M = 3.83$, $SD = .76$, $t(68) = 9.10$, $p < .001$, 95% CI [.65, 1.01], $d = 1.10$. Only 21.7% of respondents rated their satisfaction at the scale midpoint or lower. Participants were largely satisfied with the number of texts they received per week: just right ($N = 49$, 71%), not enough ($N = 1$, 1.4%), too many ($N = 19$, 27.5%); the time of day they received the messages: just right ($N = 60$, 87%), too early ($N = 4$, 5.8%), too late ($N = 5$, 7.2%); and the 12-week length of the program: just right ($N = 54$, 78.3%), too short ($N = 1$, 1.4%), too long ($N = 14$, 20.3%).

Preliminary efficacy outcomes

Results related to preliminary efficacy outcomes (farm stress knowledge, familiarity with farm stress resources, familiarity with mental health resources, farm stress management self-efficacy, and perceived stress) are presented below in four sections. Pre-test differences between the control and intervention groups are reported, followed by post-test differences between the two groups. Subsequently, tests of differences from pre- to post-test are reported for the control group, and then for the intervention group. Descriptive statistics relevant to these tests are reported in Table 3.

Pre-test differences. A series of independent samples t-tests indicated no statistically significant pre-test differences between the control and experimental groups on ratings of farm stress knowledge, $t(126) = -0.48$, $p = .63$, 95% CI [−.32, .20], $d = .09$; familiarity with farm stress resources, $t(126) = -1.40$, $p = .16$, 95% CI [−.48, .08], $d = .25$; familiarity with mental health resources, $t(126) = 0.17$, $p = .87$, 95% CI [−.31, .37], $d = .03$; farm stress management self-efficacy, $t(126) = -0.85$, $p = .40$, 95% CI [−.41, .16], $d = .15$; or perceived stress, $t(126) = -0.27$, $p = .79$, 95% CI [−.26, .20], $d = .05$.

Post-test differences. A series of independent samples t-tests indicated that compared to the control group, at post-test the intervention group reported greater farm stress knowledge, $t(110) = -4.65$, $p < .001$, 95% CI [−.91, −.36], $d = .90$; familiarity with farm stress resources, $t(110) = -3.96$, $p < .001$, 95% CI [−.81, −.27], $d = .77$; familiarity with mental health resources, $t(110) = -3.48$, $p < .001$, 95% CI [−.91, −.25], $d = .68$; and farm stress management self-efficacy, $t(110) = -2.29$, $p = .02$, 95% CI [−.63, −.02], $d = .45$. There were no statistically significant

differences between groups on perceived stress, $t(110) = 1.50$, $p < .001$, 95% CI [−.06, .44], $d = .29$.

Pre-test to post-test differences in control group. A series of paired-samples t-tests found no statistically significant differences between pre-test and post-test ratings in the control group for farm stress knowledge, $t(42) = 0.71$, $p = .48$, 95% CI [−.19, .41], $d = .11$; familiarity with farm stress resources, $t(42) = 0.90$, $p = .37$, 95% CI [−.16, .44], $d = .14$; familiarity with mental health resources, $t(42) = 0.91$, $p = .37$, 95% CI [−.16, .44], $d = .14$; stress management self-efficacy, $t(42) = -1.09$, $p = .28$, 95% CI [−.47, .14], $d = .17$; or perceived stress, $t(42) = -0.74$, $p = .46$, 95% CI [−.41, .19] $d = .11$.

Pre-test to post-test differences in experimental group. A series of paired-samples t-tests found the intervention groups' post-test scores were significantly greater than their pre-test scores on: farm stress knowledge, $t(68) = -7.25$, $p < .001$, 95% CI [−1.15, −.59], $d = .87$; familiarity with farm stress resources, $t(68) = -5.64$, $p < .001$, 95% CI [−.94, −.42], $d = .68$; familiarity with mental health resources, $t(68) = -6.84$, $p < .001$, 95% CI [−1.10, −.55], $d = .82$; and farm stress management self-efficacy, $t(68) = -5.06$, $p < .001$, 95% CI [−.86, −.35], $d = .61$. Post-test scores were significantly lower than pre-test scores on perceived stress, $t(68) = 4.03$, $p < .001$, 95% CI [.23, .73], $d = .49$.

Discussion

Farmers are prone to chronic stress and its consequents.[2,8] Research suggests that interventions to enhance mental health literacy in this population can be effective in increasing knowledge and confidence regarding mental health

Table 3. Descriptive statistics for tests of intervention efficacy.

	Intervention Group		Control Group	
	Pre (N = 72)	Post (N = 69)	Pre (N = 56)	Post (N = 43)
	M (SD)	M (SD)	M (SD)	M (SD)
Farm stress knowledge	3.08 (0.64)	3.58 (0.64)	3.02 (0.86)	2.95 (0.80)
Fam. with farm stress resources	2.85 (0.80)	3.29 (0.59)	2.65 (0.81)	2.75 (0.85)
Fam. with mental health resources	2.64 (0.95)	3.19 (0.78)	2.67 (0.99)	2.61 (0.98)
Stress management self-efficacy	3.46 (0.76)	3.87 (0.65)	3.33 (0.87)	3.54 (0.85)
Perceived stress	3.07 (0.67)	2.74 (0.65)	3.03 (0.64)	2.93 (0.65)

fam. = familiarity.

issues and decreasing the negative effects of stress.[12,13] However, barriers exist in delivering mental health literacy programs to farmers face-to-face, including perceived mental health stigma, farmers' limited time, and geographic isolation.[6,7,16] The present study reports on the development and assessment of the feasibility, acceptability, and initial efficacy of GRITT, a text-messaging mental health literacy program developed for U.S. farmers to address some of these barriers to delivery of information about mental health.

Feasibility and acceptability

Retention of participants enrolled to this study was high (nearly 84%). Furthermore, most participants in the intervention group (90%) reported that they received all text messages and linked materials. Over three quarters of intervention group participants reported satisfaction ratings above the mid-point. Together, these findings point to the feasibility and acceptability of GRITT for those who enroll.

However, recruitment for this study proved to be difficult, leading to questions about the feasibility of delivering GRITT to a broader audience. Due to social distancing regulations in response to the COVID-19 pandemic, we had to rely solely on online recruitment methods. Online recruitment led to issues with bot responses, a problem increasingly faced by researchers conducting online studies.[42]

However, in-person recruiting of farmers to a mental health literacy intervention may not be a panacea to these recruitment woes. Due to perceived stigma toward mental health issues, farmers may be unwilling to sign up for GRITT in person. Research with farmers in Wisconsin indicates that they would be most receptive to mental health information from medical professionals, spouses, and family members.[46] In future, researchers might consider incorporating the help of these trusted stakeholders in recruitment efforts. Another way to improve recruitment efforts may be to bundle the mental health literacy content with information on less stigmatizing topics that is useful to farmers, such as information on key stressors like production costs, workload, and legislative issues relevant to agriculture.[47]

Initial efficacy

Results regarding initial efficacy are promising. In addition to high satisfaction ratings for GRITT, the intervention group experienced significant increases in knowledge about farm stress, familiarity with farm stress and general mental health resources and stress management self-efficacy, and a significant pre-test to post-test drop in perceived stress. The effect sizes for intervention group pre-test to post-test changes were in the moderate-to-large range,[48] indicating a high level of effectiveness. Conversely, the control group experienced no significant changes from pre-test to post-test.

Strengths, limitations, and directions for future research

The results of this pilot trial provide initial confidence in GRITT's effectiveness. Future research should include a longer follow-up (e.g., 6 months post-intervention) to examine if its effects persist in the longer term. Additionally, a program that provides support beyond the initial 12-week intervention may be beneficial to farmers who face chronic stressors. Other outcomes to be assessed could include, for example, uptake of adaptive stress management behavior (e.g., healthy coping techniques). Though we did not originally intend to deploy GRITT during a global pandemic for which social distancing restrictions were widely established, doing so offered a unique opportunity to intervene on farm stress during a particularly stressful period. Future research should test GRITT outside this unique context.

Slightly over half (51%) of U.S. farms name a woman as an operator.[49] Little research on farmer mental health includes women, despite more women entering the profession.[50] A key strength of the present study was its inclusion of farmers identifying as female, who constituted over half of the sample. However, because convenience sampling was used, farmers who elected to participate (both male and female) may have been more familiar with, been more interested in, and

carried less stigma toward mental health topics than those who did not participate. Future research should intentionally seek out more diverse samples.

Another limitation pertains to the measures of farm stress, farm stress resources, and mental health resources, which were developed for the present study to assess the unique content provided by GRITT. These measures should be validated in future research. Finally, the control group received no intervention, which is consistent with "treatment as usual" for deploying mental health literacy training to U.S. farmers. However, future research could compare GRITT to other mental health literacy interventions and/or an attention-control condition to further ascertain its efficacy.

Conclusion

During and following the COVID-19 pandemic, reliance on digital resources has become increasingly critical,[51,52] and the time may be ripe for a text-messaging intervention like GRITT, which harnesses the power of frequently-used technology to deliver mental health information to farmers in small doses. Results of a pilot test of GRITT indicated that intervention group participants were highly satisfied with the intervention, had higher post-test scores on multiple facets of mental health literacy and stress management self-efficacy than a control group, and experienced a significant drop in perceived stress from pre-test to post-test. However, more research is needed to determine if the intervention's effects persist over time and if the intervention is helpful to a broader range of farmers. Learning more about how to recruit from this population will be critical, as empowering farmers with resources to manage their stress and mental health is as critical as ever. Future directions may include partnering with trusted stakeholders to recruit farmers to the intervention, as well as packaging mental health literacy information with other, less stigmatizing content.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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