HHS Public Access

Author manuscript

Sci Diabetes Self Manag Care. Author manuscript; available in PMC 2024 May 01.

Published in final edited form as:

Sci Diabetes Self Manag Care. 2024 April ; 50(2): 107–115. doi:10.1177/26350106241233475.

Transitioning from an In-Person Intervention to Augmented Text Messaging During COVID-19 in Mexican Americans with Prediabetes: The Starr County Diabetes Prevention Randomized Clinical Trial

Sharon A. Brown, Ph.D., R.N.[1], **Mary A. Winter, M.S.N, R.N.**[1], **Heather A. Becker, Ph.D.**[1], **Alexandra A. García, Ph.D., R.N.**[1], **Mary M. Velasquez, Ph.D.**[2], **Hirofumi Tanaka, Ph.D.**[3],

Corresponding Author: Sharon A. Brown, The University of Texas at Austin School of Nursing, 1710 Red River Street, Austin TX 78712; sabrown@mail.utexas.edu.

Sharon A. Brown
University of Texas at Austin School of Nursing
1710 Red River St.
Austin, TX 78712
Mary Winter
University of Texas at Austin School of Nursing
1710 Red River St.
Austin, TX 78712
Heather A. Becker
University of Texas at Austin School of Nursing
1710 Red River St.
Austin, TX 78712
Alexandra A. García
University of Texas at Austin School of Nursing
1710 Red River St.
Austin, TX 78712
Mary M. Velasquez
University of Texas at Austin School of Social Work
1823 Red River St.
Austin, TX 78712
Hirofumi Tanaka
University of Texas at Austin
Dept. Kinesiology Health Ed.
2109 San Jacinto Blvd.
Austin, TX 78712
William B. Perkison
University of Texas Health Science Center at Houston
School of Public Health
1200 Pressler St.
Houston, TX 77030
Eric L. Brown
University of Texas Health Science Center at Houston
School of Public Health
1200 Pressler St.
Houston, TX 77030
David Aguilar
LSU Health New Orleans
School of Medicine
433 Bolivar St.
New Orleans, LA 70112
Craig L. Hanis
University of Texas Health Science Center at Houston
School of Public Health
1200 Pressler St.
Houston, TX 77030

Conflict-of-Interest Disclosure: The Authors declare that there are no conflicts of interest.

William B. Perkison, M.D.[4], **Eric L. Brown, Ph.D.**[4], **David Aguilar, M.D.**[5], **Craig L. Hanis, Ph.D.**[4]

[1]The University of Texas at Austin School of Nursing, Austin, Texas;

[2]The University of Texas at Austin School of Social Work, Austin, Texas;

[3]The University of Texas at Austin Department of Kinesiology & Health Education, Austin, Texas;

[4]The University of Texas Health Science Center at Houston (UTHealth), School of Public Health, Houston, Texas;

[5]LSU Health New Orleans School of Medicine, Division of Cardiovascular Medicine, New Orleans, Louisiana

Abstract

Purpose: The purpose of this study was to explore the feasibility of using commonly available technology — text messaging — for diabetes prevention in rural Mexican American communities during COVID-19.

Methods: Participants were selected from a NIH-funded diabetes prevention study that, prior to COVID-19, involved in-person group intervention sessions. Participants were predominantly female adults born in Mexico and Spanish-speaking. A subsample (n=140) was divided into 3 cohorts: 1) 50 who completed the initial in-person intervention prior to the COVID-19 research pause; 2) 60 who needed additional support sessions to complete the intervention and thus received 10 text messages with links to relevant online diabetes prevention videos (TM+); and 3) 30 who received enhanced usual care involving health guidance offered during data collection (control). Repeated measures ANCOVA was used to evaluate cohort differences at 24 months post-baseline.

Results: No significant cohort differences were found for depression, eating self-efficacy, alcohol intake, fat avoidance, or sedentary behaviors. Differences in A1C (p=.058) showed both in-person and TM+ cohorts having lower mean A1C levels (5.5%) than the control cohort (5.7%). The TM+ cohort had lower BMI than other cohorts and a lower diabetes conversion rate (22.2%) compared to the control cohort (28%). Participants indicated preferences for in-person/TM+ combination interventions. The strongest positive feedback was for the TM+ intervention cooking demonstration videos.

Conclusions: Augmented text messaging, combined with in-person sessions, had similar outcomes to the all in-person strategy and thus has the potential for expanding the reach of diabetes prevention to many Mexican American communities.

Trial registration: ClinicalTrials.gov: NCT03208010

https://clinicaltrials.gov/ct2/show/NCT03208010

Keywords

diabetes prevention; Mexican Americans; prediabetes; text messaging; Hispanics

Starr County, an impoverished rural community on the Texas-Mexico border, is designated by the State of Texas as a Health Professional Shortage/Medically Underserved Area.[1] The residents are predominantly Mexican American (96.3%) and Spanish-speaking.[2] Due to the well-documented, longstanding diabetes epidemic that has plagued this community for more than 30 years, these researchers and clinicians designed and tested a series of culturally aligned diabetes self-management education and support (DSMES) interventions; these efforts resulted in A1C reductions averaging 1.4 to 1.7%-age points.[3,4]

Recognizing the challenges associated with reversing the devastating consequences of type 2 diabetes mellitus (T2DM) once the disease is established, in 2017 researchers began testing diabetes *prevention* culturally tailored for Spanish-speaking Mexican Americans living in Starr County. Combining aspects of the National Diabetes Prevention Program (DPP) and Starr County culturally-tailored DSMES interventions, the Rio Grande Valley diabetes prevention program (RGV-DPP) focused on lifestyle changes — primarily diet and activity/exercise — to target obesity, the major precursor of T2DM.[5–7] Cultural tailoring involved, at a minimum, emphasizing positive social interactions and support (e.g., in-person group sessions), culturally-informed dietary options, and language preference.[4,8,9]

By September 2019, the full sample of RGV-DPP study participants (N=300) were: 1) enrolled through a rolling recruitment plan; 2) examined at baseline to verify prediabetes and collect other health data; and 3) randomly assigned by groups (8 to 10 participants per group) to intervention or control conditions (i.e., a cluster randomized trial). In March 2020, the COVID-19 pandemic led to a six-month shutdown of all research-related in-person intervention and data collection activities. By this time, out of 10 groups of participants, 7 had completed the 12-month in-person intervention (12 weekly education plus 15 biweekly support group sessions); 3 experimental groups (n=60) had completed 17 to 22 in-person intervention sessions but still needed 5 to 10 additional support sessions to complete the intervention. Thus, *60 experimental participants* received a modified intervention: the in-person educational sessions and support group sessions they had already completed *plus* 10 support sessions delivered remotely to each participant via augmented text messaging (TM+). To complete the intervention, participants were required to view at least 8 of the 10 text messages and participate in follow-up phone calls with project staff after each text message distribution. Modifying the in-person intervention to a remote strategy provided an opportunity to compare three cohorts: 1) 50 participants randomly selected from the portion of the sample who completed the entire intervention in person as originally designed; 2) 60 participants who received the modified, combined intervention involving in-person educational and support group sessions plus 10 augmented text messages (TM+); and 3) 30 participants randomly assigned by group at baseline to serve as concurrent controls to the TM+ strategy and who received enhanced health guidance during data collection appointments (Figure 1).

The purpose here is threefold, to: 1) describe the process of modifying the in-person RGV-DPP intervention into a strategy delivered remotely during COVID-19, while maintaining curriculum content and cultural foci; 2) compare three cohorts (described above) on selected outcomes (e.g., A1C, BMI, rates of conversion to T2DM) to determine whether the remote strategy is as effective as the in-person intervention; and 3) determine participant satisfaction

with augmented text messaging. An efficient, cost-effective remote intervention designed for Spanish-speaking Mexican Americans would extend the reach of diabetes prevention to a growing population with limited health access, particularly in rural areas.

Methods

Intervention Options During COVID-19

Prior DSMES research in Starr County involved interventions delivered in-person to small groups of 8 to 10 people. Multiple focus groups held in Starr County found preferences for in-person strategies, a finding consistent with Hispanic cultural values favoring social interactions.[4,10] In March 2020, COVID-19 safety protocols restricted in-person research activities, thus requiring us to transition to a diabetes prevention intervention that could be delivered remotely. Participants confirmed Internet access, but discussions with community residents revealed that areas of the county had no, limited, or unstable Internet services. Although most community residents reported having smartphones, use of smartphone technology along the border is complicated. Phones in some areas randomly connect with phone towers in Mexico, thus interfering with connections to messages that were sent via smartphone. And focus group informants indicated that although they had computer access, they lacked computer skills and were disinterested in learning new meeting technologies.[10]

In August 2020, data collection was restarted via phone interviews and drive-through appointments for blood draws and anthropometric measurements. In October 2020, in-person research activities were restarted with implementation of safety protocols such as social distancing. Study participants who required up to 10 more support group sessions were contacted to determine interest in resuming in-person sessions. Only 1 out of 20 participants expressed a willingness to attend in-person sessions, due in part to recent COVID spikes occurring along the Texas-Mexico border.

RGV TM+ Intervention

Starr County research office staff, all of whom were community residents, recommended the design of a series of 10 “augmented” text messages. Each text message would include links to existing online videos relevant to diabetes prevention plus new videos developed by staff nurses and dietitians specifically for this project. Transition to a remote format — text messages augmented with local and Internet videos and follow-up phone coaching — was instituted.

Bilingual Mexican American office staff, community workers, nurses, and dietitians from Starr County continued to be involved in the intervention, although in a modified remote format. Office staff recruited individuals and obtained consent to participate, as well as verify smartphone access. When staff determined that participants’ phones linked to Mexican cell towers rather than U.S. cell towers, they helped participants find alternative access options.

The remote strategy — Rio Grande Valley augmented text messaging (RGV TM+) — was designed to replace biweekly in-person support groups with a focus on similar content. In December 2020, the first of 10 Spanish language text messages was distributed, followed by

one every other week for 20 weeks, to the cohort that needed additional sessions to complete the intervention. The 10 text messages included links to 5-minute videos of the project registered nurse reviewing previously learned content, e.g., recent diabetes prevention research; diabetes and COVID-19; tips for reaching dietary goals, e.g., timing of meals, reducing dietary fat, portion control, eating in restaurants including drive-thru restaurants, mindful eating, counteracting eating triggers, etc.; activity trackers (Fitbits© provided by the project); and problem solving.

URLs of relevant Spanish-language videos from the Internet were included: exercise—walking, stretching, low-impact exercises that could be done at home; importance of diabetes prevention; basics of healthy eating; handwashing to prevent COVID-19; and healthy eating on a budget. Six of the 10 text messages included links to YouTube©-posted recipes and videos of a project dietitian demonstrating preparation of simple, healthy Mexican American meals.

Within 24 hours of each RGV TM+ distribution, community workers called participants to verify access to links contained in the messages. Additional phone calls were made within seven days of RGV TM+ distribution to answer questions, provide encouragement, and determine satisfaction with the modified strategy. To reimburse for phone charges incurred, each participant received $25 at completion of a minimum of 8 of the 10 text messages, including follow-up phone calls.

Data Collection

During follow-up phone calls, data were collected on participants' suggestions for the next text message to be distributed as well as satisfaction with augmented text messaging. With COVID-19 precautions in place, full in-person data collection resumed in September 2020. Based on the enrollment date of each cohort, outcome data were collected at 3, 6, 12, 24, and 36 months. During the scheduled data collection appointments, data on demographics, acculturation, psychological factors, lifestyle factors, and physiological/physical outcomes were collected. (See Table 1.) For the main *diabetes-related physiological outcomes*, indicators of overweight/obesity and metabolic factors were selected — fasting glucose (YSI Biochemistry Analyzer, Yellow Springs, OH; average of two separate measurements), glycosylated hemoglobin (A1C, Siemens DCA Vantage, Malvern, PA), waist-to-hip ratio, and Body Mass Index (BMI, kg/m^2).

Initial ethical approval for the overall study was obtained from Institutional Review Boards of The University of Texas at Austin (IRB #2016120040) and the University of Texas Health Science Center at Houston (IRB #HSC-SPH-03–056). Spanish or English consent forms were signed by all study participants. Verbal consent to participate in the TM+ strategy was approved by the IRBs when the intervention format was modified to text messaging.

Data Analysis

Participants were between 25 and 55 years of age with no history of prior diabetes (excluding gestational). A diagnosis of prediabetes was verified and defined as impaired fasting glucose [≥100 and <126 mg/dL], impaired glucose tolerance [≥140 and <200 mg/dL on 2-hour post-load glucose], and/or an A1C ≥5.7% and <6.5%. Exclusion criteria included

a history of using hypoglycemic medications (except during pregnancy), pregnant currently or within the past 3 months, or any medical condition for which changes in diet and/or physical activity would be contraindicated (e.g., kidney failure).[11]

At baseline of the parent study, participants were assigned to groups and groups were randomly assigned to an experimental or control condition, a cluster randomized trial. Information presented here reflects analyses of data obtained from a subsample of participants (n=140) divided into three cohorts: 1) Cohort 1 (n=50) that was constituted by randomly selecting 3 of the 7 groups of participants who had completed the in-person intervention prior to the COVID-19 research pause; 2) Cohort 2 (n=60) that completed all educational and some support group sessions in person but needed additional support sessions to complete the intervention and thus received the RGV TM+ intervention (10 text messages); and 3) Cohort 3 (n=30) that was constituted by selecting the 3 groups randomly assigned (by group) at baseline to serve as controls for the 3 groups in Cohort 2 (received enhanced health guidance offered during data collection appointments). (See Figure 1 for further details.) The rationale for randomly selecting Cohort 1 from the full sample who completed the in-person intervention, rather than using the full sample, was to avoid violating assumptions of the statistical model, i.e., to attain relatively equal comparison groups and homogeneity of within-group variance.[12]

Data from a Microsoft Excel computer database were exported into SPSS Statistics Version 29.0 for analyses. Data collected at baseline and at 24 months post baseline were used. The 24-month data were selected to provide an adequate post-intervention interval for changes in health behaviors to affect physiological parameters, e.g., A1C, BMI. Descriptive analyses (frequencies, means) were used to describe participants at baseline; chi-squared tests and ANOVA were used to compare cohorts at baseline on categorical and continuous measures, respectively (Table 1). ANCOVA was used to explore data trends over time, comparing at 24 months post baseline the RGV TM+ cohort with the original in-person intervention cohort and an enhanced care control cohort (Table 2). Repeated measures ANCOVA controls for potentially confounding variables: cohort differences in baseline means and times between intervention completion and outcome measurement.[12] The Welch ANOVA test was used to examine homogeneity of within-group variance for each variable. The Games-Howell nonparametric post-hoc test, which does not require homogeneity of variance, was used to compare cohorts on any variable that showed heterogeneity. Due to relatively small cohorts, more complex data analyses were deemed inappropriate. Finally, the CONSORT checklist was used when writing the report.[13]

Results

Consistent with previous Starr County studies, participants were predominantly female, accounting for 72% to 77% of participants in each cohort; they were ~50 years of age and had 9 to 10 years of education, on average (Table 1). For *Acculturation*, a majority of participants across the three cohorts: was born in Mexico; lived in Starr County for 30 years, on average; spoke predominantly Spanish; preferred Mexican American foods but were open to eating typical American foods; and reported high levels of smartphone access. For *Psychological Factors*, participants scored relatively low on the PHQ-9 depression scale

and had moderate scores on the WEL-SF eating self-efficacy scale. For *Lifestyle Factors*, cohorts reported varying levels of daily alcohol intake, relatively low smoking levels, and similar levels of avoidance of fat in their diets. Participants stated they spent most of their waking hours (10 hours per day) in sedentary activities, e.g., watching TV, working on the computer.[11] *Selected Physiological Outcomes* — fasting plasma glucose, A1C, waist-to-hip ratio, BMI) — showed varying levels across cohorts at baseline, consistent with the diagnosis of prediabetes.

Significant cohort differences at baseline were found for acculturation: language (p=.006), acculturation: media usage (p=.017), and A1C (p=.05). The all in-person cohort had higher acculturation scores, indicating a preference for English, and a higher A1C level than the TM+ or control cohorts.

Table 2 shows ANCOVA results comparing the three cohorts on outcomes at 24 months post baseline. Due to the COVID-19 research pause, the 24-month measurement period varied across cohorts, so ANCOVA analyses controlled for length of time between individuals' intervention completion and outcome measurement dates. Additionally, ANCOVA analyses also controlled for baseline levels of each variable. The Welch ANOVA test showed homogeneity of within-group variance for all variables, except BMI.

For the *Psychological Factors* of depression and eating self-efficacy, no significant differences were found among the three cohorts at 24 months. For *Lifestyle Factors* of alcohol intake, fat avoidance, and sedentary behaviors, no statistically significant cohort differences were found. For *Physiological Outcomes* (fasting plasma glucose, A1C, waist-to-hip ratio, BMI), no statistically significant cohort differences were found. Note that differences in A1C were p=.058; although not statistically significant, the TM+ cohort had similar A1C levels and lower BMI compared with the other two cohorts. The TM+ cohort had slightly lower levels on all physiological outcome variables when compared to the usual care (control) cohort.

The Welch ANOVA test showed heterogeneity of variance for BMI (p=.037), so a Games-Howell post-hoc test was conducted, which does not assume homogeneity. The results showed that only the TM+ cohort and enhanced usual care (control) cohort significantly differed from one another (p=.029), with the mean BMI for the TM+ cohort being significantly lower at 24 months than the usual care (control) cohort.

Table 3 shows the numbers/percentages of each cohort that converted from prediabetes (baseline inclusion criterion) to categories of glycemic status post intervention. Note that the all in-person cohort had the fewest number of conversions to diabetes (16.7%), compared to other cohorts. The TM+ cohort had a lower diabetes conversion rate (22.2%) compared to the enhanced usual care (control) cohort (28%). The control cohort had the highest number that reverted to normal glycemia from prediabetes (16%).

Following each biweekly text message distribution, participants in the TM+ intervention were surveyed for their intervention preference — all in-person group sessions, TM+ only, or combination TM+/in-person groups. These individuals received a portion of the intervention in-person and then transitioned to the TM+ intervention, so they had

experienced both intervention formats. Following distribution of the 1st text message, participants generally had no specific format preference. Preferences were 82% and 68% for the combined intervention following distribution of the 5th and 10th text messages, respectively.

Discussion

The COVID-19 pandemic combined with a recent infusion of smartphone technology into Starr County on the Texas-Mexico border served as motivators for testing a smartphone-based diabetes prevention strategy, rather novel but also challenging. In addition to random linking of smartphones to Mexican phone towers, smartphone text messages also may be interrupted by weak, intermittent signals even if connected to U.S. towers.

A consistent request of past Starr County research participants was for recipes and guidance in *how* to prepare healthy Mexican American meals. Many online Hispanic recipes tend to be for foods more commonly used by other Hispanic subgroups (e.g., Cuban, Puerto Rican) and not by Mexican Americans. Most Starr County residents speak Spanish only (95%); but few health-related online videos are available in Spanish. A local dietitian and published author of a Mexican American recipe book developed six Spanish-language videos for this project. The videos, posted on YouTube©, demonstrated preparation of healthy Mexican American meals; links were sent to study participants as part of the text messaging distribution. This aspect of the intervention was the most frequently endorsed component of the text messaging series.

A 2017 systematic review of mHealth strategies for diabetes self-management, including text messaging, showed that most studies were exploratory and involved small sample sizes.[14] In a more inclusive systematic review of 25 prior studies and meta-analyses of technology-enabled diabetes self-management, researchers found improvements in A1C, similar to the study reported here.[14] Relevant studies involving Hispanics are limited, particularly of those who reside in poor rural communities similar to Starr County.[15] Clearly, this is an area needing further investigation as early pilot studies tend to suggest the potential effectiveness of such strategies. Widespread use of smartphones by most ethnic/racial groups in the U.S. makes this technology an important untapped resource.[16,17] To date, the few studies that have been conducted focused primarily on diabetes self-management, but clinical trials of text messaging diabetes prevention are beginning to emerge.[18,19] The study reported here, which focused on an underrepresented population in diabetes research, makes important contributions to that literature.

This study involved intervention modification and outcome data collected during the COVID-19 pandemic. Study findings suggest that smartphone technology was accepted in this rural community and may be useful for diabetes prevention and diabetes self-management. Given the relatively small sample size of each of the three comparison cohorts and variation in time to post-testing, results should be interpreted cautiously. The fact that participants in the in-person cohort completed the intervention and some had already completed the 24-month post-test prior to COVID may have attenuated cohort differences. The TM+ participants expressed considerable stress dealing with their vulnerability to

COVID's worst effects. Further, COVID-19 may have had direct deleterious effects on outcome measures. However, data trends demonstrated that for some key variables, e.g., A1C and BMI, text messaging combined with in-person sessions (TM+) is more effective than enhanced usual care (control) and for some outcomes, is at least as effective as the all in-person intervention. The mean BMI of the TM+ cohort was lower at 24 months than were the means for the all in-person and usual care (control) cohorts.

Conclusions

The findings support the notion that such technologies, specifically augmented text messaging, has the potential for wide-spread, cost-effective dissemination/implementation, which is sorely lacking for most interventions. As these researchers have posited previously, Mexican Americans, a vulnerable population for developing prediabetes, should be prioritized because in this minority group, T2DM is already an epidemic.[20]

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments:

The authors wish to express their sincere gratitude to the Starr County residents who participated in the diabetes prevention study. We are also grateful to the local dietitians and research office staff for their commitment and tireless efforts during the conduct of this study.

Funding Source:

This research was funded by the National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health under Award Numbers R01DK109920 and R01DK116378, and by the State of Texas. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the State of Texas.

Abbreviations:

ANCOVA	analysis of covariance
ANOVA	analysis of variance
A1C	glycosylated hemoglobin
BMI	body mass index
CONSORT	Consolidated Standards of Reporting Trials
DPP	Diabetes Prevention Program
DSMES	diabetes self-management education and support
IRB	institutional review board
PHQ-9	Patient Health Questionnaire-9
RGV-DPP	Rio Grande Valley Diabetes Prevention Program

TM+	augmented text messaging
T2DM	type 2 diabetes mellitus
WEL	SF Weight Efficacy Lifestyle Questionnaire-Short Form

References

1. Texas Department of State Health Services. Shortage area designations, 2022. Accessed October 1, 2023. https://www.dshs.state.tx.us/tpco/HPSADesignation/
2. U.S. Commerce Department, United States Census Bureau. Quickfacts: Starr County, Texas, 2023. Accessed September 28, 2023. https://www.census.gov/quickfacts/fact/table/starrcountytexas/SEX255219
3. Hanis CL, Ferrell RE, Barton SA, et al. Diabetes among Mexican Americans in Starr County, Texas. Am J Epidemiol. 1983;118(5):659–668. doi:10.1093/oxfordjournals.aje.a113677 [PubMed: 6637993]
4. Brown SA, Hanis CL. Lessons learned from 20 years of diabetes self-management research with Mexican Americans in Starr County, Texas. Diabetes Educ. 2014;40(4):476–487. doi:10.1177/0145721714531336 [PubMed: 24737885]
5. The Diabetes Prevention Program (DPP) Research Group. The Diabetes Prevention Program (DPP): Description of lifestyle intervention. Diabetes Care. 2002;25(2):2165–2171. doi:10.2337/diacare.25.12.2165 [PubMed: 12453955]
6. Wedell-Neergaard A, Krogh-Madsen R, Petersen GL, et al. Cardiorespiratory fitness and the metabolic syndrome: Roles of inflammation and abdominal obesity. PLoS One. 2018;13(3):e0194991. doi.10.1371/journal.pone.0194991 [PubMed: 29590212]
7. Lemieux I, Deprés JP. Metabolic Syndrome: past, present and future. Nutrients. 2020;12(11):3501. doi:10.3390/nu12113501 [PubMed: 33202550]
8. Brown SA, García AA, Kouzekanani K, Hanis CL. Culturally competent diabetes self-management education for Mexican Americans: the Starr County Border Health Initiative. Diabetes Care. 2002;25(2):259–268. doi:10.2337/diacare.25.2.259 [PubMed: 11815493]
9. Brown SA, Blozis SA, Kouzekanani K, et al. Dosage effects of diabetes self-management education for Mexican Americans: the Starr County Border Health Initiative. Diabetes Care. 2005;28(3):527–532. doi:10.2337/diacare.28.3.527 [PubMed: 15735182]
10. Brown SA, Perkison WB, García AA, et al. The Starr County Border Health Initiative: focus groups on diabetes prevention in Mexican Americans. Diabetes Educ. 2018;44(3):293–306. doi:10.1177/0145721718770143 [PubMed: 29644932]
11. Brown SA, Becker HA, García AA, et al. The effects of gender and country of origin on acculturation, psychological factors, lifestyle factors, and diabetes-related physiological outcomes among Mexican Americans: the Starr County Diabetes Prevention Initiative. Chronic Illn. 2023;19(2):444–457. doi:10.1177/17423953221089315 [PubMed: 35331025]
12. Wan F. Statistical analysis of two arm randomized pre-post designs with one post-treatment measurement. BMC Med Res Methodol. 2021;21(1):150. doi:10.1186/s12874-021-01323-9 [PubMed: 34303343]
13. Schulz KF, Altman DG, Moher D, & the CONSORT Group. CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. BMC Med. 2010;8(18). doi:10.1186/1741-7015-8-18
14. Greenwood DA, Gee PM, Fatkin KJ, Peeples M. A systematic review of reviews evaluating technology-enabled diabetes self-management education and support. J Diabetes Sci Technol. 2017;11(5):1015–1027. doi:10.1177/1932296817713506 [PubMed: 28560898]
15. Patton SR, Coffman MJ, De Haven MJ, Miller C, Kriner LM. Text message intervention for Latino adults to improve diabetes outcomes. Hisp Health Care Int. 2022;20(4):248–255. doi:10.1177/15404153221084610 [PubMed: 35274994]

16. Philis-Tsimikas A, Fortmann AL, Godino JG, et al. Dulce Digital-Me: protocol for a randomized controlled trial of an adaptive mHealth intervention for underserved Hispanics with diabetes. Trials. 2022;23:80. doi:10.1186/s13063-021-05899-x [PubMed: 35090520]

17. Vargas MC, Pineda GJ, Talamantes V, et al. Design and rationale of behavioral nudges for diabetes prevention (BEGIN): a pragmatic, cluster randomized trial of text messaging and a decision aid intervention for primary care patients with prediabetes. Contemp Clin Trials. 2023;130:107216. doi:10.1016/j.cct.2023.107216 [PubMed: 37169219]

18. Wang Y, Xue H, Huang Y, Huang L, Zhang D. A systematic review of application and effectiveness of mHealth interventions for obesity and diabetes treatment and self-management. Adv Nutr. 2017;8(3):449–462. doi:10.3945/an.116.014100 [PubMed: 28507010]

19. MacPherson MM, Merry KJ, Locke SR, Jung ME. mHealth prompts within diabetes prevention programs: a scoping review. Mhealth. 2022;8:20. doi:10.21037/mhealth-21-22 [PubMed: 35449504]

20. U.S. Centers for Disease Control and Prevention. National Diabetes Statistics Report, 2022. Accessed June 18, 2023. https://www.cdc.gov/diabetes/data/statistics-report/index.html

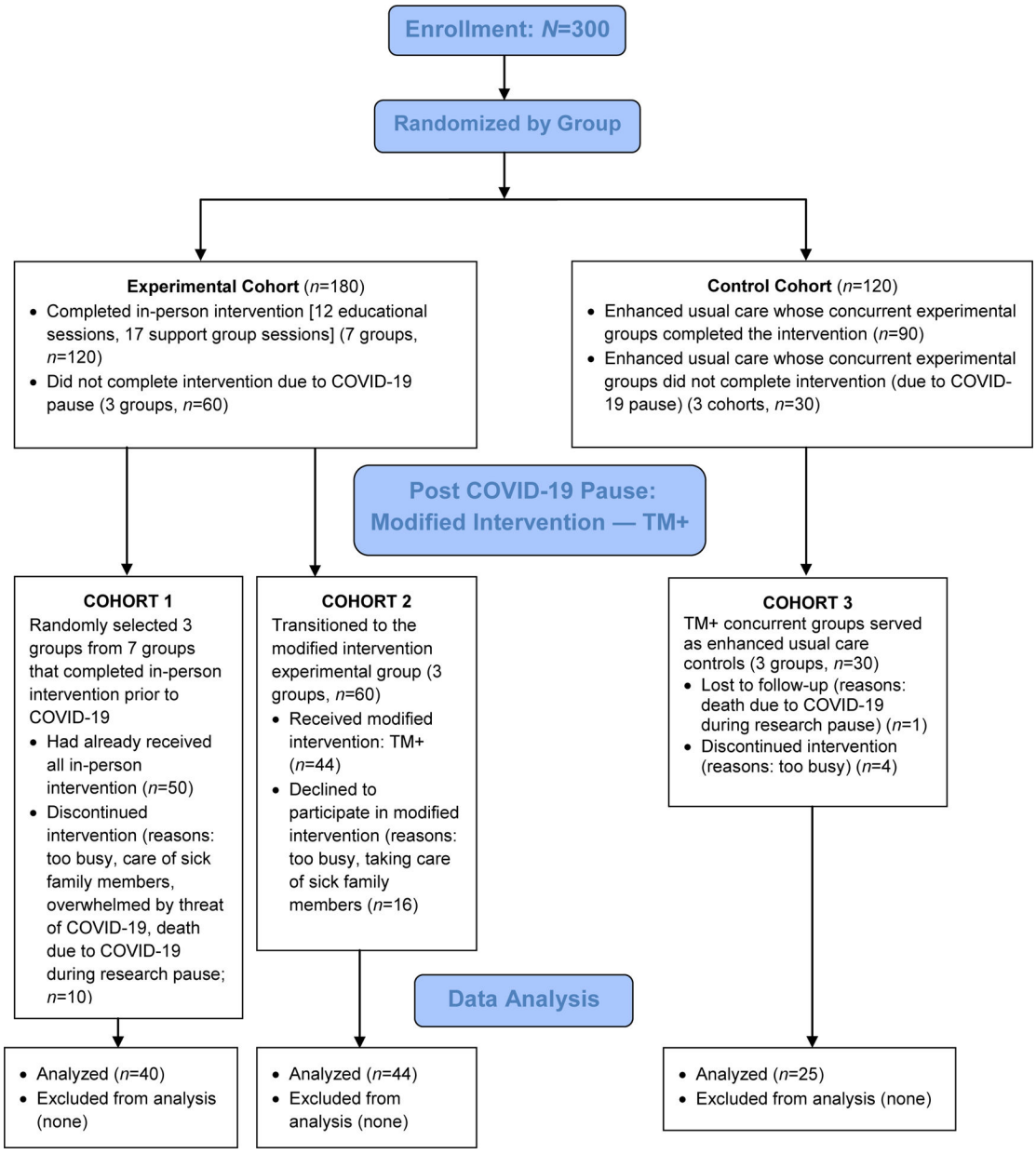

Figure 1.
CONSORT Flow Diagram

Table 1.

Comparing Baseline Characteristics of Three Cohorts (ANOVA): In-Person, In-Person Education Followed by Augmented Text Messaging (TM+), and Enhanced Usual Care (Control)

Baseline Characteristic**	Experimental Cohorts*		Enhanced Usual Care* (Control) *n* = 30	Significance (comparing 3 cohorts)
	All In-Person *n* = 50	In-Person w/ TM+ *n* = 60		
DEMOGRAPHICS				
Sex (*n* [%] female)	38 (76.0%)	43 (71.7%)	23 (76.7%)	*p* = .83
Age (years)	48.7 (6.9)	51.2 (8.2)	51.9 (7.4)	*p* = .12
Years of education	10.7 (3.3)	9.5 (3.4) *n* = 59	9.0 (4.0) *n* = 29	*p* = .08
ACCULTURATION				
Yrs. in Starr County	32.2 (10.4)	29.1 (11.6)	30.2 (13.7)	*p* = .38
Country of origin (% born Mex)	36 (72.0%)	52 (86.7%)	21 (70.0%)	*p* = .09
Acculturation: language	9.5 (5.4)	6.7 (3.7)	7.6 (3.7)	*p* = .006
Acculturation: media usage	2.4 (1.4)	1.6 (1.3)	2.0 (1.4)	*p* = .017
Acculturation: food	2.6 (0.7)	2.5 (0.8)	2.5 (0.8)	*p* = .52
Smartphone (% w/ access)	47 (94.0%)	55 (91.7%)	29 (96.7%)	*p* = .55
PSYCHOLOGICAL FACTORS				
Depressive symptoms (PHQ-9)	2.5 (3.5)	1.9 (2.6)	1.9 (4.0)	*p* = .56
Eating self-efficacy (WEL-SF)	3.0 (0.9)	3.0 (1.0)	2.6 (1.1)	*p* = .22
LIFESTYLE FACTORS				
Alcohol intake (g ethanol/week)	15.6 (51.4)	23.1 (81.4)	23.0 (59.9)	*p* = .82
Fat avoidance	0.09 (.02)	0.09 (.02)	0.09 (.01) *n* = 29	*p* = .36
Smoking(*n*/%):				*p* = .79
Current smoker	5 (10.0%)	8 (13.3%)	4(13.3%)	
Former smoker	5 (10.0%)	10 (16.7%)	5 (16.7%)	
Never smoker	40 (80.0%)	42 (70.0%)	21 (70.0%)	
Sedentary behaviors (hrs/day)	10.2 (4.0) *n* = 38	10.9 (3.0) *n* = 59	10.6 (3.0) *n* = 29	*p* = .58
PHYSIOLOGICAL OUTCOMES				
Fasting plasma glucose (mg/dL)	103.2 (11.6)	102.7 (8.7)	102.2 (7.9)	*p* = .89
Glycosylated hemoglobin (A1C)	5.8 (0.3)	5.7 (0.3)	5.7 (0.3)	*p* = .05
Waist-to-hip ratio	0.91 (.08)	0.93 (.13)	0.94 (.07)	*p* = .40
Body mass index (kg/m^2)	32.8 (6.3)	32.2 (6.2)	34.8 (6.7)	*p* = .18

Note: Cohort data are expressed as means (SD) [analyzed with ANOVA] or *n* (%) [analyzed with chi-squared tests].

*Cohort 1 = Experimental: all in-person sessions (*n* = 50 unless otherwise noted)

Cohort 2 = Experimental: in-person educational sessions followed by TM+ (*n* = 60 unless otherwise noted)

Cohort 3 = Usual care (control): usual care control cohort concurrent with TM+ cohort (n = 30 unless otherwise noted)

** **MEASURES**: Acculturation/language and food scales — language has possible scores ranging from 5–25 and media usage and food preferences range from 1–5, higher scores indicate greater use of English language/media and American foods, respectively; depression (PHQ-9) — higher scores indicate higher levels of self-reported depression; eating self-efficacy (WEL-SF) — lower scores indicate higher levels of confidence in making healthy food choices; Fat Avoidance — mean scores range from 0 to 1, higher levels indicate behavior associated with avoiding high fat intake in the diet; sedentary behaviors — higher levels indicate more time per day spent in sedentary behaviors, such as working on the computer, watching TV

Table 2.

ANCOVA Analyses of Differences in Intervention Outcomes at 24-Months Post Baseline Between 3 Cohorts, Controlling for Baseline Levels and Length of Time Between Completing Intervention and Outcome Measurement

Selected Characteristic**	Experimental Cohorts*		Enhanced Usual Care* (Control) *n* = 25	Significance (comparing 3 cohorts)
	All In-Person *n* = 40	In-Person w/ TM+ *n* = 44		
PSYCHOLOGICAL FACTORS				
Depressive symptoms (PHQ-9)	1.6 (3.5)	2.3 (4.0)	1.5 (2.4)	*p* = .31
Eating self-efficacy (WEL-SF)	2.7 (1.0)	2.9 (1.0)	2.8 (.66)	*p* = .91
LIFESTYLE FACTORS				
Alcohol intake (g ethanol/week)	3.2 (10.2)	11.9 (34.5)	12.1 (39.0)	*p* = .13
Fat avoidance	0.09 (.02)	0.09 (.02) *n* =43	0.09 (.02) *n* = 24	*p* = .74
Sedentary behaviors (hrs/day)	10.4 (3.5) *n* = 32	10.7 (2.4)	11.0 (2.3) *n* = 24	*p* = .53
PHYSIOLOGICAL OUTCOMES				
Fasting plasma glucose (mg/dL)	103.3 (11.5)	102.6 (8.9)	103.5 (9.6)	*p* = .81
Glycosylated hemoglobin (A1C)	5.5 (1.4)	5.5 (0.34)	5.7 (0.47)	*p* = .058
Waist-to-hip ratio	0.92 (.08)	0.93 (.07)	0.94 (.08)	*p* = .56
Body mass index (kg/m^2)	33.1 (6.7)	31.6 (6.9)	36.2 (6.9)	*p* = .16

*Cohort 1 = Experimental: all in-person sessions (*n* = 40 unless otherwise noted; 3 groups randomly selected from the 7 groups that had completed the intervention prior to COVID)

Cohort 2 = Experimental: in-person educational sessions followed by TM+ support (*n* = 44 unless otherwise noted)

Cohort 3 = Usual care (control): concurrent control cohort for TM+ cohort (*n* = 25 unless otherwise noted)

**MEASURES: Acculturation/language and food scales — language has possible scores ranging from 5–25 and media usage and food preferences range from 1–5, higher scores indicate greater use of English language/media and American foods, respectively; depression (PHQ-9) — higher scores indicate higher levels of self-reported depression; eating self-efficacy (WEL-SF) — lower scores indicate higher levels of confidence in making healthy food choices; Fat Avoidance — mean scores range from 0 to 1, higher levels indicate behavior associated with avoiding high fat intake in the diet; sedentary behaviors — higher levels indicate more time per day spent in sedentary behaviors, such as working on the computer, watching TV

Table 3.

Post Intervention Glycemic Status Measured at 24 Months Post Baseline*

Glycemic Status	Experimental Cohorts*		Enhanced Usual Care (Control) *n* = 25
	All In-Person *n* = 36	In-Person w/ TM+ *n* = 45	
Conversion to normal glycemia	4 (11.1%)	6 (13.3%)	4 (16%)
Prediabetes remained	26 (72.2%)	29 (64.4%)	14 (56%)
Conversion to T2DM	6 (16.7%)	10 (22.2%)	7 (28%)

*Note: All individuals met criteria for prediabetes at baseline.