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Multi-site trial using short mobile messages (SMS) to improve infant weight in low-income minorities: Development, implementation, lessons learned and future applications

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INTRODUCTION

Childhood obesity is a significant public health problem, with the overall prevalence of obesity in children higher than the Healthy People 2020 goal of 14.5%.¹ Obesity in childhood is associated with a number of health risks, including chronic disease.² Weight

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gain above the recommendation in infancy increases risk of obesity in later life,^{3,4} particularly during the first 6 months due to the metabolic programming occurring at this stage.⁵ There is higher prevalence of excessive weight gain in Hispanic (14.8%) and Native Hawaiian (11.4%) infants compared to any other group (Blacks 8.7% and Whites 8.4%).⁶ Given the high rates of obesity in disadvantaged groups,⁷ interventions early in life are particularly important in these populations.

Appropriate feeding practices in infancy are key in preventing excess weight gain in at-risk groups.⁸ Exclusive breastfeeding for the first 6 months is protective against excessive early infant gain and later obesity.⁵ However, Hispanic mothers are less likely to practice exclusive breastfeeding than White or Black mothers,⁹ and in Native Hawaiians, duration of exclusive breastfeeding through the first 6 months is lower (20%) compared to Whites (26.8%).¹⁰ Timing of introduction of complementary foods, as well as food quality and quantity, are also important for obesity prevention.^{11,12} Infant feeding practices such as early introduction of solid foods has been shown to be associated with excessive weight gain.^{13,14}

While there have been a number of studies on obesity prevention interventions for children under 2 years of age, results have been mixed. A recent systematic review of interventions to prevent obesity in socioeconomically disadvantaged children (0–5 years) revealed that of the 6 studies identified that recruited children before age 2 with anthropometric outcomes, only 1 had a small effect on BMI.¹⁵ The authors note that most studies use intensive face-to-face interventions, and that future research should explore the feasibility, acceptability and effectiveness of low-cost delivery modes such as use of mobile phone based interventions.¹⁵ According to data collected from July to December 2016 through the National Health Interview Survey, 66.3% of adults considered “poor” according to the U.S. Census Bureau’s poverty thresholds lived in wireless-only households.¹⁶ Common components of face-to-face interventions, such as education and skills training, support, and peer interaction, have been shown to be equally successful in comparable interventions using mobile devices and web-based methods.¹⁷ Further, traditional strategies such as self-monitoring, positive reinforcement, and immediate feedback have been successful in promoting behavioral change in past studies using short mobile messages (SMS).^{18,19} The use of SMS has shown tremendous potential to reach new mothers, particularly those with fewer resources.^{20,21} Interventions using SMS may increase participant retention rates^{19,22,23} and may be cost effective, sustained over time and embedded into programs such as the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).

The objectives of this paper are: (a) to describe development and implementation of an intervention seeking to test weekly SMS sent to parents/caregivers of infants to improve feeding practices and prevent excessive weight gain in infants in WIC in Hawai’i (HI) and Puerto Rico (PR), (b) to determine acceptability of the intervention, and (c) to report lessons learned from implementing this intervention. Results of the intervention regarding effect on infant feeding practices and weight will be published elsewhere.

METHODS

Study population

Participants were parents and caregivers of infants from birth to 2 months old participating in the WIC program in HI and PR. Eligibility criteria included: caregiver age 18 years and older, owner of a mobile phone with unrestricted SMS capability, responsible for infant care and willing to participate for the full study duration. Exclusion criteria included: infants with special diets, infants with limited mobility, pre-term birth (<37 weeks), small or large for gestational age (birthweight <10th or >90th percentile), inability to consent to participate, unwillingness to be randomized and not being able to read. Recruitment was conducted at 4 clinics in HI and 2 in PR, using the same protocol at both sites, with the goal of recruiting 50 participants per month. Actual recruitment spanned approximately 2.5 months in PR and 3.5 months in HI, with 40 and 28 participants recruited per month on average, respectively. Participants were recruited by determining when individuals with infants in the target age range would be going to WIC for an appointment with the help of WIC staff. Research assistants then made contact with potential participants at the clinic and asked them if they would be interested in taking part. Research assistants also approached women with small infants in the waiting area of WIC clinics. The institutional review boards at the University of [blinded] and University of [blinded] approved study procedures.

Sample size calculations indicated that 200 participants (100 per group) achieves 80% power at a 0.05 significance level to detect the effect size of 0.40 in the difference of 4-week changed continuous outcome variables (i.e., weight, food frequency questionnaire (FFQ)) between study groups using a two-sided, two sample t-test. Even after we assumed a 30% dropout rate, 140 completed participants can detect at least medium sized effect of 0.48. Based on this, 202 participants were recruited and randomized to 1 of 2 study groups, with the participants at each site divided evenly between study groups. A total of 92 participants completed the study in PR and 78 in HI.

Intervention Design

The transtheoretical model (TTM) was used as the guiding framework for message design. The TTM identifies important psychological determinants of change, such as self-efficacy, or the belief in one's ability to accomplish a task.²⁴ Constructs in the TTM such as self-efficacy and decisional balance were used in message design to address key determinants of behavior change, and targeted individuals both at the earlier and later stages of change.

Design of messages for the comparison (SMS about general infant's health issues) or intervention arm (SMS for improving feeding practices) was performed in consultation with pediatricians and WIC personnel working with the target population to ensure appropriate content and cultural relevance. The principal investigators developed intervention messages in both English and Spanish focused on reinforcing WIC breastfeeding messages, preventing overfeeding, delaying introduction of solids, and delaying and reducing baby juice consumption, as well as comparison messages on general infant's health issues, such as placing the infant on his/her back to sleep and proper use of car seats. Some of these messages were pilot tested in a group of 5 women and their infants in PR, with 100%

reporting that the utility and frequency of the messages were excellent.²¹ Subsequently, pediatricians at both sites with experience working with low-income populations evaluated messages to inform on culturally based feeding practices. For example, adding poi (mashed taro) to the bottle is a common practice in HI, while adding the contents of a baby food jar in the bottle is a common practice in PR; therefore, in the general feeding practices questionnaire, this was addressed differently for each site.

In HI, the pediatrician collaborator had experience performing research on chronic disease prevention in underserved populations and worked predominantly with Native Hawaiian populations. In PR, the pediatrician collaborator had experience performing research on obesity prevention in PR WIC participants.

Two members of the WIC staff holding a Registered Dietitian credential also reviewed the intervention messages for both sites to ensure consistency with WIC messages, and adjustments were made. Final messages were about 35–50 words long and were sent weekly on different days and times in Spanish in PR and in English in HI (Supplemental File 1). All messages were written at a 5th grade reading level per the results of readability analyses using the Flesch-Kincaid formula for English text²⁵ and the Fernández-Huerta formula for Spanish text.²⁶

The Ez Texting web-based SMS messaging platform²⁷ was used to deliver messages. This is a do-it-yourself text messaging platform that allows for sending and receiving messages from large numbers of people. To send and receive messages, 3 groups were created: comparison, intervention (lactation), and intervention (formula). Weekly messages were entered and scheduled to be sent automatically from the time a participant enrolled. The system was set up before the study began. Sent and received messages were stored on this website.

Intervention Implementation

Equal numbers of parents/caregivers were block randomized to each arm.²⁸ Instead of using single block size, random block sizes (i.e., 4, 6, and 8) were used to keep the investigators blind to the size of each block. The biostatistician created a computer-generated list of randomization numbers, allocating subjects in a 1:1 ratio into study groups. Participants assigned to the intervention group were assigned either to the lactation or formula intervention group, determined based on the breastfeeding status at the first visit. If the participant was breastfeeding at the time of the visit, she joined the lactation group. If she was formula feeding, she joined the formula group.

Upon first contact, a questionnaire was administered verbally to determine eligibility. Informed consent was obtained for eligible participants. Participants then completed a contact form and provided sociodemographic information.

To allow participants to receive messages, the research staff sent a message from participants' cell phones to the number specified by Ez Texting using the keyword corresponding to the correct group at the first in-person meeting. This allowed their phone to be registered into the appropriate group within the platform. Participants immediately

received a confirmation message, allowing researchers to determine who was registered correctly. The research staff explained that participants would receive 1 SMS weekly from that day on, and that they could respond or send comments and questions to research staff. Participants were also notified that they would be asked short questions by SMS requiring responses every other week.

Participants received 1 SMS weekly over 4 months. Each message was scheduled to be sent a specified number of days after the previous message so that SMS would arrive on different days of the week. The principal investigators determined which messages would be sent at each time point. The first messages were related to breastfeeding and appropriate formula feeding, followed by messages related to preventing overfeeding formula, recognizing satiety cues, readiness and timing for introducing complementary foods and beverages and finally for appropriate ways to feed solid foods. Approximately every 2 weeks, participants were asked to answer 7 short quantitative and qualitative questions via SMS. For example, one question was “Did you find receiving SMS about feeding your baby (1. Convenient; 2. A nuisance; 3. Easy to do; or 4. Time consuming)?” Participants responded with the corresponding number. Other questions were based on a ‘yes’ or ‘no’ response, such as “Did you find receiving text messages about feeding your baby helpful?”²⁹ These questions were sent in between the main messages after the second week.

As messages were sent, a record of the message and time sent for each participant appeared on the study website. It was also possible to view the status of messages sent to each participant through a delivery report showing whether a message bounced or was delivered. However, the system could not detect if the messages were read nor if they were deleted before reading.

In the second visit, conducted in person after 4 months, participants repeated the same measures as in the first visit. In addition, qualitative data regarding acceptability of the intervention were collected in an interview. At the end of the visit, participants were compensated for their participation (\$50).

Measures

Measurements occurred at baseline and at the end of the trial to examine the impact of the intervention on the primary endpoints for the trial, weight and infant feeding practices. Excessive weight gain was determined based on infants’ length and weight. Length (cm) was obtained using an infant WIC stadiometer. Weight (kg) was obtained using the infant WIC scale, while wearing light clothes, no shoes and clean diaper. Infants’ birth weight and length were also recorded. Infant weight-for-length percentile was calculated using the World Health Organization growth charts, as recommended by the CDC for this age.³⁰ Excessive weight was defined as weight-for-length z score ≥ 2 SD.

To evaluate infant feeding practices, participants completed an infant FFQ, which includes 52 food items with a brief description of how these were prepared and/or their source (e.g., raw, canned, etc.). It also includes different portion sizes and information on supplements use. Photographs from a booklet of food items were shown to assist participants to provide precise estimates of portion sizes. The Spanish version of the FFQ was piloted in a group of

60 mother/infant pairs in Puerto Rico to assess the clarity of the statements included.³¹ Subsequently, it was validated against 2 non-consecutive 24-hour recalls among 296 participants from WIC Puerto Rico.³² Reliability was assessed by examining the correlation between responses on the FFQ on the first and second administration performed 2 weeks apart. For the purposes of this study, the pediatrician collaborator in HI, who had experience performing research on chronic disease prevention in underserved populations and worked predominantly with Native Hawaiian populations, reviewed the tool for cultural relevance.

Data Analysis

Quantitative results were analyzed by examining the percentage of participants who provided each possible response to questions sent via SMS.

A preliminary codebook and coding guidelines were developed for analysis of qualitative interviews. Prior to coding the transcripts, two researchers (one at each site) coded the same four transcripts and achieved a kappa of 0.95, which was deemed acceptable inter-rater reliability.³³ The two researchers then coded all transcripts from their respective site using NVivo (version 10, QSR International, Inc, Burlington, MA) and added to the shared codebook as needed. Each researcher then independently identified themes for both sites. Results were compared and discussed in a conference call and agreement was reached. The techniques used for qualitative data analysis allowed for the researchers to ensure validity and reliability of findings.³⁴

RESULTS

A total of 24 comments about the messages were sent by participants in PR and 2 by those in HI. These comments were generally about what participants were doing regarding information sent. In addition, 2 questions were sent by participants in PR and 2 by those in HI. Questions were about use of antibiotics and dietary restrictions while breastfeeding, how to place baby to sleep, and how to increase breast milk supply.

Acceptability: Quantitative Analyses

Results from questions on acceptability sent via SMS are reported in Table 1. The criterion for acceptability of SMS was met, with at least 70% of participants reporting that SMS were sent at acceptable times, useful and not irritating, and easy to understand.

Acceptability: Qualitative Analyses

Results from qualitative questions on acceptability with exemplifying quotations are reported in Tables 2 and 3. Findings are reported in order of prominence in the coded data, with coding frequencies displayed.

In terms of what participants liked about the intervention, convenience was most commonly cited. Participants also mentioned the short length of the messages and the usefulness of the information received. With regards to problems experienced with the intervention, most participants reported not having any problems receiving or responding to messages. In terms of overall experience receiving the SMS, participants most commonly reported enjoying the

experience. Other themes were related to the usefulness of the information provided, the desire for additional messages, and the value of messages for new mothers.

DISCUSSION

Results of this multi-site trial using SMS were promising with regards to acceptability. The positive feedback received through both quantitative and qualitative questions mirrored results of other studies using text messaging in nutrition education programs.^{18,19,35,36} For example, in a study exploring the feasibility of using text messaging as a data collection tool to monitor an infant feeding intervention program in rural China, participants who took part in the text messaging survey gave a median acceptability rating of 4 on a 5-point scale (1=disliked very much and 5=liked very much).³⁶ Results of the current study add to the body of literature demonstrating that this format is an appropriate way to reach diverse at-risk populations.

Lessons Learned

Several issues occurred regarding sending messages. Messages were reported as “bounced” for 4 participants in HI. Research staff attempted to contact these participants but were unable to establish communication. Bounced messages may have resulted from a block from the cell phone carrier on receiving short code messages. To remove this block, participant would have needed to contact the cell phone carrier. In PR, messages were reported as “bounced” for 2 participants, 1 of which did not complete the study. The other participant completed the study but did not receive the SMS. In addition, it was discovered during the first week that 2 popular carriers in PR did not allow receiving SMS using a 5-digit numbers, as participants were not able to enter the platform using the study keyword. This issue required including a partner platform with similar interface that used a random 9-digit number to send SMS.³⁷ All messages had to be set up in this platform following the same procedures. Fifty-five participants received messages through this platform, but this posed serious problems for 4 participants, who received between 5 to 12 SMS out of 18.

In other cases, the status of the message on the study website was indicated as “sent-awaiting confirmation.” In these cases, research staff were unable to determine if the message was delivered, as some carriers do not indicate this. Research staff noted cases with this status and monitored subsequent messages sent to ensure delivery. If “sent-awaiting confirmation” appeared repeatedly, research staff contacted the participant to inquire whether messages had been received.

Other issues also arose regarding sending messages. Two participants in HI opted out of receiving messages by texting “STOP,” discontinuing their participation. In PR, no participants opted out. An additional 2 participants in HI and 2 in PR had disconnected phone numbers and did not complete the trial.

Some participants experienced problems responding to messages. If participants did not respond to a question within a 12-hour window, they were not able to respond. In terms of responding to questions sent via SMS, response from participants was greater on average for the first 4 questions (PR: 52%; HI: 55%) than for the last 3 (PR: 34%; HI: 32%).

Finally, there were some participants with whom the research staff was not able to schedule a follow-up meeting. Participants provided phone numbers, email addresses, and 1 additional form of contact at baseline. Despite this, 18 participants in HI and 8 in PR could not be reached for the second visit.

CONCLUSIONS

This study reporting development, implementation, and acceptability of the intervention, as well as lessons learned, may serve as a useful guide for researchers developing nutrition education interventions for low-income groups to be delivered using technology.

In developing such programs, there are several considerations. Tailoring of messages for the target population is an important step. In the current study, messages were developed in both Spanish and English. Pediatricians familiar with the group under study reviewed and provided feedback on messages. To determine how communication via text message is received, obtaining participant comments on SMS is an important step. In the current study, both quantitative and qualitative data were obtained regarding acceptability of the intervention to inform future work.

The intervention was a low resource intensive study conducted using an SMS service provider, which could be easily be translated in large scale to programs such as WIC. Results of evaluation of acceptability indicated that the format and content of messages were appropriate. However, it should be noted that some carriers do not allow SMS from 5-digit numbers (promotional). Further, while it was possible to see whether messages were sent and delivered, it was not possible to see whether messages were read. This information would prove useful to ensure participants could view messages delivered.

Also of note, there was no tracking of other intervention outside of the SMS. It is possible that the SMS about general health may have motivated participants to look for more information elsewhere. This is a limitation of the current study that may be addressed in a follow-up study. Results of this study with regards to acceptability may be used to inform a larger trial to examine the effects of the intervention on infant weight and feeding practices. This trial will provide translatable results for long-term effective interventions in the community that may be adopted by WIC and other similar US programs to prevent obesity in at-risk minority groups.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Ogden CL, Carroll MD, Fryar CD, Flegal KM. Prevalence of Obesity Among Adults and Youth: United States, 2011–2014. NCHS data brief. 2015;1–8.
2. Office of the Surgeon G. Reports of the Surgeon General. The Surgeon General's Vision for a Healthy and Fit Nation. Rockville (MD): Office of the Surgeon General (US); 2010.
3. Taveras EM, Rifas-Shiman SL, Belfort MB, Kleinman KP, Oken E, Gillman MW. Weight status in the first 6 months of life and obesity at 3 years of age. *Pediatrics*. 2009; 123:1177–1183. [PubMed: 19336378]
4. Nader PR, O'Brien M, Houts R, et al. Identifying risk for obesity in early childhood. *Pediatrics*. 2006; 118:e594–601. [PubMed: 16950951]
5. Young BE, Johnson SL, Krebs NF. Biological determinants linking infant weight gain and child obesity: current knowledge and future directions. *Adv Nutr*. 2012; 3:675–686. [PubMed: 22983846]
6. Johnson, B., Thorn, B., McGill, B., et al. WIC Participant and Program Characteristics 2012. AG-3198-C-11-0010. Alexandria, VA: U.S. Department of Agriculture, Food and Nutrition Service; 2013.
7. Barriuso L, Miqueleiz E, Albaladejo R, Villanueva R, Santos JM, Regidor E. Socioeconomic position and childhood-adolescent weight status in rich countries: a systematic review, 1990–2013. *BMC Pediatr*. 2015; 15:129. [PubMed: 26391227]
8. Dattilo AM, Birch L, Krebs NF, Lake A, Taveras EM, Saavedra JM. Need for early interventions in the prevention of pediatric overweight: a review and upcoming directions. *J Obes*. 2012; 2012:123023. [PubMed: 22675610]
9. Cartagena DC, Ameringer SW, McGrath J, Jallo N, Masho SW, Myers BJ. Factors contributing to infant overfeeding with Hispanic mothers. *J Obstet Gynecol Neonatal Nurs*. 2014; 43:139–159.
10. Centers for Disease Control and Prevention. National Immunization Survey (NIS). [Accessed March 21, 2017] https://www.cdc.gov/breastfeeding/data/nis_data/rates-any-exclusive-bf-socio-dem-2013.htm
11. Grote V, Theurich M, Koletzko B. Do complementary feeding practices predict the later risk of obesity? *Curr Opin Clin Nutr Metab Care*. 2012; 15:293–297. [PubMed: 22366921]
12. Pearce J, Langley-Evans SC. The types of food introduced during complementary feeding and risk of childhood obesity: a systematic review. *Int J Obes*. 2013; 37:477–485.
13. Kim J, Peterson KE. Association of infant child care with infant feeding practices and weight gain among US infants. *Arch Pediatr Adolesc Med*. 2008; 162:627–633. [PubMed: 18606933]
14. Baker JL, Michaelsen KF, Rasmussen KM, Sorensen TI. Maternal prepregnant body mass index, duration of breastfeeding, and timing of complementary food introduction are associated with infant weight gain. *Am J Clin Nutr*. 2004; 80:1579–1588. [PubMed: 15585772]
15. Laws R, Campbell KJ, van der Pligt P, et al. The impact of interventions to prevent obesity or improve obesity related behaviours in children (0–5 years) from socioeconomically disadvantaged and/or indigenous families: a systematic review. *BMC Public Health*. 2014; 14:779. [PubMed: 25084804]
16. Blumberg, S., Luke, J. Wireless Substitution: Early Release of Estimates From the National Health Interview Survey, July–December 2016. National Center for Health Statistics; 2017.
17. Nguyen HQ, Donesky-Cuenca D, Wolpin S, et al. Randomized controlled trial of an internet-based versus face-to-face dyspnea self-management program for patients with chronic obstructive pulmonary disease: pilot study. *J Med Internet Res*. 2008; 10:e9. [PubMed: 18417444]

18. Fassnacht DB, Ali K, Silva C, Goncalves S, Machado PP. Use of text messaging services to promote health behaviors in children. *J Nutr Educ Behav.* 2015; 47:75–80. [PubMed: 25282200]
19. Shapiro JR, Bauer S, Hamer RM, Kordy H, Ward D, Bulik CM. Use of text messaging for monitoring sugar-sweetened beverages, physical activity, and screen time in children: a pilot study. *J Nutr Educ Behav.* 2008; 40:385–391. [PubMed: 18984496]
20. Poorman E. Use of text messaging for maternal and infant health: A systematic review of the literature. *Matern Child Health J.* 2015; 19:969–989. [PubMed: 25081242]
21. Torres R, Soltero S, Trak MA, Tucker CM, Mendez K, Campos M, ... Joshipura K. Lifestyle modification intervention for overweight and obese Hispanic pregnant women: Development, implementation, lessons learned and future applications. *Contemp Clin Trials Commun.* 2016; 3:111–116. [PubMed: 27822567]
22. Cocosila M, Archer N, Haynes RB, Yuan Y. Can wireless text messaging improve adherence to preventive activities? Results of a randomised controlled trial. *Int J Med Inform.* 2009; 78:230–238. [PubMed: 18778967]
23. Kerr DA, Harray AJ, Pollard CM, et al. The connecting health and technology study: a 6-month randomized controlled trial to improve nutrition behaviours using a mobile food record and text messaging support in young adults. *Int J Behav Nutr Phys Act.* 2016; 13:52. [PubMed: 27098449]
24. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. *Am J Health Promot.* 1997; 12:38–48. [PubMed: 10170434]
25. Kincaid, J. Derivation of New Readability Formulas (Automated Readability Index, Fog Count and Flesch Reading Ease Formula) for Navy Enlisted Personnel. Millington, TN: USNAS; 1975. Naval Technical Training
26. Fernández-Huerta J. Medidas sencillas de lecturabilidad. *Consigna.* 1959; 214:29–32.
27. CallFire Inc. [Accessed March 21, 2017] Ez texting web-based SMS messaging platform. <https://www.eztexting.com/>
28. Efird J. Blocked randomization with randomly selected block sizes. *Int J Environ Res Public Health.* 2011; 8:15–20. [PubMed: 21318011]
29. Whitford HM, Donnan PT, Symon AG, et al. Evaluating the reliability, validity, acceptability, and practicality of SMS text messaging as a tool to collect research data: results from the Feeding Your Baby project. *J Am Med Inform Assoc.* 2012; 19:744–749. [PubMed: 22539081]
30. Centers for Disease Control and Prevention (CDC). [Accessed May 19, 2017] Growth Charts. <https://www.cdc.gov/growthcharts/>
31. Palacios CTR, Trak MA, Joshipura KJ, Willett WC. Assessing an infant food frequency questionnaire: A pilot study. *FASEB J.* 2014; 28(1 suppl):36.32.
32. Palacios C, Rivas-Tumanyan S, Santiago-Rodriguez EJ, et al. A semi-quantitative food frequency questionnaire validated in Hispanic infants and toddlers aged 0 to 24 months. *J Acad Nutr Diet.* 2017; 117:526–535. e529. [PubMed: 28188114]
33. McHugh M. Interrater reliability: the kappa statistic. *Biochem Medica.* 2012; 22:276–282.
34. Harris JE, Gleason PM, Sheean PM, Boushey C, Beto JA, Bruemmer B. An introduction to qualitative research for food and nutrition professionals. *J Am Diet Assoc.* 2009; 109:80–90. [PubMed: 19103326]
35. Brown ON, O'Connor LE, Savaiano D. Mobile MyPlate: a pilot study using text messaging to provide nutrition education and promote better dietary choices in college students. *J Am Coll Health.* 2014; 62:320–327. [PubMed: 24654921]
36. Li Y, Wang W, van Velthoven MH, et al. Text messaging data collection for monitoring an infant feeding intervention program in rural China: feasibility study. *J Med Internet Res.* 2013; 15:e269. [PubMed: 24305514]
37. CallFire Inc. [Accessed March 21, 2017] GroupTexting. <https://www.grouptexting.com/>

Results from questions on acceptability of the intervention sent via SMS to parents/caregivers of infants in WIC in HI and PR.

Table 1

Question Sent Via SMS	Intervention				Control			
	PR		HI		PR		HI	
	N	%	N	%	N	%	N	%
Frequency of SMS								
Less Frequent	1	5	3	11	0	0	2	8
Same Frequency	9	43	17	61	12	39	18	72
More Frequent	11	52	8	28	19	61	5	20
TOTAL	21	20	28	27	31	30	25	24
Time SMS sent OK								
Yes	27	100	32	97	19	100	31	100
No	0	0	1	3	0	0	0	0
TOTAL	27	25	33	30	19	17	31	28
SMS useful								
Yes	20	91	26	96		-		
No	2	9	1	4		-		
TOTAL	22	45	27	55				
SMS irritating								
Yes	3	13	2	8	0	0	1	4
No	20	87	24	92	31	100	25	96
TOTAL	23	22	26	25	31	29	26	25
SMS easy to understand								
Yes	21	100	22	100		-		
No	0	0	0	0		-		
TOTAL	21	49	22	51				

Table 2

Coding Frequencies for Most Prevalent Themes and Exemplifying Quotations Regarding What Participants (n = 81) Liked About the Study and Problems Experienced.

Prevalent themes and coding frequencies	Explanation of theme	Exemplifying quotation
Liked-Convenience_Format HI = 23; PR = 17	The SMS format was convenient and allowed participants to store messages for future reference. The time of day receiving texts was optimal for checking and reading the messages.	"They were good because I could look at the message when I had time to look at the message. I didn't have to go anywhere to talk to someone, I could just look at the message. Also, I could look back at the message later on if I wanted to."
Liked-Length_Short HI = 13; PR = 1	Messages were concise and of desirable length.	"Messages did not drag on; were direct and to the point."
Liked-Information HI = 11; PR = 4	Messages were instructive and useful.	"I learned a lot of information on feeding my child."
Problems-None HI = 29; PR = 39	No problems were experienced when receiving or responding to messages. No problems understanding the messages.	"The texts were fine and never noticed any problems."

Note: HI = Hawaii; PR = Puerto Rico.

Table 3

Coding Frequencies for Most Prevalent Themes and Exemplifying Quotations Regarding Participants' (n = 81) Experiences Receiving the SMS.

Prevalent themes and coding frequencies	Explanation of theme	Exemplifying quotation
Experience-Enjoyed HI = 14; PR = 20	The texting experience was enjoyable or the messages were encouraging.	"It's nice to receive reminders, especially when you have a rough day because they give you motivation to keep going."
Experience-Knowledge_Info HI = 9; PR = 14	Information presented in the messages was useful and had broad applications.	"Receiving messages about feeding practice was very useful."
Experience-Format_Quantity HI = 6; PR = 6	Participants desired to receive more messages or more information than was sent.	"I would like more messages a week about baby care."
Experience-Knowledge_New Mother HI = 3; PR = 6	Messages were particularly important for new mothers.	"This is a good program for first-time moms."

Note: HI = Hawaii; PR = Puerto Rico.