# THE CENTER FOR WIC NUTRITION EDUCATION INNOVATIONS AT THE USDA/ARS CHILDREN'S NUTRITION RESEARCH CENTER, BAYLOR COLLEGE OF MEDICINE

## FINAL TECHNICAL REPORT

## ABSTRACT

The United States Department of Agriculture/Agricultural Research Service (USDA/ARS) Children's Nutrition Research Center (CNRC) at Baylor College of Medicine (BCM) was awarded funding to create the USDA Center for WIC Nutrition Education Innovations (CNRC WIC Center) in August, 2012. The major goal of the CNRC WIC Center was to develop and administer a competitive process to solicit, evaluate, and fund innovative and effective WIC nutrition education sub-grants. A Request for Applications (RFA) was developed and issued two times. University-based researchers, collaborating with state/local WIC collaborators, were eligible to respond. Two review panels were conducted and four awards were made: 1) Dr. Rafael Perez-Escamilla at Yale [LATCH (Lactation Advice thru Texting Can Help)], 2) Dr. Lorrene Ritchie at University of California Nutrition Policy Institute [Online Nutrition Education: WIC in the 21st Century], 3) Dr. Jennifer Di Noia, William Paterson University, NJ [Online WIC Nutrition Education to Promote Farmer Markets Fruit and Vegetable Purchases and Consumption]; and 4) Dr. M Jane Heinig, UC-Davis [Supporting Baby Behavior Through Pediatric Offices]. These were distinct projects with different outcome measures (breakfast dietary behaviors, salt reduction, breastfeeding maintenance for 3 months, timing of first postpartum contact between mother and Peer Counselor, improvements in fruit and vegetable intake and use of farmers' market nutrition program and WIC cash value vouchers, and the effect of providing Baby Behavior tools and training designed for medical staff on provider knowledge and practice and on WIC participant outcomes (infant BMI z score).

The CNRC WIC Center coordinated the efforts among the grantees, monitored progress, and convened a Workshop at the Food and Nutrition Service office in Alexandria, VA, on July 20, 2016. The four grantees presented the outcomes of their projects at that time.

All the projects were implemented with success.

## SUMMARY OF THE CNRC WIC CENTER PROJECT, INCLUDING METHODS USED, PROJECTS FUNDED, AND SYNTHESIS OF THE RESULTS

The USDA/ARS Children's Nutrition Research Center (CNRC) at Baylor College of Medicine (BCM) was awarded funding to create the USDA Center for WIC Nutrition Education Innovations (CNRC WIC Center) in August, 2012. WIC (the Special Supplemental Nutrition Program for Women, Infants, and Children) provides nutrition education and supplemental nutritious foods to pregnant, breastfeeding, and non-breastfeeding postpartum women, and infants and children up to 5 years of age.[1] Nutrition education is the program benefit that sets WIC apart from the other Food and Nutrition Service (FNS) nutrition assistance programs.[2] The major goal of WIC nutrition education is to help at-risk participants achieve a positive change in dietary and physical activity habits, resulting in improved nutritional status and in the prevention of nutrition-related problems through optimal use of the WIC supplemental foods and other nutritious foods.[1] During fiscal year 2011, about 9 million people participated in WIC per month: 53% were children, 23% were infants, and 23% were women.[3]

The CNRC, one of six human nutrition research centers in the nation, is a world leader in research on maternal, infant and child nutrition for optimal health, development, and growth (https://www.bcm.edu/departments/pediatrics/sections-divisions-centers/childrens-nutrition-research-center). As such, the CNRC is ideally equipped to lead the WIC Center. The CNRC WIC Center worked cooperatively with the Food and Nutrition Service to develop and administer the competitive process to solicit, evaluate, and fund researcher-initiated, innovative WIC nutrition education projects to improve target behaviors.

This project had seven objectives; these are discussed below.

**Objective 1. Develop and administer a competitive process to solicit, evaluate, and fund innovative and effective WIC nutrition education sub-grants.**

Developing the RFA

The CNRC WIC Center developed a Request for Applications (RFA) to fund innovative WIC nutrition education sub-grants (Appendix 1). University-based researchers, collaborating with state/local WIC collaborators, were eligible to respond. It was anticipated that five to 8 subgrants would be awarded with funding levels of $100,000 (small) and $250,000 (large) for up to 2 years duration. The total amount of funding available for the subgrants was $1.1 million.

The CNRC WIC Center website [https://www.bcm.edu/departments/pediatrics/sections-divisions-centers/childrens-nutrition-research-center/research/wic-nutrition-education] had links to the 2011 Institute of Medicine report *Planning a WIC Research Agenda: Workshop Summary*,[4] which identified WIC research needs plus other resources. Innovation was key. Each applicant was expected to provide letters of collaboration and statements of work from collaborating state and/or local WIC agencies.

The RFA specified page length and specific content required in the application. For example, grantees had to agree to: 1) use common measures if possible (to facilitate a meta-analysis), 2) take part in conference calls at the beginning of the award and every 3 months thereafter, 3) submit quarterly reports, and 4) submit all abstracts and manuscripts for posting on the CNRC

WIC Center website. All awardees were expected to attend the workshop in year 4; the proposal budget had to include costs to attend. Indirect costs were limited to 10%.

All studies were to conduct formative research, because of the innovative aspect of the proposed projects. In addition to outcome evaluations, process data, including data on recruitment, dose, and fidelity to the intervention were to be collected. The extent of common measures was dependent on the specific research studies funded by the CNRC WIC Center.
The first RFA was posted on 12/2/12. A letter of intent was due on 3/22/13; the deadline for grant submission was 4/26/13. The RFA was advertised on a variety of professional websites, professional list serves, and through professional organizations and journals.

The CNRC WIC Center offered expert advice during the 4 months between the posting of the RFA and the application due date (April, 2013) to assist potential applicants. The areas of expert advice (research design, theory, technology. statistics, formative and process evaluation, economics) were listed on the CNRC WIC Center website, as was information related to process evaluation. Other links were available for sources of validated questionnaires.

Each application was assigned an identification number that reflected 1) target population area (pregnant, breastfeeding or postpartum women, infants, children) and 2) type of study (technology-based or not). The applications were assigned to reviewers based on these 3 parameters. Dr. Cullen submitted all application summaries to FNS and discussed the proposals with FNS.

Competitive review process.
Consultant Dr. Marilyn Swanson, retired USDA CSREES National Program Leader for Maternal and Child Health and former grant panel review manager for USDA NIFA grants, served as the grant panel review manager. She recruited 12 reviewers who were noted scientists in Maternal and Child Health, intervention research, and technology.

The major review assessment criteria were 1) Significance (how the field will be advanced if this proposed research is successful), 2) Innovation (how this research will add to/advance the field), 3) Approach (Scientific methods), 4) Investigator qualifications, and 5) Environment (support from institution and WIC collaborators). These are the review criteria of the NIH peer review system and were adapted for this RFA (http://grants.nih.gov/grants/guide/notice-files/NOT-OD-09-025.html). Scoring materials were developed and sent to all reviewers. A teleconference was conducted prior to the review conference. Three reviewers were assigned to each application.

The CNRC WIC Center created a special SharePoint website for the review process. The website had a separate section for reviewers. The reviewers could complete the review of their assigned applications and upload the documents to the CNRC WIC Center SharePoint website.

A teleconference review panel was held on 8/13/13 to discuss the grant applications and assign final scores. The final scores were ranked to select the sub-grant awardees. Dr. Cullen submitted the updated summaries for those selected to FNS. Reviewers received compensation for reviewing the applications.

There were two applications that received funding ($250,000 each), in September, 2013:

Dr. Rafael Perez-Escamilla at Yale University (Yale):

*LATCH Lactation Advice thru Texting Can Help*

Exclusive breastfeeding rates among mothers participating in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) are lower than for other mothers in the United States. Thus, there is a need to reach out and improve breastfeeding support among low-income women. Mobile technology, in particular text messaging, is emerging as a promising platform for communicating with patients, including low-income populations. In fact, WIC breastfeeding peer counselors have noted that many moms will only connect on a text message agenda and sometimes it is the only way to reach moms. This study, which will be co-led by Professor Rafael Pérez-Escamilla and Dr. Nurit Harari from the Yale School of Public Health, will test the effectiveness of a web-based two-way texting intervention, whose feasibility has been successfully piloted, to improve exclusive breastfeeding rates among WIC mothers. This texting intervention was designed to provide both breastfeeding education (through an automated texting schedule) and to improve communication between WIC mothers and breastfeeding peer counselors (via an affordable two-way messaging platform) during pregnancy, perinatally and postnatally. This intervention was designed to be used as an adjunct tool by breastfeeding peer counselors. This unique texting platform allows for all text-based communication to be recorded. Thus, lactation consultants and WIC supervisors can monitor and supervise text based communications and can help them triage home visits. The specific aims of this study are to determine if the texting intervention, named LATCH (Lactation Advice thru Texting Can Help), improves exclusive breastfeeding rates during the first 6 months postpartum among WIC mothers being served by peer counselors and to determine possible mechanisms by which the intervention may work (contact with peer counselor within 48 hours of delivery, increased points of contact between mother and peer counselor both prenatally and postpartum, and/or improved supervision by lactation consultant). This will be a randomized controlled effectiveness trial of WIC mothers enrolled in four breastfeeding peer counselor programs in three different Connecticut towns. Mothers will be randomly assigned in a 1:1 ratio to either the control arm (breastfeeding peer counselor support program without texting) or the intervention arm (breastfeeding peer counselor support program with texting). Pregnant women will be enrolled between 18-28 weeks gestation when they are referred to the WIC breastfeeding peer counselor program at four WIC sites in Connecticut. Inclusion criteria will include: age >18 years, prenatal intention to breastfeed, having an unlimited text message cell phone plan, 5$^{th}$ grade or greater literacy level, and fluency in English or Spanish. This study will allow us to study the effectiveness of a texting-intervention to improve exclusive breastfeeding rates among WIC mothers. Using technology and digital media to improve communication and coordination among WIC staff and WIC participants in this manner may prove to be an effective model of nutrition education to improve nutrition behavior among WIC participants. If proven effective, the LATCH prototype could have major implications for WIC as it could later be expanded to strengthen other aspects of WIC nutrition education related to pregnancy, infancy and early childhood.

Dr. Lorrene Ritchie at University of California Nutrition Policy Institute (UC-NPI), Berkeley, CA and Dr. Shannon Whaley, Director of Research and Evaluation at the Public Health Foundation Enterprises WIC Program:

*Online Nutrition Education: WIC in the 21st Century*

A rigorous evaluation of the relative impact of online versus traditional clinic-based modes of delivering nutrition education in WIC has not been conducted. Effective online education with low-income populations has the potential for increased exposure to quality education, improved efficiency, and positive impact in WIC. We hypothesize that women in WIC receiving online nutrition education will score as well as or better than women receiving clinic-based group nutrition education on change in knowledge, self-efficacy, stage of change, and behaviors, and that women will rate the online nutrition education as more convenient than clinic-based group education. To test these hypotheses we will conduct a randomized, comparison trial (online versus group nutrition education) among a sample of 600 women in WIC and 600 mothers of 1- to 5-year-olds in WIC from three local WIC clinics in California. We will survey WIC participants at three time points for both topics [baseline (pre-education), immediately following education (post-education) and 3 months later (follow-up)], with an additional 9-month followup for the salt trial. We will test two nutrition education topics: salt reduction with women in WIC, and child breakfast eating with mothers of children in WIC. We will leverage years of ongoing collaborative research on WIC between UC NPI and Public Health Foundation Enterprises (PHFE) WIC, and build upon investments by PHFE WIC in an online nutrition education delivery system in place since 2012. Findings from this study will be useful in supporting expansion of online nutrition education in WIC and beyond.

After discussion with FNS, a second RFA was prepared. It was posted on 10/2/13 for a second round of applications. A letter of intent was due on 12/18/13; the deadline for grant submission was 1/29/14. The same review process was conducted, managed by Dr. Marilyn Swanson. The applications were reviewed on 5/13/14 and 2 applications received awards ($250,000 each) in June, 2014.

Dr. Jennifer Di Noia, William Paterson University, NJ (WPU-NJ):

*Online WIC Nutrition Education to Promote Farmers' Market Fruit and Vegetable Purchases and Consumption*

This project will develop and test a web-based nutrition education lesson to promote fruit and vegetable consumption among women enrolled in WIC. Designed to leverage an existing resource – vouchers provided to WIC participants for fresh fruit and vegetable purchases through the Farmers' Market Nutrition Program (FMNP) – the lesson will be conceptually grounded in formative research on knowledge, attitudes and skills influencing farmers' market fruit and vegetable (F/V) purchases and consumption and theoretical understanding of approaches for modifying them. The lesson will have three modules, each consisting of 1) behavior change content presented through a video segment featuring WIC participants and 2) an interactive activity to build targeted knowledge, attitudes, and skills. The module goals will be to increase knowledge of the FMNP and WIC-authorized farmers' markets and promote favorable attitudes towards farmers' market F/Vs; promote positive outcome expectations for consuming locally grown F/Vs and improve farmers' market F/V knowledge and asking skills, and improve F/V food safety and preparation

skills. Separate samples of women will be recruited to participate in 1) focus groups for guiding lesson content development and pretesting the resulting content, 2) cognitive testing to assess the clarity and interpretability of items and response formats in measures of knowledge, attitudes and skills developed for the study, 3) one-on-one sessions to assess reactions to initial versions of video segments developed for the lesson, and 4) the outcome evaluation. The research will evaluate the lesson, relative to existing online nutrition education, in a randomized, pretest, posttest, and follow-up design among women from the collaborating local WIC agency.

Dr. M Jane Heinig, UC-Davis (UC-D):

*Supporting Baby Behavior Through Pediatric Offices*

Infant-feeding practices such as early cessation of exclusive breastfeeding, early introduction of solid foods, use of sugary beverages, and overfeeding are associated with increased risk for poor health outcomes. Public health interventions, often focused on motivational messages have had limited success in preventing these behaviors, particularly among participants in WIC. In preliminary studies, we found that parents' misinterpretation of infant behaviors was associated with uniformed infant-feeding decisions. Collaborating with the California Department of Public Health WIC Division (CA WIC), we created and tested an innovative program to improve parents' abilities to form realistic expectations and better recognize normal infant sleep and crying patterns. In 2010-2011, CA WIC initiated a statewide Baby Behavior Campaign. In an effort to develop consistent messaging for WIC participants related to infant behavior, this project will test low-cost video trainings and tools targeted to medical staff in pediatric clinics serving low-income families, including WIC mothers, in order to support ongoing Baby Behavior education for WIC participants. Age-specific messages and materials will be developed to help providers to effectively address parents' most common questions related to infant feeding and behavior during each regularly scheduled well-baby check. Online surveys of providers, medical staff, and participants will be used assess knowledge transfer, acceptance, and feasibility of message delivery as well to evaluate the added value of provider education versus WIC-only Baby Behavior messages for participants. The study will be conducted among approximately 480 WIC-enrolled patients in 30 physician offices (randomly assigned to intervention vs. control groups) who serve the WIC population in California. We hypothesize the cost-neutral intervention will result in age-appropriate growth trajectories as assessed by the change in infant weight-for-length Z-score during the first 6 months. It also is expected that the intervention will improve adherence to infant-feeding guidelines, improve indicators of maternal stress and self-efficacy, and be associated with normal values on indicators of infant development. If successful, this collaborative effort between WIC and community health care providers could serve as a model for other health interventions by building a continuum of care to improve infant-feeding practices and reduce children's risk for overweight and obesity.

There was $100,000 remaining after the four awards. FNS approved an additional $25,000 for each grantee for additional research needs that each PI identified.

**Objective 2. Coordinate efforts among the grantees and monitor progress.**

The CNRC WIC Center SharePoint site was used for sharing study materials. The four grantees and their staff had access via passwords. There were private folders for each grantee and general access folders with grantee information and study materials.

Quarterly conference calls were held. The minutes from the calls were posted on the SharePoint site.

Each grantee prepared written quarterly reports. These were appended to the Quarterly Report prepared by Dr. Cullen and submitted to FNS. The Quarterly Reports were posted on the SharePoint site.

At the first quarterly conference call of the four grantees, it was noted that the four projects were different and did not share any common intervention outcomes. The following common baseline questionnaires for use by the four grantees were identified: demographics, food security status (2-items)[5], and breastfeeding status (Appendix 2). Table 1 presents the demographic characteristics across the four projects.

Because there were no common outcome measures, the Publications and Presentations (P&P) Committee (the principal investigators (PIs) and Dr. Cullen) decided not to meet regularly. The P&P would meet via conference call after the studies were completed to discuss the possibility of papers from the baseline data, and possibly on experiences working collaboratively with WIC partners.

| Table 1. Demographic characteristics of the participants across the four projects | | | | | | | |
|---|---|---|---|---|---|---|---|
| | UC-NPI | | UC-D | | WPU-NJ | | Yale |
| | Breakfast (N=590) | Salt (N=514) | Health Care Providers (N=84) | Study Mothers (N=186 ) | Focus Groups (N = 169) | Intervention (N = 744) | (n=174) |
| Age in years (mean) | 31.9 | 31.7 | NA | 27.4 | 30 | 28.9 | 26.8 |
| Food Insecure (%) | 45.7 | 50.7 | NA | 29.7 | 61 | 55 | 12.5 |
| Ethnicity % | | | | | | | |
| African-American | 6.2 | 4.1 | 3.6 | 10.4 | 27 | 30 | 0 |
| Hispanic | 82.2 | 88.1 | 20.1 | 65.1 | 64 | 59 | 74.7 |
| Other | 11.7 | 7.7 | 30.9 | 24.5 | 0 | 0 | 25.3 |
| Education % | | | | | | | |
| < High school | 32 | 36.4 | 0 | 23.3 | 54 | 50 | 15.3 |
| ≥High school | 68 | 63.62 | 100% | 76.7 | 46 | 50 | 84.8 |
| Marital status % | | | | | | | |
| Married/living with partner | 65.9 | 68.2 | NA | 69 | 44 | 42 | 69.4 |
| Single | 34.1 | 31.8 | NA | 28 | 31 | 41 | 30.6 |

**Objective 3. Assess the findings from the grantees' study evaluations and produce a summary and synthesis (a meta-analysis on the results) and widely disseminate this information.**

The four projects had unique outcomes (the change in knowledge, self-efficacy, and behaviors related to child breakfast eating and salt reduction; improvement in exclusive breastfeeding rates; farmers' market fruit and vegetable purchases and consumption among women enrolled in WIC; and the effect of providing Baby Behavior tools and training designed for medical staff on provider knowledge and practice and infant growth patterns. Therefore a meta-analysis could not be conducted and a summary of the four projects was produced.

Target Populations and Project Aims

The target populations and aims of each project are presented in Table 2.

Table 2. Target populations, overall objectives, and specific aims of the projects.

| Grantee | Target population | Overall objective | Specific Aims |
|---|---|---|---|
| UC-NPI | Mothers of young children enrolled in WIC in Los Angeles, CA | To evaluate the use, preferences for, and impact on WIC participants of online nutrition education in comparison to WIC nutrition education delivered using a standard-practice group class held at the WIC clinic. | To assess differences between intervention and comparison groups of mothers of young children from pre-education to post-education and follow-up in change in knowledge, self-efficacy, and behaviors related to 1) child breakfast eating and 2) salt reduction. 3) To assess differences between intervention and comparison groups of mothers of young children immediately after education in rating of utility and satisfaction with nutrition education. |
| Yale | Women receiving prenatal care in WIC clinics in Connecticut | To test the effectiveness of a web-based two-way texting intervention, to improve exclusive breastfeeding rates among WIC mothers. | To assess: 1. Exclusive breastfeeding (EBF) status at 2 weeks and 3 months postpartum; and (2) the time to first contact with BFPC after giving birth (immediately, within 48 hours, or within the first 1-2 weeks). |
| WPU-NJ | Women enrolled in WIC in the New Jersey area | To develop and test an online WIC nutrition education program to promote farmers' market fruit and vegetable purchases and consumption | 1 To develop a prototype theory-driven, web-based nutrition education lesson to promote farmers' market fruit and vegetable (F/V) purchases and consumption among women enrolled in WIC. 2. To evaluate lesson effects on F/V intake, Farmers' Market Nutrition Program (FMNP) voucher redemption, and the redemption of cash value vouchers at farmers' markets immediately following and 3 and 6 months after the lesson in a randomized four-arm design (new lesson, new lesson + FMNP vouchers, existing online health education, existing online health education + FMNP vouchers). |
| UC-D | Medical staff serving a high-proportion of WIC-eligible families and WIC mothers of infants in the Davis, CA area. | To evaluate the effect of providing Baby Behavior tools and training designed for medical staff on provider knowledge and practice and on WIC participant outcomes. | 1. To evaluate the impact of the intervention on provider knowledge and practice 2. To evaluate the impact of the intervention on WIC infant growth patterns. 3. To identify and describe mediating factors which influence the effects of the intervention on infant growth outcomes including a) adherence to current infant-feeding guidelines; b) indicators of maternal stress and self-efficacy; and (c) indicators of infant development. 4. To evaluate the impact of the intervention on the WIC program and provider costs and indicators. |

Intervention Development

The development processes that were used to design the four interventions are described in Table 3.

Table 3. The Intervention Development Process

| Grantee | Intervention Development Process |
|---|---|
| UC-NPI | The UC-NPI and PHFE WIC team led the selection of breakfast and salt lessons and 2-3 learning objectives. The team gathered information from multiple sources, including USDA websites, journal articles and other WIC programs and developed the 2 classes. A complete class was tested live, first in English and then Spanish, with 10 to 15 WIC participants. A criteria list was used to assess that the class met the learning objectives goals, and the presenter asked participants for specific feedback about the content and usefulness of the class material. After testing, the materials were edited, finalized and produced.<br><br>Questionnaires developed for the study were pilot tested in both English and Spanish with 10-15 mothers of 1 to 5 year old children enrolled in WIC. |
| Yale | In a pilot study (Harari et al, under review), three focus groups were held with 21 mothers from a hospital-based primary care center and a federally qualified community health center to help tailor the text messages for the target population. Information that would be helpful to prepare mothers for the breastfeeding experience, and to help them to overcome barriers to breastfeeding was obtained. Participants also provided information on their cell phone plans. A steering committee developed the text messages using the Theory of Planned Behavior. A small feasibility study was conducted with 52 WIC moms to test the text messaging. |
| WPU-NJ | A WIC advisory board was convened to meet monthly throughout project. Focus groups (14 groups, n=56 participants-in English and Spanish) were held to gather data for guiding the development of each of three lesson modules. A second round of focus groups (12 groups [n=52 participants]) reviewed the planned content and gave feedback on 1) likely effects of the module on targeted knowledge, attitudes and skills, 2) content, if any, that should be eliminated, and 3) content, if any, that should be changed to increase potential effects. Draft questionnaires were developed. Cognitive testing interviews with 15 participants gathered data for improving items and response formats that were unclear and/or difficult to understand. Rough cuts of video segments developed for the first lesson module were assessed in one-on-one sessions. Five participants each viewed English- and Spanish-language versions of the segments. The feedback guided edits to and/or re-filming of footage lacking quality, relevance, and impact. Revised segments underwent pretesting in a second round of 1:1 sessions. |

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| UC-D | The Baby Behavior training (7-8 hours) for WIC staff was adapted for the Health Care Provider (HCP) video trainings. The initial 2 video modules totaled 60 minutes for HCP and 80 minutes for staff. A total of 8 HCPs reviewed the provider video and provided feedback; 13 medical staff members reviewed and commented on the staff video. Both groups provided suggestions for improvement; most recommended shortening the videos and providing more practical examples of the messages being used in pediatric environments. The 2 modules were shortened to a total of 55 minutes for HCP and 60 minutes for staff. Approximately one third of each training was devoted to examples of application of the messages in clinical settings.<br>The Baby Behavior booklet provided to CA WIC participants was reviewed for content to be used during the well-child contacts. Five handouts were created, one for each of the well-baby checks (1-week, 2-weeks, 2-months, 4-months and 6-months of age), covering information useful for parents of newborns and infants. The handouts were developed and tested for acceptance and understanding among English-speaking WIC participants, then translated into Spanish and tested among Spanish-speaking WIC participants. Concerns about text density resulted in a specific test of "longer" (approximately 70-100 words per section) versus "shorter" (approximately 40 to 60 words per section) versions. "Longer" versions were consistently preferred over the shorter versions of the materials. Handouts were modified based on feedback and tested again. |

Project Variables and Assessment Questionnaires

The variables and assessment questionnaires used for each project are presented in Table 4.

Table 4. Project variables and assessment questionnaires for each project

| Grantee | Project variables and assessment questionnaires |
|---|---|
| UC-NPI | Aim 1. Breakfast Study (pre, post, and 2-4 month follow-up)<br>1. Breakfast-related knowledge (n=2 items)[a]<br>2. Breakfast-related attitudes (n=5 items)[6]<br>3. Parent-reported breakfast eating frequency behaviors (n=10 parent and n=12 child)[7]<br><br>Aim 2. Salt Study (pre, post, 2-4 and 9 month follow-up)<br>1. Salt-related knowledge (n=2 items)[a]<br>2. Salt-related self – efficacy (n=6 items)[6]<br>3. Salt-related behaviors (n=7 items)[8]<br>4. Salt-related dietary behaviors (n=10 items)[9]<br><br>Aim 3. Satisfaction Study (post)<br>1. Satisfaction with breakfast and salt classes (n=1 for each) [a]<br>2. Shared information from class with others (n=1 for each)[a]<br>3. Preference for next class (in person or online) (n=1 for each)[a]<br>4. Preference for next class at follow-up (n=1 for each)[a]<br><br>Demographics and Food Security<br><br>[a] Developed and tested for this study-See Appendix 3. |
| Yale | The primary *dependent* variable of interest was exclusive breastfeeding status (EBF vs. partial breastfeeding) at 2 weeks and 3 months postpartum<br>1. Used a modified version of the breastfeeding status question from the Infant Feeding Practices Study II (IFPS II) neonatal questionnaire [a] (see Appendix A).<br><br>The secondary outcome was the timing of first postpartum contact between mother and PC.<br>1. How soon after your baby was born were you in touch with your peer counselor? (1) immediately after your baby was born; (2) Within 48 hours after delivery; (3) Within 1 week of delivery; (4) Within 2 weeks of delivery.<br>[a] Available at http://www.cdc.gov/breastfeeding/data/ifps/index.htm |
| WPU-NJ | 1. FV intake [pre, immediately post, and 3 and 6 months after post]<br>- Frequency of intake was measured using the F/V module of the 2013 Behavioral Risk Factor Surveillance System questionnaire.<br>- Quantity of intake was measured with a 2-item screener developed by the National Cancer Institute.<br>2. Redemption of Farmers' Market Nutrition Program (FMNP) vouchers<br>3. Redemption of CVVs at farmers' markets.<br>- Data provided by local/state WIC agencies on vouchers issued to and redeemed by participants.<br>4. Knowledge of the FMNP and WIC-authorized farmers' markets, attitudes towards farmers' market F/Vs, awareness of locally grown, seasonal F/Vs, farmers' market |

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|---|---|
| | F/V purchases (ever purchased F/Vs at a farmers' market, purchased F/Vs at a farmers' market in the past two weeks [and among those who recently purchased F/Vs at a farmers' market, whether this was their first time at a farmers' market, whether they asked farmers if they accept FMNP vouchers and CVVs, and whether they paid for their paid for F/Vs with FMNP vouchers and CVVs, respectively] and intentions to purchase F/Vs at a farmers' market in the next two weeks), F/V food safety skills, farmers' market asking and F/V preparation skills, and positive outcome expectations for consuming locally grown F/Vs.[a]<br>5. User satisfaction with the lesson received (ratings, on a 7-point scale, of the extent of enjoyment, interest in, and likelihood of recommending the lesson to other WIC participants).[a]<br>6. Lesson dose (data recorded by research assistants [RAs] and tracked through the website on the number of lesson modules and activities participants completed [a total of three each for the new lesson and one each for existing online health education lessons])<br>7. Distractions, if any, experienced during lesson play (recorded by RAs)<br>8. Participant self-report data on existing online lessons, if any, completed prior to the study<br>8. Measures of new information learned from the lesson and talking to family and friends about new information learned, whether this was the first time completing an online WIC nutrition education lesson and the perceived novelty of the lesson.<br>9. Among women who received the new lesson, measures of what was remembered most about the lesson; what was liked and disliked about the lesson and what, if anything, could be done to improve it; transportation into the video narrative and identification with the characters; liking and learning from lesson activities; the activity that was liked the most; the F/V the participant chose to learn a recipe about and whether the participant tried the recipe at home; and whether the participant opened follow-up emails sent after the lesson, watched the videos, and tried the recipes shown and the perceived helpfulness of the information provided.<br>10. Participant enrollment and tracking measures: the number screened, determined eligible/ineligible and enrolled/not enrolled (during recruitment), and follow-up calls made/completed, follow-up assessments scheduled/completed and problems, if any, encountered in reaching participants.<br>[a] Developed and tested for this study: See Appendix 6. |
| UC-D | 1. Age-appropriate weight-for-length trajectories as assessed by the change in weight-for-length Z-score during the first 6 months.<br>2. Mediating factors which influence the effects of the intervention on infant growth outcomes include (a) increased breastfeeding duration and exclusivity and reduced use of formula volumes that exceed pediatric guidelines; b) indicators of maternal stress and self-efficacy; and c) normal values on indicators of infant development) [ See Appendix 5].<br>3. The program is cost neutral to WIC agencies. Costs of the intervention to the provider will be estimated based on provider survey outcomes and indicators of patient satisfaction. |

Project Outcomes

The outcomes from each project are presented in this section using the Reach, Effectiveness, and Maintenance)-(Adoption, Implementation, and Maintenance (RE-AIM) framework. RE-AIM enables intervention development and evaluation teams to assess essential program elements that can improve the sustainable adoption and implementation of effective, evidence-based health promotion programs. The RE-AIM framework includes individual level components (Reach, Effectiveness, and Maintenance) as well as organizational or setting level components (Adoption, Implementation, and Maintenance).[10, 11]

At the individual level, *Reach* involves assessing the percent of potentially eligible participants that take part in a study. *Efficacy or Effectiveness* examines the impact of the intervention on primary outcomes. *Maintenance* assesses long-term intervention effects (greater than 6 months post intervention).

Setting level components include *Adoption*- the percent of settings and intervention agents within these settings (e.g. medical offices/physicians) who participated. *Implementation* at the setting level refers to the extent that the various intervention components were delivered as intended (fidelity). Finally, *Maintenance* assesses the extent that the intervention was continued and became part of routine practice.

Because the four projects were included intervention development and feasibility testing, *Adoption* and setting - level *Maintenance* could not be assessed. Individual-level *Maintenance* was only assessed in one project for one outcome.

The *Reach* of each project is presented in Table 5. The majority of WIC client participants in the four projects were Hispanic. This percentage was similar to the overall ethnic distribution of the WIC clinics in the projects. The *efficacy outcomes* from the four projects are summarized in the four subgrantees reports.

**Table 5. Reach Outcomes (RE-AIM model)**

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| UC-NPI | Breakfast Lesson:<br>N=1,578 enrolled in WIC; N=667 recruited; 590 completed pre, post, and 2-4 month follow-up (359 for the in-person class and 231 completed the online class) (88.5% retention). The majority of participants were Hispanic (83%), about 47% were food insecure.<br><br>Salt Reduction Lesson:<br>N=1,387 enrolled in WIC; N=666 recruited; 514 completed pre, post, 2-4 month and 9-month follow-ups (257 for the in-person class and 257 completed the online class) (77.5% retention). The majority were Hispanic (88%); about 51% were food insecure.<br><br>The ethnic distribution of participants attending the PHFE WIC program is 84% Hispanic, 6% African-American, 4% Caucasian, 4% Asian, and 2% other. |
| Yale | A total of 249 women at the WIC clinics were screened and initially consented to participate. Five of these mothers participated in the pre-testing phase, and 32 were unable to be reached for their baseline interview. There were 212 mothers who completed their baseline assessment and were randomized to either the intervention or control group (85% enrolled), 75% were Hispanic; about 12.5% were food insecure.<br><br>In 2015, the racial/ethnic breakdown of the WIC population in the state was 51.2% Hispanic, 22.5% Non-Hispanic white, 20.4% Non-Hispanic black, and 5.9% Other. |
| WPU-NJ | Of 1,345 women at the WIC clinics who were approached, 64 were ineligible, 537 were eligible but declined to participate and 744 were enrolled (58% consent rate). Participants had a mean age of 29 years; 17% were pregnant and 21% were breastfeeding. Most were Hispanic (59%) and African American (30%); 55% were food insecure.<br><br>In the WIC clinic where this study was conducted, approximately 66% of participants were Hispanic, 13% African American, and 21% white or other. |

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| UC-D | Of the 81 health care clinics contacted, 17 enrolled in the study; however one clinic withdrew participation when the sole physician left the practice. In the remaining 16 clinics, 96 HCPs consented to participate. Of these, 84 HCPs completed the baseline survey, 77 completed the midpoint survey, 64 completed the endpoint survey; 76% of the HCPs were female, 48.8% white, 19% Hispanic, 29.8% Asian, with a mean of 14 years in practice.<br><br>In the clinics, 212 women whose children were enrolled in WIC were screened and 186 (88%) enrolled. About 65% of mothers were Hispanic, 10% African American, and 12% white. Nearly 30% of enrolled mothers were food insecure.<br><br>The ethnic distribution for CA WIC participants statewide is 84% Hispanic, 6% African American, 4% Caucasian, and 4% Asian% and other. |

**UC-NPI: Online Nutrition Education: WIC in the 21st Century**

*Background*

The University of California's Nutrition Policy Institute and the Public Health Foundation Enterprises WIC Program (PHFE-WIC) partnered on the "Online Nutrition Education: WIC in the 21st Century" project. This project included a rigorous evaluation of the impact of online and traditional clinic based modes of delivering nutrition education in WIC on dietary behavior outcomes. It also evaluated WIC participants' preferences for and satisfaction with online nutrition education in comparison to WIC nutrition education delivered using a standard-practice group class held at the WIC clinic.

*Methods*

For each of two intervention trials, approximately 600 WIC participants were randomly assigned into online vs in-person nutrition education modalities at three local WIC clinics in California. Women assigned to the online modality received a phone call from WIC research staff the week prior to their WIC appointment and were asked to take a breakfast or salt class online before coming into WIC. They were emailed and/or texted the link to access nutrition education online. Only WIC participants with internet access (by phone, tablet or computer) were eligible to participate in the study. Questionnaires can be found in Appendix 3.

The online breakfast and salt lessons were designed to exactly mirror the content provided during the in-person group lesson using text, prompts, questions on knowledge, behaviors and goal-setting, and visual images. The online lesson allowed participants to interact by providing open-ended responses to questions. The online lesson provided similar content as the in-person lesson similar to how the instructor asked participants to contribute to the class discussion. The online lesson consisted of written and simultaneous audio presentation of the class material.

*Results*

*Aim 1. Breakfast Study*

The breakfast class began with participants being asked if they had eaten breakfast that day. Photos of an energetic and tired child and hot and cold breakfasts were used to dispel misconceptions regarding breakfast. A MyPlate visual was used to view portions and food groups of common breakfast foods. The lesson concluded with a review of the lesson plan and discussing challenges during breakfast time. Both in-person and online breakfast classes were offered in English and Spanish and were estimated to take roughly 15-20 minutes to complete. Of the 590 WIC participants in our sample, 359 (61%) participated in the in-person education group and 231 (39%) participated in the online education group. The majority of participants were Hispanic (83%) and mothers (97%). Most (71%) of the participants were 35 years old or younger.[12]

Changes within and between in-person and online groups were compared using t tests and $x^2$ tests. Analysis of covariance and generalized estimating equations were used to assess differences in change between groups.

Participants were asked, "How much sugar can WIC cereals have per serving?" The in-person group showed a larger improvement in knowledge from pre-questionnaire to post-questionnaire and a greater decline in retention from post-questionnaire to follow-up compared to the online

group. There were no significant differences in knowledge between groups between pre-questionnaire and follow-up (see Figure 1[12]). Participants in both groups increased and retained knowledge about how much juice WIC recommends per day; there were no significant differences between the in-person and online groups (see Figure 2[12]). Participants also showed improvement for other knowledge questions related to breakfast beliefs that were covered in the lesson, and there were no significant differences between groups. At 2-4 months following the class both education groups reported similar reductions in barriers to eating breakfast due to time constraints, not having enough foods at home, hunger, and difficulty with preparation. Increases in the frequency of eating breakfast were greater for both the parent and child in the online group compared to the in-person group. There also was a greater decline in children's vegetable intake at breakfast at follow-up in the in-person group compared to the online group. For more detailed results, please see Au et al.[12]

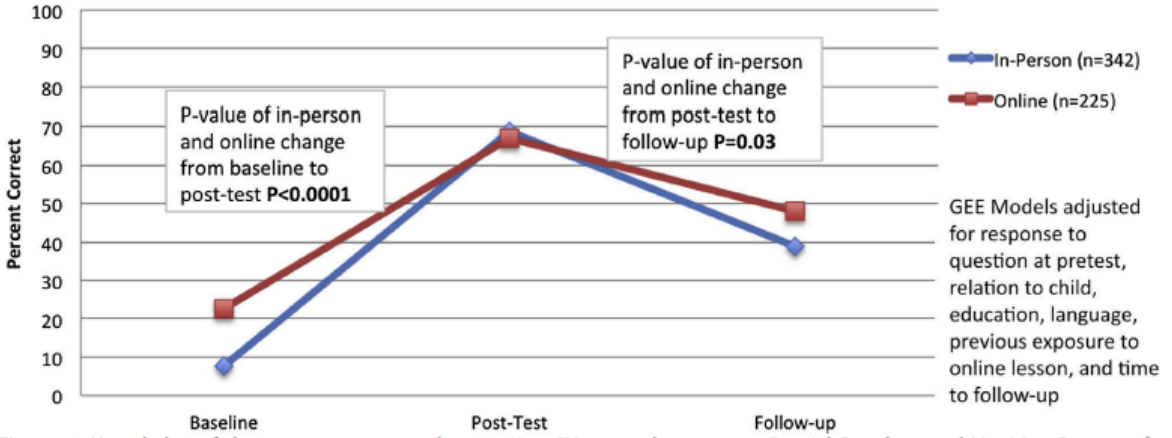


**Figure 1.** Knowledge of the correct answer to the question, "How much sugar can Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) cereal have per serving?" after taking the WIC breakfast lesson, by in-person and online nutrition education group (N=581). Generalized estimating equation (GEE) models adjusted for response to question at pretest, relation to child, education, language, previous exposure to online lesson, and time to follow-up.

494 JOURNAL OF THE ACADEMY OF NUTRITION AND DIETETICS March 2016 Volume 116 Number 3

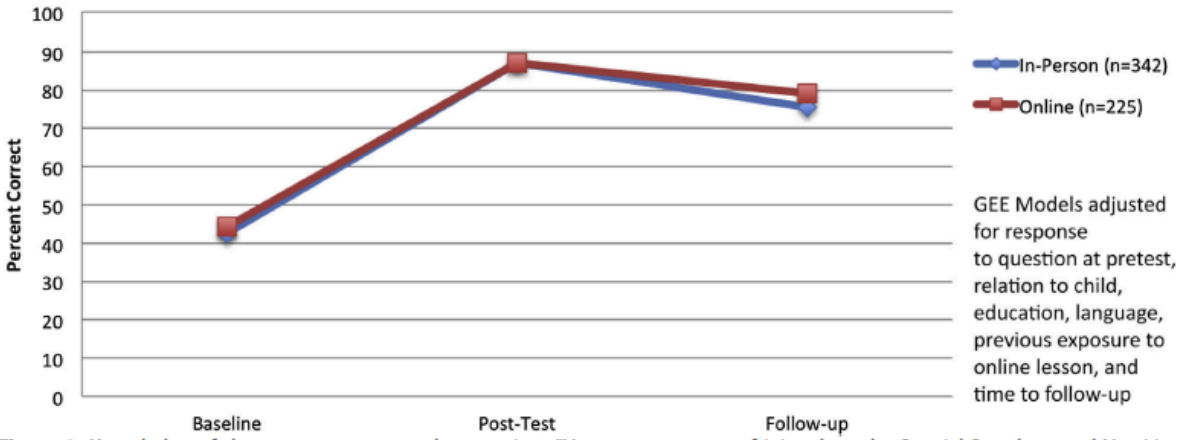


**Figure 2.** Knowledge of the correct answer to the question, "How many ounces of juice does the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) recommend per day?" after taking the WIC breakfast lesson, by in-person and online nutrition education group (N=581). Generalized estimating equation (GEE) models adjusted for response to question at pretest, relation to child, education, language, previous exposure to online lesson, and time to follow-up.

*Aim 2. Salt Study*
The salt class was innovative because no studies have assessed the impact of salt education on low-income women in WIC. At the start of the class participants were asked if they knew how much salt they consumed and knew about hidden salt in foods. Reasons were presented for limiting salt intake. Visuals such as food models and photos were used to teach participants to read food labels and identify high sodium foods. The group in-person lesson concluded with a group discussion focused on improving self-efficacy. Participants discussed challenges and each participant set goals related to limiting sodium intake using strategies from a handout titled, "What can you do to reduce your salt?"

Of the 514 WIC participants, 257 (50%) participated in the in-person education 257 (50%) were in the online education group. The majority were Hispanic (88.1%) and about half (53.9%) spoke Spanish as their primary language. A majority had graduated from high school (63.6%). Positive changes in knowledge and self-efficacy were retained 2-4 and 9 months later for both groups ($P<0.05$). Both groups reported significant changes in behaviors related to using less salt in cooking ($P<0.0001$) and eating fewer foods with salt added at the table or during cooking ($P<0.001$) at 2-4 and 9 months. Results from this study are currently in press.[13]

*Aim 3. Satisfaction Study:*
Of the 1,170 participants, 653 (56%) participated in the in-person education and 517 (44%) were in the online group. The majority were Hispanic (84%) and mothers (97%). Most (67%) were 35 years old or younger.[14]

Participants were highly satisfied with their education, with online participants showing slightly higher satisfaction than in-person participants. In-person participants were more likely to report sharing findings from their class with others compared to online participants. Immediately following the class and at 2-4 months follow-up, the online group reported a stronger preference than the in-person group for online delivery. While these differences were statistically significant, it is clear that both groups were highly satisfied and very likely to share what they learned with others.

More Spanish speakers than English speakers were satisfied with the class regardless of mode of delivery. Within the in-person group, Spanish speakers had a stronger preference than English speakers for in-person nutrition education for their next WIC class at post-test and follow-up. Within the online group, there was no difference between Spanish and English speakers on preference for modality of nutrition education at post-test or follow-up.

At follow-up, an additional question was asked to participants in the salt intervention regarding their preference for how they would like to receive future education (n=577): online, in-person, or combination of both. A majority in both the online (45%) and in-person groups (53%) preferred a combination of online and in-person delivery of nutrition education. Within the in-person group, more Spanish than English speakers preferred in-person education (33% vs. 11%); no difference was observed by language within the online group.

Compared to participants who took the online breakfast class (for whom a training video was not available), substantially fewer participants (15%) who took the online salt class reported issues

with logging in/finishing the class, a 19% reduction. The majority (88%) of online salt participants (n=162) reported that the video was very helpful. There were no differences in reported difficulty with accessing the online class by language groups. For more detailed results, see Au et al.[14]

**Yale: LATCH - Lactation Advice thru Texting Can Help**

*Background*

The LATCH study randomly allocated 174 women receiving prenatal care in four WIC clinics in Connecticut to the standard breastfeeding peer counseling program (control group, N=80) or to an enhanced program scheduled to receive prenatal, perinatal and postnatal breastfeeding promotion and support (intervention group, N=94). Text messages were developed based on the Health Action Process Approach (HAPA) framework. The primary outcome was exclusive breastfeeding (EBF) at 2 weeks and 3 months postpartum and the secondary outcome was time-to-contact between study participants and their breastfeeding peer counselor (BFPC). The field work for the LATCH study was conducted from August, 2014 to January, 2016 and it was registered at clincicaltrials.gov prior to the start of recruitment (#NCT02214849). The goal of this draft report is to provide an update on the key findings and lessons learned from LATCH.[15]

*Study population.* Eligible participants were pregnant women 18 years of age or older who attended the breastfeeding peer counseling program (BFPC) at one of four WIC sites in Connecticut. Women were recruited if they were 28 weeks gestation or less, expressed the intention to breastfeed, were carrying a singleton fetus, and who had unlimited text messaging on their mobile phone plans. Women were excluded from the study if they had a miscarriage, gave birth prematurely (< 37 weeks gestation), withdrew from the BFPC program, or were carrying multiple fetuses. Participants were excluded once their baby was born if the baby weighed less than 5 pounds, spent more than 3 days in the neonatal intensive care unit, or if medication given to mother or baby precluded breastfeeding.

*Sample characteristics by study group*. Control and intervention group participants had very similar socio-economic, demographic, motivational and biomedical characteristics at baseline indicating that the randomization procedures worked. Women were on average 26.8 years old, had an average pre-pregnancy BMI of 28.0, and 40.8% were first time mothers. Women planned to breastfeed for an average of 9.3 months, 74.7% identified as Hispanic, 67.1% preferred to speak English, 69.4% were living with a partner; 39.2% had less than high school, and 47.9% were receiving SNAP benefits. The later was the only descriptive variable that was significantly different between groups (56.7% in the intervention vs. 38% in the control group). Women within the intervention and control groups were equally distributed across study sites. Finally, there were no between group differences in infant's age at the "two-week" interview (20.3±10.0 vs. 20.7±12.3 days old) in the control and intervention groups, respectively (p=0.82).

*Procedure.* Participants were recruited, consented, and enrolled in LATCH by their BFPC. Each participant completed an intake survey with their BFPC and upon completion received an automated text message from the Mobile Commons (MC) web based two-way text messaging platform, indicating that they had been enrolled. Each was then called by a bilingual bicultural research assistant trained in conducting telephone interviews. Participants were asked to complete their baseline interview over the phone and upon completion were randomized to the intervention or control group. Participants in the intervention arm received the standard of care BFPC program + the SMS intervention (described below). Those in the control arm received the standard of care BFPC program. The peer counselors used the MC platform to monitor and interact with study participants through SMS prenatally and up to 3 months postpartum. Follow-up interviews were conducted by a trained bilingual bicultural interviewer who was blind to study condition at approximately 2 weeks and 3 months post-partum. Participants received $10

for their baseline interview, $10 for their 2 week interview and $25 for their 3 month follow-up interview (study instruments are attached in Appendix 4).

*Sample size*. We originally planned to enroll 125 mothers to the texting intervention and 125 mothers as controls, expecting to detect a 20% difference in exclusive breastfeeding between the control and texting arms, with 89% power. A sample size of 250 was estimated to be sufficient to account for mother-infant pairs that may be excluded from the study due to prolonged neonatal ICU stay, prematurity, unresponsiveness to introductory text, relocation or lost to follow-up (e.g. new phone number). Based on our ongoing pilot study the non-participation rate was assumed to be 10%, however, this rate was underestimated. Of the 212 women randomly assigned to the intervention and control groups prenatally, 174 were included in the post-partum phase of the study and of these we were unable to reach 47 women, yielding an analytical sample of 127 women. Thus, the follow-up rate at two weeks post-partum was 73.0% (127/174) suggesting that non-significant findings need to be interpreted with caution. A comparison of 6 socio-economic and demographic characteristics (ethnicity/race, parity, marital status, education, income SNAP) and group allocation showed that women lost to follow up were significantly more likely to have at least high school education compared with women who stayed in the study (72% vs. 55%, p=0.045). There were no significant difference for any of the remaining 6 variables included in the drop out bias analysis including group allocation (59% among drop outs vs. 52% among those remaining study were in intervention group, p=0.515).

*Study sites and staff*. Four WIC BFPC sites in Connecticut participated in the study representing a teaching hospital, a federally qualified health center, and two community-based agencies all serving low-income and minority women. Four of the seven BFPC's were part time and three were full time. Two of the IBCLC's were full time and one was part time at two different study sites.

A total of seven BFPC's and three Internationally Board Certified Lactation Consultants (IBCLC's) that agreed to participate were trained on the LATCH study protocol in a half-day training in May of 2014. During the training, IBCLC's and BFPCs were provided with step by step instructions on the use of the Mobile Commons (MC) two-way texting platform and on how to screen for potential participants. On-site and/or telephone based support was provided by LATCH research staff during the study implementation to help with technical issues that were challenging at the beginning (e.g., training BFPC s on how to switch texting protocols from prenatal to postnatal phase). Supervision was also provided by study staff throughout study implementation to support fidelity of implementation of text messaging protocols. Overall, BFPC's and IBCLC's accepted the MC system, which was very stable the vast majority of the time. However, as indicated below there were issues related to the part time staffing coverage that most of the sites had, preventing them from responding in a timely manner on several occasions to a text messaging query or request.

*Text messaging platform*. SMS messages were sent to intervention participants through the HIPAA-compliant Mobile Commons platform. Messages designed for each trimester of pregnancy and up to three months postpartum were sent automatically by the MC platform using a pre-determined schedule. The platform recorded when the messages were sent, whether they

were received by the participant, and all message exchanges between participants with their BFPC.

*Intervention.* In addition to the standard of care breastfeeding peer counseling program, intervention participants received a series of text messages during the prenatal and post-partum period sent according to a predetermined schedule that varied in message frequency over time. Text messaging was researcher-initiated with the first text sent automatically after intake to confirm participation. Messages were sent approximately three times per week from the time of randomization up to 20 days before the expected due date, at which point messages were sent daily until the baby was born. During the first two weeks postpartum five messages per day were sent during days 1 to 4, four messages per day during days 5 and 6, and three messages per day for days 7 to 14. During weeks three to twelve postpartum 1 to 3 messages were sent per day with the number diminishing to one per day by the end of the 3-month postpartum period.

*Message design and content.* Messages were designed to address action self-efficacy and action planning in the prenatal period and maintenance and recovery self-efficacy and coping planning in the postpartum period. Self-efficacy messages were designed to improve participants' confidence in their capability to initiate breastfeeding (action self-efficacy), continue breastfeeding in the face of barriers and setbacks (maintenance self-efficacy), and begin breastfeeding again if they have stopped (recovery self-efficacy). During the prenatal period messages focused on acquiring self-efficacy through images (e.g., videos and photos of proper positioning) and/or verbal persuasion (e.g., text message conversations with BFPC). In the post-partum period self-efficacy was reinforced through direct or mastery experience and verbal persuasion.

The text messages protocol was based on the HAPA framework. Prenatal and peripartum text messages built upon those developed during the pilot project that preceded this study and were expanded upon to cover up to three months postpartum. Message content covered the benefits of breastfeeding for mother and child, debunked breastfeeding myths, showed examples of proper positioning, explained how to tell if baby is getting enough milk, and reinforced the BFPC's supportive role. Messages were developed with feedback from BFPC's and IBCLC's and included both SMS and MMS message types. MMS messages included links to pictures, web-pages, and videos all accessed via the mobile browser. Next, messages were mapped to the constructs of the HAPA model through an iterative process among the study's investigators. This process was designed to ensure that a relatively equal number of SMS messages addressed the core constructs of the HAPA model (i.e., self-efficacy, action planning and coping planning). Messages emphasized the positive aspects of engaging breastfeeding (vs. the negative aspects of not engaging with it). Text messages were translated into Spanish and all MMS content was obtained in Spanish as well. Finally, messages were tailored, addressing each participant by her first name and were periodically signed with the peer counselors first name.

*Measures and Outcome Variables*

The primary *dependent* variable of interest was exclusive breastfeeding status (EBF vs. partial breastfeeding) at 2 weeks and 3 months postpartum. EBF was defined following the WHO definition which indicates that EBF allows for an infant's consumption of breast milk only, no

other liquids (not even water), allowing only for token amounts of medical fluids. To assess breastfeeding status we used a modified version of the breastfeeding status question from the Infant Feeding Practices Study II (IFPS II) neonatal questionnaire (see Appendix 4).

The secondary outcome was the timing of first postpartum contact between mother and BFPC. Women were asked "how soon after your baby was born were you in touch with your peer counselor? (1) immediately after your baby was born; (2) Within 48 hours after delivery; (3) Within 1 week of delivery; (4) Within 2 weeks of delivery.

*Results*

Impact findings showed that LATCH had a strong and significant impact on facilitating early contact between the mother and her BFPC and this finding was seen across study sites, although the within clinic differences were not always statistically significant due to limited statistical power for the within site comparisons.

At 2 weeks postpartum LATCH had a small effect on EBF in the expected direction although it was not statistically significant (EBF difference between intervention and control group = 6.1%, p=.497). Effect modification analyses showed large effect size differences as a function of study site (EBF at 2 weeks: 47.1% (intervention group) vs. 33.1% (control group) in study site 1; 40% vs. 53.3% in study site 4, no or opposite effect in remaining 2 sites), level of maternal education (64.5% vs. 39.4% among those with less or more than high school; no impact among those with high school), income (78.5% vs. 45.5% among those with higher incomes; no difference among those with lower incomes), ethnicity (58% vs. 43.2% among Hispanics; no impact among non-Hispanics); English speaker (53.7% vs. 35.3%; no impact among Spanish speakers); planning BF for > 6 months (56.8% vs. 44.1%; no impact among those planning to BF < 6 months); pre-pregnancy BMI (63% vs. 43.55 among those underweight or with BMI in normal range; no impact among those overweight/obese). Because the study was not powered to test for interactions (i.e., effect modification) it is not surprising that most of these effect modifications were not statistically significant. However, collectively they strongly suggest that women who were socio-economically better off (i.e., a monthly income > (vs. < $1000)) and more motivated to breastfeed were the ones that benefitted from LATCH. To test this hypothesis we developed a "potential LATCH benefit" additive score based on adding the presence of three indicators that are readily available to WIC providers: pre-pregnancy BMI (underweight/normal); language preference (English); and planned BF duration (planning BF for > 6 months). One point was added for the presence of each indicator, thus the score ranged from 0 to 3 points. As expected there was a strong differential impact of the intervention among those with the highest possible score compared with those with less potential to benefit from the intervention. It is also important to note that a within-intervention group analysis showed that those who engaged more with the MC two-way texting platform were also more likely to be EBF by two weeks postpartum.

At 3 months post-partum there was no impact of LATCH on EBF (30.6% (N=67) vs. 32.8% (N=62), respectively (p= 0.851) or any BF (74.6% (N=67) vs. 71.0% (N=62), respectively (p=0.694). In contrast with the 2 week findings there was no significant effect modification by any of the independent variables and EBF at 3 months pp.

Overall, the text messaging protocols were successfully implemented although the partial BFPC coverage in most clinics sometimes posed a challenge with regards to a prompt response to mothers. There was a greater intensity of engagement (defined as the total number of two-way text messaging conversations) during the prenatal period (range: 0-15; mean ± SD: 5.48 ± 3.5) than during the first two weeks post-partum (range: 0-11; mean ± SD: 3.70 ± 2.5). It is noteworthy that during the prenatal period 54 out of 94 participants (57.4%) exchanged at least 4 two-way text messages with their BFPC. These participants were considered to have a "high intensity of engagement." The text messaging data of the 54 high-intensity of engagement participants was qualitatively analyzed to determine domains, themes, and sub-themes during the prenatal and postpartum periods. Four main domains were identified: (1) the mechanics of breastfeeding; (2) social support; (3) baby's nutrition; and (4) BFPC's maintaining contact with participants. During the first two weeks post-partum the same four domains were identified, although as expected, specific content of the themes differed from the prenatal period.

Overall BFPCs reported that mothers understood and liked the text messages. The main concern identified by BFPCs was that when the automated messages were signed with the BFPC's name, it was sometimes confusing for the mother; she did not know whether she was receiving an automated or a real-time message from her BFPC. This was particularly frustrating to mothers when it happened that they had recently sent a query to BFPC and later on would receive a message signed by the BFPC with information that had nothing to do with the mother's query. Future LATCH-like applications should develop a texting system that helps the user to clearly distinguish between real time vs. automated text messages.

The study was not designed to test the sustainability of LATCH. However, feedback from the state WIC coordinator as well as the IBCLC's and BFPCs strongly suggests that Connecticut would consider adopting LATCH provided the issue of partial coverage with BFPC s is addressed.

## UC-Davis: Supporting Baby Behavior Through Pediatric Offices

In 2010-2011, California A WIC initiated a statewide Baby Behavior Campaign. In an effort to develop consistent messaging for WIC participants related to infant behavior, this project tested low-cost video trainings and tools targeted to medical staff in pediatric clinics serving low-income families, including WIC mothers, in order to support ongoing Baby Behavior education for WIC participants. The intervention was comprised of 2 components: training for Health Care Providers (HCP) and medical staff in clinics who see WIC enrolled pediatric patients, and WIC participant education. HCP and staff completed a one-hour video-based training. The content of the training builds providers' knowledge and skills to support WIC parents' recognition and understanding of common healthy infant behaviors that may be misinterpreted by parents. The education is based on an established evidence base related to normal physiology of infants. After completion of the intervention trainings, health care providers and medical staff were asked to use what they learned with the mothers of infants in their care. Short visit-specific handouts for mothers were provided as tools to reinforce the verbal education.

Online surveys were used at baseline, midpoint, and endpoint to assess the intervention's influence on HCP and medical staff members' knowledge, use of Baby Behavior messages and materials, and their comfort level with topics covered in the Baby Behavior intervention. Questionnaires can be found in Appendix 5. Providers and staff in the intervention group were also asked to complete a training evaluation after watching both videos. A subgroup of HCP in both groups voluntarily participated in group or individual interviews by phone and/or during site visits to provide further information about their environments, additional constraints, and the context for the intervention.

Additionally, information about mother and WIC enrolled infant anthropometry, infant-feeding practices, and Baby Behavior content shared during each well-baby contact was obtained from participating clinics. Online surveys of WIC participants were used assess knowledge transfer, acceptance, and feasibility of message delivery as well to evaluate the added value of provider education versus WIC-only Baby Behavior messages for participants.

The majority of the participating HCPs indicated that the training was well organized, included new information, and would likely to result in changes in their practice.

While all of the HCP agreed or slightly agreed that the messages would be useful to their patients' parents, 73% agreed or slightly agreed with the statement that they already talked about the topics with patients. Just under half agreed or slightly agreed that the training was too long. However, nearly 80% indicated that they would like additional training.

Nearly all of the providers agreed or slightly agreed that the handouts were age appropriate (96%), well organized (96%), and engaging (94%), and their use would make it easier to share the study messages (91%). However, some of the providers agreed or slightly agreed that the handouts were too long (42%) and not likely to be useful in their practice (28%). Suggestions for improving the videos included reduction of repetitive sections and the addition of vignettes of realistic examples of the use of the messages during well-baby contacts. One provider stated that he disagreed with some of the video content related to expectations for sleep duration.

A series of 8 questions were asked to assess providers' retention of the video content at midpoint, total scores (out of 8) were 5.5 vs. 4.9 in the intervention and control groups, respectively. Scores in the final survey were higher in both groups, 6.9 vs. 5.7 in the intervention and control groups, respectively. These differences were not significant; a sample size of over 105 doctors would be required to detect a similar effect size between groups.

Providers were asked a series of questions about their use of the messages with parents during the well-baby contacts. While there were no differences between groups at baseline in the subjects of parents' questions or topics discussed during the appointments, at endpoint, providers in the intervention group were more likely than those in the control group to address study specific topics such as calming crying infants, reasons babies cry, infant fussiness, and the range of infant cues. Providers in the intervention group were also more likely to discuss how parents determine if the baby was getting enough to eat and common feeding frequency ($P < .05$), compared to the providers in the control condition clinics.

Although some of the providers lost confidence in their ability to talk about Baby Behavior between the training and the midpoint survey, confidence scores had increased to nearly post-training levels by the endpoint. There was also a sharp increase in the proportion who reported that the Baby Behavior messages were easy to share. At endpoint, more than 80% of providers in the intervention group reported that they thought the handouts were helpful for parents and nearly all (97%) agreed or slightly agreed that learning the messages seemed to reduce parents stress. More than 90% of these providers also agreed or slightly agreed that the study messages empowered patients to make more informed infant-feeding decisions.

Providers in both groups were asked a series of questions about their infant feeding recommendations offered during well-baby contacts. While recommendations for the duration of exclusive breastfeeding or the age at which solid foods should be introduced did not differ between groups, a higher proportion of providers in the intervention group reported at midpoint that they would never recommend cereal be put in the bottle (81 vs. 63%, intervention vs. control, respectively, $P < .05$). There were no differences between groups on referrals for breastfeeding services.

Data were collected from WIC participating women prenatally at enrollment and at 5 time points postpartum using online surveys. Mothers were asked to report what topics were covered during the office visits. There were no significant differences in the frequency of topics discussed. Both groups reported cues, crying and sleep topics were covered in their visits. Mothers were also asked to rate their relationships with the providers as well as their experience in the doctors' office. There were no significant differences between groups in ratings of either the office visit or their relationship with the providers at any time point.
There were no differences between groups in infant feeding, growth, or development outcomes. Mothers in the intervention group had higher self-efficacy scores at the 1 week visit. However, there were no other differences found between groups in maternal self-efficacy, depression indicators, or stress. At this time, it is not known if a larger sample of mother-infant dyads would have yielded different results. As a follow-up to this work and to increase our sample size, we have requested and are in the process of obtaining infant feeding and growth information from redacted medical records from 14 of our 16 clinics.

## WPU-NJ: Online WIC Nutrition Education to Promote Farmers' Market Fruit and Vegetable Purchases and Consumption

The outcome evaluation to assess lesson effects on F/V intake and farmer's market nutrition program (FMNP) voucher redemption immediately following and 3 and 6 months after the lesson in a randomized four-arm design (new lesson, new lesson + FMNP vouchers, existing online health education, existing online health education + FMNP vouchers) was conducted under Aim 2 of the project as summarized below.[16]

*Questionnaires/Variables Measured*

At pretest, the following socio-demographic variables were measured: date of birth, pregnancy status, due date (pregnant women), breastfeeding status, race, ethnicity, nativity, preferred language, language(s) spoken at home, marital status, educational attainment, educational attainment of spouse or partner, number of children in the household under age 19, number of children in the household between 2 and 5 years of age, number of other adults in the household, employment status, and participation in assistance programs. Validated measures of food security status and social desirability also were administered (Appendix 6).

Assessed at pretest, posttest, and 3- and 6-month follow-up, outcome measures were knowledge of the FMNP and WIC-authorized farmers' markets, attitudes towards farmers' market F/Vs, awareness of locally grown seasonal F/Vs, farmers' market F/V purchases (ever purchased F/Vs at a farmers' market, purchased F/Vs at a farmers' market in the past two weeks [and among those who recently purchased F/Vs at a farmers' market, whether this was their first time at a farmers' market, whether they asked farmers if they accept FMNP vouchers and cash value vouchers (CVVs), and whether they paid for their paid for F/Vs with FMNP vouchers and CVVs, respectively] and intentions to purchase F/Vs at a farmers' market in the next two weeks), F/V food safety skills, farmers' market asking and F/V preparation skills, and positive outcome expectations for consuming locally grown F/Vs (measured using instruments developed for the study). The frequency and quantity of F/V intake were assessed with validated instruments. Frequency of intake was measured using the F/V module of the 2013 Behavioral Risk Factor Surveillance System questionnaire. Quantity of intake was measured with a 2-item screener developed by the National Cancer Institute. Voucher redemption was assessed using data provided by local and state WIC agencies on vouchers issued to and redeemed by participants.

Process measures included lesson dose (data recorded by research assistants [RAs] and tracked through the website on the number of lesson modules and activities participants completed [a total of three each for the new lesson and one each for existing online health education lessons]), distractions, if any, experienced during lesson play (recorded by RAs), participant self-report data on existing online lessons, if any, completed prior to the study, user satisfaction with the lesson received (ratings, on a 7-point scale, of the extent of enjoyment, interest in, and likelihood of recommending the lesson to other WIC participants), measures of new information learned from the lesson and talking to family and friends about new information learned, whether this was the first time completing an online WIC nutrition education lesson and the perceived novelty of the lesson. Among women who received the new lesson, measures of the following also were administered: what was remembered most about the lesson; what was liked and disliked about the lesson and what, if anything, could be done to improve it; transportation into the video narrative and identification with the characters; liking and learning from lesson activities; the activity that

was liked the most; the F/V the participant chose to learn a recipe about and whether the participant tried the recipe at home; and whether the participant opened follow-up emails sent after the lesson, watched the videos, and tried the recipes shown and the perceived helpfulness of the information provided. Among all participants, RAs collected information on the number screened, determined eligible/ineligible and enrolled/not enrolled (during recruitment), and follow-up calls made/completed, follow-up assessments scheduled/completed and problems, if any, encountered in reaching participants. Study questionnaires are appended as are publications describing instruments that were administered in the study. Papers describing instruments the investigators drew from in developing measures for the study also are appended.

*Results*

The following three variables differed by arm at baseline despite randomization: receiving assistance other than WIC, pregnancy status, and breastfeeding status. A fourth variable, social desirability trait, differed by arm among those who did not complete posttest and 3- and 6-month follow-up assessments (N = 51). A smaller proportion of those in the existing lesson arm were receiving assistance other than WIC (60%) than were those in the three other arms (between 72% and 73% across arms) ($p < .05$). Smaller percentages of women in new and existing lesson arms were pregnant (9% and 12%, respectively) than were those in new lesson + vouchers and existing lesson + vouchers arms (25% and 22%, respectively, $p < .01$). Similarly, fewer women in new and existing lesson arms were breastfeeding (16% and 15%, respectively) than were women in new lesson + vouchers and existing lesson + vouchers arms (28% and 25% respectively, $p < .01$). Among those lost to posttest and follow-up assessments, differences by arm were found in social desirability trait ($p < .05$). Social desirability trait was higher among those in the new lesson + vouchers condition (mean = 8.25 ± 1.29) as compared to those in the new lesson condition (mean = 6.55 ± 1.86). A small number of participants (91 or 12% of the sample) completed a previous WIC online lesson (most commonly, lessons on F/V and breastfeeding). The number of previous lessons completed did not differ by arm. These variables were controlled for in all further analyses.

Outcome Evaluation

1. **Hypothesis:** Women in the new lesson + FMNP vouchers condition will have higher F/V intake at posttest and follow-up measurements relative to women in the three other conditions.

   Using an intent-to-treat approach (i.e., all women analyzed as randomized regardless of their adherence to the protocol), three repeated measures of each outcome were entered into linear mixed-effects (LME) models. LME models generalize classical analysis of repeated measures and allow for data missing at random, so that data from all participants who completed at least one of three assessments (at posttest, 3-month follow-up, or 6-month follow-up) were used. Covariates in the LME models included the baseline value of the outcome, time (entered as a class variable to model a potentially non-linear pattern over time), covariates, condition, and a condition by time interaction to model the potentially changing effect of the experimental condition as time progressed. Differences in least square (LS) means and standard errors (SE) were output for each model, and differences among them by condition were tested at each time point.

Using a conventional level of statistical significance ($p < .05$), analyses revealed that F/V intake did not differ over time by arm. However, differences in F/V intake by arm were found using a probability level of $p < .10$. At 6-month follow-up, participants in the new lesson condition had a higher frequency of F/V intake (LS mean = 3.90, SE = .22) than participants in the existing lesson condition (LS mean = 3.78, SE = .23).

2. **Hypothesis:** Women who receive the new lesson will have higher F/V intake at posttest and follow-up measurements relative to women who receive existing online health education. Analyses were conducted using LME models as described above.

   Here too, using a conventional level of statistical significance ($p < .05$), F/V intake did not differ over time by lesson. However, when using a probability value of $p < .10$, we found that at 3-month follow-up, the frequency of F/V intake was higher among those in the new lesson condition (LS mean = 3.76, SE = .14) as compared to those in the existing lesson condition (LS mean = 3.46, SE = 14).

   Whether the absence of effects (by arm and by lesson) on F/V intake using a conventional level of statistical significance were due to weaknesses of the measures used to assess intake or a lack of intervention effectiveness is not known. Possibly, greater lesson exposures were needed to modify intake. We attempted to reinforce content with follow-up emails sent to participants one, two, and three months after the lesson. Of the 371 participants randomized to receive the new lesson, 302 (81%) reported having an email address and provided the address when registering on the website. Yet, of these 302 women, the percentages reporting having opened the emails sent were modest (33%, 16%, and 11%, respectively). As such, most were not exposed to materials designed to reinforce lesson content. Findings highlight the need to identify effective approaches for delivering follow-on content in longitudinal intervention trials.

3. **Hypothesis:** Women who receive FMNP vouchers will have higher F/V intake at posttest and follow-up measurements relative to women who do not receive FMNP vouchers.

   Here too, LME models were used.

   We expected that F/V intake would be higher among those who received FMNP vouchers as compared to those who did not (because receiving them would give women opportunities to purchase F/V at farmers' markets). Findings were in the opposite direction than was expected at 6-month follow-up, i.e., the frequency of vegetable intake and the frequency of F/V intake were significantly higher among those who did not receive vouchers (LS mean = 2.11, SE =.10) as compared to those who received them (LS mean =1.83, SE = .09), $p < .05$. The mean frequency of F/V intake also was higher among those who did not receive FMNP vouchers (LS mean = 3.85, SE = .17) as compared to those who received them (LS mean = 3.32, SD = .15).

   The higher F/V intake found at 6-month follow up among those who did not receive FMNP vouchers as compared to those who received them was surprising. Our analytic procedure of mixed modeling included dropouts under a missing at random assumption; yet, if this assumption was violated, estimates of effects could be biased. To evaluate the pattern of missing values due to attrition, we compared F/V intake at the last time point before attrition

by arm, lesson, and FMNP voucher receipt. F/V intake did not differ by arm or by lesson among dropouts, leading us to conclude that the success of randomization was not affected by attrition. With respect to FMNP voucher receipt, there were no differences in dropout rates, but some differences in F/V intake among dropouts approached significance. Among those who dropped out between 3- and 6-month follow-up assessments, the quantity of vegetable intake was higher among those who received FMNP vouchers (LS mean = 1.80, SE = 1.22) as compared to those who did not (LS mean = 1.49, SE = .98), $p < .10$. The frequency of fruit intake also was higher among those who received FMNP vouchers (LS mean = 1.82, SE = 1.53) as compared to those who did not (LS mean = 1.39, SE = 1.33), $p < .10$. Possibly, participants dropped out because they had used the vouchers and saw no reason to continue with the study. The problem is that the "received vouchers" condition lost participants with higher F/V intake at 3-month follow-up. This helps explain why at 6-month follow-up, F/V intake was lower in the "received vouchers" condition than it was in the "did not receive vouchers" condition (contrary to what was expected).

4. **Hypothesis:** The redemption of CVVs at farmers' markets will be higher among women who receive the new lesson relative to women who receive existing online health education.

   Preliminary analyses of CVV data revealed that a small proportion of participants redeemed their CVVs at farmers' markets. Differences in the rate of redemption between those exposed to new and existing lessons were therefore examined with cross tabulations and Fisher's exact test. This statistic is appropriate for contingency tables with low cell counts.

   Only 8 participants (1%) redeemed their CVVs at farmers' markets; seven received the new lesson and one received an existing lesson (Fisher's exact $p < .05$).

   Lesson effects on the redemption of CVVs at farmers' markets are important. Although the rate of redemption was low, it was higher than the rate among the small number of states reporting this information (< 1%). Anecdotally, we believe that the change was due to improvements in awareness that CVVs could be redeemed at farmers' markets (RAs noted that women who received the new lesson often reported that this was something new they learned from the lesson). In exploratory analyses conducted among women who answered the item "CVVs can be redeemed at farmers' markets (true/false)" incorrectly at baseline, we found that those in the new as compared to existing lesson condition were significantly more likely to answer the question correctly at posttest (OR = 3.89, 95% CI [2.40, 6.31]) and 3-month follow-up (OR = 2.25, 95% CI [1.29, 3.92]), $p < .01$. Corresponding percentages were as follows: 75% (new lesson) and 45% (existing lesson) responding correctly at posttest; 79% (new lesson) and 62% (existing lesson) answering correctly at 3-month follow-up.

5. **Hypothesis:** FMNP voucher recipients who receive the new lesson will have higher voucher redemption relative to those who receive existing online health education.

   Logistic regression analysis was used to relate the binary outcome of voucher redemption (yes/no) to the lesson received (new or existing).

Among FMNP voucher recipients, voucher redemption did not differ by lesson. However, exploratory moderator analyses revealed that Spanish language preference moderated lesson effects on FMNP voucher redemption among all FMNP voucher recipients as well as in the subset of foreign-born voucher recipients (all $p < .01$ for the lesson by language preference interaction). In the sample of FMNP voucher recipients, there was no lesson effect on voucher redemption among those not preferring to speak Spanish, OR = .97, 95% CI (.58, 1.60) whereas there was a positive effect of the new versus existing lesson on voucher redemption among those preferring to speak Spanish, OR = 2.08, 95%, CI (1, 4.35). The moderating effect of Spanish language preference was even more pronounced in the subset of foreign-born participants. While there was a negative lesson effect among those not preferring to speak Spanish (OR=.33, 95% CI [.11, 1.01]), there was a strong positive effect of the new versus existing lesson among those preferring to speak Spanish (OR=2.36 95%, CI [1.06, 5.27]).

The above findings led us to consider whether the differences were explained, in part, by differences in reactions to English- and Spanish-language versions of the lesson. The development of each was guided by focus groups during which barriers to purchasing farmers' market F/Vs (identified in focus groups convened during the grant-writing stage of the project) were presented. Participants were then asked who, among WIC participants, might endorse the different barriers, what might change each character's mind about shopping at farmers' markets, and whether the different characters in the lesson should know one another. English- and Spanish-speaking participants gave different responses to the first two questions. As such, the characters and storylines in English- and Spanish-language lessons differed. Interestingly, when we compared process data by version of the new lesson received, we found that those who completed the Spanish- as compared to English-language lesson had a stronger identification with the characters and were more likely to report having tried the recipe they learned at home. Participants could choose which version of the lesson to complete (English or Spanish). Most participants preferring to speak Spanish (70%) chose to complete the Spanish-language version. The stronger endorsements of this version of the lesson may explain the differences found. We will examine whether participants reacted differently to other aspects of English- and Spanish-language lessons once we finish coding participant responses to open-ended questions about the new lesson. As of March 31, 2017, when this report was produced, analyses are ongoing.

Process Evaluation

6. **Hypothesis:** Lesson effects on F/V intake and voucher redemption will be mediated by improvements in targeted knowledge, attitudes, and skills.

   Although we originally planned to examine lesson effects on intermediate outcomes only, we decided to also look at the effects of arm (lesson, lesson + FMNP vouchers, existing online health education, existing online health education + vouchers) on these outcomes. Analyses were conducted using LME models. For binary outcomes, the effects of arm and lesson were examined with logistic regression analysis. Mediation analyses were not performed owing to the lack of condition effects on FV intake and FMNP voucher redemption and the low CVV rate of redemption.

Differences by Arm

Significant differences by arm were found in knowledge of the FMNP and FV food safety skills at posttest and 3- and 6-month follow-up (all $p < .01$ and .05, respectively); farmers' market-specific knowledge at posttest and 3-month follow-up (all $p < .05$); familiarity with locally grown seasonal items at 6-month follow-up ($p < .05$); knowledge of seasonal items found at farmers' markets in July at posttest ($p < .05$); food-specific knowledge at posttest and 3- and 6-month follow-up (all $p < .05$); and farmers' market FV preparation skills at posttest ($p < .05$). Least square means and standard errors for measures of intermediate outcomes over time by trial arm are shown in Table 6.

Differences by Lesson

Significant differences by lesson were found in knowledge of the FMNP at posttest ($p < .01$); FV food safety skills at posttest and 3- and 6-month follow-up (all $p < .05$); familiarity with locally grown seasonal items at posttest and 6-month follow-up (all $p < .05$); knowledge of seasonal items found at farmers' markets in July at posttest ($p < .01$); food-specific knowledge at posttest and 3-month follow-up (all $p < .01$); and farmers' market FV preparation skills at posttest ($p < .05$). Least square means and standard errors for measures of intermediate outcomes over time by lesson are shown in Table 7.

Binary Measures

Differences by Arm

Significant differences by arm were found in knowledge of WIC-authorized farmers' markets at posttest and 3- and 6-month follow-up (all $p < .01$), ever having purchased FV at a farmers' market at 3-month follow-up ($p < .01$), and intentions to purchase FV at a farmers' market at posttest and 3-month follow-up (all $p < .01$). Odds ratios and 95% confidence intervals for measures of binary outcomes over time by trial arm are shown in Table 8.

Differences by Lesson

Significant lesson effects also were found in knowledge of WIC-authorized markets at posttest and 3- and 6-month follow-up (all $p < .01$) and intentions to purchase FV at a farmers' market at posttest ($p < .01$). Odds ratios and 95% confidence intervals for measures of binary outcomes over time by lesson are shown in Table 9.

7. **Hypothesis**: Receipt of more of the lesson will be associated with more favorable outcomes.

   LME and logistic regression models were used to examine whether receipt of more of the WFS lesson (as measured by whether all lesson modules and activities were completed [yes/no]) fostered more favorable outcomes. The models included FV intake, voucher redemption, and knowledge, attitudes, and skills as outcomes and the following explanatory variables: lesson dose, pretest measures of each outcome, and other covariates. The significance of the coefficient for the lesson dose variable was used to test the hypothesis.

Ninety-four percent of participants completed all modules and activities in the lesson they received. The most common reason for not completing a lesson was technical issues with lesson play. Dose-response effects were examined for intermediate outcomes found to differ by arm as described above. Food-specific knowledge was higher among those who competed all new lesson videos and activities at posttest and 3-month follow-up (LS mean = 10.44, SE = .12 and LS mean = 10.04, SE = .13, respectively) as compared to those who did not (LS mean = 9.85, SE = .26 and LS mean = 9.32, SE = .27, respectively). At posttest, those who completed all new lesson videos and activities were also more likely to be aware of WIC-authorized markets than were those who did not, OR = 2.72, 95% CI (1.16, 6.36).

Most participants completed all videos and activities, suggesting that fidelity to the protocol was high. Some technical issues could not be prevented (e.g., network server was down), whereas others occurred for unknown reasons (e.g., lesson froze, video restarted). Although the software developer was available to troubleshoot when problems occurred, we were not always able to resolve the issues. The developer beta-tested and debugged the lesson prior to release; however, there was insufficient time for internal testing by the investigators. Planning an earlier release date is therefore recommended in future projects of this type so that sufficient time can be allocated to such testing.

8. **Hypothesis**: User satisfaction with the lesson received will be higher among women who receive the new lesson relative to women who receive existing online health education.

   Item ratings on the measure of user satisfaction were averaged across the number of scale items (resulting in scores ranging from 1 to 7). A mean score $\geq 5.0$ was considered evidence of a high degree of satisfaction. Differences by lesson in the ratings were examined with analysis of covariance. Analyses were controlled for the aforementioned covariates.

   Among those in the new lesson condition, the mean satisfaction rating of 6.67 (on a 7-point scale) was above the a priori criterion defining a high degree of satisfaction (a score $\geq 5.0$) and was significantly higher than the mean rating found among those in the existing lesson condition.

   Though not among formal study hypotheses, we additionally examined differences, by lesson, in new information learned from the lesson, talking to family about new information learned, talking to friends about new information learned and the perceived novelty of the lesson. On measures other than perceived novelty (which did not differ by lesson), mean ratings were higher among those in the new as compared to the existing lesson condition.

   Among those receiving the new lesson, we also examined lesson effects on variables tied to the theoretical underpinnings of the program and the extent of liking and learning from lesson activities. The theoretical variables were transportation into the narrative (the extent to which participants were absorbed with the story being told in the lesson) and identification with characters (the extent to which participants perceived characters as similar to them), a factor shown to influence receptivity to messages conveyed by characters. Ratings on measures of transportation, identification, and liking and learning from lesson activities were above 5.0 on a 7-point scale. Of the activities included in the lesson, most participants (54%) reported liking the recipe activity most. Smaller and similar percentages liked the farmers'

market locator tool (25%) and the true/false questions about July F/Vs (22%). Of the foods participants could learn a recipe about (blueberries, yellow summer squash, or kale), most chose blueberries (48%). Slightly more than two-fifths of participants (44%) reported having tried the recipe they saw at home.

The new lesson was well received by participants. Quantitative ratings of user satisfaction, transportation into the lesson narrative, identification with characters, and the extent of liking and learning from lesson activities were uniformly high. The extent of liking of the recipe activity suggests that activities of this type may be particularly useful for improving knowledge of and skills in preparing F/Vs among women enrolled in WIC.

**Table 6.** Least square means and standard errors for intermediate outcomes over time by trial arm

| | Least square means and standard errors | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Posttest | | | | 3-month follow-up | | | | 6-month follow-up | | | |
| | WFS | WFS V | EHE | EHEV | WFS | WFS V | EHE | EHEV | WFS | WFS V | EHE | EHEV |
| Knowledge of the FMNP | **4.88 (.08)** | **5.07 (.07)** | **4.45 (.08)** | **4.85 (.07)** | **4.79 (.09)** | **5.07 (.08)** | **4.71 (.09)** | **5.01 (.08)** | **4.67 (.10)** | **5.11 (.09)** | **4.82 (.10)** | **4.90 (.09)** |
| Attitudes towards FMFV | 12.27 (.66) | 11.05 (.59) | 10.70 (.65) | 11.10 (.60) | 11.92 (.70) | 10.24 (.65) | 11.48 (.73) | 11.42 (.63) | 12.03 (.78) | 10.19 (.73) | 11.45 (.81) | 12.27 (.70) |
| FV food safety skills | **67.80 (.92)** | **68.47 (.82)** | **63.99 (.91)** | **63.49 (.84)** | **66.70 (.98)** | **66.58 (.91)** | **64.13 (1.01)** | **62.59 (.88)** | **69.11 (1.10)** | **66.44 (1.02)** | **66.13 (1.13)** | **65.23 (.98)** |
| FM-specific knowledge | **1.37 (.08)** | **1.65 (.07)** | **1.39 (.09)** | **1.51 (.08)** | **1.42 (.09)** | **1.75 (.08)** | **1.51 (.10)** | **1.63 (.08)** | **1.51 (.10)** | 1.69 (.09) | 1.35 (.11) | 1.68 (.09) |
| FM asking skills | .55 (.33) | .92 (.25) | .45 (.32) | 1.14 (.28) | .49 (.35) | .85 (.33) | 1.31 (.56) | .68 (.34) | 1.29 (.40) | 1.31 (.45) | 1.30 (.59) | 1.66 (.46) |
| Familiarity with LGSI | 2.81 (.05) | 2.82 (.04) | 2.70 (.05) | 2.67 (.04) | 2.79 (.05) | 2.86 (.05) | 2.76 (.05) | 2.75 (.05) | **2.81 (.06)** | **2.93 (.05)** | **2.80 (.06)** | **2.70 (.05)** |
| Knowledge of LGSI found at FM in July | **8.08 (.11)** | **8.22 (.11)** | **7.99 (.11)** | **7.80 (.10)** | 8.14 (.12) | 7.91 (.11) | 7.85 (.12) | 7.95 (.11) | 8.17 (.13) | 8.17 (.12) | 7.98 (.14) | 8.05 (.12) |
| Food-specific knowledge | **10.42 (.14)** | **10.31 (.13)** | **9.47 (.14)** | **9.33 (.13)** | **9.76 (.15)** | **10.11 (.14)** | **9.40 (.16)** | **9.31 (.14)** | **9.83 (.17)** | **10.01 (.16)** | **9.92 (.18)** | **9.44 (.15)** |
| Positive outcome expecta-tions | 2.91 (.03) | 2.93 (.03) | 2.86 (.03) | 2.88 (.03) | 2.85 (.03) | 2.92 (.03) | 2.92 (.04) | 2.90 (.03) | 2.95 (.04) | 2.97 (.04) | 2.97 (.04) | 2.96 (.03) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FMFV preparation skills | **72.50 (.02)** | **72.19 (.82)** | **71.72 (.91)** | **69.63 (.84)** | 73.06 (.98) | 72.33 (.90) | 72.53 (1.01) | 71.55 (.97) | 73.27 (1.09) | 72.99 (1.01) | 73.07 (1.13) | 71.40 (.97) |

WFS indicates WIC Fresh Start; WFSV, WIC Fresh Start plus vouchers; EHS, existing online health education; EHEV, existing online health education lesson plus vouchers; FMNP, farmers' market nutrition program; FM, farmers' market; FV, fruit and vegetable; LGSI, locally grown, seasonal items. Least square means and standard errors were derived from linear mixed effects models that controlled for baseline measures of each outcome and variables found to differ by arm at baseline and among those lost to posttest and follow-up measurements. Means highlighted in bold differ significantly from one another. Differences consistent with a priori hypotheses (WFSV > WFS, EHE, and EHEV) are reported. Knowledge of the FMNP: WFSV > EHE, EHEV (posttest); WFSV > WFS, EHE; WFS > EHEV (3-month follow-up); WFSV > WFS, EHE (6-month follow-up). FV food safety skills: WFSV > EHE, EHEV (posttest); WFSV > EHE, EHEV (3-month follow-up); WFS > EHE, EHEV (6-month follow-up). Farmers' market-specific knowledge: WFSV > WFS, EHE (posttest); WFSV > WFS, EHE (3-month follow-up). Familiarity with locally grown, seasonal items: WFSV > EHEV (6-month follow-up). Knowledge of locally grown, seasonal items found at farmers' markets in July: WFSV > EHEV (posttest). Food-specific knowledge: WFSV > EHE, EHEV (posttest); WFSV > WFS, EHE, EHEV (3-month follow-up); WFSV > EHEV (6-month follow-up). Farmers' market FV preparation skills: WFSV > EHEV (posttest).

**Table 7.** Least square means and standard errors for secondary outcomes over time by lesson

| | Least square means and standard errors | | | | | |
|---|---|---|---|---|---|---|
| | Posttest | | 3-month follow-up | | 6-month follow-up | |
| | WFS | EHE | WFS | EHE | WFS | EHE |
| Knowledge of the FMNP | **5.01 (.06)** | **4.69 (.06)** | 4.96 (.06) | 4.91 (.06) | 4.93 (.07) | 4.90 (.07) |
| Attitudes towards FMFV | 11.53 (.47) | 10.80 (.47) | 10.96 (.51) | 11.33 (.50) | 10.98 (.56) | 11.80 (.56) |
| FV food safety skills | **68.08 (.66)** | **63.65 (.66)** | **66.57 (.71)** | **63.20 (.71)** | **67.67 (.78)** | **65.54 (.78)** |
| FM-specific knowledge | 1.55 (.06) | 1.49 (.06) | 1.61 (.06) | 1.61 (.07) | 1.62 (.07) | 1.58 (.07) |
| FM asking skills | .82 (.21) | .87 (.23) | .72 (.24) | .86 (.30) | 1.38 (.30) | 1.60 (.36) |
| Familiarity with LGSI | **2.82 (.03)** | **2.69 (.03)** | 2.83 (.04) | 2.76 (.04) | **2.87 (.04)** | **2.74 (.04)** |
| Knowledge of LGSI found at FM in July | **8.15 (.08)** | **7.89 (.08)** | 8.02 (.08) | 7.91 (.08) | 8.17 (.09) | 8.02 (.09) |
| Food-specific knowledge | **10.36 (.10)** | **9.39 (.10)** | **9.93 (.11)** | **9.35 (.11)** | 9.92 (.12) | 9.65 (.12) |
| | 2.92 (.02) | 2.88 (.02) | 2.89 (.02) | 2.91 (.02) | 2.96 (.03) | 2.97 (.03) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Positive outcome expectations | | | | | | |
| FMFV preparation skills | **72.25 (.66)** | **70.52 (.66)** | 72.81 (3.58) | 73.65 (3.56) | 73.48 (4.01) | 73.77 (3.99) |

*WFS indicates WIC Fresh Start; EHE, existing online health education; FM, farmers' market; FV, fruit and vegetable; LGSI, locally grown, seasonal items. Least square means and standard errors were derived from linear mixed effects models that controlled for baseline measures of each outcome and variables found to differ by arm at baseline and among those lost to posttest and follow-up measurements. WFS and EHE means highlighted in bold differ significantly from one another.

**Table 8.** Odds ratios and 95% confidence intervals for binary outcomes over time by trial arm

| | Odds ratios, 95% confidence intervals, and p values | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Posttest | | | | 3-month follow-up | | | | 6-month follow-up | | | |
| | Arm against which WFSV arm is compared | | | | Arm against which WFSV arm is compared | | | | Arm against which WFSV arm is compared | | | |
| Outcome | WFS | EHS | EHEV | p | WFS | EHE | EHEV | p | WFS | EHE | EHEV | p |
| Knowledge of WIC-authorized FM | 1.85 (.95, 3.58) | **4.51 (2.42, 8.42)** | **2.44 (1.29, 4.62)** | < .01 | **2.25 (1.04, 4.90)** | **5.06 (2.40, 10.69)** | **2.18 (1.01, 4.71)** | < .01 | 1.50 (.64, 3.52) | **4.41 (2.00, 9.71)** | 1.53 (.68, 3.42) | < **.01** |
| Ever purchased FV at FM | 1.78 (.90, 3.53) | 1.06 (.52, 2.16) | 1.30 (.66, 2.58) | .29 | **8.69 (3.05, 25.00)** | **6.04 (2.05, 17.76)** | **3.36 (1.12, 10.04)** | < .01 | 1.65 (.60, 4.54) | 1.50 (.53, 4.24) | 1.05 (.37, 2.96) | .68 |
| Purchased FV at FM past 2 weeks | 1.07 (.58, 1.95) | 2.17 (1.14, 4.16) | 1.25 (.71, 2.21) | .09 | .81 (.39, 1.69) | 2.22 (.90, 5.46) | 1.07 (.52, 2.16) | .17 | .44 (.17, 1.13) | .68 (.24, 1.90) | .77 (.29, 2.03) | .35 |
| Intentions to purchase FV at FM | **2.91 (1.41, 6.02)** | **5.15 (2.57, 10.35)** | **2.02 (.97, 4.21)** | < .01 | **2.04 (1.10, 3.80)** | **2.34 (1.25, 4.41)** | **.98 (.51, 1.86)** | < .01 | .97 (.53, 1.77) | .96 (.51, 1.78) | 1.09 (.61, 1.92) | .97 |

*WFSV indicates WIC Fresh Start plus vouchers; WFS, WIC Fresh Start; EHE, existing online health education; EHEV, existing online health education plus vouchers; FM; farmers' market; FV, fruit and vegetable. Odds ratios and confidence intervals were derived from generalized linear mixed effects models that controlled for baseline measures of each outcome and variables found to differ by arm at baseline and among those lost to posttest and follow-up measurements. Odds ratios and confidence intervals indicate the likelihood of the outcome among those in the WFSV arm relative to the comparison group. Values highlighted in bold indicate a significant difference between the comparison group and participants in the WFSV arm. P values shown are for tests of the equality of odds ratios.

**Table 9.** Odds ratios and 95% confidence intervals for binary outcomes over time by lesson

| | Odds ratios, 95% confidence intervals, and p values | | | | | |
|---|---|---|---|---|---|---|
| | Posttest | | 3-month follow-up | | 6-month follow-up | |
| | WFS as compared to EHE lesson | p | WFS as compared to EHE lesson | p | WFS as compared to EHE lesson | p |
| Knowledge of WIC-authorized FM | **2.40 (.46, 1.29)** | < .001 | **2.10 (.27, 1.22)** | < .01 | **2.08 (.20, 1.27)** | < .01 |
| Ever purchased FV at FM | .86 (-.60, .31) | .53 | 1.04 (-.50, .58) | .88 | .89 (-.77, .56) | .75 |
| Purchased FV at FM past 2 weeks | 1.53 (-.00, .85) | .05 | 1.54 (-.10, .97) | .11 | 1.15 (-.51, .79) | .67 |
| Intentions to purchase FV at FM | **1.78 (.15, 1.00)** | < .01 | 1.01 (-.39, .42) | .94 | 1.04 (-.36, .45) | .83 |

*WFS indicates WIC Fresh Start; EHE, existing online health education; FM; farmers' market; FV, fruit and vegetable. Odds ratios and confidence intervals were derived from generalized linear mixed effects models that controlled for baseline measures of each outcome and variables found to differ by arm at baseline and among those lost to posttest and follow-up measurements. Odds ratios and confidence intervals indicate the likelihood of the outcome among those completing the WFS lesson as compared to an EHE lesson. Values highlighted in bold indicate a significant difference by lesson. P values are for tests of the equality of odds ratios.

*Adoption Outcomes (RE-AIM model)*

The online Breakfast and Salt Reduction lessons have been adopted by the PHFE WIC program in Southern California.

*Implementation Outcomes (RE-AIM model)*

Implementation outcomes are found in Table 10.

| **Table 10. Implementation Outcomes (RE-AIM model)** | |
|---|---|
| UC-NPI | Breakfast Lesson:<br>N=667 recruited; 590 completed pre, post, and 2-4 month follow-up (359 for the in-person class and 231 completed the online class) (88.5% retention).<br><br>Salt Reduction Lesson:<br>N=666 recruited; 514 completed pre, post, 2-4 month and 9-month follow-ups (257 for the in-person class and 257 completed the online class) (77.2% retention). |
| Yale | Text messaging was researcher-initiated with the first text sent automatically after intake to confirm participation. Messages were sent approximately three times per week from the time of randomization up to 20 days before the expected due date, at which point messages were sent daily until the baby was born. During the first two weeks postpartum five messages per day were sent during days 1 to 4, four messages per day during days 5 and 6, and three messages per day for days 7 to 14. During weeks three to twelve postpartum 1 to 3 messages were sent per day with the number diminishing to one per day by the end of the 3-month postpartum period.<br><br>Overall, the text messaging protocols were successfully implemented although the partial PC coverage in most clinics sometimes posed a challenge with regards to a prompt response to mothers. During the prenatal period 54 out of 94 participants (57.4%) exchanged at least 4 two-way text messages with their BFPC. These participants were considered to have a "high intensity of engagement." |
| WPU-NJ | Of those randomized to receive the new lesson, 87% completed all videos and activities as intended. Process data (notes taken by RAs on distractions, if any, experienced during lesson play) revealed that among those not completing all videos and activities (N = 48), the following distractions occurred (in descending order of frequency of mention): technical issues with lesson play (48%), participant had to leave for another appointment (21%), participant was distracted by children (21%), and participant had to leave because ride was waiting (13%). Note: percentages do not total to 100% because more than one distraction could be recorded. |
| UC-D | Approximately 82% of the providers randomly assigned to the intervention group watched the video training. Providers reporting using the study materials only with study participants (29%), with study participants and some others (36%), or with all parents (16%). About 19% never used the handouts even after receiving training and less than 10% utilized the video clips offered to illustrate infant behaviors. Administrative barriers were given as the most common reasons for not using the handouts or videos with parents. Technical issues also limited the use of the videos. |

*Maintenance Outcomes (RE-AIM model)*

Only The UC-NPI project was able to assess maintenance. Outcomes for the Salt Reduction lesson were assessed at 9 months post lesson. For both the in-person and online groups, there were significant reductions in the: frequency of eating at fast food and other restaurants at both follow-up time points; frequency of eating any food with salt added at the table or during cooking at both follow-up time points; and average frequency of eating from a list of 11 high-salt foods at the 9-month follow-up.

Based on between group comparisons, the online group reported greater improvements compared to the in-person group for: increasing self-efficacy for adding less salt to foods when cooking and adding no salt to foods at the table at 9 months; reducing the amount of salt added at table at 9-months; decreasing intake of pizza and any foods with salt added at the table or during cooking at 9-months; and decreasing eating at fast-food restaurants. The in-person group reported greater improvements compared to the online group for: increasing self-efficacy for reading the Nutrition Facts Label and adding no salt to foods at the table at 9-months.

**Objective 4. Sponsor and coordinate a workshop on observations and findings.**

A Workshop was convened on July 20, 2016, at the FNS office in Alexandria, VA. The agenda included presentations by the four grantees and their WIC partners on progress to date and lessons learned (Appendix 7). Other attendees included the CNRC WIC Center co-investigators and consultants, FNS staff, and guests. A Workshop Summary was prepared and is available on the Center website (https://www.bcm.edu/departments/pediatrics/sections-divisions-centers/childrens-nutrition-research-center/research/wic-nutrition-education).

**Objective 5. Provide FNS with an electronic copy of all published manuscripts resulting from the subgrants at the time of submission for publication and in final form when published.**

The FNS received copies of the presentations and published manuscripts. The list of presentations and published manuscripts to date can be found in Appendix 8.

**Objective 7. Disseminate findings.**

The final report will be made available via various websites and publications (Table 11).

Table 11. Dissemination Activities

| Posted on various websites-list serves |
|---|
| 1. USDA-FNS |
| 2. CNRC-BCM website |
| 3. The Foods and Nutrition SPECialists list serve (original audience was state and federal Cooperative Extension Service organizations). |
| 4. The Society for Nutrition Education and Behavior list serve: Sneeze_l@email.rutgers.edu |
| 5. The Salud America! Website (The RWJF Research Network to Prevent Obesity Among Latino Children is a national network of researchers, community leaders, policymakers, and other stakeholders. http://www.salud-america.org/join.html.) |
| 6. WIC State coordinators http://www.fns.usda.gov/wic/Contacts/ContactsMenu.HTM |
| 7. The National WIC Association (NWA). http://www.nwica.org/ |
| 8. Robert Wood Johnson Foundation Center to Prevent Childhood Obesity (no-reply@reversechildhoodobesity.org) |
| 9. Peer reviewed publications (See Appendix 8) |
| 10. Presentations (See Appendix 8) |

# RECOMMENDATIONS FOR COST-NEUTRAL APPROACHES TO IMPROVING WIC'S IMPACT ON NUTRITION EDUCATION AND AN APPROXIMATE ESTIMATE OF THE COST-BENEFIT ASSOCIATED WITH THE IMPACTS DESCRIBED

**Objective 6. Provide FNS with recommendations for cost-neutral approaches to improving WIC nutrition education efforts, including cost-benefit analyses.**

UC-NPI:

Use of online education enhances the WIC participant options for receiving nutrition education. Online education is a cost-neutral approach to delivering education that this study has demonstrated to be effective. Our examination of the cost of the development and implementation of online education and live education suggests that *developing* the lesson for the two forms has a similar cost. Both modalities require a parallel system of class development starting at basic development, then testing and finally finalizing the curriculum. A PHFE WIC nutrition education team of 2-3 individuals constantly reviews the literature and trends in nutrition topics to select topics of high interest to WIC participants. In fact, participants are often asked about the topics they would like to learn more about. Preliminary meetings lead to the selection of a topic and 2-3 learning objectives. The nutrition education team then gathers information from multiple sources, including USDA websites, journal articles and other WIC programs and develops a 20-minute class. This includes a lesson plan, a PowerPoint presentation, and attractive pictures and visuals to be used in the online class. A complete class is then tested live, first in English and then Spanish, with ~30 WIC participants and staff at 1 PHFE WIC site. A criteria list is used to assess that the class meets the learning objectives goals, and the presenter also asks participants for specific feedback about the content and usefulness of the class material. After testing, the materials are edited, finalized and produced for the 55 PHFE WIC sites. At the same time, the material is programmed into the PHFE WIC online system. As the content and usefulness of the material is established during the live testing phase, testing of the online lesson is done internally with staff unfamiliar with the class.

The significant differences in cost come from two areas that differ substantially between the two modalities. On the online education side, the architecture to deliver and support online education can represent a significant cost. Online education requires a platform/online system into which classes can be programmed. PHFE WIC has this architecture in-house due to a robust IT department with the capacity to write software supporting an online education platform. Thus, costs associated with hiring a consultant or firm to develop and manage a system were not incurred by PHFE WIC, nor does PHFE WIC have to pay another entity to use their online system and education modules. It is expected that most WIC agencies would not have the capacity to develop such a system internally so there would be costs associated with using another entity's online system. Overall, costs of the *development* of online education are somewhat higher than for developing live education.

On the live education side, the staff time needed to deliver live education is the significant cost. At PHFE WIC, classes are offered at all times when the WIC clinics are open, meaning one full

time position is required at every WIC site to deliver group education. At PHFE WIC, this position is often rotated between staff at each site such that multiple staff teach classes. Given that nutrition education is a central focus of the WIC Program, the costs associated with the delivery of this education are built into the program and are in fact a required use of the Nutrition Services Administration dollars allocated to each state and local agency. In terms of staff time, delivery of live education is more expensive than delivery of online education.

The outcome of this research is improving breakfast eating habits and salt-related behaviors through multiple modes of nutrition education. A cost-benefit analysis would examine the impact of these behavior changes on health outcomes, such as healthier weight, less hypertension, and less chronic disease. Such an analysis was beyond the scope of this study.

Yale:

Cost-effectiveness analyses were not conducted given the lack of statistically significant impacts of LATCH on EBF rates at 2 weeks and 3 months. However important costing information can be gleaned from LATCH. The Mobile Commons web based texting platform monthly fee was $2000. However only a small fraction of the capacity of the platform was used for this study and we estimate that with this fee the needs of the whole state of Connecticut could be met. Furthermore, we also concluded that 2 to 3 IBCLCs would be enough to oversee to platform exchanges to make sure that clients' requests are fielded on time by peer counselors. LATCH paid a rate of $25 per hour of peer counselor and $36 per hour of lactation consultant based on an estimated effort of 4 hours of BFPC's time per mom.

WPU-NJ

Because there was no significant increase in F/V intake in this feasibility study, we are unable to conduct a cost benefit analyses or provide recommendations for a cost-neutral approach for nutrition education on this topic at this time.

UC-D:

Because there were no significant differences between groups in our primary outcomes, we are unable to conduct a cost benefit analysis. However, because the modest costs of using the messages and materials are borne entirely by the health care providers, there is no cost of this potential intervention to the WIC program. Using general estimates of costs (proprietary cost information such as physician salaries was not available to us), we have estimated costs to a "typical" provider as follows.

The estimated cost per patient is $3.58. To calculate total cost per patient, both the training component and cost of the printed handouts were combined using the following assumptions:

1. Each pediatrician is paired with 1 medical assistant (MA) and each watch the 1 hour video training

2. Each pediatrician/MA pair sees 260 newborn patients per year (1 per week day)

3. Each patient attends 5 well-baby visits between birth and 6 months of age, receiving 1 single page, double-sided, color handout at each visit

Specifically, the training component was estimated to be $112.14 per pediatrician/MA pair assistant, based on the California-specific median and mean hourly wages, respectively, from the Bureau of Labor and Statistics, May 2015 (https://www.bls.gov/oes/current/oes291065.htm, https://www.bls.gov/oes/current/oes319092.htm). The costs of the handouts were estimated to be $0.63 each, based on printing estimates from the UC Davis printer.

## LESSONS LEARNED

UC-NPI:

Both in-person group and online education improved participants' nutrition knowledge, self-efficacy and behaviors. While some differences were noted between the two modalities of delivering nutrition education, they tended to be small. Providing a training video appears to help WIC participants with online access issues and preferences for online delivery increase after exposure. Taken together these findings suggest that online WIC nutrition education can be considered as a beneficial and a relatively inexpensive way to augment more traditional modes of delivery of nutrition education in WIC.

It is essential that the research community and WIC community partner in endeavors that examine the impact of WIC Program functions on participant behavior and health. At the same time, it is critical that research within the WIC setting not place undue burden on WIC program staff or WIC participants. WIC research partnerships require close collaboration and recognition that WIC sites have various limitations. WIC staff are not trained in research and data collection, thus studies need to provide data collection support and the funds that accompany these efforts. A strength of the current study is the examination of nutrition education in a real-world WIC setting, paired with funding that allowed for staff training and support for data collection.

Yale:

An important lesson learned from LATCH is that the two-way texting platform created demand or expectation from WIC mothers to have timely responses from their breastfeeding peer counselors (BFPC's) to the breastfeeding needs of their clients expressed via the text messages. For example, whereas LATCH was properly implemented in the sites with full BFPC coverage to meet the demand, this was not the case in the site that had a very part time BFPC coverage. Even though this may not be a cost-neutral recommendation (unless major increases in BF save enough dollars from less formula distribution), the LATCH experience confirms that it is important for WIC clinics who are interested in using the two-way texting platform as an adjunct tool for BFPCs to ensure that there will be sufficient coverage to respond with quality and in a timely manner to their clients' demand for BF support through the text messaging system. Together with the State Department of Public Health (which is the WIC administrator), the Yale team is exploring the possibility of developing and applying for a program evaluation grant to: a) estimate the two-way texting platform costs to cover the needs of all WIC clinics in the State, b) develop a statewide IBCLC network to oversee the quality of the text messaging system (content and process) and provide lactation management advice and support to BFPCs as needed , c) estimate the costs of the IBCLC structure needed as well as to fill the BFPC capacity needed to run the LATCH prototype effectively across the State, and d) estimate the impact and cost-effectiveness of the scaled-up LATCH model.

The study just completed with funding from FNS-Baylor will provide the preliminary costing data and projections for the whole State based on the actual salaries and time devoted to LATCH

by the IBCLCs and BFPCs in the four WIC sites that participated in the trial, taking into account time saved as a result of using the texting platform.

WPU-NJ:

The support of WIC agency representatives (at state and local levels) was vital to the success of the project. RAs were housed at the local WIC agency, affording them ongoing access to participants. WIC agency staff helped RAs reach participants who had moved or whose contact information had changed (provided them with contact information on file). We were able to speak with participants lost to follow-up when returning to the clinic for services. Some participant gift cards (mailed after telephone follow-up assessments) were returned undeliverable. Agency staff put flags in the computer system so that when the participants returned for services, the staff could give them their gift cards. The agency also devoted staff to the task of recording voucher numbers of FMNP vouchers and CVVs distributed to participants (918 FMNP vouchers and 21,656 CVVs in total). None of this would have been possible without the ongoing support of the Co-I from the local WIC agency. The Co-I from the state WIC agency also assisted by helping keep the project on track, e.g., by ensuring the timely reporting of data on the redemption of FMNP vouchers and CVVs issued to participants. Both Co-Is were advisory board members; as such, they were actively involved in all phases of the work.

UC-D:

Despite logistical challenges, our results indicate that a low-cost video-based training can be used successfully to inform and enable health care providers to deliver messages consistent with WIC education during well-child contacts. The training and materials resulted in changes in practice among our participating providers and study messages were shared within the time constraints of the appointments and without adversely affecting relationships with patients' mothers. However, the video trainings were considered too long by some and lacking in specific clinical examples. The age-specific handouts were considered to be useful and engaging but for some providers, too long or too similar to handouts they were already using to be of value. The video clips were rarely used, limited by the clinic environments and the appointment time constraints.

Having worked only with hospitals and hospital administration prior to the start of this project, we learned quickly that conducting research in outpatient environments included multiple levels of administrative approval, significant costs, and bureaucratic delays that we had not anticipated. Despite extending the period of clinic recruitment to 12 months rather than the 4 months initially planned, we were unable to locate and enroll as many clinics as intended. Administrative delays and limitations (including one participating organization prohibiting recruitment of women in their obstetric clinic) also resulted in our inability to reach our sample size for mother-infant dyads. Additional constraints such as staff turnover and inaccurate estimates of patient caseload by clinic staff members also resulted in barriers to achieving our recruitment goals. Despite intense efforts, including the addition of WIC clinics as recruitment sites and increasing the number of staff members dedicated to recruitment, barriers to recruitment remained. We are in

the process of obtaining redacted, retrospective data from electronic medical records of infants born within the intervention period. These redacted data will be used to augment the data collected directly from the study participants and used in ad hoc analyses.

Future studies would be best carried out in larger medical organizations where pediatric clinics are co-located with obstetric clinics. Obtaining approvals from the highest levels of management are necessary prior to the recruitment and enrollment of physicians. The time needed to obtain those approvals must be included in the study timeline. Another barrier that we faced was the allocation of the time needed for the medical assistants to participate. Our original approach was to more closely duplicate the efforts in California WIC where all of the staff were trained. Given that medical assistants were barred from providing education to patients in nearly all of our participating clinics, future studies could avoid this barrier by not including medical assistant training. However, other allied staff such as lactation consultants and/or health educators may benefit from training if they are present in the pediatric environments.

CNRC WIC Center

The major goal of the CNRC WIC Center was to develop and administer a competitive process to solicit, evaluate, and fund innovative WIC nutrition education sub-grants. The CNRC WIC Center successfully completed the goal and awarded funds to four researchers to develop and test innovative projects. As documented in this final report (and in the published papers), the grantees were successful in conducting their innovative pilot projects. Although statistical significance for major study outcomes was not obtained for three of the studies, these were pilot studies that documented feasibility and identified problems that need to be addressed in future studies.

This grant mechanism was designed to link university-based researchers with state and/or local WIC agency staff. As noted in the 'Lessons Learned' section, all the grantees reported that the support and collaboration with the state and local WIC staff was an essential component necessary for success. The researchers are continuing their collaborations with their WIC partners and will conduct future studies together to test innovative WIC nutrition education efforts and breastfeeding support to help at-risk participants achieve positive changes in dietary and physical activity habits, resulting in improved nutritional status and in the prevention of nutrition-related problems. The success of this collaboration model should encourage local and state agencies and researchers to establish partnerships for future research projects to enhance WIC nutrition education efforts.

## CITATIONS

1. Colman S, Nichols-Barrer IP, Redline JE, Devaney BL, Ansell SV, Joyce T. Effects of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC): A Review of Recent Research. Alexandria, VA: US Department of Agriculture - Food and Nutrition Service; 2012.

2. Coleman-Jensen A, Nord M, Andrews M, Carlson S. Household Food Security in the United States in 2010. Washington, DC: US Department of Agriculture - Economic Research Service; 2011.

3. Oliveira V. The Food Assistance Landscape: FY 2011 Annual Report. Washington, DC: US Department of Agriculture - Economic Research Service; 2012.

4. Institute of Medicine. Planning a WIC Research Agenda: Workshop Summary. Washington, DC: National Academies Press; 2011. Available from: www.fns.usda.gov/sites/default/files/HealthImpactsWIC_IOM.pdf.

5. Hager ER, Quigg AM, Black MM, Coleman SM, Heeren T, Rose-Jacobs R, et al. Development and validity of a 2-item screen to identify families at risk for food insecurity. *Pediatrics* 2010;126(1):e26-32.

6. Bandura A. Guide for constructing self-efficacy scales. In: Pajares F, Urdan T, editors. Self Efficacy Beliefs of Adolescents. Greenwich, CT: Information Age Publishing; 2006. p. 307-338.

7. Townsend M, Sylva K, Shilts M, Davidson C, Leavens L, Sitnick S. Healthy Kids Survey. 2011 [Accessed 2017 January 24]; Available from: http://chks.wested.org/about/

8. Walker D. Investigation of a dietary behavior questionnaire as a predictor of dietary sodium intake [Clinical Research Project]. Spokane, WA: Washington State University; 1996. Available from: https://research.libraries.wsu.edu/xmlui/handle/2376/3918.

9. Arcand J, Abdulaziz K, Bennett C, L'Abbe M R, Manuel DG. Developing a web-based dietary sodium screening tool for personalized assessment and feedback. *Appl Physiol Nutr Metab* 2014;39(3):413-4.

10. Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: The RE-AIM framework. *Am J Public Health* 1999;89(9):1322-7.

11. Dzewaltowski DA, Glasgow RE, Klesges LM, Estabrooks PA, Brock E. RE-AIM: Evidence-based standards and a Web resource to improve translation of research into practice. *Ann Behav Med* 2004;28(2):75-80.

12. Au LE, Whaley S, Rosen NJ, Meza M, Ritchie LD. Online and in-person nutrition education improves breakfast knowledge, attitudes, and behaviors: A randomized trial of participants in the Special Supplemental Nutrition Program for Women, Infants, and Children. *J Acad Nutr Diet* 2016;116(3):490-500.

13. Au LE, Whaley S, Gurzo K, Rosen NJ, Meza M, Ritchie LD. Evaluation of online and in-person nutrition education related to salt knowledge and behaviors among WIC participants. *J Acad Nutr Diet* 2017;[in press].

14. Au LE, Whaley S, Gurzo K, Meza M, Ritchie LD. If you build it they will come: Satisfaction of WIC participants with online and traditional in-person nutrition education. *J Nutr Educ Behav* 2016;48(5):336-342 e1.

15. Martinez J, Harari H, Segura-Pérez S, Goeschel L, Bozzi V, Pérez-Escamilla R. Impact of the Lactation Advice Through Texting Can Help (LATCH) trial on time-to-first-contact and exclusive breastfeeding among WIC participants. *J Nutr Educ Behav* 2017;[under review].

16. Di Noia J, Monica D, Sikorskii A, Cullen KW. Outcomes of a randomized controlled trial of nutrition education to promote farmers' market fruit and vegetable purchases and consumption among women enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). 2016;[submitted].