RESEARCH
Original Research

Evaluation of Online and In-Person Nutrition Education Related to Salt Knowledge and Behaviors among Special Supplemental Nutrition Program for Women, Infants, and Children Participants

Lauren E. Au, PhD, RD; Shannon E. Whaley, PhD; Klara Gurzo, MA; Martha Meza; Nila J. Rosen, MPH; Lorrene D. Ritchie, PhD, RD

ARTICLE INFORMATION

Article history:
Submitted 15 June 2016
Accepted 21 December 2016
Available online 9 February 2017

Keywords:
Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)
Salt
Education
Online
Behavior

http://dx.doi.org/10.1016/j.jand.2016.12.013

ABSTRACT

Background The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) differs from other federal nutrition programs in that nutrition education is a required component. WIC programs traditionally provide in-person education, but recently some WIC sites have started offering online education. Education focused on reducing salt intake is an important topic for WIC participants because a high-sodium diet has been associated with high blood pressure, and low-income populations are at increased risk.

Objective Our aim was to examine the impacts of traditional in-person and online nutrition education on changes in knowledge, self-efficacy, and behaviors related to reducing salt intake in low-income women enrolled in WIC.

Design Although a comparison of groups was not the primary focus, a randomized trial examining the impact of online and in-person nutrition education on participant knowledge, self-efficacy, and behaviors related to salt intake was conducted.

Participants/setting Five hundred fourteen WIC participants from three Los Angeles, CA, WIC clinics received either in-person (n=257) or online (n=257) education. Questionnaires assessing salt-related knowledge, self-efficacy, and behaviors were administered at baseline and 2 to 4 months and 9 months later from November 2014 through October 2015.

Results Positive changes in knowledge and self-efficacy were retained 2 to 4 months 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 to 4 months and 9 months.

Conclusions Both online and in-person education resulted in improvements during a 9-month period in knowledge, self-efficacy, and reported behaviors associated with reducing salt intake in a low-income population. Offering an online education option for WIC participants could broaden the reach of nutrition education and lead to long-term positive dietary changes.

J Acad Nutr Diet. 2017;117:1384-1395.

NUTRITION EDUCATION IS A REQUIRED COMPONENT of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), which serves 8 million low-income participants annually in the United States, a population at high nutritional risk.[1,2] WIC programs traditionally provide in-person education, but recently some WIC sites have started offering online education.

WIC online education services have been well received and have led to successful behavior change.[3-6] For example, a study of WIC participants in Michigan found that online education improved participant's fruit and vegetable intake more than traditional group education.[3] In addition, in a similar population of WIC participants in California, both in-person and online education were effective in reducing breakfast skipping and improving other breakfast-related behaviors.[5] With access to the Internet increasing rapidly in the United States,[7] and a more diverse WIC clientele, there is a need to explore innovative education methods that promote positive dietary-related outcomes.

The purpose of this study was to examine the impacts of in-person (delivered in a group format) and online nutrition education on changes in knowledge, self-efficacy, and behaviors related to salt intake in a sample of adult WIC

participants randomly assigned to mode of education. Salt was chosen as the lesson topic because it had not been taught before at participating study sites and studies have shown the potential adverse effects of high-sodium diets include high blood pressure,[8-12] heart disease,[13,14] and stroke.[15,16] To our knowledge, no studies have assessed the impact of salt education on low-income women in WIC. The hypothesis was that there would be positive changes from baseline to two end points in knowledge, self-efficacy, and reported dietary behaviors in both groups. The two end points were short-term (2 to 4 months) and longer-term (9 months) post nutrition education.

METHODS

Participants

A randomized trial examining the impact of online and in-person nutrition education on participant knowledge, self-efficacy, and behaviors related to salt intake was conducted. A random sample of qualifying participants, including equal numbers of English and Spanish primary speakers, was assigned to the online group. The sample was stratified because previous studies have shown different responses to questions related to WIC from English- and Spanish-speaking participants.[17-19] The remaining sample not assigned to the online group was assigned to the traditional in-person education group.

Participants scheduled to come to any of three Public Health Foundation Enterprises WIC study sites during November to December 2014, when the salt education class was to be normally taught in person, were included in the study. Exclusion criteria were age younger than 18 years; pregnant; unable to read English or Spanish; plans to not return to the WIC clinic during the subsequent 4 to 5 months; or no access to the Internet (via desktop or laptop computer or other mobile device, including smartphone). The

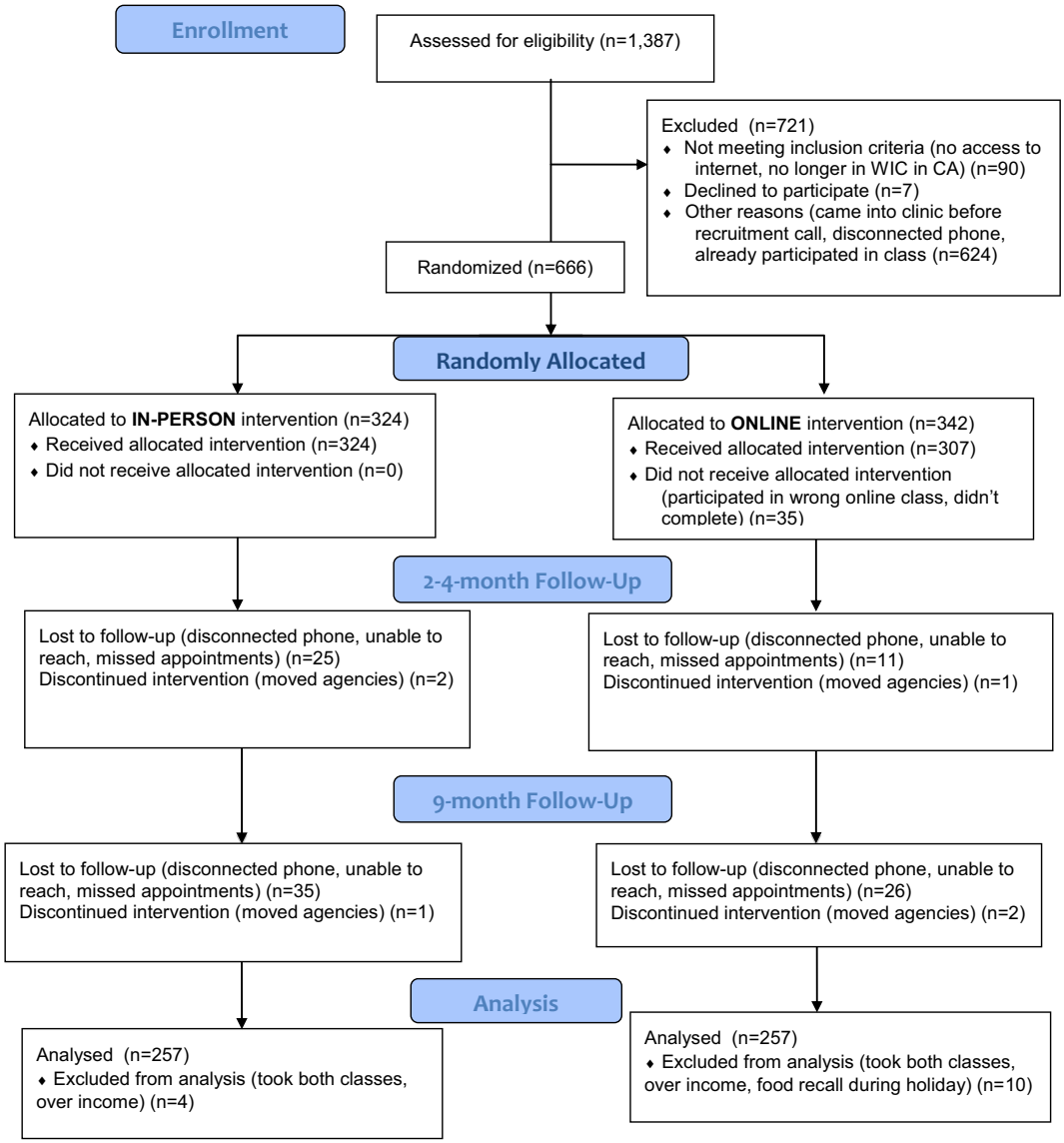

Figure. Recruitment flow diagram of in-person group and online education participants recruited from three Public Health Foundation Enterprises Special Supplemental Nutrition Program for Women, Infants, and Children clinics in Los Angeles, CA.

Table 1. Comparison of demographic characteristics for in-person group and online education modalities of adults recruited from three Public Health Foundation Enterprises Special Supplemental Nutrition Program for Women, Infants, and Children clinics in Los Angeles, CA

Characteristic (n=514)[a]	In-person (n=257)	Online (n=257)	*P* value[b]
	←——*mean (SD)*[c]——→		
Age, y (n=514)	31.5 (7.5)	31.8 (6.4)	0.53
	←——*n (%)*——→		
Race/ethnicity (n=489)			0.26
White	5 (2.1)	5 (2.0)	
Hispanic	205 (85.1)	226 (91.1)	
African American	12 (5.0)	8 (3.2)	
Asian	9 (3.7)	4 (1.6)	
Other	10 (4.2)	5 (2.0)	
Education (n=514)			0.65
Not high school graduate	96 (37.4)	91 (35.4)	
High school graduate and above	161 (62.7)	166 (64.6)	
Marital status (n=513)			0.007*
Married	110 (42.8)	138 (53.9)	
Single	67 (26.1)	38 (14.8)	
Living with partner	54 (21.0)	48 (18.8)	
Widowed/divorced/separated	26 (10.1)	32 (12.5)	
Primary language (n=514)			0.79
English	117 (45.5)	120 (46.7)	
Spanish	140 (54.5)	137 (53.3)	
Duration of WIC[d] participation (n=505)			0.14
<1 y	25 (10.0)	21 (8.3)	
1 to 2 y	66 (26.3)	58 (22.8)	
3 to 4 y	74 (29.5)	62 (24.4)	
5 or more y	86 (34.3)	113 (44.5)	
Work status (n=511)			0.37
Full-time	47 (18.5)	45 (17.5)	
Part-time	57 (22.4)	46 (17.9)	
Not working	150 (59.1)	166 (64.6)	
School status (n=508)			0.80
Full-time	11 (4.4)	14 (5.5)	
Part-time	25 (9.9)	27 (10.6)	
Not in school	217 (85.8)	214 (83.9)	
	←——*mean (SD)*——→		
Time from baseline to 2- to 4-mo follow-up, d (n=514)	103.6 (17.6)	96.5 (10.8)	<0.0001*
Time from baseline to 9-mo follow-up, d (n=514)	286.9 (17.6)	279.8 (18.0)	<0.0001*
	←——*n (%)*——→		
Food insecure (n=505)	136 (53.8)	120 (47.6)	0.17
Participate in SNAP[e] (n=514)	99 (38.5)	94 (36.6)	0.65

(*continued on next page*)

Table 1. Comparison of demographic characteristics for in-person group and online education modalities of adults recruited from three Public Health Foundation Enterprises Special Supplemental Nutrition Program for Women, Infants, and Children clinics in Los Angeles, CA (*continued*)

Characteristic (n=514)[a]	In-person (n=257)	Online (n=257)	*P* value[b]
	←——— *n (%)* ———→		
Previous exposure to online WIC class (n=514)	44 (17.1)	67 (26.1)	0.01*
Follow-up method at 2 to 4 mo (n=514)			0.15
Self-administered paper questionnaire	152 (59.1)	136 (52.9)	
Interviewer-administered phone interview	105 (40.9)	121 (47.1)	
Follow-up method at 9 mo (n=514)			0.17
Self-administered paper questionnaire	171 (66.5)	156 (60.7)	
Interviewer-administered phone call interview	86 (33.5)	101 (39.3)	

[a]Because of missing values, the total n is not the same for all variables.
[b]Differences in continuous variables by *t*-test and categorical variables by χ^2 and Fisher's exact test.
[c]SD=standard deviation.
[d]WIC=Special Supplemental Nutrition Program for Women, Infants, and Children.
[e]SNAP=Supplemental Nutrition Assistance Program.
*$P<0.05$.

University of California, Berkeley, Institutional Review Board–approved the study protocol and all participants provided verbal informed consent.

Participants in the in-person group came in for their regular WIC appointment and received a salt nutrition lesson in groups of 2 to 6. Participants in the online group were called before their WIC appointment and provided a link to access the salt lesson online at their convenience. They were also sent an online link to a short video with instructions on how to access the online class.

Intervention Description: Salt Education Class

Public Health Foundation Enterprises WIC nutrition education staff followed a standard curriculum development protocol to develop the content for a new salt education class.[5] Research on salt was reviewed, ensuring presentation of evidence-based information aligned with expert recommendations of the Dietary Guidelines for Americans,[20] the Academy of Nutrition and Dietetics,[21] and the American Heart Association.[22] The content of the salt lesson was designed with a focus on principles of learner-centered education.[23,24] The group class was developed first and used as the basis for developing the online class so that the content was as similar as possible between modalities.

The instructor of the in-person WIC class began by asking whether participants knew how much salt they consumed and about hidden salt in foods, and then discussed reasons why limiting salt is important. Visuals such as food models were used to teach participants to read food labels and identify high-salt foods. The lesson concluded with a group discussion focused on improving self-efficacy. Participants discussed challenges and each participant set goals related to limiting salt intake using strategies from a handout titled, "What Can You Do to Reduce Your Salt?"

Both the in-person and the online classes took 15 to 20 minutes to complete and were offered in English or Spanish. The online salt lesson provided similar content and consisted of written and simultaneous audio presentation of the class material. The online class included questions to participants with opportunity for open-ended responses, allowing for an interactive component. Participants also set goals related to salt intake by choosing between multiple-choice options on the screen.

Data Collection

Data were collected by questionnaire before and at 2 to 4 months and 9 months after both modalities of the class. Newly developed knowledge questions were created based on class content. Self-efficacy questions related to using salt in cooking and serving foods low in salt were adapted from existing self-efficacy scales.[25] Behavior-change questions focused on the topics taught in the class and were adapted from a dietary behavior questionnaire.[26] Food frequency questions related to salt intake were adapted from a salt dietary intake screening tool used to assess the amount and sources of salt in the diet.[27] Before administration, all questions were pilot-tested with nine English speakers and eight Spanish speakers, and wording was revised for clarity as needed. Pilot testing was conducted at WIC sites that were not involved in the study to ensure no participants would have been exposed to the questionnaire before the study.

A 40-item baseline questionnaire, containing 2 knowledge, 6 self-efficacy, 21 behavior, and demographic questions, was self-administered on paper by participants who received in-person instruction before the class commenced and collected by the WIC educator who was teaching the class. For online participants, an identical questionnaire was embedded in the online lesson and completed by participants before they began the educational module. After 2 to 4 months and again 9 months after the salt class, a 55-item follow-up questionnaire was either self-administered on paper when participants returned to the WIC clinic or

interviewer-administered via a phone call from a WIC research staff member. The 2- to 4-month and 9-month follow-up questionnaires contained the same knowledge, self-efficacy, and behaviors questions as the baseline questionnaire. The follow-up questionnaires included additional demographic questions used in the study and satisfaction questions that were not included in the study.

Statistical Analyses

Demographic variables were dichotomized for education, language, food insecurity status, participation in the Supplemental Nutrition Assistance Program, previous exposure to an online class, and method of follow-up data collection. Race/ethnicity, marital status, length of time participants in WIC, and work and school status were categorized. Independent sample *t*-tests and χ^2 analyses were used to compare differences in demographic characteristics between the in-person and online education modalities. Outcomes variables of interest included change in salt-related knowledge, self-efficacy, and behaviors from baseline to both follow-up end points. Questions were grouped as the following: within-modality changes in knowledge and self-efficacy, reported behaviors in the past 30 days, and reported behaviors in the past 7 days.

Multiple linear regression models were used to compare changes from baseline to follow-up periods within in-person and online modalities in knowledge, self-efficacy, and behavior outcomes. The format for administration of the follow-up questionnaires varied (self-administered paper or online questionnaire or interviewer-administered by phone) for both education modalities. When examining changes within a specific modality, significant time by follow-up administration method interaction terms were included in both 2- to 4-month and 9-month models. Because the method of administration may have impacted participants' responses for within-modality comparisons, the mean baseline to follow-up change is presented for in-person and online participants who completed the self-administered version of the survey at both baseline and follow-up. The models included time (0=baseline, 1=follow-up), follow-up method (0=self-administered, 1=interviewer-administered), and interaction of time and follow-up method. The significance levels are based on the *P* value of the time coefficients, which represents the change from baseline to follow-up for the self-administered group.

Multiple linear regression models were also used to compare changes from baseline to follow-up between in-person and online modalities. In addition to the baseline value of the outcome variable, covariates included marital status, duration of WIC participation, time between baseline and follow-up questionnaires, and previous exposure to online education. Because the share of participants with the interviewer-administered follow-up method was similar in both the online and in-person modalities at both follow-up periods (2 to 4 months and 9 months), both follow-up methods were included in this comparison. Data were analyzed using SAS, version 9.4.[28] A *P* value of <0.05 was considered statistically significant.

RESULTS

Data were analyzed for 514 of 666 WIC participants. A total of 152 participants who had been randomly assigned were excluded: 14 participants no longer qualified for WIC because their household income exceeded the eligibility limit set by the US Department of Agriculture, or were deleted from the sample because their food recall fell within a holiday week (eg, Thanksgiving) in which food habits were likely altered; 35 online participants completed the wrong online class or did not finish the salt class; and 103 participants were lost to follow-up due to disconnected phone numbers, unable to be reached, moved agencies, or missed appointments (Figure).

The majority of study participants were Hispanic (88.1%), and about half (53.9%) spoke Spanish as their primary language. A majority had graduated from high school (63.6%). There were no statistically significant differences between in-person and online education modalities for parent age, race/ethnicity, education, primary language, duration of WIC participation, work or school participation, food insecurity, Supplemental Nutrition Assistance Program status, or type of follow-up questionnaire administered (self- or interviewer-administered) (Table 1). Differences between groups were found for marital status ($P<0.007$) with more single parents in the in-person group compared to the online group (26.1% vs 14.8%). Compared to the online modality, the in-person modality had longer time to follow-up of about 1 week between baseline and 2- to 4-month follow-up (104 days vs 97 days; $P<0.0001$), and 9-month follow-up (287 days vs 280 days; $P<0.0001$), and fewer had previous exposure to an online WIC nutrition education class ($P=0.01$) (Table 1).

Improvements in knowledge about salt were significant for both the in-person and online groups at the 2- to 4-month time point. However, these improvements largely disappeared at the 9-month time point, except for the online group's knowledge retention of the main source of dietary salt. Significant improvements were observed for each of the six self-efficacy questions at both 2 to 4 months and 9 months, although the pattern varied slightly by time point for the in-person and online groups (Table 2).

Reported behavior changes, which were reported as frequencies in the past 30 days, were significant across all time periods for both education modalities. These behaviors included cooking with less salt, adding less salt at the table, reading labels for sodium, purchasing foods with lower salt content, limiting salty food intake, looking for lower salt items, and substituting herbs or spices for salt (Table 3).

There were some significant decreases in foods high in salt consumed during the last 7 days between baseline and follow-up time points for both education modalities. For both the in-person and online groups, there were significant reductions in frequency of eating at fast-food and other restaurants at 9 months; frequency of eating any food with salt added at the table or during cooking at both follow-up time points; and mean frequency of eating items on a list of 11 high-salt foods at the 9-month follow-up. In addition, for both groups at 9 months, there were reductions in frequency of the following foods consumed during the past 7 days: processed meats, canned or packaged soups, and snack foods (Table 4).

Table 5 compares significant changes from baseline to follow-up between participants in the two education modalities. The online modality reported greater improvements compared to in-person modality for retaining the knowledge that the daily recommended limit for sodium intake is

Table 2. Change in salt-related knowledge and self-efficacy by in-person group and online education modalities of adults recruited from three Public Health Foundation Enterprises Special Supplemental Nutrition Program for Women, Infants, and Children who completed self-administered questionnaires from baseline to 2- to 4-month follow-up and from baseline to 9-month follow-up[a]

	Self-Administered Questionnaires							
	In-Person Within-Modality Comparison				Online Within-Modality Comparison			
	2 to 4 mo (n=152)		9 mo (n=171)		2 to 4 mo (n=136)		9 mo (n=156)	
Variable	Baseline[b]	Change[c]	Baseline[b]	Change[c]	Baseline[b]	Change[c]	Baseline[b]	Change[c]
Knowledge	← *n (% correct)* →							
Main source of dietary salt	80 (55.2)	**28*** (19.3)**	90 (55.1)	12 (7.5)	74 (54.8)	**16* (11.9)**	85 (54.8)	**23** (14.8)**
Amount of sodium adults should consume daily	26 (17.6)	**12* (8.1)**	29 (17.4)	3 (1.8)	27 (19.9)	**29*** (21.3)**	32 (20.5)	12 (7.7%)
Self-efficacy[d]	← *mean (SD[e])* →							
Add less salt to foods cooking	2.7 (0.6)	**0.1* (0.6)**	2.7 (0.6)	0.0 (0.7)	2.6 (0.6)	**0.1** (0.6)**	2.7 (0.5)	**0.2*** (0.6)**
Add no salt to foods cooking	2.0 (0.7)	**0.2** (0.8)**	2.0 (0.7)	**0.2*** (0.9)**	2.2 (0.8)	−0.1 (0.8)	2.3 (0.7)	**0.1* (0.7)**
Almost always purchase foods low in sodium	2.5 (0.7)	**0.2* (0.7)**	2.5 (0.7)	**0.1* (0.7)**	2.4 (0.7)	**0.2*** (0.7)**	2.4 (0.7)	**0.2*** (0.7)**
Read the Nutrition Facts Label for sodium	2.5 (0.7)	0.1 (0.7)	2.5 (0.7)	**0.2*** (0.8)**	2.5 (0.7)	0.1 (0.7)	2.5 (0.7)	**0.1* (0.7)**
Add less salt to foods at the table	2.7 (0.6)	**0.1* (0.7)**	2.7 (0.6)	**0.1* (0.7)**	2.8 (0.5)	**0.1** (0.6)**	2.8 (0.5)	0.1 (0.6)
Add no salt to foods at the table	2.4 (0.7)	**0.2** (0.8)**	2.5 (0.7)	0.1 (0.9)	2.7 (0.6)	0.1 (0.6)	2.7 (0.6)	0.1 (0.7)

[a]Because of missing values, the total n is not the same for all variables.

[b]Due to differences in self-administered questionnaire completion at follow-up periods, the baseline samples differed.

[c]Change was calculated by subtracting the baseline value from the month follow-up value (2 to 4 mo or 9 mo). A positive change indicates an increase in knowledge or self-efficacy; a negative change indicates a decrease in knowledge or self-efficacy. Multiple linear regression model included time, follow-up method (0=self-administered, 1=interviewer-administered), and the interaction of time by the follow-up method. The significance levels were based on the *P* value of the time coefficient. Boldface indicates statistical significance at *$P<0.05$; **$P<0.01$; ***$P<0.001$.

[d]Responses scored as follows: 1=not sure, 2=a little sure, 3=very sure.

[e]SD=standard deviation.

Table 3. Change in salt behaviors (frequency in the past 30 days) by in-person group and online nutrition education modalities of adults recruited from three Public Health Foundation Enterprises Special Supplemental Nutrition Program for Women, Infants, and Children who completed self-administered questionnaires from baseline to 2- to 4-month follow-up and from baseline to 9-month follow-up[ab]

	Self-Administered Questionnaires							
	In-Person Within-Modality Comparison				Online Within-Modality Comparison			
	2 to 4 mo (n=152)		9 mo (n=171)		2 to 4 mo (n=136)		9 mo (n=156)	
Variable	Baseline[c]	Change[d]	Baseline[c]	Change[d]	Baseline[c]	Change[d]	Baseline[c]	Change[d]
	←mean (SD[e])→							
Add salt to foods when cooking	3.4 (1.3)	**−0.6*** (1.5)**	3.5 (1.26)	**−0.7*** (1.3)**	3.1 (1.3)	**−0.6*** (1.3)**	3.2 (1.3)	**−0.7*** (1.4)**
Add salt to foods at the table	1.8 (1.1)	**−0.2*** (1.1)**	1.9 (1.1)	**−0.3*** (1.1)**	2.0 (1.2)	**−0.5*** (1.3)**	2.1 (1.2)	**−0.8*** (1.2)**
Read the Nutrition Facts Label to look at the amount of sodium	2.6 (1.4)	**0.9*** (1.4)**	2.5 (1.4)	**1.0*** (1.4)**	2.2 (1.2)	**0.9*** (1.3)**	2.2 (1.2)	**1.0*** (1.4)**
Not purchase a food because it had too much sodium	2.6 (1.4)	**0.9*** (1.4)**	2.5 (1.3)	**0.9*** (1.5)**	2.3 (1.2)	**0.8*** (1.3)**	2.4 (1.2)	**0.8*** (1.5)**
Limit the amount of salty food	3.2 (1.3)	**0.7*** (1.2)**	3.2 (1.5)	**0.6*** (1.3)**	3.5 (1.2)	**0.7*** (1.5)**	2.7 (1.2)	**0.8*** (1.5)**
Look for products labeled as sodium free, low sodium, or reduced sodium	2.8 (1.5)	**0.8*** (1.4)**	2.8 (1.4)	**0.9*** (1.4)**	2.4 (1.3)	**0.8*** (1.4)**	2.4 (1.3)	**1.1*** (1.5)**
Add herbs or spices to foods instead of salt	3.0 (1.3)	**0.6*** (1.4)**	3.0 (1.3)	**0.5*** (1.5)**	3.0 (1.4)	**0.4** (1.4)**	2.8 (1.3)	**0.6*** (1.6)**

[a]Because of missing values, the total n is not the same for all variables.

[b]Responses scored as follows: 1=almost never, 2=once in a while, 3=sometimes, 4=often, 5=almost always.

[c]Due to differences in self-administered questionnaire completion at follow-up periods, the baseline samples differed.

[d]Change is calculated by subtracting the baseline value from the follow-up value (2 to 4 mo or 9 mo). A positive change indicates an increase in the frequency of the behavior; a negative change indicates a decrease in the frequency of the behavior. Multiple linear regression model includes: time, follow-up method (0=self-administered, 1=interviewer-administered), and the interaction of time by the follow-up method. The significance levels are based on the *P* value of the time coefficient. Boldface indicates statistical significance at $^{**}P<0.01$; $^{***}P<0.001$.

[e]SD=standard deviation.

Table 4. Change in salt-related dietary behaviors (days over the past 7 days) by in-person group and online nutrition education modalities of adults recruited from three Public Health Foundation Enterprises Special Supplemental Nutrition Program for Women, Infants, and Children who completed self-administered questionnaires from baseline to 2- to 4-month follow-up and from baseline to 9-month follow-up[a]

	Self-Administered Questionnaires							
	In-Person Within-Modality Comparison				Online Within-Modality Comparison			
	2 to 4 mo (n=152)		9 mo (n=171)		2 to 4 mo (n=136)		9 mo (n=156)	
Variable	Baseline[b]	Change[c]	Baseline[b]	Change[c]	Baseline[b]	Change[c]	Baseline[b]	Change[c]
Eat at the following places	← mean (SD[d]) d/wk →							
Fast food	1.3 (1.2)	−0.2 (1.3)	1.3 (1.3)	**−0.2* (1.2)**	1.3 (1.2)	**−0.3** (1.2)**	1.3 (1.1)	**−0.4*** (1.2)**
Other restaurant	1.1 (1.2)	**−0.3* (1.3)**	1.1 (1.3)	**−0.3** (1.4)**	1.0 (1.0)	−0.2 (1.3)	1.0 (1.0)	**−0.3** (1.1)**
Eat the following foods								
Canned beans or vegetables	1.3 (1.7)	−0.1 (2.0)	1.2 (1.6)	−0.1 (2.0)	1.1 (1.5)	0.1 (1.8)	1.3 (1.7)	−0.2 (1.8)
Pizza	0.7 (0.9)	−0.0 (0.9)	0.7 (1.0)	0.2 (1.3)	0.6 (0.8)	−0.1 (0.9)	0.6 (0.8)	0.1 (1.0)
Cheese	2.0 (1.6)	−0.1 (1.9)	2.0 (1.5)	−0.2 (1.7)	1.6 (1.2)	**0.6*** (1.6)**	1.7 (1.4)	0.2 (1.4)
Frozen seasoned meat, poultry, fish	1.1 (1.4)	−0.1 (1.5)	1.3 (1.5)	−0.3 (1.9)	1.0 (1.3)	0.1 (1.7)	1.1 (1.5)	−0.2 (1.8)
Processed meats	1.6 (1.4)	−0.2 (1.7)	1.6 (1.3)	**−0.3* (1.7)**	1.5 (1.3)	−0.1 (1.4)	1.5 (1.3)	**−0.3* (1.6)**
Frozen packaged appetizers or sides	0.5 (1.0)	−0.0 (1.2)	0.5 (1.0)	−0.0 (1.2)	0.4 (0.8)	0.0 (0.8)	0.5 (0.9)	−0.0 (1.1)
Other packaged meals or sides	1.0 (1.4)	−0.2 (1.4)	0.9 (1.2)	**−0.2* (1.3)**	0.8 (1.2)	−0.1 (1.4)	0.9 (1.2)	−0.2 (1.2)
Canned or packaged soups	0.8 (1.4)	−0.2 (1.4)	0.8 (1.3)	**−0.4** (1.4)**	0.8 (1.0)	−0.2 (1.2)	0.7 (1.0)	**−0.3** (1.1)**
Ready to use or packaged condiments	1.4 (1.4)	−0.1 (1.7)	1.4 (1.4)	−0.1 (1.6)	1.5 (1.2)	**−0.3* (1.4)**	1.5 (1.4)	−0.3 (1.3)
Ready to use or packaged sauces marinades	1.0 (1.3)	−0.2 (1.6)	0.9 (1.1)	−0.1 (1.5)	1.1 (1.2)	−0.2 (1.4)	0.9 (1.2)	−0.2 (1.2)
Snack foods	1.2 (1.3)	**−0.3* (1.4)**	1.3 (1.5)	**−0.2* (1.4)**	1.2 (1.2)	0.0 (1.5)	1.2 (1.2)	**−0.2* (1.4)**
Mean of the above foods	1.1 (0.8)	−0.1 (0.8)	1.1 (0.8)	**−0.2* (0.8)**	1.0 (0.6)	−0.0 (0.6)	1.1 (0.7)	**−0.1* (0.7)**
Any food with salt added at the table or during cooking	2.1 (2.1)	**−0.7*** (2.4)**	2.2 (2.2)	**−0.6** (2.3)**	2.2 (2.3)	**−1.0*** (2.4)**	2.3 (2.3)	**−1.1*** (2.4)**

[a]Because of missing values, the total n is not the same for all variables.
[b]Due to differences in self-administered questionnaire completion at follow-up periods, the baseline samples differed.
[c]Change was calculated by subtracting the baseline value from the month follow-up value (2 to 4 mo or 9 mo). A positive change indicates an increase in the frequency of the behavior; a negative change indicates a decrease in the frequency of the behavior. Multiple linear regression model included: time, follow-up method (0=self-administered, 1=interviewer-administered), and the interaction of time by the follow-up method. The significance levels are based on the *P* value of the time coefficient. Boldface indicates statistical significance at **P*<0.05; ***P*<0.01; ****P*<0.001.
[d]SD=standard deviation.

Table 5. Differences in changes of salt-related knowledge, self-efficacy, and behaviors between in-person group and online education modalities of adults recruited from three Public Health Foundation Enterprises Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) from baseline to 2-4-month follow-up and from baseline to 9-month follow-up[a]

	All Questionnaires							
	In-Person Within-Modality Comparison (n=257)			Online Within-Modality Comparison (n=257)			In-Person vs Online Modality Comparison: Change Score (n=514)	
		2 to 4 mo	9 mo		2 to 4 mo	9 mo	2 to 4 mo	9 mo
Variable	Baseline	Change from baseline	Change from baseline	Baseline	Change from baseline	Change from baseline	Difference in change from baseline[b]	Difference in change from baseline[b]
Knowledge	*n (% correct)*							
Amount of sodium adults should consume daily	45 (17.9)	37 (14.7)	19 (7.5)	50 (19.5)	78 (30.4)	41 (16.0)	**−15.7***	−8.5
Self-efficacy[c] (negative change score means online improved more)	*mean (SD[d])*							
Add less salt to foods when cooking	2.6 (0.6)	0.2 (0.7)	0.1 (0.7)	2.6 (0.6)	0.1 (0.6)	0.2 (0.6)	0.1 (0.6)	**−0.1* (0.7)**
Read the Nutrition Facts Label while shopping to look at the amount of sodium in the package	2.5 (0.7)	0.2 (0.8)	0.3 (0.8)	2.5 (0.7)	0.1 (0.7)	0.2 (0.7)	0.1 (0.7)	**0.2* (0.7)**
Add no salt to foods at the table	2.5 (0.7)	0.2 (0.8)	0.2 (0.8)	2.7 (0.6)	0.1 (0.7)	0.1 (0.7)	0.1 (0.8)	**0.01** (0.8)**
Behaviors (days over the past 7 d) (positive change score means online improved more)								
Eat at fast-food restaurant	1.3 (1.3)	−0.3 (1.4)	−0.2 (1.3)	1.3 (1.2)	−0.4 (1.3)	−0.5 (1.3)	0.1 (1.3)	**0.3*** (1.2)**
Eat at another restaurant	1.1 (1.2)	−0.5 (1.3)	−0.4 (1.4)	1.1 (1.2)	−0.4 (1.3)	−0.5 (1.3)	**−0.04* (1.3)**	0.1 (1.4)
Eat pizza	0.7 (1.0)	−0.2 (1.1)	0.0 (1.2)	0.7 (1.0)	−0.2 (1.1)	−0.2 (1.1)	0.0 (1.1)	**0.2* (1.2)**
Any food with salt added at the table or during cooking	2.2 (2.2)	−1.2 (2.5)	−1.1 (2.4)	2.4 (2.2)	−1.6 (2.4)	−1.6 (2.36)	0.4 (2.4)	**0.5* (2.4)**
Behaviors (frequency in the past 30 d)[e] (positive change score means online improved more)								
Add salt to foods at the table	1.8 (1.1)	−0.3 (1.2)	−0.4 (1.2)	2.2 (1.3)	−0.8 (1.4)	−0.9 (1.3)	**0.5* (1.3)**	**0.5* (0.1)**

[a]Because of missing values, the total n is not the same for all variables.

[b]*P* values are for difference in change between the in-person and online modalities. In-person vs online difference in change score is calculated by subtracting the online change score from the in-person change score. Multiple linear regression model included: response to baseline question, marital status, duration of WIC participation, time between baseline and follow-up, and previous online exposure. Boldface indicates statistical significance at *$P<0.05$; **$P<0.01$; ***$P<0.001$.

[c]Responses scored as follows: 1=not sure, 2=a little sure, 3=very sure.

[d]SD=standard deviation.

[e]Responses scored as follows: 1=almost never, 2=once in a while, 3=sometimes, 4=often, 5=almost always.

<2,300 mg at 2 to 4 months (P=0.02) and increasing self-efficacy for adding less salt to foods when cooking (P=0.03). The following behaviors significantly improved more from baseline for the online compared to the in-person modality: reducing the amount of salt added at table over the past 30 days at 2 to 4 months (P=0.01) and 9 months (P=0.02); reducing frequency of fast-food restaurants at 9 months (P=0.0008); decreasing intake of pizza (P=0.02); and any food with salt added at the table or cooking at 9 months (P=0.04). Relative to the online group, the in-person group reported greater improvements in: increasing self-efficacy for reading the Nutrition Facts Label (P=0.02 at 9 months); adding no salt to foods at the table at 9 months (P=0.003); and reducing eating out at other types of restaurants at 2 to 4 months (P=0.02).

DISCUSSION

Both online and traditional in-person education successfully promoted reducing salt intake in WIC participants. Both modalities improved participants' salt-related knowledge, self-efficacy, and behaviors and, for the most part, these improvements were retained over many months. While retention of knowledge mostly disappeared at 9-month follow-up, salt-related behavior changes were maintained, which is an indicator of the success of the intervention. There were few significant differences between online and in-person modalities and results did not suggest a pattern of one modality being superior to the other.

Compared to other behavioral intervention studies that have tried to reduce salt intake,[29-32] this study found that the online group showed greater improvements for some longer-term salt-related behaviors, such as reducing the added salt during cooking and at the table and reducing intake of all foods with salt added. These daily behaviors were retained at 9 months and may be indicative of sustainability of the online education intervention. In addition, when participants opt to use online education, this may provide WIC nutrition educators more time for individualized counseling. On the other hand, the in-person education group had greater improvements for reading nutrition labels and eating out less at restaurants. It is important to note, however, that there were few significant differences between education modalities, and that these differences were physiologically small.

These findings are consistent with other studies comparing online education to traditional delivery methods. In a meta-analysis, online education studies found substantial improvements in outcomes that were similar to positive changes found with traditional in-person education.[33] Examples of these outcomes included increased exercise time, increased knowledge of nutritional status, increased knowledge of asthma treatment, increased participation in healthcare, and weight-loss maintenance.[33] A 2011 comparison found that WIC online nutrition education was superior to traditional methods in educating on fruit and vegetable consumption.[3] However, in that study,[3] participants were allowed to self-select their form of nutrition education, in contrast to the random assignment in our study, as well as another study examining breakfast outcomes in a similar population of WIC participants.[5]

Strengths of this study included the random assignment of a diverse, low-income population to in-person and online nutrition modalities and focus of the nutrition education on salt intake, which is an area of high public health importance. The study also utilized a pre–post design that provided an assessment of the retention of knowledge and change in self-efficacy and behaviors at both shorter (2 to 4 months) and longer (9 months) end points. The generalizability of the study's findings to other WIC settings was enhanced by using WIC materials and protocols for the implementation.

There were also limitations to the study. It was not possible to have a control group that received no education for two reasons: first, nutrition education is federally required in all WIC programs and second, having a control group that received education on an alternative topic was not possible because the WIC agency that conducted the study currently offers all participants group education on the same topic simultaneously. In this study, it was not possible for all participants to complete the follow-up questionnaire using the same mode of administration as at baseline. In order to have high follow-up rates, multiple methods for reaching participants were employed (self- or interviewer-administered). Change in the follow-up methodology could have resulted in increased social desirability bias.[34,35] Another limitation, albeit a diminishing one as Internet access becomes more universal, is that results may only be generalizable to women with regular Internet access by phone, tablet, or computer.

CONCLUSIONS

This study provides evidence that WIC nutrition education, a cornerstone of WIC, impacts dietary behavior and that these changes largely persist up to 9 months after a single class. Both in-person and online nutrition education can lead to self-efficacy and behavior change related to reducing salt intake in WIC participants. There were few differences between education modalities and results did not suggest a pattern of one modality being superior to the other. Promotion of online nutrition education could expand the reach of WIC nutrition education to more clients, potentially reducing salt intake in this low-income population.

References

1. US Department of Agriculture. Women, Infants and Children (WIC) Revitalizing Quality Nutrition Services (RQNS). http://www.fns.usda.gov/wic/revitalizing-quality-nutrition-services-rqns. Published 2013. Accessed August 19, 2015.
2. US Department of Agriculture. Women, Infants, and Children (WIC) frequently asked questions. 2014; http://www.fns.usda.gov/wic/frequently-asked-questions-about-wic. Accessed October 20, 2014.
3. Bensley RJ, Anderson JV, Brusk JJ, Mercer N, Rivas J. Impact of internet vs traditional Special Supplemental Nutrition Program for Women, Infants, and Children nutrition education on fruit and vegetable intake. *J Am Diet Assoc*. 2011;111(5):749-755.
4. Bensley RJ, Hovis A, Horton KD, et al. Accessibility and preferred use of online web applications among WIC participants with Internet access. *J Nutr Educ Behav*. 2014;46(3 suppl):S87-S92.
5. 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.
6. 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.
7. Pew. Who's online: Internet user demographics. http://www.pewinternet.org/data-trend/internet-use/latest-stats/. Published 2014. Accessed October 15, 2014.

8. Weinberger MH, Fineberg NS, Fineberg SE, Weinberger M. Salt sensitivity, pulse pressure, and death in normal and hypertensive humans. *Hypertension*. 2001;37(2 Pt 2):429-432.
9. Aburto NJ, Ziolkovska A, Hooper L, Elliott P, Cappuccio FP, Meerpohl JJ. Effect of lower sodium intake on health: Systematic review and meta-analyses. *BMJ*. 2013;346:f1326.
10. Graudal NA, Hubeck-Graudal T, Jurgens G. Effects of low-sodium diet vs high-sodium diet on blood pressure, renin, aldosterone, catecholamines, cholesterol, and triglyceride (Cochrane Review). *Am J Hypertens*. 2012;25(1):1-15.
11. He FJ, Li J, Macgregor GA. Effect of longer term modest salt reduction on blood pressure: Cochrane Systematic Review and meta-analysis of randomised trials. *BMJ*. 2013;346:f1325.
12. Institute of Medicine. Sodium intake in populations: Assessment of evidence. http://www.nap.edu/openbook.php?record_id=18311&page=R1. Published 2013. Accessed August 19, 2015.
13. Strazzullo P, D'Elia L, Kandala NB, Cappuccio FP. Salt intake, stroke, and cardiovascular disease: Meta-analysis of prospective studies. *BMJ*. 2009;339:b4567.
14. Takachi R, Inoue M, Shimazu T, et al. Consumption of sodium and salted foods in relation to cancer and cardiovascular disease: The Japan Public Health Center-based Prospective Study. *Am J Clin Nutr*. 2010;91(2):456-464.
15. Tomonari T, Fukuda M, Miura T, et al. Is salt intake an independent risk factor of stroke mortality? Demographic analysis by regions in Japan. *J Am Soc Hypertens*. 2011;5(6):456-462.
16. Gardener H, Rundek T, Wright CB, Elkind MS, Sacco RL. Dietary sodium and risk of stroke in the Northern Manhattan study. *Stroke*. 2012;43(5):1200-1205.
17. Ritchie LD, Whaley SE, Spector P, Gomez J, Crawford PB. Favorable impact of nutrition education on California WIC families. *J Nutr Educ Behav*. 2010;42(3 suppl):S2-S10.
18. Seth JG, Evans AE, Harris KK, et al. Preschooler feeding practices and beliefs: Differences among Spanish- and English-speaking WIC clients. *Fam Commun Health*. 2007;30(3):257-270.
19. Seth JG, Isbell MG, Atwood RD, Ray TC. Addressing language barriers in client-centered health promotion: Lessons learned and promising practices from Texas WIC. *Health Promot Pract*. 2015;16(3):320-328.
20. US Department of Agriculture, US Department of Health and Human Services. Dietary Guidelines for Americans, 2010. 7th ed. http://www.cnpp.usda.gov/dietaryguidelines.htm. Published 2010. Accessed December 19, 2014.
21. Academy of Nutrition and Dietetics. The facts on sodium and high blood pressure. http://www.eatright.org/resource/health/wellness/heart-and-cardiovascular-health/the-facts-on-sodium-and-high-blood-pressure. Published in 2015. Accessed March 11, 2015.
22. American Heart Association. Sodium and salt. http://www.heart.org/HEARTORG/HealthyLiving/HealthyEating/Nutrition/Sodium-and-Salt_UCM_303290_Article.jsp-.VvGp-hIrI8Y. Published 2015. Accessed January 10, 2014.
23. Gilboy MB, Heinerichs S, Pazzaglia G. Enhancing student engagement using the flipped classroom. *J Nutr Educ Behav*. 2015;47(1):109-114.
24. Gerstein DE, Martin AC, Crocker N, Reed H, Elfant M, Crawford P. Using learner-centered education to improve fruit and vegetable intake in California WIC participants. *J Nutr Educ Behav*. 2010;42(4):216-224.
25. Bandura A. Guide for constructing self-efficacy scales. In: Pajares F, Urdan T, eds. *Self-efficacy Beliefs of Adolescents*. Greenwich, CT: Greenwich Information Age Publishing; 2006:307-337.
26. Walker D. *Investigation of a Dietary Behavior Questionnaire as a Predictor of Dietary Sodium Intake*. Pullman, WA: Intercollegiate Center for Nursing Education, Washington State University; 1996.
27. Arcand J, Abdulaziz K, Bennett C, L'Abbé MR, Manuel DG. Developing a web-based dietary sodium screening tool for personalized assessment and feedback. *Appl Physiol Nutr Metab*. 2014;39(3):413-414.
28. SAS [computer program]. Version 9.4. Cary, NC: SAS Institute Inc; 2013.
29. The effects of nonpharmacologic interventions on blood pressure of persons with high normal levels. Results of the Trials of Hypertension Prevention, Phase I. *JAMA*. 1992;267(9):1213-1220.
30. Whelton PK, Appel LJ, Espeland MA, et al. Sodium reduction and weight loss in the treatment of hypertension in older persons: A randomized controlled trial of nonpharmacologic interventions in the elderly (TONE). *JAMA*. 1998;279(11):839-846.
31. Anderson CA, Cobb LK, Miller ER, et al. Effects of a behavioral intervention that emphasizes spices and herbs on adherence to recommended sodium intake: Results of the SPICE randomized clinical trial. *Am J Clin Nutr*. 2015;102(3):671-679.
32. Cook NR, Cutler JA, Obarzanek E, et al. Long term effects of dietary sodium reduction on cardiovascular disease outcomes: Observational follow-up of the trials of hypertension prevention (TOHP). *BMJ*. 2007;334(7599):885-888.
33. Wantland JD, Portillo JC, Holzemer LW, Slaughter R, McGhee ME. The effectiveness of web-based vs non-web-based interventions: A meta-analysis of behavioral change outcomes. *J Med Internet Res*. 2004;6(4):e40.
34. Hebert JR, Ebbeling CB, Matthews CE, et al. Systematic errors in middle-aged women's estimates of energy intake: Comparing three self-report measures to total energy expenditure from doubly labeled water. *Ann Epidemiol*. 2002;12(8):577-586.
35. Hebert JR, Ma Y, Clemow L, et al. Gender differences in social desirability and social approval bias in dietary self-report. *Am J Epidemiol*. 1997;146(12):1046-1055.

AUTHOR INFORMATION

L. E. Au is an assistant researcher, K. Gurzo is a data analyst, and L. D. Ritchie is director and cooperative extension specialist, Nutrition Policy Institute, Division of Agriculture and Natural Resources, University of California, Berkeley. S. E. Whaley is director of research and evaluation and M. Meza is executive assistant for special projects, Public Health Foundation Enterprises WIC, Irwindale, CA. N. J. Rosen is a senior associate, Informing Change, Berkeley, CA.

Address correspondence to: Lauren E. Au, PhD, RD, Nutrition Policy Institute, Division of Agriculture and Natural Resources, University of California, 2115 Milvia St, Suite 301, Berkeley, CA 94704. E-mail: leau@ucanr.edu

STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT

This project has been supported by federal funds from the US Department of Agriculture, Food and Nutrition Service through grant WIC NEI-12-TX to Baylor College of Medicine to the Nutrition Policy Institute at the University of California Division of Agriculture and Natural Resources. The contents of this publication do not necessarily reflect the view or policies of the US Department of Agriculture, nor does mention of trade names, commercial products, or organizations imply endorsement by the US Government.

ACKNOWLEDGEMENTS

The authors wish to thank Patricia Crawford, DrPH, RD, with the Nutrition Policy Institute, University of California Division of Agriculture and Natural Resources, for her thoughtful review of the manuscript; and the WIC sites, staff, and participants who were part of the study.