



# 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

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## ABSTRACT

**Background** Although in-person education is expected to remain central to the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) service delivery, effective online nutrition education has the potential for increased exposure to quality education and a positive influence on nutrition behaviors in WIC participants. Education focused on promoting healthy breakfast behaviors is an important topic for WIC participants because breakfast eating compared with breakfast skipping has been associated with a higher-quality diet and decreased risk for obesity.

**Objective** To examine the influences of online and in-person group nutrition education on changes in knowledge, attitudes, and behaviors related to breakfast eating.

**Design** Randomized-controlled trial comparing the effectiveness of online and in-person nutrition education between March and September 2014.

**Participants/setting** Five hundred ninety WIC participants from two Los Angeles, CA, WIC clinics were randomly assigned to receive in-person group education (n=359) or online education (n=231). Education focused on ways to reduce breakfast skipping and promoted healthy options at breakfast for parents and their 1- to 5-year-old children participating in WIC. Questionnaires assessing breakfast-related knowledge, attitudes, and behaviors were administered before and after education, and at a 2- to 4-month follow-up.

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

**Results** Changes in knowledge between pretest and follow-up at 2 to 4 months were similar between groups. Both groups reported reductions in barriers to eating breakfast due to time constraints, not having enough foods at home, and difficulty with preparation. Increases in the frequency of eating breakfast were greater for both the parent ( $P=0.0007$ ) and child ( $P=0.01$ ) in the online group compared with the in-person group during the same time points.

**Conclusions** Overall, this study demonstrates that both in-person and online nutrition education were effective in increasing breakfast-related knowledge in WIC participants, reducing breakfast skipping, and improving other breakfast-related behaviors, showing the potential usefulness for online education modalities for future WIC services.

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**N**UTRITION EDUCATION FOR ALL ADULT PARTICIPANTS sets the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) apart from all other federal nutrition assistance programs. Due to its broad reach to more than 8 million mothers and children a year,<sup>1</sup> WIC's success in improving nutrition during pregnancy and early childhood has a substantial influence on the nation's health.<sup>2</sup> Traditionally, WIC

has relied upon individual and group education where mothers and other caregivers are provided nutrition information during clinic visits.<sup>3</sup> Multiple studies have documented the effectiveness of in-person nutrition education in the WIC setting.<sup>4-6</sup> With rapid technologic advances and a more diverse WIC clientele, the need to explore innovative education methods that achieve positive outcomes in nutrition-related behaviors is needed.

Use of technology for health behavior change is a rapidly growing field of study. Use of multimedia kiosks, videos, and online educational modules has been evaluated and associated with improvements in a variety of health-related outcomes, including client enjoyment,<sup>7-9</sup> knowledge and stage of change in infant and child-feeding practices,<sup>10-13</sup> food safety,<sup>14</sup> stage of change in dietary intake,<sup>15-20</sup> physical activity,<sup>16,20</sup> and weight management.<sup>21,22</sup> In a 9-month WIC study, Bensley and colleagues<sup>23</sup> found that online education improved adult participant's fruit and vegetable intake more than traditional group education. However, because participants were allowed to choose their mode of nutrition education, the results may have been influenced by self-selection bias. Recent reviews have therefore called for studies of online education using more rigorous designs.<sup>24,25</sup>

Access to the Internet has rapidly increased in the United States, with 87% of adults using the Internet in 2014.<sup>26</sup> Currently, 90% of American adults have a cellular telephone and 58% have smartphones.<sup>27</sup> Whereas Internet use is still lower among Spanish-speakers than English-speakers and higher among individuals with more education, the digital divide is diminishing.<sup>28,29</sup> In fact, more Hispanic individuals (61%) have a smartphone compared with whites (53%) or African Americans (59%).<sup>27</sup> In a cross-sectional sample of WIC clients surveyed in 2011, half of the respondents (51%) accessed the Internet on a computer device, 23% accessed it via a cellular telephone, and 25% used computerized devices and cellular telephones equally.<sup>30</sup>

To our knowledge, a rigorous evaluation of the relative influences of online and traditional in-person modes of delivering nutrition education in WIC has not been conducted. Given the uncertain federal fiscal climate and the growing interest of WIC participants in accessing education through technology, the development and use of innovative methods of effectively delivering nutrition education to WIC participants has never been more imperative. Therefore, the purpose of this study was to examine the influences of online and in-person group nutrition education on changes in knowledge, attitudes, and behaviors related to breakfast eating in a randomly selected sample of WIC participants. Breakfast was selected as the lesson topic because it had not been taught before as part of nutrition education at WIC-participating study sites and studies have shown that breakfast eating compared with breakfast skipping has been associated with a higher-quality diet and decreased risk for obesity.<sup>31</sup> The hypothesis was that WIC participants receiving online nutrition education would be comparable in breakfast-related knowledge, attitudes, and behavior change scores compared with the in-person nutrition education group. Findings from this study are expected to be useful in providing further documentation of the influence of in-person education, as well as expanding the literature on the influence of online nutrition education in WIC participant behavior change.

## METHODS

### Participants

WIC participants were recruited from a list of all participants scheduled to come to two WIC Public Health Foundation Enterprises study sites during the 2-month period when the breakfast class was taught in person (April to May 2014).

Potential WIC participants were called and asked a series of questions to determine eligibility. These calls were conducted in English and Spanish and clarification questions were answered via telephone. Exclusion criteria included aged younger than 18 years, no child in WIC between ages 1 and 5 years, pregnant, unable to read English or Spanish, a child with any condition known to influence food intake, plans to not return to their 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). Pregnant mothers were excluded because pregnant mothers attended group education related to pregnancy and breastfeeding and would not attend the in-person breakfast class. From this eligible group of WIC participants, a random sample of equal numbers of English-speaking and Spanish-speaking participants was selected and assigned to the online group. The remaining sample was not contacted and remained in the in-person education group. Verbal consent was obtained prior to administering the questionnaire and lesson to participants. The University of California, Berkeley, Institutional Review Board approved the study protocol.

Women assigned to the in-person group came in as usual for their regular WIC appointment and received a group nutrition lesson on breakfast. Women assigned to the online group received a telephone call from WIC research staff the week before their WIC appointment and were asked to take the breakfast class online before coming into WIC for their appointment. Women assigned to the online group were e-mailed and/or texted the link to access nutrition education online and instructed to visit the website and complete the breakfast class before their next WIC appointment. Participants were told this would allow them to receive WIC education via the Internet and would facilitate a faster visit at the WIC site for voucher pick-up and individual counseling. In cases where WIC participants refused to complete the online class, then they could attend the in-person education group class and were not included in the study.

### Intervention Description: Breakfast Class

Following standard curriculum development protocol, the Public Health Foundation Enterprises WIC nutrition education staff developed the in-person group breakfast class and pilot tested the class in English and Spanish with 10 to 15 WIC participants. The content of the breakfast lesson was focused on the principals of learner-centered education.<sup>32,33</sup> The goals of the breakfast class were to teach participants why it is important for adults and children to eat breakfast every day, why skipping breakfast can lead to poorer health for children and adults, how WIC foods can be used to make healthy breakfasts, and to have participants set personal goals for eating healthier breakfasts. Additional dietary messages taught in the class were: WIC cereals are healthy cereals and have 6 g sugar or less, fruit is a healthy breakfast option, and limit juice to 4 to 6 oz/day. Both in-person and online breakfast classes was offered in English and Spanish and were estimated to take roughly 15 to 20 minutes to complete.

### Structure of the In-Person Breakfast Class

The WIC instructor began the class with asking who had eaten breakfast that day, followed by describing the reasons

why breakfast is important using a poster board as a visual. Photographs of an energetic child and tired child and hot and cold breakfasts were used to dispel misconceptions regarding breakfast beliefs. A MyPlate visual was used to view portions and food groups of common breakfast foods. The lesson concluded with the group discussing challenges at breakfast time and referring to a pamphlet entitled, "Easy Breakfasts with WIC Foods" for tips and strategies for healthy breakfast options.

### Structure of the Online Breakfast Class

The online breakfast lesson was designed to exactly mirror the content provided during the in-person group lesson using text, prompts, and visual images. The online lesson consisted of single screens for each question and allowed participants to interact by providing open-ended responses. The online lesson began with asking whether the participant had breakfast by allowing the participant to type a response. The online lesson used the same photograph visuals of the tired and energetic child and hot and cold breakfasts. The lesson concluded with a review of the lesson plan and discussing challenges during breakfast time. The MyPlate visuals and tips and strategies for healthy breakfast options were also shown.

### Data Collection

Study participants completed a questionnaire directly before and after the lesson, and at a 2- to 4-month follow-up to assess breakfast knowledge, attitudes, and behaviors. The questionnaires were identical in the in-person and online groups. Breakfast eating frequency questions were adapted from the Healthy Kids Survey.<sup>34</sup> Self-efficacy questions related to eating and making breakfast were adapted from existing self-efficacy scales.<sup>35</sup> Knowledge questions were based on lesson content and newly developed. Food insecurity questions were taken from the validated two-item screener to identify families at risk for food insecurity.<sup>36</sup> Before administration, all survey questions were pilot-tested with 10 to 15 mothers of 1- to 5-year-old children in English and in Spanish. Pilot testing was conducted at WIC sites that were not involved in the study to ensure no participants would have been exposed to the questionnaires before the study.

The prequestionnaire consisted of 12 questions and was completed before the lesson commenced and then was collected by the WIC educator who was teaching the lesson. Immediately after the class, the WIC educator distributed a postquestionnaire with 12 questions to all lesson attendees. The postquestionnaire contained the same breakfast-related knowledge questions as the prequestionnaire, in addition to questions about the utilization of and satisfaction with the format of the lesson. In the WIC administrative office, the questionnaires were de-identified by removing all WIC identification numbers and replacing them with study ID numbers to prepare them for data entry. For online participants, the identical pre- and postquestionnaires were embedded in the online lesson directly before and after the online module.

The follow-up questionnaire included 19 questions and was administered 2 to 4 months after the breakfast lesson through either a paper survey at the WIC site at the participant's next WIC clinic visit or a telephone call from WIC staff.

The follow-up questionnaire contained similar breakfast-related knowledge, attitudes, and behaviors questions as the prequestionnaire, in addition to demographic questions not asked at baseline (ie, relation to child, marital status, education, length of time in WIC, and food insecurity).

### Statistical Analyses

Analyses were conducted by research staff at University of California, Berkeley, on the 590 of 667 eligible WIC participants. A total of 77 women were excluded for the following reasons: two participants had participated in both the online and in-person nutrition education groups, 2 had a time to follow-up that was <2 months, 5 did not have a 1- to 5-year-old child in WIC, 12 did not complete the prequestionnaire, and 56 in the online group were missing postquestionnaires due to a computer malfunction. The 56 participants who were missing postquestionnaires were not significantly different in demographic characteristics from the online group participants who were included in the total sample. Descriptive variables included race/ethnicity, parent education, marital status, relation to child, length of time family in WIC, language, work and school participation, food insecurity status, and previous exposure to an online lesson. Race/ethnicity categories were aggregated to white, Hispanic, African American, Asian, and multiracial/other. Parent education was dichotomized to high school graduate yes or no. Marital status was categorized to married, single, living with partner, and widowed/divorced/separated. Relation to child was dichotomized to mother and nonmother. Length of time family in WIC was categorized by <1 year, 1 to 2 years, 3 to 4 years, and 5 or more years. Language was categorized to English or Spanish. Work and school participation were categorized as full-time, part time, and none. Food insecurity was dichotomized as food insecure yes or no based on an affirmative answer to one or more of the following questions: In the past 12 months, "we worried whether our food would run out before we got money to buy more" and "the food that we bought just didn't last, and we didn't have money to get more." Previous exposure to an online lesson was dichotomized to yes or no. Outcome variables of interest included changes in knowledge, attitudes, and behaviors from pretest to follow-up.

Independent sample *t* tests and  $\chi^2$  analyses were used to compare demographic characteristics of online and in-person nutrition education groups. Paired *t* tests were used to compare differences within-group pre-post changes. Analysis of covariance and generalized estimating equations were used to compare changes between groups in outcomes of knowledge, attitudes, and behaviors. Covariates that were controlled for included baseline question, relation to child, language, education, time to follow-up, and any previous exposure to an online lesson because they were found to be significantly different between the online and in-person groups. Data were analyzed using SAS version 9.4 (2013, SAS Institute Inc). A *P* value <0.05 was considered statistically significant in all analyses.

### RESULTS

Of the 590 WIC participants in our sample, 359 (60.8%) participated in the in-person education group and 231 (39.2%) participated in the online education group (Table 1).

**Table 1.** Comparison of demographic characteristics for in-person and online education groups of participants with 1- to 5-year-old children recruited from two Public Health Foundation Enterprises Special Supplemental Nutrition Program for Women Infants and Children (WIC) clinics in Los Angeles, CA

Characteristic (N=590) <sup>a</sup>	In-Person (n=359)	Online (n=231)	P value <sup>b</sup>
	←—————mean±standard deviation—————→		
Age (n=580) (y)	31.85±7.06	32.01±6.27	0.77
Child age (n=587)	2.35±1.09	2.52±1.11	0.08
Time to follow-up (n= 590) (d)	105.90±12.47	93.52±16.03	<0.0001
	←—————n (%)—————→		
<b>Race (n=590)</b>			0.56
White	15 (4.18)	15 (6.49)	
Hispanic	295 (82.17)	190 (82.25)	
African American	14 (3.90)	9 (3.90)	
Asian	24 (6.69)	12 (5.19)	
Other	11 (3.06)	5 (2.16)	
<b>Education (n=585)</b>			0.01
Not high school graduate	128 (35.96)	59 (25.97)	
High school graduate and above	228 (64.04)	171 (74.03)	
<b>Marital status (n=589)</b>			0.19
Married	180 (50.14)	105 (45.65)	
Single	83 (23.12)	64 (27.83)	
Living with partner	58 (16.16)	45 (19.57)	
Widowed/divorced/separated	38 (10.58)	16 (6.96)	
<b>Relation to child (n=589)</b>			0.04
Mother	342 (95.53)	228 (98.70)	
Nonmother	16 (4.47)	3 (1.30)	
<b>Language (n=590)</b>			<0.0001
English	175 (48.75)	152 (65.80)	
Spanish	184 (51.25)	79 (34.20)	
<b>Length of time family in WIC (n=566) (y)</b>			0.10
<1	32 (9.33)	9 (4.04)	
1-2	79 (23.03)	50 (22.42)	
3-4	120 (34.99)	80 (35.87)	
5 or more	112 (32.65)	84 (37.67)	
<b>Work (n=576)</b>			0.92
Full-time	70 (19.77)	47 (21.17)	
Part-time	67 (18.93)	41 (18.47)	
No	217 (61.30)	134 (60.36)	
<b>School (n=574)</b>			0.95
Full-time	17 (4.82)	11 (4.98)	

(continued on next page)

**Table 1.** Comparison of demographic characteristics for in-person and online education groups of participants with 1- to 5-year-old children recruited from two Public Health Foundation Enterprises Special Supplemental Nutrition Program for Women Infants and Children (WIC) clinics in Los Angeles, CA (continued)

Characteristic (N = 590) <sup>a</sup>	In-Person (n = 359)	Online (n = 231)	P value <sup>b</sup>
Part-time	34 (9.63)	23 (10.41)	
No	302 (85.55)	187 (84.62)	
<b>Food insecurity (n=573) (yes)<sup>c</sup></b>	165 (47.55)	97 (42.92)	0.28
<b>Previous exposure to online lesson (n=589) (yes)</b>	42 (11.73)	52 (22.51)	<b>0.0005</b>

<sup>a</sup>Because of missing values, the sample size is not the same for all variables.

<sup>b</sup>Differences in continuous variables by *t* test and categorical by  $\chi^2$  test. Boldface type indicates a significant *P* value.

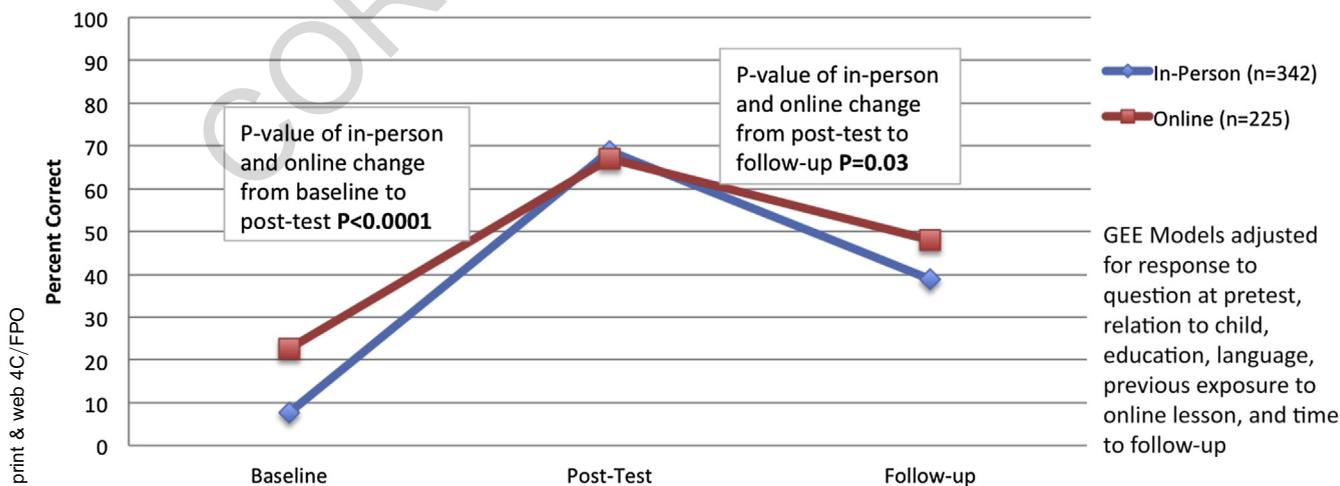
<sup>c</sup>Food insecurity was defined as an affirmative answer to one or more of the following questions: In the past 12 months, "we worried whether our food would run out before we got money to buy more" and "the food that we bought just didn't last, and we didn't have money to get more."

The majority of participants were Hispanic (82.6%) and mothers (96.8%). Most (71.4%) of the participants were aged 35 years or younger. There were no statistically significant differences between in-person group and online education groups for parent age, child age, race, marital status, length of time in WIC, work or school participation, or food insecurity. However, education, relation to child, primary language spoken, time to follow-up, and a previous exposure to an online lesson (ie, having taken at least one online lesson before) differed between the two groups. There were more nonmothers (ie, fathers or grandparents) than mothers in the in-person education group compared with the online education group (4.5% vs 1.3%). There were fewer parents with at least a high school degree in the in-person education group compared with the online group (64.0% vs 74.0%). There were more Spanish speakers in the in-person education group than in the online group (51.3% vs 34.2%). Time to follow-up differed between groups with a longer duration between presurvey and follow-up for the in-person group compared with the online group (106 days vs 94 days). A lower

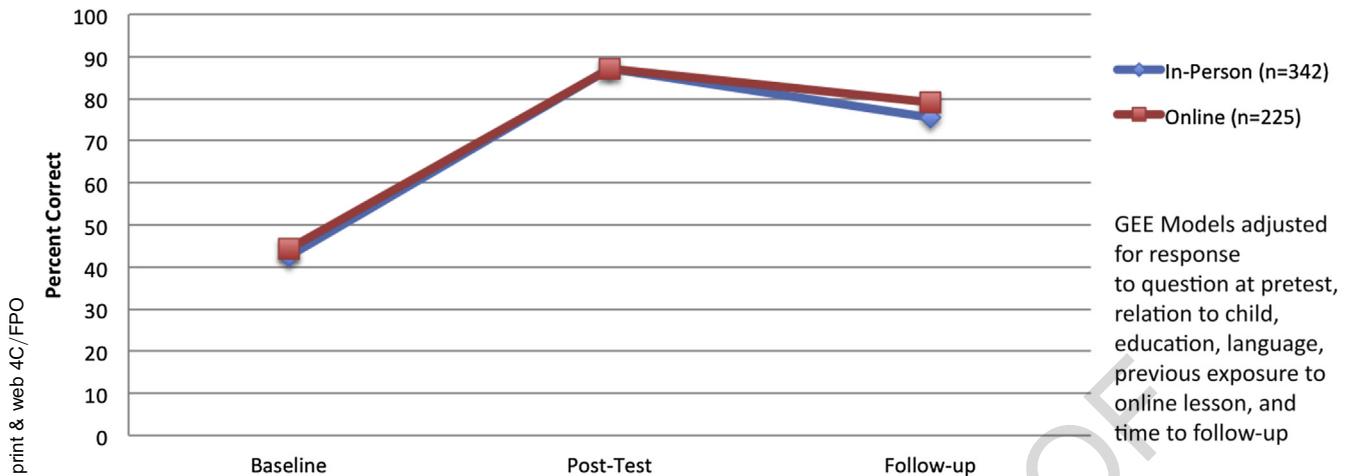
proportion of the in-person group had previous exposure to an online WIC nutrition education lesson (11.7% vs 22.5%).

Participants were asked, "How much sugar can WIC cereals have per serving?" and there was a significant difference in knowledge retention between the two groups from baseline to postquestionnaire and postquestionnaire to follow-up (Figure 1). The in-person group showed a larger improvement in knowledge from prequestionnaire to postquestionnaire ( $P < 0.0001$ ) and a greater decline in retention from postquestionnaire to follow-up compared with the online group ( $P = 0.03$ ). Participants increased and retained knowledge about how much juice WIC recommends per day, and there were no significant differences between the in-person and online groups (Figure 2). Participants also showed improvement for other knowledge questions related to breakfast beliefs directly following the lesson, and there were no significant differences between groups (Table 2).

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



**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.



**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.

(Table 3). Although the responses to the self-efficacy questions changed within groups for different measures, change scores were not significantly different between groups (Table 3). Increases in the frequency of eating breakfast were greater for both the parent and child in the online group compared with the in-person group (Table 4). Further, there was a greater decline in children’s vegetable intake at breakfast at follow-up in the in-person group compared with the online group ( $P=0.02$ ).

## DISCUSSION

Results of this study demonstrate that online nutrition education can be an effective addition to traditional in-person group education to promote healthy breakfast behaviors in WIC participants. Similar to in-person group education, online nutrition education improved participants’ breakfast-related knowledge, attitudes, and behaviors and were maintained over several months of time.

Overall, the breakfast lesson improved most breakfast-related behaviors for all participants regardless of how it was administered. Positive changes in knowledge were seen in both groups, showing that participants were able to retain the information they learned at follow-up. These findings are consistent with other studies comparing online education to in-person delivery methods.<sup>37,38</sup> For example, in a 2011 study of low-income adults,<sup>37</sup> most nutrition-related behavior outcomes, which included breakfast eating, improved significantly in both online and in-person education groups, showing that both interventions were effective. In the present study, at baseline the in-person group included more children who ate or drank something at breakfast compared with the online group. Although adjustments were made for baseline, it is important to note that the in-person group had little opportunity for improvement because they started considerably higher than the online group. In a study of WIC participants examining fruit and vegetable intake after an online or in-person education intervention Bensley and colleagues<sup>23</sup> found that online nutrition education contributed

to a higher fruit and vegetable consumption at follow-up. Further, in a meta-analysis comparing Internet interventions with non-Internet-based interventions on health behavior outcomes, the Internet intervention studies showed similar improvements in knowledge and behavior change outcomes, such as increased knowledge of nutritional status and increased exercise time.<sup>38</sup>

In the present study, English-speakers and Spanish-speakers behaved differently in how they chose to receive their education. Although participants were randomly assigned to the in-person or online group, more Spanish-speakers were unable to access online education and/or failed to complete the online education than English-speakers. Differences in the utilization and satisfaction of the mode of education between English and Spanish speakers will be examined in a larger sample of WIC participants. From the perspective of the dietetics profession, the findings highlight the value of allowing WIC participants the flexibility and convenience of choosing between multiple nutrition education modalities, which could potentially lead to sustained behavior change in this population.

Strengths of the study included the large and multiethnic sample size of WIC participants in >1 WIC location and the rigorous evaluation of the relative influence of online compared with in-person modes of delivering nutrition education in WIC. The study also used a pretest, posttest, and 2- to 4-month follow-up design that provided an assessment of the short- and long-term retention of knowledge and change in attitudes and behaviors. Furthermore, the study took place using traditional WIC protocols and WIC staff-implemented nutrition education curriculum in an effort to make the findings as relevant to the real world as possible.

There were also study limitations. Although participants were randomized to in-person or online at the beginning of the study, not all participants assigned to each group completed the study, resulting in different attrition rates between groups. In addition, a computer error caused the loss of posttest data from some participants in the online group, which further reduced the sample size of this group. The

**Table 2.** Knowledge directly after taking the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) breakfast lesson by in-person and online nutrition education participants from two Public Health Foundation Enterprises WIC clinics in Los Angeles, CA<sup>a</sup>

Knowledge item	In-Person (n = 330)				Online (n = 218)				In-person vs online change score	In-person vs online (change) P value <sup>e</sup>
	Baseline	Posttest	In-person change score	P value <sup>d</sup>	Baseline	Posttest	Online change score	P value <sup>d</sup>		
	←—mean±standard deviation—→				←—mean±standard deviation—→				mean±standard deviation	
Children behave better when they have eaten breakfast <sup>b</sup>	3.68±0.83	3.79±0.72	0.10±0.89	<b>0.03</b>	3.74±0.68	3.83±0.54	0.10±0.77	0.06	0.11±0.84	0.88
Hot breakfasts are healthier than cold breakfasts <sup>bc</sup>	2.96±1.05	2.69±1.15	-0.27±1.28	<b>0.001</b>	2.86±1.05	2.40±1.20	-0.46±1.22	<b>&lt;0.0001</b>	-0.35±1.24	0.06
It is easy to make breakfast using WIC foods <sup>b</sup>	3.60±0.87	3.76±0.74	0.17±0.94	<b>0.001</b>	3.73±0.61	3.84±0.51	0.11±0.67	<b>0.01</b>	0.14±0.84	0.61

<sup>a</sup>Because of missing values, the sample size is not the same for all variables.

<sup>b</sup>Responses scored as follows: 1=disagree a lot, 2=disagree a little, 3=agree a little, and 4=agree a lot.

<sup>c</sup>A lower number represents a more desirable answer.

<sup>d</sup>Paired sample *t* test. Boldface type indicates a significant *P* value.

<sup>e</sup>Analysis of covariance adjusted for response to question at pretest, relation to child, education, language, and previous exposure to online lesson.

**Table 3.** Breakfast-related attitudes at baseline and follow-up at 2 to 4 months by in-person and online nutrition education participants from two Public Health Foundation Enterprises Special Supplemental Nutrition Program for Women Infants and Children (WIC) clinics in Los Angeles, CA<sup>a</sup>

Breakfast-related attitude	In-Person (n=356)				Online (n=231)				In-person vs online change score	In-person vs online (change) P value <sup>d</sup>
	Baseline	Follow-up	In-person change score	P value <sup>c</sup>	Baseline	Follow-up	Online change score	P value <sup>c</sup>		
	←—mean±standard deviation—→				←—mean±standard deviation—→				mean±standard deviation	
<b>Reasons for skipping breakfast during past 30 d<sup>b</sup></b>										
Lack of time	1.88±1.05	1.80±1.10	−0.09±1.31	0.22	1.77±1.14	1.60±0.95	−0.18±1.14	<b>0.02</b>	0.09±1.25	0.14
Lack of enough food at home	1.47±0.82	1.40±0.89	−0.07±0.96	0.20	1.59±0.93	1.26±0.68	−0.33±0.99	<b>&lt;0.0001</b>	0.27±0.97	0.20
Lack of hunger	1.80±0.99	1.69±1.05	−0.11±1.17	0.07	1.70±0.96	1.52±0.88	−0.18±1.00	<b>0.005</b>	0.07±1.10	0.31
Difficulty preparing breakfast	1.17±0.55	1.22±0.84	0.04±0.89	0.37	1.26±0.78	1.11±0.51	−0.15±0.82	<b>0.007</b>	0.19±0.86	0.09
<b>Self-efficacy<sup>e</sup></b>										
Eat breakfast every morning	2.81±0.45	2.80±0.50	−0.01±0.60	0.86	2.81±0.47	2.85±0.45	0.03±0.60	0.31	−0.04±0.59	0.08
Give child breakfast every morning	2.97±0.21	2.99±0.17	0.02±0.26	0.10	2.94±0.27	2.99±0.09	0.05±0.28	<b>0.01</b>	−0.03±0.27	0.94
Give child a fruit at breakfast every morning	2.79±0.43	2.85±0.40	0.06±0.53	<b>0.03</b>	2.76±0.46	2.84±0.40	0.08±0.55	<b>0.04</b>	−0.02±0.54	0.41
Give child a vegetable at breakfast every morning	2.47±0.67	2.39±0.68	−0.08±0.82	0.07	2.35±0.72	2.35±0.67	0.00±0.84	1.00	−0.08±0.83	0.41
Give child other WIC foods besides fruits and vegetables at breakfast every morning	2.87±0.37	2.88±0.36	0.02±0.47	0.50	2.83±0.45	2.90±0.31	0.07±0.53	<b>0.03</b>	−0.06±0.49	0.35

<sup>a</sup>Because of missing values, the sample size is not the same for all variables.<sup>b</sup>Responses scored as follows: 1=almost never, 2=once in a while, 3=sometimes, 4=often, and 5=almost always.<sup>c</sup>Paired samples *t* test. Boldface type indicates a significant *P* value.<sup>d</sup>Analysis of covariance adjusted for response to question at pretest, relation to child, education, language, and previous exposure to online lesson.<sup>e</sup>Responses scored as follows: 1=not sure, 2=a little sure, and 3=very sure.

**Table 4.** Change in parent-reported breakfast behaviors over the past 7 days by in-person and online nutrition education participants from two Public Health Foundation Enterprises Special Supplemental Nutrition Program for Women Infants and Children (WIC) clinics in Los Angeles, CA<sup>a</sup>

Behavior	In-Person (n=341)				Online (n=231)				In-person vs online change score	In-person vs online (change) P value <sup>c</sup>
	Baseline	Follow-up	In-person change score	P value <sup>b</sup>	Baseline	Follow-up	Online change score	P value <sup>b</sup>		
	← mean d/wk ± standard deviation →				← mean d/wk ± standard deviation →				mean d/wk ± standard deviation	
<b>Parent</b>										
Eat breakfast	5.91±1.63	6.01±1.48	0.09±1.78	0.33	6.02±1.62	6.37±1.18	0.36±1.65	<b>0.001</b>	-0.26±1.73	<b>0.0007</b>
Eat breakfast with child	5.33±2.06	5.32±2.02	-0.01±2.33	0.93	5.29±2.18	5.46±2.03	0.17±2.19	0.23	-0.19±2.28	0.14
<b>Child</b>										
Eat or drink something for breakfast	6.60±1.18	6.62±1.20	0.02±1.37	0.82	5.94±1.26	6.81±0.83	0.87±1.49	<b>&lt;0.0001</b>	-0.85±1.42	<b>0.01</b>
Eat breakfast that contained fruit (not counting fruit juice)	5.09±1.88	4.81±1.88	-0.28±2.29	<b>0.02</b>	4.58±1.89	4.80±1.96	0.22±2.14	0.13	-0.50±2.23	0.08
Eat breakfast that contained a vegetable	3.33±2.46	2.89±2.32	-0.44±2.68	<b>0.002</b>	3.08±2.31	3.04±2.25	-0.04±2.48	0.81	-0.41±2.60	<b>0.02</b>
Eat breakfast that contained other WIC foods	5.55±1.81	5.84±1.71	0.29±2.24	<b>0.02</b>	5.47±1.61	5.91±1.57	0.43±2.02	<b>0.001</b>	-0.14±2.16	0.10
Eat breakfast at preschool or child care	1.49±2.43	1.00±2.05	-0.50±2.81	<b>0.002</b>	1.52±2.48	0.74±1.80	-0.78±2.56	<b>&lt;0.0001</b>	0.28±2.70	0.41
Not sure what child ate for breakfast	0.59±1.62	0.51±1.57	-0.08±2.01	0.46	0.55±1.51	0.47±1.58	-0.08±2.17	0.58	-0.00±2.08	0.38

<sup>a</sup>Because of missing values, the total n is not the same for all variables.<sup>b</sup>Paired samples t test. Boldface type indicates a significant P value.<sup>c</sup>Analysis of covariance adjusted for response to pretest question, relation to child, education, language, time to follow-up, and previous exposure to online lesson. Boldface type indicates a significant P value.

## RESEARCH

online education group was more educated, included fewer Spanish-speakers, had fewer nonmothers, had a shorter time to follow-up, and had previously participated in an online lesson compared with the in-person group. As a result of this limitation, the differences between the two groups for language, education, relation to child, time to follow-up, and previous exposure to an online lesson were controlled for in the main analysis. Another limitation is there could have been potential bias of participants to answer the questionnaires in a way to please the WIC educator because the educator taught the lesson and administered the questionnaire. To minimize this potential bias, participants placed their questionnaires in an envelope and were later identified by removing all WIC identification numbers and replacing them with study ID numbers by WIC research staff. Further, the in-person lessons could vary in quality because of different teachers, which will be explored in a larger set of WIC participants.

## CONCLUSIONS

This research provides evidence that both in-person and online nutrition education can lead to positive changes in breakfast-related knowledge, attitudes, and behaviors. Further application of online nutrition education for WIC participants could broaden the reach of WIC education and increase positive behavior outcomes. Future research should study other nutrition education topics because results from this type of study can inform the development of innovative and effective nutrition education to a diverse WIC population.

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## STATEMENT OF POTENTIAL CONFLICT OF INTEREST

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