Breast and Cervical Cancer Screening Literacy Among Korean American Women: A Community Health Worker–Led Intervention

Hae-Ra Han, RN, PhD, Youngshin Song, RN, PhD, Miyong Kim, RN, PhD, Haley K. Hedlin, PhD, Kyounghae Kim, RN, PhD, Hochang Ben Lee, MD, and Debra Roter, DrPH

Objectives. To test a community health worker (CHW)-led health literacy intervention on mammogram and Papanicolaou test screening among Korean American women.

Methods. We conducted a cluster-randomized trial at 23 ethnic churches in the Baltimore, Maryland–Washington, DC, metropolitan area between 2010 and 2014. Trained CHWs enrolled 560 women. The intervention group received an individually tailored cancer-screening brochure followed by CHW-led health literacy training and monthly telephone counseling with navigation assistance. Study outcomes included receipt of an age-appropriate cancer screening test, health literacy, cancer knowledge, and perceptions about cancer screening at 6 months.

Results. The odds of having received a mammogram were 18.5 (95% confidence interval [CI] = 9.2, 37.4) times higher in the intervention than in the control group, adjusting for covariates. The odds of receiving a Papanicolaou test were 13.3 (95% CI = 7.9, 22.3) times higher; the odds of receiving both tests were 17.4 (95% CI = 7.5, 40.3) times higher. Intervention effects also included increases in health literacy and positive perceptions about cancer screening.

Conclusions. A health literacy–focused CHW intervention successfully promoted cancer-screening behaviors and related cognitive and attitudinal outcomes in Korean American women. (*Am J Public Health.* 2017;107:159–165. doi:10.2105/AJPH.2016.303522)

Despite considerable progress in US cancer control over the past 20 years,[1] Korean American women suffer significant cancer disparities.[2,3] They have the second highest cervical cancer incidence rate among 6 major Asian ethnic groups; the incidence rate is also higher than that of non-Hispanic White and Black women (11.9 per 100 000 vs 7.1 and 9.9 per 100 000 for non-Hispanic White and Black women, respectively).[2] The breast cancer rate has also been increasing at a much higher rate than in other ethnic groups.[3] Data indicate that recent immigrant women (e.g., Asian women) are particularly vulnerable to late-stage diagnosis for breast[3] and cervical[2] cancer. Regular mammography and Papanicolaou (Pap) tests are accepted as a critical strategy in early detection and timely treatment of breast and cervical cancer. Yet, Korean American women have had consistently lower mammogram and Pap test rates than have other ethnic groups.[4]

Non–English-speaking immigrants in the United States face significant language and access barriers to these tests.[5] This is especially true for Korean immigrants: more than 80% speak Korean at home, and 55% report difficulty with English.[6] In addition to limited English proficiency, this group is characterized by significant health literacy deficits. Health literacy—the degree to which individuals have the capacity to obtain, process, and understand basic health information and services to make appropriate health decisions[7]—is recognized as a critical element of access to high-quality, patient-centered care. Health literacy deficits among Korean American women are a significant barrier in obtaining breast and cervical cancer screening tests.[5,8]

Recent systematic reviews and meta-analyses[9–11] of interventions designed to increase mammogram and Pap screening participation among ethnic minority women have included culturally sensitive interventions using community health workers (CHWs). For the most part, the interventions have focused on increasing knowledge or accommodating women's needs and have produced small effect sizes.[9–11] None of the studies in these reviews has attempted to directly address the health literacy skill deficits of ethnic minority women as a strategy to improve cancer-screening participation rates. We address this gap by testing the impact of a CHW intervention focused on building health literacy skills among Korean American women.

ABOUT THE AUTHORS

Hae-Ra Han and Kyounghae Kim are with the School of Nursing, Johns Hopkins University, Baltimore, MD. Youngshin Song is with the College of Nursing, Choongnam University, Choongchung-Do, Korea. Miyong Kim is with the School of Nursing, University of Texas, Austin. Haley K. Hedlin is with the Department of Medicine, Stanford University, Stanford, CA. Hochang Ben Lee is with the School of Medicine, Yale University, New Haven, CT. Debra Roter is with the Bloomberg School of Public Health, Johns Hopkins University.

Correspondence should be sent to Hae-Ra Han, RN, PhD, FAAN, Johns Hopkins University School of Nursing, 525 N. Wolfe Street, Baltimore, MD 21205-2110 (e-mail: hhan3@jhu.edu). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.

This article was accepted October 14, 2016.

doi: 10.2105/AJPH.2016.303522

METHODS

We conducted this study between March 1, 2010, and November 30, 2014. We used a cluster-randomized wait list control design to compare a CHW-led health literacy intervention with an educational control. Detailed recruitment methods are described elsewhere.[12] In brief, trained CHWs from 23 ethnic churches in the Baltimore, Maryland–Washington, DC, Metropolitan Area recruited the study sample. The inclusion criteria were (1) was a Korean American woman, (2) was aged 21 to 65 years, (3) had not had either a mammogram (for women aged ≥ 40 years only) or a Pap test within the past 24 months, and (4) was able to read and write Korean or English. On the basis of the American Cancer Society's current cancer-screening guidelines, every woman in the study was overdue at the time of enrollment.

Once CHWs identified eligible women, trained bilingual research assistants visited each church to obtain written informed consent and collect data. A total of 560 women agreed to participate and completed a study questionnaire at baseline (intervention: n = 278; control: n = 282). At baseline, the majority of the sample (n = 336) were overdue for both mammography and a Pap test screening, 63 women were overdue for a mammogram only, and 161 women were overdue for a Pap test only (137 were ineligible for a mammogram because they were younger than 40 years).

Sample Size Calculation

The primary outcome was adherence to age-appropriate screening guidelines at 6-month follow-up.

After careful consideration of reported effect sizes of CHW interventions for breast and cervical cancer screening,[13,14] we assumed that the proportion of women screened differed by 18% for both cancers with an intraclass correlation (ICC) efficient of 0.10[15] and a dropout rate of 30%. A sample size of 480 would achieve a statistical power of 0.88 to detect a minimal difference between the intervention and control groups at an α coefficient of 0.05.

Selection and Training of CHWs

We selected 29 CHWs (14 CHWs in the intervention churches and 15 CHWs in the control churches) on the basis of interest, availability, and commitment to this project. All CHWs were women, were in their late 40s to early 60s, and had at least a high school level of education. None had worked in the area of breast or cervical cancer.

CHW training differed by group assignment: CHWs in the intervention group received 16 hours of training over 3 days, whereas CHWs in the control group received 5 hours of training in 1 day. We validated CHW competency on the basis of interactive training activities in several core areas, including participant orientation to the study, health literacy training session presentation using select examples, and 1-on-1 counseling with navigation support using a standardized protocol.

Randomization and Intervention

We randomized the participating churches (intervention = 11; wait list control = 12) on the basis of their size and location. The wait list control group received publicly available educational brochures related to breast and cervical cancer. The intervention group received an individually tailored cancer-screening brochure, health literacy skills training, and telephone counseling with navigation assistance.

We mailed the intervention group participants an educational brochure tailored to their individual risk factors for breast and cervical cancer. After this initial mailing, trained CHWs delivered health literacy skills training in a 1.5- to 2-hour-long group meeting. We designed the health literacy component to promote Korean American women's (1) understanding of key medical terminology used in conjunction with breast and cervical cancer screening, (2) screening of relevant medical instructions (e.g., appointment slips, follow-up instructions), and (3) familiarity with appropriate steps to navigate the health care system for mammogram and Pap test screening.

Community members and clinicians were engaged in the formative work leading up to the development of the health literacy intervention. We made observations at primary physician's offices, obstetrics and gynecology clinics, and mammogram facilities to identify common scenarios and medical communication that participants were likely to encounter in these settings. On the basis of our observations, we produced a DVD and picture guidebook to help participants feel confident and prepared to engage with the health care system when seeking screening services. The CHWs facilitated small group meetings of 7 or 8 women at a time in a variety of community sites (e.g., ethnic churches, the CHWs' homes, food courts in ethnic grocery stores, popular ethnic cafés) to practice key medical phrases in English and role-play the scenarios presented in the DVD and guidebook.

At the end of the session, participants received a copy of the DVD and guidebook to reinforce what they learned and practiced in class. CHWs scheduled and planned the group meetings and contacted their participants via telephone, via text messaging, or face-to-face. Dedicated study staff members worked closely with the CHWs to help facilitate the coordination of small group meetings by providing a checklist and complete packages of educational materials and by checking in before and after scheduled group meetings. CHWs then made monthly telephone calls to reinforce the new skills and knowledge acquired from the health literacy training and to provide navigation assistance with individually specified barriers over a 6-month period.

Measures

We used a study questionnaire to assess individual characteristics. We assessed mammography and Pap test use via self-report at baseline and medical record review at 3 and 6 months. We used several instruments to measure psychosocial outcomes in the precede–proceed model[16]: health literacy, cancer knowledge, and perceptions about cancer screening. The instruments were made available in Korean.

We measured health literacy with the Assessment of Health Literacy in Cancer Screening.[17] This assessment includes 52 items that assess print literacy, numeracy, and familiarity with and comprehension of cancer-specific words. Example questions are

"How familiar are you with the following words?" and "Please read the passages below and select a word to fill in each blank." The Assessment of Health Literacy in Cancer Screening has been validated in a Korean sample[17] with α coefficients ranging from 0.70 for the numeracy scale to 0.96 for both the familiarity and the total scales.

We measured cancer knowledge with 2 tests: (1) the Breast Cancer Knowledge Test, which consists of 18 items translated into Korean with an α coefficient of 0.81[18]; and (2) the Cervical Cancer Knowledge Test, which consists of 10 items validated in Korean women, with an α coefficient of 0.80 to 0.89.[19] Example items include "Most breast cancer is associated with hereditary factors" and "Heavy smokers have an increased risk of cervical cancer." Because of the recent scientific findings about human papillomavirus (HPV) and cervical cancer, we added 10 items about HPV to the Cervical Cancer Knowledge Test (e.g., "HPV causes cervical cancer").

We used a decisional balance measure to assess perceptions about cancer screening.[20] Decisional balance refers to weighing the relative pros and cons of cancer screening and making a decision. To facilitate cancer screening, positive perceptions about cancer screening must increase and negative perceptions must decrease.[20] Example items are "Those people who are close to me will benefit if I have a mammogram" and "A Pap test can be done so quickly that it is not a bother to have one." The Cronbach α for the original scale ranged from 0.83 to 0.90, and α coefficients were 0.80 for mammogram and 0.84 for Pap testing in this sample.

Statistical Analyses

We used descriptive statistics to establish sample characteristics; we compared intervention and control groups at baseline using the independent sample *t* test or χ^2 test, as appropriate.

For the primary outcomes, we used generalized estimating equations (GEE) to fit marginal models comparing the odds of receiving an age-appropriate screening test in the intervention group to the odds in the control group at 6-month follow-up. We used GEE models with exchangeable working correlation matrices to account for correlated observations from women sampled from the same cluster (i.e., church).[21] We fit 3 separate models to estimate the population-averaged odds ratios (ORs) of adherence to mammogram, Pap testing, and both. We included only women who were eligible for mammogram screening, Pap test, or for both in the mammogram, Pap test, or both model. We adjusted all GEE models for age, years of education, health insurance status, employment status, level of English proficiency, years of US residence, and family history of breast cancer.

For psychosocial outcomes, we used linear mixed-effect models to estimate the difference between intervention and control groups in change from baseline. We used a mixed-effect model to account for correlated observations resulting from the cluster sampling design.[22] We used the restricted maximum likelihood method to fit the models. We adjusted the linear models regressing the change score (score at 6 months – score at baseline) on intervention group membership for the baseline score on the outcomes, age, years of education, health insurance status, employment status, level of English proficiency, years of US residence, and family history of breast cancer.[23]

We have presented results from analyses accounting for the missing follow-up data by assuming women with missing observations at follow-up had the same value as at baseline. For the screening outcome, we assumed that women who had missing information on the screening at 6 months did not undergo screening. For the psychosocial outcomes, we assumed there was no change in scores at 6 months in women who did not complete follow-up. We excluded from the analysis women who were missing baseline data. We fit models using a complete case analysis in a sensitivity analysis.

In post hoc analysis, we formally tested whether having read the intervention materials was an effect modifier of the intervention's effect on screening behaviors or psychosocial outcomes through the use of a statistical interaction term added to the models. We used the Wald test to investigate whether the coefficient on the interaction term was statistically significant ($P < .05$). We compared each intervention category with the control group in the GEE and linear models.

We calculated ICC for the binary outcomes.[24] We estimated the within-class correlation from the fit GEE model. For continuous outcomes, we calculated the ICC using the variance components from a 1-way analysis of variance. We completed all statistical analysis in R version 2.15.0 (R Foundation for Statistical Computing, Vienna, Austria). We used several R packages in our analysis: geepack,[25] nlme,[26] and ICC.[27]

RESULTS

Final analyses included 560 participants (data are available as a supplement to the online version of this article at http://www.ajph.org in the appendix). Participant baseline characteristics are summarized in Table 1. Despite randomization, the control group included more women who had higher subjective income and English proficiency.

Changes in Cancer-Screening Behaviors

At 6 months, 56.1% and 54.5%, respectively, of those in the intervention group received a mammogram and a Pap test compared with 10.0% and 9.2%, respectively, of women in the control group. Close to half (46.4%) of those eligible for both tests completed a mammogram and a Pap test compared with 6.5% in the control group. The odds of getting a mammogram were 18.5 (95% confidence interval [CI] = 9.2, 37.4) times higher in the intervention group than in the control group when adjusting for covariates. Similarly, the odds of getting a Pap test were 13.3 (95% CI = 7.9, 22.3) times higher in the intervention group than in the control group after adjusting for covariates. For a woman eligible for both mammogram and Pap test, the odds of getting both tests were 17.4 (95% CI = 7.5, 40.3) times higher in the intervention group than in the control group after adjustment (Table 2). The ORs seen in the sensitivity analysis including only women who had follow-up data were slightly larger than were those seen in the primary analysis (Table A, available as a supplement to the online version of this

TABLE 1—Characteristics of Participants at Baseline: Baltimore, MD–Washington, DC, Metropolitan Area, 2010–2014

Characteristic	Total (n = 560), No. (%) or Mean ±SD	Intervention (n = 278), No. (%) or Mean ±SD	Control (n = 282), No. (%) or Mean ±SD	P
Age, y (range = 21–64)	46.1 ±8.5	45.8 ±8.6	46.4 ±8.4	.44
Marital status				.78
Married or partnered	479 (85.5)	237 (86.6)	242 (85.7)	
Separated, widowed, or divorced	62 (11.1)	32 (11.6)	30 (10.6)	
Never married	19 (3.4)	9 (3.2)	10 (3.6)	
Education				.40
High school graduate or less	197 (35.2)	106 (37.9)	91 (32.3)	
Some college or more	363 (64.8)	172 (62.1)	191 (67.7)	
Employment				.87
Working full or part time	324 (57.9)	162 (58.3)	162 (57.5)	
Unemployed, retired, or other	236 (42.1)	116 (41.7)	120 (42.5)	
Length of stay in the United States, y (range = 1–62)	15.4 ±9.7	15.1 ±10.1	15.7 ±9.3	.47
Income level				.046
Very comfortable or comfortable	148 (26.4)	60 (21.6)	88 (31.2)	
Just OK	193 (34.5)	100 (36.0)	93 (33.0)	
Uncomfortable or very uncomfortable	217 (39.5)	118 (42.5)	101 (35.9)	
Health insurance	212 (37.9)	106 (38.1)	106 (37.6)	.90
Primary care provider	193 (34.5)	99 (35.6)	94 (33.3)	.57
English proficiency				.046
Not at all or poor	227 (40.5)	126 (45.3)	101 (35.8)	
Fair	202 (36.1)	98 (35.3)	104 (36.9)	
Fluent	131 (23.4)	54 (19.4)	77 (27.3)	
Past history of screening				
Never received a mammogram	260 (46.4)	132 (47.5)	128 (45.4)	.62
Never received a Pap test	287 (51.3)	147 (52.9)	140 (49.7)	.44
Never received any test (mammogram or Pap test)	157 (29.8)	81 (31.0)	76 (28.6)	.54
Family history of breast cancer	30 (5.4)	20 (7.2)	10 (3.6)	.06

Note. Pap = Papanicolaou.

article at http://www.ajph.org). Estimated ORs ranged between 15.3 and 23.2 and remained statistically significant.

Changes in Psychosocial Outcomes

The effects of the study intervention on psychosocial outcomes are presented in Table 3. The mean increase in health literacy was 7.0 points (95% CI = 4.9, 9.0) higher on average in women in the intervention group than in women in the control group when adjusting for covariates. For breast and cervical cancer knowledge, the change in the number of correct items in the intervention group was, respectively, 0.7 (95% CI = –0.1, 1.6) and –0.1 (95% CI = –0.3, 0.1) on average when adjusting for covariates.

For perceptions about cancer screening, the estimated mean increase in the intervention group was 1.3 points (95% CI = 0.4, 2.1) on average for breast cancer and 1.1 points (95% CI = 0.5, 1.6) on average for cervical cancer. The effects seen in the sensitivity analysis to evaluate the impact of missing data were consistent with those seen in the primary analysis (Table B, available as a supplement to the online version of this article at http://www.ajph.org).

Post Hoc Analysis

The effects of participant receipt of the intervention are presented in Table 4. Among women in the intervention group who read all the intervention materials, the odds of getting a mammogram were 31.1 (95% CI = 15.1, 63.9) times higher than in the control group women when adjusting for covariates; the odds among women in the intervention group who read some or none of the materials were 13.6 (95% CI = 6.9, 26.8) times higher. Similarly, the odds of getting a Pap test among women in the intervention group who read all materials were 26.7 (95% CI = 14.3, 49.7) times higher than in women in the control group after adjusting for covariates. Among women who read some or none of the materials, the estimated odds of getting a Pap test were 9.6 (95% CI = 6.0, 15.3) times higher in the

TABLE 2—Comparison of Behavioral Outcomes Between Intervention and Control Groups at 6 Months: Baltimore, MD–Washington, DC, Metropolitan Area, 2010–2014

Test	Intervention Group,[a] No. (%)	Control Group,[a] No. (%)	Difference Between Groups, %	OR (95% CI)[b]
Mammogram (n = 399)	111/198 (56.1)	20/201 (10.0)	46.1	18.5 (9.2, 37.4)
Pap test (n = 497)	134/246 (54.5)	23/251 (9.2)	45.3	13.3 (7.9, 22.3)
Both tests (n = 336)	77/166 (46.4)	11/170 (6.5)	39.9	17.4 (7.5, 40.3)

Note. CI = confidence interval; OR = odds ratio; Pap = Papanicolaou.

[a]Estimated from generalized estimating equations model accounting for clustering within a church and adjusting for age, insurance, English proficiency, years of US residence, years of education, employment, and family history of breast cancer.

[b]Women who were missing their screening status at follow-up were assumed to have not undergone screening.

intervention group than in the control group after adjusting for covariates. The interaction term was not statistically significant among women eligible for both tests (data not shown). The findings in the complete case sensitivity analysis were similar (Table C, available as a supplement to the online version of this article at http://www.ajph.org).

Regarding psychosocial outcomes, we observed no effect modification in the primary analysis including all women (data not shown). In women who completed the questionnaire at follow-up, the interaction term was only significant in the breast and cervical cancer knowledge models. Among women who read all the materials, the mean increase in breast cancer knowledge was 2.3 (95% CI = 1.6, 2.9) additional correct items in women who were in the intervention group compared with women in the control group when adjusting for covariates. Among women who read some or none of the materials, the estimated increase in number of correct items was 1.5 (95% CI = 0. 9, 2.0). For cervical cancer knowledge, the estimated increase in the number of correct items was 1.1 (95% CI = 0.6, 1.7) among women who read all materials and 0.9 (95% CI = 0.4, 1.3) among women who read some or none of the materials (Table C; ICC estimates are available as a supplement to the online version of this article at http://www.ajph.org in Table D).

DISCUSSION

We found that a CHW-led health literacy intervention can increase mammogram and Pap test rates among Korean American women. The findings demonstrate the effectiveness of a multifaceted health literacy approach for women with limited English proficiency as a promising strategy to diminish disparities in breast and cervical cancer screening.

CHW interventions using knowledge education with or without navigation assistance resulted in 6% to 33% between-group differences for mammography and 7% to 29% for Pap screening.[28] The between-group differences observed in our health literacy–focused intervention study were substantially larger, yielding mammography rates of 56.1% and Pap test rates of 54.5% (compared with 10.0% and 9.2%, respectively, for an educational control). The cost per screening required for a woman in our intervention group to receive a screening test compared with those in the control group, measured as the estimated incremental cost-effectiveness ratio (ICER), was $236.[29] Although few studies report a threshold by which to compare the ICER results, the ICER for interventions using CHWs was $726 for a Pap test among Chinese women[30] and $2451 for mammography among women living in rural areas (ethnicity unavailable).[31] Direct comparisons of our findings to these studies are not possible, because

TABLE 3—Comparison of Psychosocial Outcomes Between Intervention and Control Groups at 6 Months: Baltimore, MD–Washington, DC, Metropolitan Area, 2010–2014

	Intervention Group, Mean ±SD		Control Group, Mean ±SD		Estimated Mean Difference Between Groups (95% CI)[b]
Psychosocial Outcomes	Baseline	6 Months[a]	Baseline	6 Months[a]	
Health literacy (n = 560)	19.9 ±12.9	32.1 ±12.7	21.9 ±12.3	27.2 ±13.0	7.0 (4.9, 9.0)
Knowledge about					
Breast cancer (n = 560)	7.8 ±4.2	11.0 ±3.9	7.8 ±3.8	10.4 ±3.8	0.7 (–0.1, 1.6)
Cervical cancer (n = 560)	4.2 ±2.4	5.6 ±2.4	4.2 ±2.2	5.3 ±2.6	–0.1 (–0.3, 0.1)
Perceptions about screening for					
Breast cancer (n = 560)	47.7 ±5.6	50.0 ±6.0	47.7 ±6.3	49.0 ±6.0	1.3 (0.4, 2.1)
Cervical cancer (n = 558)	51.4 ±5.9	54.4 ±6.1	52.0 ±6.6	53.1 ±6.0	1.1 (0.5, 1.6)

Note. CI = confidence interval.

[a]Women who were missing psychosocial outcomes at follow-up were assumed to have no change in their scores from baseline.

[b]Mean change in score for intervention group minus mean change in score for control group was estimated using linear mixed-effects models adjusted for the baseline score on the outcome, age, years of education, health insurance status, employment status, level of English proficiency, years of US residence, and family history of breast cancer.

TABLE 4—Effect of Having Read the Intervention Materials on Screening Behaviors: Baltimore, MD–Washington, DC, Metropolitan Area, 2010–2014

Behavioral Outcomes	Screened, No. (%)	OR (95% CI)[a]
Mammogram (n = 399)[b]		
Intervention		
Read all	53/75 (70.7)	31.1 (15.1, 63.9)
Read some or none	58/123 (47.2)	13.6 (6.9, 26.8)
Control		
Read all	9/89 (10.1)	1.0 (0.6, 1.7)
Read some or none	11/112 (9.8)	1.0 (Ref)
Pap test (n = 497)[c]		
Intervention		
Read all	54/76 (71.1)	26.7 (14.3, 49.7)
Read some or none	80/170 (47.1)	9.6 (6.0, 15.3)
Control		
Read all	9/106 (8.5)	0.9 (0.6, 1.6)
Read some or none	14/145 (9.7)	1.0 (Ref)

Note. CI = confidence interval; OR = odds ratio. Estimated from generalized estimating equations model accounting for clustering within a church and adjusting for age, insurance, English proficiency, years in United States, years of education, employment, and family history of breast cancer.

[a]All estimates were calculated compared with a reference group of women who read some or none in the control group.

[b]*P* for interaction = .005.

[c]*P* for interaction < .001.

both studies calculated an ICER for a specific type of cancer screening, whereas we did not. Nevertheless, the ICER of $236 per additional screening seems reasonable when matched against other ICER values.[30,31]

The magnitude of our intervention effects is also likely a function of the CHWs' dedication, competence, shared characteristics—language, age, culture, and geographical area—and social networks, which built on common social and cultural norms in encouraging Korean American women to obtain cancer screening. In a focus group study,[12] our CHWs noted that the rigorous training on the study protocol and acquired competency from training triggered positive changes in their self-esteem and motivation that might have led to greater trust and building successful partnerships with the study participants. Similarly, the intervention effects may be attributed to our fidelity in monitoring CHW activities. Recent meta-analyses[9,10] revealed that CHW interventions resulting in a small or negative effect size (i.e., reduced cancer-screening rates after intervention) failed to adequately monitor CHW activities.

Having read the intervention materials was a significant effect modifier on the main study outcomes. In particular, the likelihood of the intervention participants completing a screening test doubled for both cancers when participants indicated that they had read all the intervention materials compared with those who read only some or none at all. Testing the effect modifier enabled us to gain additional insights into the importance of assessing treatment receipt—the degree to which interventions are received as planned[32]—in community-based cancer control interventions. A dietary intervention trial[33] revealed that participant motivation was associated with better intervention outcomes (i.e., higher energy reduction) in a sample of healthy women. Further research is warranted to examine the effect of participant motivation as an intervention effect modifier and ways that participant motivation can be promoted to maximize treatment receipt.

The study intervention significantly improved health literacy and perceptions about cancer screening but not cancer knowledge. We had revised an existing cancer knowledge test[19] to add items addressing HPV and its role in the etiology of cervical cancer, and this information may have been challenging for study participants. In a separate focus group study, a subsample of our study participants noted a lack of awareness and knowledge about HPV in the Korean American community.[34] Because of consistent cervical cancer disparities among recent immigrant women, such as Korean Americans,[2] future cervical cancer control interventions should incorporate key concepts about HPV and ways that HPV vaccinations can be promoted as a primary prevention strategy.

Limitations

The major study limitation was generalizing results beyond a church setting. Although more than three quarters of Korean Americans report attending ethnic churches on a regular basis, there are other community settings where cancer-screening interventions have successfully been tested for ethnic minority groups, including community organizations, cultural centers, and community health centers.[35]

Study limitations also include our inability to disentangle active intervention components. Because of the substantially larger effect size of our CHW-led health literacy intervention compared with other interventions using CHWs, investigating the effect of health literacy training alone appears to be a reasonable next step.

Conclusions

The CHW-led health literacy intervention was successful in promoting mammogram and Pap test screening among Korean American women. We incorporated health literacy training as a new intervention approach and obtained substantially larger effect sizes for both mammogram and Pap tests compared with other CHW interventions. Our results extend previous research demonstrating the benefit of CHW interventions for improving cancer-screening rates in underserved racial/ethnic minorities. The findings support the integral role of health literacy training to help transform the design of breast and cervical cancer-screening intervention from a knowledge-based to a skills-building focus. The health

literacy–focused CHW intervention approach holds great promise that might be productively disseminated to other types of cancer-screening behavior in different ethnic groups. AJPH

CONTRIBUTORS

H.-R. Han originated the study, drafted the article, led the writing, and supervised the study. H.-R. Han, Y. Song, M. Kim, H. K. Hedlin, and K. Kim contributed to the acquisition, analysis, and interpretation of the data. M. Kim, H. B. Lee, and D. Roter contributed to the development of the study concept and design. All authors contributed to the critical revision of the article.

ACKNOWLEDGMENTS

This study was supported by the National Cancer Institute (grant R01 CA129060).

The authors are grateful to all Korean American women and community health workers who participated in this study and to the research staff members, Jung-Ah Ahn, Hyekyung Chin, and Myunghee Kim, for their assistance with data collection.

Note. The National Cancer Institute had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, and approval of the article; or the decision to submit the article for publication.

HUMAN PARTICIPANT PROTECTION

Johns Hopkins's institutional review board approved the study protocol.

REFERENCES

1. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2015. *CA Cancer J Clin*. 2015;65(1):5–29.

2. Wang SS, Carreon JD, Gomez SL, Devesa SS. Cervical cancer incidence among 6 Asian ethnic groups in the United States, 1996 through 2004. *Cancer*. 2010;116(4):949–956.

3. Ooi SL, Martinez ME, Li CI. Disparities in breast cancer characteristics and outcomes by race/ethnicity. *Breast Cancer Res Treat*. 2011;127(3):729–738.

4. Chawla N, Breen N, Liu B, Lee R, Kagawa-Singer M. Asian American women in California: a pooled analysis of predictors for breast and cervical cancer screening. *Am J Public Health*. 2015;105(2):e98–e109.

5. Jacobs EA, Karavolos K, Rathouz PJ, Ferris TG, Powell LH. Limited English proficiency and breast and cervical cancer screening in a multiethnic population. *Am J Public Health*. 2005;95(8):1410–1416.

6. US Census Bureau. Language spoken at home by ability to speak English for the population. 2012. Available at: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_1YR_B16001&prodType=table. Accessed April 11, 2016.

7. Ratzan SC, Parker RM. *Introduction—Current Bibliographies in Medicine 2000–1: Health Literacy January 1990 Through October 1999*. Bethesda, MD: National Institutes of Health; US Department of Health and Human Services; 2000.

8. Lee E, Menon U, Nandy K, et al. The effect of a couples intervention to increase breast cancer screening among Korean Americans. *Oncol Nurs Forum*. 2014;41(3):E185–E193.

9. Han HR, Lee JE, Kim J, Hedlin HK, Song H, Kim MT. A meta-analysis of interventions to promote mammography among ethnic minority women. *Nurs Res*. 2009;58(4):246–254.

10. Han HR, Kim J, Lee JE, et al. Interventions that increase use of Pap tests among ethnic minority women: a meta-analysis. *Psychooncology*. 2011;20(4):341–351.

11. Chan DN, So WK. A systematic review of randomised controlled trials examining the effectiveness of breast and cervical cancer screening interventions for ethnic minority women. *Eur J Oncol Nurs*. 2015;19(5):536–553.

12. Choi E, Heo GJ, Song Y, Han HR. Community health worker perspectives on recruitment and retention of recent immigrant women in a randomized clinical trial. *Fam Community Health*. 2016;39(1):53–61.

13. Taylor VM, Hislop TG, Jackson JC, et al. A randomized controlled trial of interventions to promote cervical cancer screening among Chinese women in North America. *J Natl Cancer Inst*. 2002;94(9):670–677.

14. Yabroff KR, Mandelblatt JS. Interventions targeted toward patients to increase mammography use. *Cancer Epidemiol Biomarkers Prev*. 1999;8(9):749–757.

15. Donner A, Klar N. *Design and Analysis of Cluster Randomization Trials in Health Research*. New York, NY: Oxford University Press; 2000.

16. Green LW, Kreuter MW. *Health Program Planning: An Educational and Ecological Approach*. 4th ed. New York, NY: McGraw-Hill; 2005.

17. Han HR, Huh B, Kim MT, Kim J, Nguyen T. Development and validation of the assessment of health literacy in breast and cervical cancer screening. *J Health Commun*. 2014;19(suppl 2):267–284.

18. Lee H, Kim J, Han HR. Do cultural factors predict mammography behaviour among Korean immigrants in the USA? *J Adv Nurs*. 2009;65(12):2574–2584.

19. Park S, Chang S, Chung C. Effects of a cognition–emotion focused program to increase public participation in Papanicolaou smear screening. *Public Health Nurs*. 2005;22(4):289–298.

20. Rakowski W, Clark MA, Pearlman DN, et al. Integrating pros and cons for mammography and Pap testing: extending the construct of decisional balance to two behaviors. *Prev Med*. 1997;26(5 pt 1):664–673.

21. Liang KY, Zeger SL. Longitudinal data-analysis using generalized linear-models. *Biometrika*. 1986;73(1):13–22.

22. Rabe-Hesketh S. *Multilevel and Longitudinal Modeling Using Stata*. 2nd ed. College Station, TX: Stata Press; 2008.

23. Vickers AJ. The use of percentage change from baseline as an outcome in a controlled trial is statistically inefficient: a simulation study. *BMC Med Res Methodol*. 2001;1:6.

24. Crespi CM, Wong WK, Mishra SI. Using second-order generalized estimating equations to model heterogeneous intraclass correlation in cluster-randomized trials. *Stat Med*. 2009;28(5):814–827.

25. Højsgaard S, Halekoh U, Yan J. The R package geepack for generalized estimating equations. *J Stat Softw*. 2006;15(2):1–11.

26. Pinheiro J, Bates D, DebRoy S, Sarkar D; R Core Team. _nlme: linear and nonlinear mixed effects models. Available at: http://CRAN.R-project.org/package=nlme. Accessed July 1, 2016.

27. Wolak ME, Fairbairn DJ, Paulsen YR. Guidelines for estimating repeatability. *Methods Ecol Evol*. 2011;3(1):129–137.

28. Kim K, Choi JS, Choi E, et al. Effects of community-based health worker interventions improve chronic disease management and care among vulnerable populations: a systematic review. *Am J Public Health*. 2016;106(4):e3–e28.

29. Schuster AL, Frick KD, Huh BY, Kim KB, Kim M, Han HR. Economic evaluation of a community health worker-led health literacy intervention to promote cancer screening among Korean American women. *J Health Care Poor Underserved*. 2015;26(2):431–440.

30. Thompson B, Thompson AL, Chan NL, Hislop GT, Taylor VM. Cost effectiveness of cervical cancer screening among Chinese women in North America. *Asian Pac J Cancer Prev*. 2007;8(2):287–293.

31. Andersen MR, Hager M, Su C, Urban N. Analysis of the cost-effectiveness of mammography promotion by volunteers in rural communities. *Health Educ Behav*. 2002;29(6):755–770.

32. Lichstein KL, Riedel BW, Grieve R. Fair tests of clinical trials: a treatment implementation model. *Adv Behav Res Ther*. 1994;16(1):1–29.

33. Poore KM, Depper JB, Heilbrun LK, Lababidi S, Covington C, Djuric Z. Effect of participant motivation on rapid dietary changes in an intervention trial. *J Hum Nutr Diet*. 2002;15(3):211–214.

34. Kim K, Kim B, Choi E, Song Y, Han HR. Knowledge, perceptions, and decision making about human papillomavirus vaccination among Korean American women: a focus group study. *Womens Health Issues*. 2015;25(2):112–119.

35. Baker DW, Brown T, Buchanan DR, et al. Comparative effectiveness of a multifaceted intervention to improve adherence to annual colorectal cancer screening in community health centers: a randomized clinical trial. *JAMA Intern Med*. 2014;174(8):1235–1241.