



A Culturally Adapted Breast and Cervical Cancer Screening Intervention Among Muslim Women in New York City: Results from the MARHABA Trial

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Abstract

We examine the efficacy of MARHABA, a social marketing-informed, lay health worker (LHW) intervention with patient navigation (PN), to increase breast and cervical cancer screening among Muslim women in New York City. Muslim women were eligible if they were overdue for a mammogram and/or a Pap test. All participants attended a 1-h educational seminar with distribution of small media health education materials, after which randomization occurred. Women in the *Education + Media + PN* arm received planned follow-ups from a LHW. Women in the *Education + Media* arm received no further contact. A total of 428 women were randomized into the intervention (214 into each arm). Between baseline and 4-month follow-up, mammogram screening increased from 16.0 to 49.0% in the *Education + Media + PN* arm ($p < 0.001$), and from 14.7 to 44.6% in the *Education + Media* arm ($p < 0.001$). Pap test screening increased from 16.9 to 42.3% in the *Education + Media + PN* arm ($p < 0.001$) and from 17.3 to 37.1% in the *Education + Media* arm ($p < 0.001$). Cancer screening knowledge increased in both groups. Between group differences were not statistically significant for screening and knowledge outcomes. A longer follow-up period may have resulted in a greater proportion of up-to-date screenings, given that many women had not yet received their scheduled screenings. Findings suggest that the educational session and small media materials were perhaps sufficient to increase breast and cervical cancer screening among Muslim American women. ClinicalTrials.gov NCT03081507.

Keywords Asian Americans · Muslim Americans · Breast cancer screening · Cervical cancer screening · Community-based participatory research

Introduction

Islam is one of the fastest growing religions in the United States (US). While religious affiliation is not collected on the census, an estimated 3.45 million Muslims lived in the

US in 2017, up from 2.35 million in 2007, with a projection that the Muslim population will reach 8.1 million by 2050. Around 58% of US Muslims are immigrants, and within the Muslim population, there is great ethnic, social, and cultural diversity. Among foreign-born Muslims, the largest group hails from South Asia, followed by the Middle East and North Africa [1]. The largest concentration of US Muslims lives in New York City (NYC) and the surrounding metropolitan area; there are an estimated 700,000 Muslim residents and 250 mosques [2].

Community-based studies have found that Muslim women have lower rates of timely breast and cervical cancer screenings compared to other racial and ethnic groups, though population-wide data is limited [3, 4]. Qualitative studies have also shown low rates of timely screenings and a lack of knowledge regarding Pap testing and cervical cancer [5, 6]. Common documented barriers to breast and cervical

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cancer screening among Muslim women often relate to religious concerns, which include modesty, decency, and the perception that breast and cervical exams are inconsistent with Islamic beliefs and customs; exposure of the body may be perceived as a violation of modesty and can result in feelings of anxiety and embarrassment [3–5]. Additional barriers include limited knowledge of screening guidelines, language concordance, perceived discrimination, transportation barriers, and lack of insurance or underinsurance [7, 8].

Community health worker (CHW) and/or lay health worker (LHW) interventions are a promising strategy to address multilevel barriers to cancer screening; CHWs and LHW are community-based non-professionals often coming from the communities they serve, who help fill a gap in linking underserved individuals to the healthcare system [9]. A systematic review on interventions to increase breast and cervical cancer screening among Asian American women found that LHW interventions helped participants address access-to-care barriers and increased preventive cancer screenings [10]. Given the diversity of the Muslim population and potentially different cancer screening barriers, LHW can reflect their communities' local needs and priorities, as well as tailor the health promotion interventions appropriately.

In 2013, a series of key informant interviews with Muslim leaders in NYC were conducted to understand contextual factors impacting the health-seeking behaviors of Muslim women and to solicit recommendations for development of health interventions. Key informants noted variations in ethnic beliefs and practices across diverse Muslim communities as barriers to care, asserting the importance of educational and in-language materials and messaging, and engagement of mosques and religious leaders [6]. Building on these findings, we conducted a mixed-method study with 98 Muslim women in NYC from diverse ethnic communities, which revealed low rates of timely mammogram (71%) among women ≥ 40 years of age and low rates of timely Pap tests (54%) among women ≥ 21 years of age, despite high rates of insurance and access to a primary healthcare provider. However, limited English proficiency, a potential barrier to care, was high. Barriers to screening included a lack of interpretation services and female healthcare providers, and limited culturally competent care. There also was misinformation and limited knowledge about cancer screenings, as well as high stigma, when discussing cancer openly among community members. Women believed that the mosque and key community and religious leaders would be an effective approach to disseminate information.

The Community Preventive Services Task Force recommends a small media approach, using videos and printed materials (e.g., brochures, pamphlets, flyers, newsletters), to educate and motivate individuals to get screened for cancer. A small Arkansas study presented African American women

with a Susan G. Komen Breast Cancer Foundation shower card, in combination with an education session and breast self-examination demonstrations. The control group received no session. The intervention group had significantly higher cancer knowledge and belief scores compared to the control group [11].

To our knowledge, prior to our investigation, only two breast and/or cervical cancer interventions have been documented with Muslim American women. Both interventions leveraged stakeholder engagement (e.g., community-based organizations, mosques) to develop religiously tailored messaging that addressed barriers to breast and/or cervical cancer screening. The first intervention was mosque-based and peer-led, and increased the likelihood of obtaining a mammogram in a sample of 58 South Asian and Arab/American Muslim women [12]. The second intervention was piloted with 30 Somali American Muslim women and 10 male Imams in a mosque setting. It was found to be feasible and acceptable; overall attitudes towards breast and cervical cancer screening improved [13]. While these studies demonstrated the feasibility of partnering with community stakeholders to create and deliver religiously tailored interventions with Muslim American women, they had small sample sizes, lacked a comparison group, and did not evaluate the *uptake* of breast and cervical cancer screening. In addition, they did not integrate or evaluate a patient navigation (PN) component to address upstream healthcare-related navigation barriers.

Guided by community-based participatory research (CBPR), social marketing theory, and formative research with Muslim community partners in NYC, we co-created with community partners “Muslim Americans Reaching for Health and Building Alliances” (MARHABA), a culturally and religiously adapted LHW intervention to increase breast and cervical cancer screening among Muslim American women in NYC [14]. MARHABA is a two-arm randomized controlled trial (RCT) comparing an *Education + Media + PN* arm to an *Education + Media* arm. We hypothesize that compared to the *Education + Media* arm, at 4-month follow-up, the *Education + Media + PN* arm will have higher rates of (1) timely receipt of mammogram, and (2) timely receipt of Pap test.

Methods

The lead CHW in the MARHABA study had been an active community leader for over 20 years. She had previously worked on CHW interventions in the South Asian community, and had taken part in a CHW core competency training program which consisted of a two-part, 105-h training. Nine LHW were recruited from the community and trained by the CHW and project coordinators. The CHW was a full-time

employee at NYU Medical Center, while the LHW were part-time and supervised by the CHW. A specially designed project training manual provided the LHW with detailed knowledge about cancer screenings; their training lasted approximately 9 h. Topics included background on Muslims in the US, cancer screening recommendations, project details (goals, participation criteria, participant engagement, screening and informed consent, survey administration, the education seminar, follow-up contacts), frequently asked questions on breast and cervical cancer, and screening resources. LHW were provided with business cards to aid in follow-up with participants. When LHW and the CHW accompanied participants to screening visits, they used the opportunity to provide guidance on cultural tailoring care delivery to health providers serving the Muslim communities. For example, mammogram technicians were taught “right” and “left” in Bangla, and doctors were educated on Muslim cultural beliefs.

Study Design and Recruitment

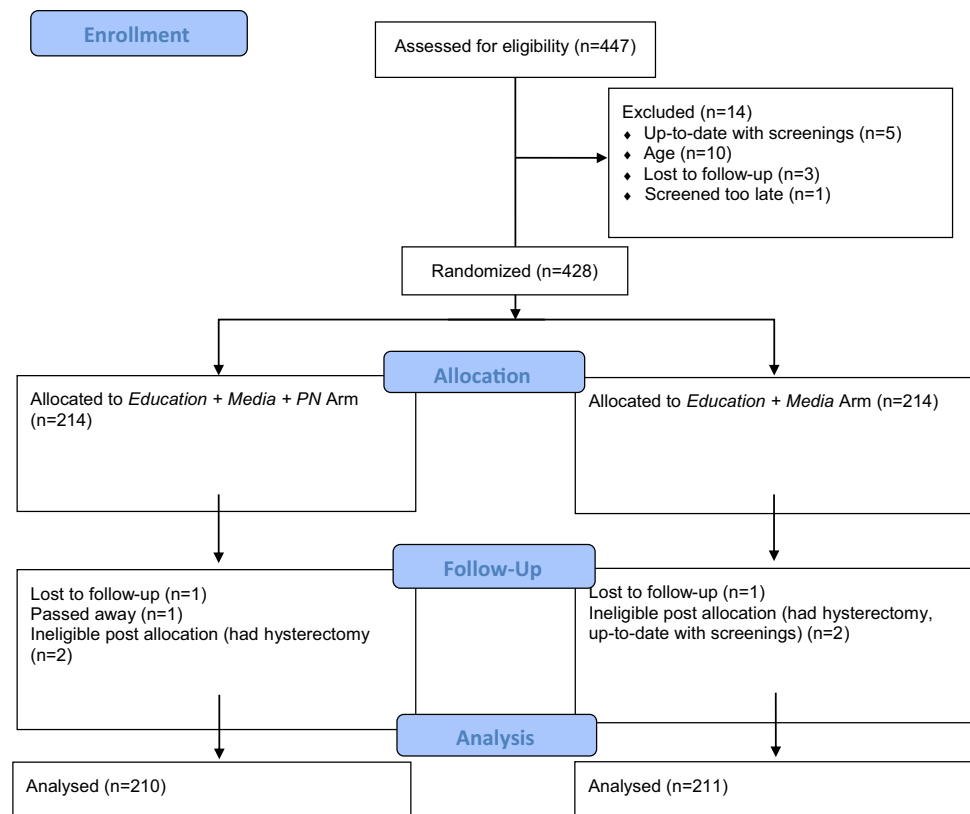
The MARHABA intervention was conducted in partnership with local community-based organizations (CBOs) and mosques in NYC. Muslim American women were recruited to participate in the study by LHW through community contacts of LHW, at mosques after prayers and/or prayer groups, and at CBOs in Brooklyn, Queens, and the Bronx. Participants were eligible for the study if they met the following criteria: (1) self-identification as Muslim; (2) female; (3) residence in a NYC borough; (4) age 40–75; and (5) self-reported receipt of mammogram greater than 2 years ago or never and/or self-reported receipt of Pap test greater than 3 years ago or never (if no hysterectomy). Women who had received breast reconstructive surgery were considered ineligible for participation.

The educational seminar was one session. It took place at mosques, community centers, homes of community members of LHW, or in parks. Often there was a physical activity component, such as an exercise session with stretching, which was an additional incentive for women to join. The seminar was provided in-language (i.e., English, Bengali, and Arabic) by the CHW or LHW. A few of the seminars that were delivered to Indonesian women were presented in English while being translated by a hired individual into Indonesian. The US Preventive Services Task Force (USPSTF) screening guidelines were included as part of the educational seminar; these guidelines recommend mammogram screening beginning at age 50, discussion with a doctor from age 40 to 49, and discussion about Pap screening with a doctor if older than 65 [15]. Given the propensity of women in Muslim countries presenting with breast cancer at a younger age and later stage, the full sample was recommended to initiate mammography screening [16].

During the session, all women were provided with small media health education materials (e.g., brochures and palm cards) regarding breast and cervical cancer. These materials were guided by social marketing theory [17]. They were developed in several languages (English, Bengali, Arabic, and French), and were culturally and linguistically adapted in order to appeal and be accessible to Muslim women. We also conducted extensive formative research with the communities to clarify the four P’s of the marketing mix to ensure the intervention materials were tailored to Muslim women. Specifically, the content of the small media materials minimized the barriers (*Price*) to breast and cervical cancer screening identified in the formative research (e.g., culturally tailoring the messaging and providing guidance on cancer screening access). For example, participants received guidance on their rights to request a female healthcare provider or a provider who spoke their native language, and all materials contained information on accessing low-cost or free cancer screenings in NYC, including locations and contact information of clinical sites offering screening services. The materials framed breast and cervical cancer screening as a strategy to maintain a healthy mother role, which aligns with the community’s family-centered cultural and gender norms (*Product*). The intervention was delivered by trusted LHW and in community settings frequented by women (*Place*). The small media materials were created in-language by an advertising firm specializing in Asian American marketing, with input from community members. Materials included a flip chart with information presented during the session, posters, brochures, and palm cards (*Promotion*).

After completion of the educational seminar, participants were randomized by age group into either the *Education + Media + PN* arm or the *Education + Media* arm. Family members were randomized into the same group to help prevent contamination. The *Education + Media + PN* arm received additional in-person or phone interactions to provide support on locating and making appointments for screening tests, which also included assistance with transportation. The additional support from the LHW was individualized to each participant’s specific needs; therefore, contamination was unlikely. After 4 months, participants in both arms were contacted by the LHW to complete a follow-up survey in-person or by phone. The intervention took place between March 2017 and September 2018. IRB approval was obtained through NYU Grossman School of Medicine in 2017.

A total of 447 individuals were assessed for eligibility, and 428 were randomized into the intervention (214 into each study arm). In the *Education + Media + PN* arm, one individual was lost to follow-up, one passed away, and two became ineligible post allocation. In the *Education + Media* arm, one individual was lost to follow-up and two became ineligible post allocation (Fig. 1).

Fig. 1 MARHABA study CONSORT diagram

Dependent Variables Primary outcomes included up-to-date screenings for mammogram and Pap test. In the baseline and follow-up surveys, individuals self-reported whether they had ever received the screening tests and the date of their most recent screening test. If an individual had received a mammogram in the past 2 years, they were considered up-to-date for a mammogram, and if an individual had received a Pap test in the past 3 years, they were considered up-to-date for a Pap test. Individuals having received a hysterectomy were not included in the Pap test analysis.

Socio-Demographics Socio-demographic variables included age, ethnicity (South Asian, Middle Eastern, and other, which included Southeast Asian and African), nativity, total years lived in the US, education (less than high school, high school graduate/some college, and college graduate), employment status (employed vs. unemployed), and marital status (married/living with a partner vs. widowed/divorced).

Healthcare Access and Preferences Variables included insurance status at baseline (private, public, and uninsured) and questions regarding medical care (asked at baseline and follow-up): “Do you have a healthcare provider who speaks in a language in which you can comfortably communicate,” “I prefer to receive medical care from a doctor or healthcare provider of my own race, ethnic, or religious group,” and “I

prefer to receive medical care from a doctor or healthcare provider who is female.”

Scale Variables The Perceived Ethnic Discrimination Questionnaire—Community Version (PEDQ-CV) was used to measure perceived discrimination (previously validated in a multiethnic Asian sample, which included Muslim individuals) [18]. Four subscales assessed the following types of discrimination: stigmatization, social exclusion/rejection, threat/aggression, and discrimination at the workplace. The mean of the total responses for each subscale was calculated for a measure of 1–5, with 5 representing the greatest discrimination. Religious discrimination was modified from the Everyday Discrimination Scale [19]. The mean of the total responses was calculated for a measure of 1–5, with 5 representing the greatest religious discrimination. The Spiritual Health Locus of Control scale sought to measure control over health with connection to spirituality [20]. Four subscales assessed the following areas: spiritual/life faith, active/spiritual, God’s grace, and passive spiritual. The mean of the total responses for each subscale was calculated for a measure of 1–5, with 5 representing the highest faith. Islamic modesty was modified from earlier versions of the Islamic Modesty Scale [3]. The mean of the responses was calculated for a measure of 1–5, with 5 representing the greatest modesty. Breast and cervical cancer knowledge

questions were adapted from training materials; responses were coded as 1 (true) and 0 (false); breast cancer included five questions and was scored from 0 to 5, and cervical cancer included six questions and was scored from 0 to 6. All questions were asked at baseline and follow-up, and are detailed in Appendix Table 1.

Data Analysis Descriptive statistics present socio-demographic characteristics and outcome variables overall and by study arm. Means and standard deviations (SDs) are reported for continuous variables, and frequencies are reported for categorical variables; chi-square tests were performed for categorical variables, and *t*-tests were performed for continuous variables. Bivariate analyses compared screening outcomes at follow-up by baseline characteristics, stratified by study arm, to inform the logistic regression models.

Logistic generalized estimating equation (GEE) models using proc genmod were constructed to predict timely receipt of a mammogram and timely receipt of a Pap test in the *Education + Media + PN* arm vs. the *Education + Media* arm, while adjusting for time-point, socio-demographic and health access variables, breast or cervical cancer knowledge, and scale variables found to be associated with outcomes using $p < 0.20$ in a bivariate analysis. The same models were constructed for receipt of a screening test or scheduled screenings tests during the follow-up period. All models were constructed for the entire sample, as well as the subset using recommended age per USPSTF guidelines (age 50–74, for mammogram and age 40–65, for Pap test). Continuous GEE models using proc genmod were also constructed for change in breast and cervical cancer knowledge, and the intervention effect (the interaction between study arm and time-point) is presented. Knowledge was run for the entire sample, regardless of age or hysterectomy status. All analyses were conducted using SAS version 9.4.

Results

Table 1 presents baseline characteristics of the total analytic sample and by study arm. Mean age was 54.0 (SD=9.1). The majority (99.5%) were born outside the US. Ethnicity was predominantly South Asian (62.1%), followed by Middle Eastern (32.6%), Southeast Asian (4.8%), and African (0.5%). The majority (60.6%) had less than a high school education, spoke English not well or not at all (73.3%), and were insured (93.5%); of those insured, 89.4% had public insurance. PECD-CV subscales, religious discrimination, and cancer screening knowledge were low, while Islamic modesty was high. English fluency differed significantly by study arm; 77.9% of the *Education + Media + PN* arm spoke

English not well or not at all (77.6%) compared to 68.9% in the *Education + Media* arm.

Navigation encounters by the LHW were collected for 180 of the women (86%) in the *Education + Media + PN* arm. Mean encounters were 2.7, ranging from 1 to 5. Navigation encounters took place by phone or in person. Participants informed the LHW of scheduled and completed screening appointments, as well as difficulties in making the appointments. LHW would further explain the screening exams, further motivate the participants to be screened, and help to make appointments for participants if that assistance was requested.

Most women were not up-to-date with a mammogram at baseline (84.0% of the *Education + Media + PN* arm and 85.3% of the *Education + Media* arm). Among individuals in the *Education + Media + PN* arm who were not up-to-date with a mammogram at baseline ($n = 173$), 54.9% had scheduled an appointment and 40.5% had received a mammogram by the 4-month follow-up. Among individuals in the *Education + Media* arm who were not up-to-date with a mammogram at baseline ($n = 175$), 48.6% had scheduled a mammogram appointment and 36.8% had received a mammogram by the 4-month follow-up. Similarly, most women were not up-to-date with a Pap test at baseline (83.1% of the *Education + Media + PN* arm and 82.7% of the *Education + Media* arm). Among individuals in the *Education + Media + PN* arm who were not up-to-date with a Pap test at baseline ($n = 167$), 38.9% had scheduled an appointment for and 30.1% had received a Pap test by the 4-month follow-up. Among individuals in the *Education + Media* arm who were not up-to-date with a Pap test at baseline ($n = 170$), 33.5% had scheduled an appointment for and 25.9% had received a Pap test by the 4-month follow-up.

Mammogram screening increased significantly in both arms between baseline and the 4-month follow-up (*Education + Media + PN*, 16.0 to 49.0%; *Education + Media*, 14.7 to 44.6%). The fully adjusted odds of an up-to-date mammogram (including intervention arm, timepoint, age, ethnicity, education, marital status, English proficiency, insurance, provider speaking comfortable language, stigmatization, exclusion/rejection, passive spiritual, God's grace, and breast cancer knowledge) for the *Education + Media + PN* arm was 1.32 times the odds of the *Education + Media* arm (95% CI=0.86, 2.02). Subset by age (50–74), the fully adjusted odds of an up-to-date mammogram for the *Education + Media + PN* arm was 1.42 times the odds of the *Education + Media* arm (95% CI=0.81, 2.48). At the 4-month follow-up, the rate of up-to-date mammogram screening or scheduled mammogram was 62.1% in the *Education + Media + PN* arm compared to 56.9% in the *Education + Media* arm. Models for an up-to-date mammogram or a scheduled mammogram found no significant group differences (see Table 2; GEE model results are not presented).

Table 1 Baseline characteristics of randomized MARHABA participants, $n = 421$

	Total ($n = 421$)	Education + media + PN arm ($n = 210$)	Education + media arm ($n = 211$)	p -value
Socio-demographics				
Age, mean (SD), y	54.0 (9.1)	53.8 (9.1)	54.1 (9.1)	0.760
Born in the US	2 (0.5)	0 (0.0)	2 (0.5)	0.499
Time lived in US, mean (SD), y	11.6 (8.4)	11.0 (8.2)	12.1 (8.6)	0.179
Ethnicity				0.478
South Asian	62.1	61.4	62.8	
Middle Eastern	32.6	34.3	31.0	
Southeast Asian	4.8	4.3	5.2	
African	0.5	0.0	1.0	
Married/living with partner, %	85.9	85.7	86.1	0.904
Education level, %				0.117
Less than high school	60.6	63.5	57.8	
High school/some college	23.7	24.5	22.8	
College graduate	15.7	12.0	19.4	
Employed, %	13.5	13.2	13.7	0.900
Speaks English not well/not at all	73.2	77.6	68.9	0.048
Healthcare access and preferences				
Health insurance				0.962
Private/work or company	4.1	3.9	4.3	
Public (Medicare, Medicaid, or other)	89.4	89.8	89.0	
No health insurance	6.5	6.3	6.7	
Has a health provider speaking a comfortable language	85.3	84.1	86.5	0.501
Prefers to receive medical care from provider of own race, ethnic, or religious group	62.1	60.7	63.6	0.727
Prefers to receive medical care from a female provider	75.2	76.7	73.7	0.587
PECD-CV scales, mean (SD)				
Stigmatization	1.09 (0.31)	1.09 (0.32)	1.09 (0.30)	0.780
Exclusion/rejection	1.24 (0.44)	1.24 (0.45)	1.25 (0.44)	0.926
Threat	1.06 (0.30)	1.06 (0.35)	1.05 (0.24)	0.772
Workplace	1.20 (0.41)	1.21 (0.41)	1.19 (0.41)	0.812
Religious discrimination, mean (SD)	1.02 (0.28)	1.04 (0.25)	1.01 (0.31)	0.426
Spiritual health locus, mean (SD)				
Spiritual life/faith	4.08 (0.92)	4.06 (0.92)	4.09 (0.92)	0.737
Active spiritual	4.41 (0.79)	4.39 (0.82)	4.43 (0.77)	0.632
God's grace	4.41 (0.73)	4.36 (0.80)	4.46 (0.67)	0.188
Passive spiritual	2.75 (1.47)	2.70 (1.46)	2.80 (1.49)	0.519
Islamic modesty, mean (SD)	4.01 (0.73)	4.02 (0.73)	4.00 (0.73)	0.725
Breast cancer knowledge, mean (SD)	2.49 (1.65)	2.45 (1.68)	2.53 (1.63)	0.636
Cervical cancer knowledge, mean (SD)	2.28 (1.96)	2.21 (1.95)	2.35 (1.97)	0.440

SD, standard deviation; *US*, United States

Pap test screening increased significantly in both arms between baseline and the 4-month follow-up (*Education + Media + PN*, 16.9 to 42.3%; *Education + Media*, 17.3 to 37.1%). The fully adjusted odds of an up-to-date Pap test (including arm, timepoint, age, ethnicity, education, marital status, English proficiency, insurance, provider speaking comfortable language, exclusion/rejection, threat/

aggression, passive spiritual, spiritual life, religious discrimination, Islamic modesty, and cervical cancer knowledge) for the *Education + Media + PN* arm was 1.11 times the odds of the *Education + Media* arm (95% CI=0.72, 1.71). Subset by age (40–65), the fully adjusted odds of an up-to-date Pap test in the *Education + Media + PN* arm was 1.07 times the odds of the *E Education + media* arm (95% CI=0.68, 1.68). At

Table 2 Changes in breast and cervical cancer screening and knowledge between baseline and 4-month follow-up, $n = 421$

	Education + media + PN arm, $n = 210$			Education + media arm, $n = 211$		
	Baseline, n (%)	4-month, n (%)	p -value	Baseline, n (%)	4-month, n (%)	p -value
Mammogram screening uptake						
Mammogram < 2 years (age 40–75))	33 (16.0)	101 (49.0)	<0.001	30 (14.7)	91 (44.6)	<0.001
Mammogram < 2 years (age 50–74)	26 (19.6)	70 (52.6)	<0.001	20 (16.1)	58 (46.8)	<0.001
Mammogram < 2 years or scheduled (age 40–75)	33 (16.0)	128 (62.1)	<0.001	30 (14.7)	116 (56.9)	<0.001
Mammogram < 2 years or scheduled (age 50–74)	26 (19.6)	85 (63.9)	<0.001	20 (16.1)	74 (59.7)	<0.001
Pap test screening uptake ^a						
Pap test < 3 years (age 40–75)	32 (16.9)	80 (42.3)	<0.001	34 (17.3)	73 (37.1)	<0.001
Pap test < 3 years (age 40–65)	28 (17.0)	71 (43.0)	<0.001	31 (18.7)	67 (40.4)	<0.001
Pap test < 3 years or scheduled (age 40–75)	32 (16.9)	95 (50.3)	<0.001	34 (17.3)	84 (42.6)	<0.001
Pap test < 3 years or scheduled (age 40–65)	28 (17.0)	83 (50.3)	<0.001	31 (18.7)	77 (46.4)	<0.001
Cancer knowledge						
Breast cancer, mean (SD)	2.5 (1.7)	4.2 (0.9)	<0.001	2.6 (1.6)	4.1 (0.9)	<0.001
Cervical cancer, mean (SD)	2.2 (1.9)	4.6 (1.8)	<0.001	2.4 (2.0)	4.5 (1.8)	<0.001

^aDenominator does not include women who have received a hysterectomy

4-month follow-up, the rate of up-to-date Pap test or scheduled Pap test was 50.3% in the *Education + Media + PN* arm compared to 42.6% in the *Education + Media* arm. Models for an up-to-date Pap test or a scheduled Pap test found no significant group differences (see Table 2; GEE model results are not presented).

Breast and cervical cancer knowledge increased significantly in both arms between baseline and 4-months, and there were no significant between group differences once placed into the adjusted models (data not presented). Mean breast cancer knowledge increased from 2.5 to 4.2 in the *Education + Media + PN* arm, and from 2.6 to 4.1 in the *Education + Media* arm. Mean cervical cancer knowledge increased from 2.2 to 4.6 in the *Education + Media + PN* arm, and from 2.4 to 4.5 in the *Education + Media* arm.

Discussion

This study presents the results of a RCT comparing the efficacy of *Education + Media + PN* vs. *Education + Media* on breast and cervical cancer screening outcomes among Muslim women living in NYC. Both arms showed a significant increase in breast and cervical cancer screening between baseline and the 4-month follow-up, suggesting that the educational session and small media materials were perhaps sufficient to drive the increase in cancer screening. An intervention study among Korean American women utilizing LHW, follow-up counseling and navigation has also shown significant increases in cancer screening [21]. Our intervention included a small media component *in addition to* breast and cervical cancer education, supporting that culturally

adapted small media materials may be a powerful strategy to promote behavior change.

Many women in both groups of our intervention had scheduled screenings that had not been performed by the study end. Participants reported long wait times between scheduling and attending appointments, a barrier which has been reported in other studies [22]. In the *Education + Media + PN* arm, an additional 13.1% had scheduled but not yet received a mammogram, and an additional 8.4% had scheduled but not yet received a Pap test; and among the *Education + Media* arm, an additional 12.3% had scheduled but not yet received a mammogram, and an additional 6.4% had scheduled but not yet received a Pap test.

Both groups also showed significant improvement in breast and cervical cancer knowledge between baseline and the 4-month follow-up. However, these changes were not significantly different across intervention arms, once placed into adjusted models. This gain in knowledge among both groups is not surprising, as all women received the culturally and linguistically adapted small media materials related to breast and cervical cancer knowledge. Previous studies have also shown increases in knowledge related to cancer and cancer screening among Muslim American and Asian American women after attendance at educational sessions [23, 24].

Our study has a few limitations that merit noting. First, mammogram and Pap screening status was based on self-report, and medical records were not used. This reporting approach may have biased our screening rates. Future research should strive to ascertain cancer screening outcomes using objective measures (e.g., reviewing medical records) to avoid possible self-reporting bias. Second, the 4-month follow-up period may not have

been long enough to fully capture screening behavior, as many women reported having scheduled a screening, but their appointment was more than 4 months away. This lengthy wait period would lead to a potential underestimation of our primary outcome. Third, the *Education + Media + PN* arm had lower education levels at baseline compared to the *Education + Media* arm. However, the *Education + Media + PN* arm showed significant positive changes in cancer screening behaviors and knowledge at follow-up. Fourth, our sample was largely South Asian and Middle Eastern, thus may not be representative of the Muslim population at large, which includes a large proportion of African women. Fifth, the majority of our sample was insured, although the majority of those insured had public insurance. Research has suggested that uninsured individuals and those insured with Medicaid have worse cancer screening outcomes compared to those with private insurance or Medicare [25]. Sixth, the follow-up survey was conducted by LHW involved in the intervention delivery, which may have increased social desirability bias in both groups. Finally, because we followed USPSTF guidelines, certain age groups in our sample were advised to discuss age screening guidelines with a doctor (40–49 for mammogram and 66–74 for Pap screening).

Our findings have implications for the development of future breast and cervical cancer screening programs among limited English-proficient, immigrant Muslim women. As positive changes in cancer screening were shown in both arms, it is likely that the educational session and small media materials that included culturally tailored information on how and where to access low-cost cancer screening services had an influence on many women before the receipt of LHW navigation. It is also important to note that our social marketing-informed small media approach was guided by our partnership with multiple community partners and our extensive formative work in the community. For example, qualitative interviews we conducted with community members highlighted healthcare barriers to cancer screening access. We specifically addressed these barriers in the intervention through tips and resources on how to navigate the healthcare system.

Overall, our project experience supports that integrating CBPR with social marketing approaches is a promising strategy to promote breast and cervical cancer screening in Muslim American communities. The small media materials were created in partnership with a multicultural advertising company and guided by input from our community partners; thus, special consideration was taken on the cultural and linguistic aspects of the media materials. The potential replicability for other immigrant groups merits exploration.

Conclusions

This study found a significant increase in breast and cervical cancer screening uptake in both study arms, demonstrating that a community-partnered approach to develop and offer an educational session with culturally informed small media materials may have the ability to promote breast and cervical cancer screening among a hard-to-reach, low literacy community population.

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Declarations

Conflict of Interest The authors declare no competing interests.

Disclaimer The findings and conclusions are those of the authors and do not necessarily represent the official position of the CDC.

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