Journal of Community Health (2019) 44:988–997
https://doi.org/10.1007/s10900-019-00671-4

ORIGINAL PAPER

Knowledge Assessment and Screening Barriers for Breast Cancer in an Arab American Community in Dearborn, Michigan

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Abstract

Breast cancer (BC) is the most common malignancy afflicting women during their lifetime. Screening for breast cancer can reduce mortality through early cancer detection. Lack of knowledge is an important barrier leading to low screening rates. Little research has evaluated breast cancer knowledge and barriers to receiving appropriate screening among Arab Americans. Given that the Arab American population has grown approximately 47% since 2000, this study was designed to assess breast cancer knowledge and screening barriers in an Arab American community. An anonymous survey addressing knowledge assessment and screening for breast cancer was distributed at the Arab Community Center for Economics and Social Services in Dearborn, MI between June 2015 and August 2017. The survey was modified based on a similar study that was conducted Among Adult Saudi women in a primary health care setting. 102 non-BC survivors, 48 BC survivors and 50 men participated in this study. Gaps in knowledge around the role of age and family history, as well as cancer presentation were noted among the participants. Additionally, 51% of non-BC survivors over the age of 40 years have not had a screening mammogram in the past 2 years with leading causes being absence of symptoms, lack of health insurance, and absence of family history. Healthcare providers and community organizations should work towards increasing knowledge levels, reducing misconceptions and improving screening rates for breast cancer among Arab Americans. Increasing community outreach and education and navigating the community's health beliefs and practices can optimize the process of information delivery to community members.

Keywords Breast cancer · Arab Americans · Screening · Community · Barriers

Background

Breast cancer (BC) is the most common malignancy afflicting women, with an estimated 1 in 8 women in the U.S. diagnosed during their lifetime [1]. Because of this large incidence, breast cancer research has become a multibillion dollars industry. The National Institute of Health spends more than 500 million dollars yearly on breast cancer research alone [2]. While this may seem high, the burden of breast cancer on today's modern society is heavy, as the second leading cause of cancer death in women. Treatment cost estimates range between 20,000 and 100,000 dollars per patient [3]. Many risk factors have been identified which indicate that, in addition to heritable factors, there are many non-heritable factors in a woman's lifestyle that may lead to a higher or lower risk of developing breast cancer [4]. Screening for breast cancer has been shown to reduce mortality through early cancer detection

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[5]. Early diagnosis for breast cancer ultimately leads to reduction in healthcare costs [6].

Breast Cancer screening guidelines have differed among the various national organizations. The American College of Obstetricians and Gynecologist (ACOG) currently recommends beginning screening at the age of 40 years through performing annual mammograms, whereas the American Cancer Society (ACS) recommends mammogram screening starting at the age of 45 years [6, 7]. The U.S. Preventive Services Task Force (USPSTF), on the other hand, recommends biennial screening mammography for women beginning at the age of 50 years [8]. Effective communication between clinicians, patients, and their family members fosters shared knowledge and understanding and leads to productive medical decision making [9]. Education and knowledge sharing should be provided for women of all ages as younger women can plan upcoming steps once they reach the appropriate screening age. With the knowledge of risk factors, breast cancer education can bring stronger awareness and encourages timely screening measures to ultimately reduce disease burden.

The Census Bureau estimates that at least 1.9 million Americans are of Arab descent; while the Arab American Institute Foundation estimates that the number is closer to 3.7 million, which accounts for one percent of the US population [10]. Although Arab Americans live in all 50 states of America, two-thirds of them are concentrated in ten states, one-third of them live in California, New York, and Michigan, and about 94% of Arab Americans live in metropolitan areas with Los Angeles, Detroit, New York, Chicago, and Washington, D.C being the top five metropolitan areas for Arab American concentration [10]. Per the 2010 census, 40% of Dearborn's population is of Arab ancestry [11]. Recent studies around Arab Americans highlight that Arab Americans have higher female breast cancer incidence compared to other minority groups such as Blacks or Hispanics [12]. Analysis of the Surveillance, Epidemiology, and End Results (SEER) data from Metropolitan Detroit showed that Arab American women have a worse breast tumor profile and are more likely to have poorly differentiated tumors, more estrogen receptor negative disease, increased regional involvement (higher stage), and a preponderance of disease at a younger age than African Americans or European Americans [13]. A 2008 study addressing breast cancer among minority and immigrant women have shown a noticeable disparity in the mortality rate and the diagnoses of breast cancer in this population [14]. Arab women particularly are less likely to have ever had mammogram screening and have a lower prevalence of mammography compared to other racial/ethnic groups [14]. Some studies among Arab communities in the United States have looked into the barriers faced to access cancer screenings such as language, transportation, lack of knowledge, family responsibilities, and time among others [15].

Despite the realization of barriers, there has been paucity of literature when it comes to evaluating the extent of knowledge these women possess regarding breast cancer. Because the healthcare system plays a critical role in delivering such knowledge, it is also equally important to evaluate the extent of knowledge in a group of women with higher levels of exposure to the health system such as BC survivors, in order to ensure that proper education on breast cancer and proper screening is also being delivered to all women. Gaining an understanding of the knowledge and current screening status for breast cancer among Arab American BC survivors can give us better insight into the quality of care and management that BC survivors are receiving in this community. In addition, many Arab communities, particularly older generations, are generally conservative where women are more likely to rely on their husbands and male figures for support [16]. With such cultural and traditional role held by some Arab families, it is important to acknowledge the role of men in Arab American households, particularly as immigrants, as they could influence women's health options and decisions [17]. There is very limited literature when it comes to Arab men's understanding of breast cancer and more importantly, there is no literature when it comes to Arab American men's knowledge of breast cancer [16, 17].

With the increase in public health awareness for breast cancer over the past 10 years and more, it is very important to gain a better understanding for the Arab American community's knowledge on breast cancer and barriers to screening. This can allow us to gain a broader perspective into the knowledge level within the larger community by accommodating for both genders and hence better fill the gaps needed to improve screening rates. The objective of this study is to assess the knowledge levels and screening barriers for breast cancer among Arab Americans in the Dearborn community with the goal of increasing the screening uptake.

Methods

Study Design

This cross-sectional study was determined to be exempt from Institutional Review Board (IRB) review at the University of Michigan in accordance with federal regulations. An anonymous survey was conducted at the Arab Community Center for Economics and Social Services (ACCESS) in Dearborn, MI between June 2015 and August 2017. The survey addressed breast cancer knowledge and screening barriers. The study was modified based on a similar study that was conducted Among Adult Saudi women in a primary health care setting [18]. We utilized the survey in this study as it was used among Arab women, a culturally similar population, and it reflected low knowledge regarding risk factors and screening among that population. We administered the first 10 surveys as pilot testing with no further modifications done for the remainder of the survey collection phase.

Study Participants

Study participants were selected through convenience sampling at ACCESS and included: (1) non-BC survivors, meaning women with no history of a breast cancer diagnosis, who are clients and patients at ACCESS, (2) BC women survivors who are clients of the Breast and Cervical Cancer Control Program (BCCCP) at ACCESS, and (3) men who are clients at ACCESS. Men completed only the knowledge assessment section of the study. All participants were consented before participating in this study and participation was voluntary. All participants' identities were protected by using an identifier study ID number on the survey document which was separated from the consent form. All surveys were stored in a locked cabinet at ACCESS that was only accessible by study administrators.

Recruitment

Men and women were recruited conveniently in person from patients and clients who were in the waiting room for clinical or social work appointments at ACCESS. Participants were asked to participate only if they identified as Arab Americans. BC survivors were recruited conveniently via phone from a list of BC survivors who are part of the BCCCP program at ACCESS. Given the difficulty in collecting responses from survivors, addressed later in this paper, we intended to have an equal number of men and twice a number of non-BC survivors within this study and hence aimed for a total of 200 participants.

Inclusion Criteria

Only those who identified as Arab Americans were eligible to participate. Information was obtained by trained bilingual survey administrators who communicated with participants in the English or Arabic language. The scope of the study was explained to all participants and informed consent was obtained. Data around breast cancer diagnosis in BC survivors was obtained directly from the participants and supplemented by information found in their medical charts at ACCESS. No monetary compensation was offered for participation.

Statistical Analysis

Analysis was performed using SAS 9.4. All continuous variables were evaluated for normality using the Shapiro–Wilk statistic with a chosen alpha of 0.05. Continuous variables were described as mean ± standard deviation and were compared using *t* test and one-way ANOVA for parametric data and medians and ranges for non-parametric data. Categorical data were described as absolute numbers and percentages and were compared using the Chi squared test.

Results

Demographics

A total of 200 Arab American adults participated in the study between June 2015 and August 2017. The participants included 102 non-BC survivors, 48 BC-survivors, and 50 men. The response rate was 83% for survivors and 91% for non-BC survivors and men. Characteristics of study subgroups are summarized in Table 1. There were no significant differences in educational attainment and family history of breast cancer. Most of the study participants were of Lebanese, Yemeni, and Iraqi origin. Nearly half of the non-BC survivors were 40 years or under in age while almost all the BC survivors were over the age of 40 years. The median age for breast cancer diagnosis among BC survivors was 46 years.

Knowledge Assessment

The questions addressed in the knowledge assessment are highlighted in Table 2. Most participants were aware that breast cancer is the most frequent type of cancer occurring in women, that breast cancer is treatable, that breastfeeding reduces the risk of developing breast cancer, and that breast cancer can occur in women with no family history of the disease. Almost 70% of BC survivors knew that breast cancer doesn't necessarily have to present in a form of a painful lump, compared to 40% of non-BC survivors and men answering correctly. 78% of non-BC survivors, on the other hand, were aware that breast cancer is not rare in women over the age of 65 years compared to 39% of BC survivors and 48% of men answering correctly. Slightly lower than a quarter of BC survivors thought that younger women are more likely to develop breast cancer than older women. Around half of all participants within each category knew that obesity increases the risk of breast cancer, that a family history of male breast cancer could increase the risk of female breast cancer within the same family, and that diet could affect the risk of developing breast cancer. Most participants in each category were not aware that

Table 1 Characteristics of participants

	Non-BC survivors (n = 102)	BC survivors (n = 48)	Men (n = 50)	P^a
Country of origin				
Lebanon	31.7	51.1	36.0	< 0.0001
Yemen	43.4	2.1	28.0	
Iraq	10.9	34.0	26.0	
Other[b]	13.9	12.8	10.0	
Age				
Less than or equal to 40 years	42.2	2.1	58.0	< 0.0001
Over 40 years	57.8	97.9	42.0	
Marital status				
Married	74.5	72.9	76.0	0.003
Never married	6.9	2.1	20.0	
Divorced	13.7	12.5	4.0	
Widowed	4.9	12.5	0.0	
Educational attainment				
Less than high school	35.3	37.5	16.0	0.056
High school	23.5	27.1	26.0	
More than high school	41.2	35.4	58.0	
Income				
Under $10,000	44.9	20.5	16.0	< 0.0001
$10,000–$30,000	32.7	70.5	32.0	
$30,000–$50,000	17.4	6.8	34.0	
> $50,000	5.1	2.3	18.0	
Occupation				
Health	16.0	4.2	16.0	< 0.0001
Education	3.0	8.3	4.0	
Retired/student	13.0	4.2	28.0	
Unemployed/homemaker	66.0	81.3	14.0	
Other	2.0	2.1	38.0	
Breast cancer first degree history				
Yes	19.6	20.8	26.0	0.16
Breast cancer stage				
0 ductal carcinoma in situ	NA	18.8	NA	–
I	NA	31.3	NA	
II	NA	20.8	NA	
Unknown	NA	29.2	NA	
Breast cancer chemoradiation agents				
Chemotherapy (active/past)	NA	58.3	NA	–
Radiation (active/past)	NA	62.5	NA	–
Age at breast cancer diagnosis, median (interquartile range)	NA	46 (35–49)	NA	–

Data are % unless otherwise specified

Denominators may vary as a result of missing data

NA not applicable, *BC* breast cancer

[a] *P* values obtained using Chi squared test for categorical data

[b] Other countries include: Egypt, Jordan, Morocco, Palestine, Saudi Arabia, Syria

women of all races and ethnicities have different risks for developing breast cancer. The number of correct answers among all participants was 64%. More specifically, the number of correct answers among non-BC survivors was 68% compared to 61% for each of the BC survivors and men. This higher value for knowledge in non-BC survivors was statistically significant (p = 0.0148).

Table 2 Knowledge assessment

Knowledge statements [correct answers]	Correct answers			
	Non-BC survivors (n = 102)	BC survivors (n = 48)	Men (n = 50)	P^a
Breast cancer typically present with pain in a form of a lump [False]	40.6	68.8	40.0	0.003
Women over age of 65 rarely get breast cancer [False]	77.5	39.1	48.0	< 0.001
Breast cancer is the most frequent type of cancer occurring in women [True]	84.3	93.8	92.0	0.161
Breast cancer is untreatable [False]	87.0	89.4	82.0	0.550
Obesity increases the risk of breast cancer [True]	50.5	56.5	54.0	0.779
A family history of male breast cancer increases the risk of female breast cancer [True]	55.5	61.4	46.0	0.313
Breastfeeding increases the risk of having breast cancer [False]	92.1	91.3	84.0	0.282
Breast cancer doesn't happen in women with no family history of the disease [False]	92.1	95.7	78.0	0.008
Women of all races and ethnicities have equal risk for developing breast cancer [False]	32.4	8.5	20.0	0.005
Younger women are more likely to develop breast cancer than older women [False]	72.3	24.4	68.0	< 0.001
Diet affects the risk for developing breast cancer [True]	64.4	65.2	58.0	0.700
Mean Score (% ± St Dev)	7.4 (67.5 ± 14.1)	6.7 (61.2 ± 16.2)	6.7 (60.9 ± 17.4)	0.015

Data are % unless otherwise specified

Denominators may vary as a result of missing data

[a] *P* values obtained using *t*-test and one-way ANOVA for parametric data

Knowledge levels were divided into high and low based on the number of correct answers per total number of questions. 7/11 was used as the cutoff for high knowledge which is reflective of the overall mean knowledge score among the three participant categories. 73% of non-BC survivors had a high level of knowledge, compared to 56% of BC survivors and 48% of men as highlighted in Table 3. These number were relatively unchanged and remained statistically significant, even when only participants over the age of 40 years were included. In addition, knowledge levels were not significantly different between participants who were over the age of 40 years and those under or equal to 40 years. Although those with a history of first degree relatives for breast cancer had a higher level of knowledge compared to those without it, the differences in knowledge levels were not statistically significant. Additionally, although the distribution of country of origin was significantly different among the 3 groups, when comparing knowledge levels between the 3 most reported countries of origins, the levels were not significantly different. From an educational attainment standpoint, 75% of participants with more than a high school degree had a high level of knowledge compared to a statistically lower value of around 50% knowledge level for those with a high school degree or less.

Screening Assessment

Screening history for women participants was highlighted in Table 4. Only women over the age of 40 years were accounted for in the control group. Almost 50% of non-BC survivors had no health insurance compared to less than 10% of BC survivors. All BC survivors have seen a physician within the past year as compared to about 75% of non-BC survivors. All BC survivors have also had their breasts examined by a healthcare professional within the past 2 years as compared to around 75% of non-BC survivors. In terms of doing mammograms, nearly all BC survivors performed mammograms once a year or more than once a year. In comparison, 50% of non-BC survivors performed mammograms yearly while 25% of them had never had a mammogram and the other 25% of them did not get regular mammograms or have them less than once every 2 years. Additionally, 51% of non-BC survivors have not had a mammogram over the past 2 years while over 90% of BC survivors have had one over the past 2 years. The average age for first mammogram was early 40 s for both non-BC and BC survivors. Lastly, in terms of self-breast exams, 94% of BC survivors reported being taught how to perform a self-breast exam as compared to 68% of non-BC survivors. In regard to those who have been

Table 3 Knowledge assessment comparison for various demographic parameters

	High knowledge level[a]	
	Total participants	P[b]
Participant		
Non-BC survivors	74 (72.5)	0.008
BC survivors	27 (56.2)	
Men	24 (48.0)	
Participant (Over age 40)		
Non-BC survivors	41 (69.5)	0.014
BC survivors	26 (55.3)	
Men	7 (33.3)	
First degree relatives		
Yes	32 (74.4)	0.068
No	93 (59.2)	
Country of origin		
Lebanon	52 (70.3)	0.242
Iraq	21 (52.5)	
Yemen	35 (59.3)	
Other[c]	17 (68.0)	
Educational attainment		
Less than high school	32 (51.6)	0.005
High school	27 (54.0)	
More than high school	66 (75.0)	
Age[d]		
Less than or equal to 40 years	34 (77.3)	0.095
Over 40 years	67 (63.2)	

[a] Level of knowledge is considered high if the participants answered ≥ 7/11 questions correct

[b] P values obtained using Chi squared test for categorical data

[c] Other countries include: Egypt, Jordan, Morocco, Palestine, Saudi Arabia, Syria

[d] Taking only women participants into account

Data are n (%)

taught self-breast exams, the majority of BC survivors stated that they perform them once a month or more while the majority of non-BC survivors stated that they perform them either a few times a year or never.

Finally, reasons cited for not having a mammogram over the past 2 years are highlighted in Table 5. The leading causes for women not having a mammogram within the past 2 years were: not finding any problems with their breasts (49%), not having health insurance (46%), not having a family history of breast cancer (24%), feeling they are too young for screening (18%), and finding mammograms too expensive (15%). Other reported reasons included lack of transportation and the fear of knowing. Additionally, 2 of the 4 BC survivors who reported not having a mammogram in the past 2 years attributed the reason to being instructed by their physicians to perform PET scans instead.

Discussion

Knowledge Implications

Our findings suggest that gaps in knowledge exist around breast cancer among a subset of Arab Americans from the Dearborn community. Specifically, gaps in knowledge around breast cancer were present when it came to presenting signs and risk factors such as age, obesity, race and diet. Being familiar with this knowledge gap should allow community organizations and awareness campaigns to focus specifically on such knowledge misconceptions to properly educate community members about breast cancer. Additionally, BC survivors had a lower level of knowledge compared to non-BC survivors over the age of 40 years or overall. The age of 40 years was used as our cut-off age as it represents the lowest age to begin screening as recommended by one of the 3 main breast cancer screening guidelines, namely the ACOG guidelines [7]. This signifies a gap within the BC survivors' knowledge, most of which they receive by physicians and healthcare professionals throughout their treatment course. Hence, this calls for the importance of ensuring that physicians are appropriately communicating breast cancer knowledge to their patients as they are going through their treatment journey. Additionally, the knowledge assessment highlighted that men have the lowest knowledge levels amongst participants. Although this finding isn't too surprising given that the majority of breast cancer cases occur in females, it is important for healthcare professionals to give a holistic educational approach regarding cancer to men as well. Within the Arab American culture, a male figure plays a critical role within a family. Empowering men with knowledge about breast cancer may help bring more awareness to screening among females in a family.

Knowledge as it Relates to Demographics

Consistent with our hypothesis, this study additionally highlights a gap in knowledge across the different educational attainments. It is important to find appropriate means to educate patients of all educational attainments about breast cancer. Communicating with providers can be an essential component for women's understanding of breast cancer and their ability to communicate their knowledge of cancer to other family members; hence reducing the overall knowledge gap around this disease [19]. Overall, comparing the levels of knowledge found in this study to those obtained in the survey which we modified our study based of [18], it is encouraging to note that our overall mean knowledge level obtained for

Table 4 Screening history

	Non-BC survivors (n = 102)	BC survivors (n = 48)	P^a
Health insurance			
No insurance	49.1	8.3	< 0.0001
Medicaid/medicare	40.7	72.9	
Private	10.2	18.8	
Last time visited physician			
1 to 6 months ago	45.8	83.3	0.0004
6 months to a year ago	25.4	16.7	
More than 1 year ago	27.2	0.0	
Never visited one	1.7	0.0	
Last time a health professional examined your breast			
Less than a year ago	45.8	89.6	< 0.0001
Between 1 and 2 years	20.3	10.4	
More than 2 years ago	13.6	0.0	
Never had one	20.3	0.0	
How often do you have mammograms			
More than once per year	0.0	19.2	< 0.0001
Once per year	51.7	78.7	
Once or less every 2 years	1.7	0.0	
I do not get regular mammograms/I never had one	39.7	2.1	
Age at first mammogram			
Average age	42.3 ± 8.5	41.0 ± 8.5	0.476
Taught self breast exams			
Yes	67.8	93.8	0.001
How often do you do self breast exams[b]			
More than once a month	22.5	46.7	0.001
Once a month	12.5	31.1	
A few times a year	32.5	11.1	
Never	32.5	11.1	
Time of last mammogram			
Less than a year ago	35.1	80.4	< 0.0001
Between 1 and 2 years	14.0	10.9	
More than 2 years ago	50.9	8.7	

Data are % or mean & standard deviation

Denominators may vary as a result of missing data

[a] *P* values obtained using Chi squared test for categorical data or *t*-test for parametric data

[b] Denominator includes only those who selected "Yes" for being taught self-breast exams

the cohort of targeted Arab Americans, 64.3%, is higher than that obtained in the study of Arabs in Saudi Arabia of 56.4%. Although a comparison to US knowledge level is unavailable, we can yet note that more education is necessarily for members of the Arab American community to achieve better knowledge around breast cancer and ultimately more awareness about screening guidelines.

Screening Rates Implications

From a screening standpoint, our findings suggest poor screening outcomes with only 49% of non-BC survivors over the age of 40 years receiving a mammogram in the past 2 years. This number is much lower than that found in whites and other ethnicities within the United States. According

Table 5 Screening barriers for women who have not had a mammogram in the past 2 years

Barrier	Women participants (n = 33)
I don't feel any problems with my breasts	48.5
I don't have health insurance	45.5
I don't have breast cancer in my family	24.2
I am too young	18.2
It is too expensive	15.2
I don't have transportation	9.1
I am afraid to know	6.1
It is painful	0.0

Data are %, sorted by percentage reported

to the American Cancer Society, mammography screening rates varied by race with 65% of Caucasian women 40 and older having a mammogram in the past 2 years while the number varied between 59 and 69% for Asians, American Indians, Hispanics, and Black women [20]. Data obtained on Arab women in Michigan dating back to 2013 showed that an estimated 40.4% of Arab women 40 years and older in Michigan reported having both a clinical breast exam and a mammogram within the past year compared to 50.4% of all women aged 40 years and older in Michigan in 2012 [21]. This yet shows the lower screening rates for breast cancer among Arab American women in specific and women in Michigan in general. Hence, it is critical that more public health efforts are being taken within this specific community to help improve the screening rates among Arab Americans. Healthcare professionals should be more aware of the poor screening rates within this community as they consider their approach within their practice to help encourage women to undergo screening.

Screening Barriers Implications

Identified barriers to screening for Arab American women dating back to 2008 included embarrassment, discomfort, modesty, and fear of detection [14]. Our data on the other hand have shown that, aside from financial reasons, inappropriate breast cancer understanding related to presenting signs, age, and family history were within the leading causes for women not receiving mammography screening within the past 2 years. This reassures the importance of proper education about cancer misconceptions within this community. It is worth noting that compared to non-BC survivors, BC survivors were more proactive about their overall health, with a higher proportion of these women having regular physician visits, breast exams, mammograms, and self-breast exams. Although getting routine screening and health checkups are excellent preventative steps, it is important to note that self-breast exams are no longer a recommendation for breast cancer screening by ACS or USPSTF but still recommended by ACOG [6–8].

Strengths

One strength for this study was analyzing the data in subgroups in the knowledge assessment section. This allowed us to gain further insight into the Arab American community knowledge base regarding breast cancer whether from the standpoint of non-BC survivors, BC survivors or men. Another strength was within the data collection method which allowed to observe current screening trends in BC survivors and hence appreciate their awareness and proactive approach towards improving their health outcomes.

Limitations

A limitation to this study was that non-BC survivors included a high percentage of women who were under the age of 40 years. This was due to the convenience sampling of all women in the waiting rooms where the majority happened to be relatively younger. To account for age, we divided our women participants into 2 categories, those over the age of 40 years and those equal and under, to better understand the knowledge levels of participants. Additionally, we accounted for age in the screening history and barriers analysis by focusing on only women in the over the age of 40 years category. A second limitation is the recall bias of data collection which is unavoidable in the nature of our study. We asked our participants to give as accurate information they could remember as possible. A third limitation is the grouping of all participants as Arab Americans while disregarding the number of years they have been in the US. It would be interesting to see if immigration status such as number of years in the US would influence the knowledge responses and screening rates, which would help better identify the subset of Arab Americans that requires stronger awareness and understanding for breast cancer. Another limitation was the low number of participants in addition to the sampling method being convenience as opposed to simple random sampling. Having more participants in each category would have brought additional power and strength to this study. It is noteworthy that when it came to BC survivors, some women were hesitant to participate, and a few refused as they "did not wish to remember the cancer diagnosis days and were trying to forget". In terms of BC survivors however, 83% of recruited BC-survivors accepted to participate in the study as compared to 91% of recruited non-BC survivors and men. This high response rate hence further adds to the validity of the results obtained in our study.

Future Directions

One future direction for this study involves looking deeper into the various sources of information used by Arab Americans to obtain their knowledge on breast cancer. This can be a very informative tool to allow targeting the education and outreach to the appropriate resources. Another future direction could be assessing local physicians' understanding of breast cancer screening guidelines and their attitudes towards screening recommendations within the Arab American community. This can help us better understand the type of information that women receive from healthcare providers in regard to breast cancer screening and ensure that proper information is being delivered to patients.

Conclusion

The current study highlights breast cancer knowledge gaps specific to presenting signs and risk factors such as age, obesity, race, and diet within a subset of Arab Americans from the Dearborn community. This suggests that it's important for clinicians, as trusted sources of information, to be aware of Arab American's medical knowledge gap to better serve and educate this community. These findings also encourage reflection on the resources used by this community to obtain their knowledge and understanding regarding breast cancer. Appropriate bilingual health education programs and awareness campaigns among other resources should be implemented and optimized to ensure that community members are receiving accurate information on this topic. In addition, the current study provides further evidence for poor mammogram screening among Arab American women with barriers relating to financial constraints and misconception about the presenting signs, age, and family history. Although it is excellent to see that BC survivors are very conscious about proper and timely screening for breast cancer, it is crucial that non-BC survivors are also receiving appropriate and timely screening. Healthcare providers and community organizations should work towards improving screening rates for women in the Arab American community through being culturally competent and through navigating the health beliefs and practices in this community to optimize the physician–patient interaction and communication. In summary, this study adds further support to the literature regarding the need for improving the knowledge levels, reducing the misconceptions and improving the screening rates for breast cancer among Arab Americans.

Acknowledgements We would like to thank Hoda Eldaou, Ghada Aziz, Suhir Abdulghafoor and Mona Alanazi from ACCESS for helping with data collection. We would also like to thank Dr. Anne Blackwood-Chirchir for providing feedback during the survey development.

Data Availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval For this type of study formal consent is not required.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

1. Noone, A. M., Howlader, N., Krapcho, M., Miller, D., Brest, A., Yu, M., Ruhl, J., Tatalovich, Z., Mariotto, A., Lewis, D. R., Chen, H. S., Feuer, E. J., Cronin, K. A. (Eds.). SEER cancer statistics review, 1975–2015, National Cancer Institute. Bethesda, MD, https://seer.cancer.gov/csr/1975_2015/, based on November 2017 SEER data submission, posted to the SEER web site, April 2018.
2. Project List by Category. NIH: Research Portfolio Online Reporting Tools. U.S. Department of Health and Human Services, 18 May 2018. https://report.nih.gov/categorical_spending.aspx.
3. Campbell, J. D., & Ramsey, S. D. (2009). The costs of treating breast cancer in the US: A synthesis of published evidence. *Pharmacoeconomics, 27*(3), 199–209.
4. Breast Cancer Risk Factors Table. Non-Profit Breast Cancer Organization. Susan G. Komen. Retrieved September 2018, from https://ww5.komen.org/BreastCancer/BreastCancerRiskFactorsTable.html.
5. Elmore, J. G., Armstrong, K., Lehman, C. D., & Fletcher, S. W. (2005). Screening for breast cancer. *JAMA, 293*(10), 1245–1256.
6. Oeffinger, K. C., Fontham, E. T., Etzioni, R., Herzig, A., Michaelson, J. S., Shih, Y. T., et al. (2015). Breast cancer screening for women at average risk: 2015 guideline update from the American Cancer Society. *JAMA, 314*(15), 1599–1614.
7. ACOG Statement on Revised American Cancer Society Recommendations on Breast Cancer Screening. American College of Obstetricians-Gynecologists. October 2015. Retrieved September 2018, from https://www.acog.org/About-ACOG/News-Room/Statements/2015/ACOG-Statement-on-Recommendations-on-Breast-Cancer-Screening.
8. Final Update Summary: Breast Cancer: Screening. U.S. Preventive Services Task Force. January 2016. Retrieved September 2018, from https://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/breast-cancer-screening.
9. Epstein, R. M. & Street Jr., R. L. (2007). Patient-centered communication in cancer care: Promoting healing and reducing suffering. National Cancer Institute, NIH Publication No. 07-6225, Bethesda.
10. Arab American Institute, Web. Retrieved September 2018, from http://www.aaiusa.org/demographics.
11. Data access and dissemination systems (DADS). American FactFinder—Results. Retrieved September 2018, from www.census.gov.

12. Bergmans, R., Soliman, A. S., Ruterbusch, J., et al. (2014). Cancer incidence among Arab Americans in California, Detroit, and New Jersey SEER registries. *American Journal of Public Health, 104*(6), 83–91.
13. Hensley, A. S., Schwartz, K., Soliman, A., et al. (2009). Breast cancer characteristics at diagnosis and survival among Arab-American women compared to European- and African- American women. *Breast Cancer Research and Treatment, 114,* 339–346.
14. Schwartz, K., Fakhouri, M., Bartoces, M., Monsur, J., & Younis, A. (2008). Mammography screening among Arab American women in metropolitan Detroit. *Journal of Immigrant and Minority Health, 10*(6), 541–549.
15. Shah, S. M., Ayash, C., Pharaon, N. A., et al. (2008). Arab American immigrants in New York: Health care and cancer knowledge, attitudes, and beliefs. *Journal of Immigrant and Minority Health, 10*(5), 429–436.
16. Donnelly, T. T., Al-Khater, A. H., Al-Bader, S. B., et al. (2017). Perceptions of Arab men regarding female breast cancer screening examinations-Findings from a Middle East study. *PLoS ONE, 12*(7), 180696.
17. Al-Amoudi, Samia M., & Abduljabbar, Hassan S. O. (2012). Men's knowledge and attitude towards breast cancer in Saudi Arabia. A cross-sectional study. *Saudi Medical Journal, 33*(5), 547–550.
18. Amin, T., Al Mulhim, A. R., & Al Meqihwi, A. (2009). Breast cancer knowledge, risk factors and screening among Adult Saudi women in a primary health care setting. *Asian Pacific Journal of Cancer Prevention, 10*(1), 133–138.
19. Peipins, L. A., Rodriguez, J. L., Hawkins, N. A., Soman, A., White, M. C., Hodgson, M. E., et al. (2018). Communicating with daughters about familial risk of breast cancer: Individual, family, and provider influences on women's knowledge of cancer risk. *Journal of Women's Health, 27*(5), 630–639.
20. American Cancer Society. Cancer Prevention & Early Detection Facts & Figures, 2017–2018. American Cancer Society, 2017. Retrieved September 2018.
21. Hekman, K., Weir, S., Fussman, C., Lyon-Callo, S. (2015). Health Risk Behaviors Among Arab Adults Within the State of Michigan: 2013 Arab Behavioral Risk Factor Survey. Lansing, MI: Michigan Department of Health and Human Services, Lifecourse Epidemiology and Genomics Division and Health Disparities Reduction and Minority Health Section; Lansing, MI.