



Breast cancer screening outcomes among Mexican-origin Hispanic women participating in a breast cancer screening program

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ABSTRACT

Breast cancer is the commonest occurring cancer and the leading cause of cancer death among Hispanic women in the USA. Although their overall breast cancer incidence and mortality is lower, incidence rates are rising faster and mortality declines are lower than other groups. It is expected that the breast cancer burden will rise as this population ages and becomes more acculturated. It is therefore important to better characterize their screening outcomes. This is an observational study of socioeconomically disadvantaged Hispanic women participating in a community-based breast cancer screening program that offered no-cost testing and navigation services in two US-Mexico border counties. Outcomes include results of screening mammograms, diagnostic tests and breast findings. Of 1,966 eligible women, 1,675 (85%) completed a screening mammogram and were included in this analysis. Mean age was 56 years (SD: 6.8 years, range 50 to 75.6 years); 99% were Hispanic and 83.6% had less than high school education. 19.3% of the initial mammogram results were abnormal (BIRADS 0, 3, 4, or 5); a diagnostic mammogram was indicated in 12.2% (n = 205), a diagnostic ultrasound in 26.4% (n = 443), and biopsies in 3.0% (n = 51) of the total. Eleven women (0.66%) had breast cancer diagnosed. Mexican-origin Hispanic women had higher recall rates, but similar biopsy and cancer rates to general screening populations despite their overall lower incidence and mortality in the USA. This suggests that the expected rise in future breast cancer burden among US Hispanics due to aging and acculturation could occur sooner than expected.

1. Introduction

Invasive breast cancer is the most common cancer and the leading cause of cancer death among Hispanic women in the US (Miller et al., 2018; American Cancer Society, 2018). Despite a lower overall incidence compared to non-Hispanic white women, the rate of new breast cancers detected in Hispanic women is rising at a faster rate (Miller et al., 2018; American Cancer Society, 2018). Similarly, although breast cancer mortality is lower overall among Hispanic women, their rate of mortality decline is lower than among non-Hispanic White women (Miller et al., 2018; American Cancer Society, 2018). Additionally, Hispanic women are more likely to be diagnosed with larger, more aggressive, and advanced stage cancer (American Cancer Society, 2018;

American Cancer Society, 2019; Iqbal et al., 2015; Sineshaw et al., 2014; Lantz et al., 2006; Banegas and Li, 2012; DeSantis et al., 2019; Chlebowski et al., 2005). As the population proportion of Hispanics in the United States increases (Ennis et al., 2011); breast cancer incidence and mortality are anticipated to increase as well (Smith-Bindman et al., 2006; John et al., 2005; Stern et al., 2016). Hispanics in the US are a diverse group arising from many countries with distinct traditions, values and socioeconomic conditions; and patterns of disease but disaggregated data by subgroup is generally lacking. Breast cancer prevalence among Mexican origin women is similar to that of Central and South American and lower compared to Puerto Rican whereas mortality rates are slightly lower to that of Cuban and Puerto Rican women (Miller, et al., 2018; Pinheiro et al., 2017; Zamora et al., 2019).

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One of the reasons for these trends in incidence and mortality among Hispanic women is their lower rates of screening mammography (American Cancer Society, 2019; Smith-Bindman et al., 2006). Mammography decreases the likelihood of late-stage breast cancer (Gangnon et al., 2015). National data suggests that Hispanic women are less likely to have had a mammogram within the past two years when compared to non-Hispanic white women (Miller, et al., 2018; Chlebowski et al., 2005; Goding Sauer et al., 2019; American Cancer Society, 2019; National Center for Health Statistics (US). Health, United States, 2016; Abraído-Lanza et al., 2004). Cultural characteristics (Yanez et al., 2016; Austin et al., 2002). Hispanic sub-group (Shoemaker and White, 2016); geography (Coughlin et al., 2003; Nuño et al., 2011); cost (Abraído-Lanza et al., 2004; Schueler et al., 2008); lack of access to healthcare (American Cancer Society, 2019; Laws and Mayo, 1998; Rodriguez et al., 2020; Valdez et al., 2001; Palmer et al., 2005; Selvin and Brett, 2003); time living in the United States (Schueler et al., 2008; Rodriguez et al., 2020). English language proficiency (Austin et al., 2002; Ramachandran et al., 2015; Stein and Fox, 1990); and overall fear about safety, pain, or abnormal results (Austin et al., 2002; Schueler et al., 2008; Ramachandran et al., 2015; Fayanju et al., 2014) are factors associated with lower screening rates. The relative contribution of these factors is unclear; in one study among foreign born Hispanic women, controlling for socioeconomic factors (Rodriguez et al., 2020) reversed the association with screening mammography. Furthermore, once an abnormal mammogram is detected, Hispanic women have been shown to have a longer time to diagnostic follow up (Press et al., 2008; Stuver, 2011) and are more likely to receive treatment below standard of care when compared to non-Hispanic white women (Chen and Li, 2015; Ooi et al., 2011). Also, there may be differences by subgroup, for instance Mexican origin women in the US are the least likely to have had a screening mammogram in the previous 2 years (Shoemaker and White, 2016; Zambrana et al., 1999).

As the Hispanic population in the US ages and become more acculturated, it is expected that the breast cancer burden will increase in this group. In order to improve breast cancer outcomes and to prevent the anticipated rise in cases, it is essential not only to promote early detection, but also to better understand screening mammography outcomes in this group. Although several studies report data on mammogram findings (White et al., 2015; Warren et al., 2006; Claye, 2016); stage at diagnosis (Iqbal et al., 2015; Lantz et al., 2006; DeSantis et al., 2019; Chlebowski et al., 2005; Ooi et al., 2011); and tumor marker subtypes (DeSantis et al., 2019; Chlebowski et al., 2005; Ooi et al., 2011; Serrano-Gómez et al., 2018) among Hispanic women diagnosed with breast cancer, there is a lack of prospective studies among Hispanic screening populations. The purpose of this study therefore, was to address this by describing clinical outcomes among Mexican-American women participating in a community-based breast cancer screening program.

2. Materials and methods

2.1. Study design and eligibility

In this study we report the clinical outcomes among women participating in a multicomponent community-based breast cancer screening program implemented in a predominantly Hispanic community (the El Paso and Hudspeth County Breast Cancer Education Screening and Navigation Program, BEST). The program was developed based on a community assessment and utilized a systematic planning process to address personal and logistic barriers to screening in this population. Inclusion criteria for the program were women aged 50–75 years with a self-reported Texas address who were uninsured and due for a screening mammogram (no mammogram for two years or more) based on the United States Preventive Services Task Force guidelines (United States Preventive Services Taskforce). For this study, we included those women who completed their screening mammogram. For the small

proportion of women undergoing repeat screening mammograms, only the initial mammogram was included together with all subsequent diagnostic testing. Participants signed a service consent to receive program services. Institutional Review Board approval was obtained for secondary data analysis of a deidentified data set prior to data analysis.

2.2. Study setting and intervention

The intervention was conducted between June 2014 and June 2017 in El Paso County, Texas, an underserved US-Mexico border county with a high proportion percentage of Hispanics (81%) (United States Census Bureau, 2019); high poverty rates (20%) (United States Census Bureau, 2019); a high proportion of uninsured (23%) (Texas Medical Association); and low educational attainment. The intervention consisted of culturally tailored, bilingual, and theory-based community outreach, education, no-cost screening, diagnostic and navigation services. The education and program addressed insufficient knowledge, cultural barriers and lack of access to screening and diagnostic services. Women were recruited from 59 partnering community sites (churches, health fairs, community centers, community colleges, and food banks) and from 2 participating clinic sites by two community health workers who were trained on program materials and protocols. They delivered in-person education in English or Spanish with the aid of a flip chart at participating community and clinic sites to women eligible for the program. Screening test appointments were scheduled by the community health worker in a radiology department in a participating hospital and recommended guidelines for screening and follow up were adhered to. BEST program staff received and entered all patient information and test results into a program database. A program navigator scheduled screening and diagnostic tests, performed reminder calls, tracking and communication of results, and explanation of next steps. The program covered costs for screening or diagnostic mammogram, breast ultrasound, and stereotactic or ultrasound guided biopsy. If cancer was diagnosed, the navigator provided specialist referrals and guided the participant through the process of finding coverage through local and state programs.

2.3. Data collection

Potential participants were recruited in El Paso County, Texas by program community health workers who used an eligibility and intake form to determine eligibility for services and to collect demographic (age, race/ethnicity, country of birth, health insurance type, language preference, marital status, years residing in the US, work status) and contact information, past screening information (ever had a mammogram, date of most recent mammogram), family history of breast cancer or ovarian cancer, and Ashkenazi Jewish heritage, self-reported health and whether they had a regular physician. Past screening history was determined by self-report. The forms were delivered to the central program office on a regular basis and all participant information was entered into a centralized database for tracking and reporting purposes. All program test results and communication were also logged into the database.

2.4. Analysis

Descriptive statistics were utilized to describe the population and all clinical outcomes. Outcomes reported included screening test results and findings including the distribution of density type, the BIRADS designation, and recall rate, results of diagnostic testing, the number of cancers and final diagnoses. BIRADS is a classification system for mammography used to report results using standardized language. BIRADS 0 corresponds to incomplete imaging requiring additional diagnostic studies. BIRADS 1 corresponds to a mammogram that has no significant findings, whereas BIRADS 2 has significant findings that are characteristically benign. Findings that are probably benign are

categorized as BIRADS 3. BIRADS 4 indicates a significant finding that is suspicious for malignancy while BIRADS 5 reports findings that are highly suggestive of malignancy. Lastly, BIRADS 6 is how known, biopsy-proven malignancy is categorized (National Cancer Institute PCORI).

We also examined the association between demographic and clinical variables and breast density. We screened variables using univariable multinomial logistic regression. Any variables which were found to be statistically significant at 15% level of significance in unadjusted multinomial logistic regression were considered for final multivariable multinomial logistic regression. We conducted multivariable multinomial logistic regression (MLR) analyses in two ways (a) keeping four categories of breast density, and (b) after merging heterogeneous breast with extremely dense breast groups. We used $\alpha = 0.25$ as the criterion for inclusion in the model as recommended by (Bursac et al., 2008). In our unadjusted analysis, the five variables, age ($p < 0.001$), health status ($p = 0.0009$), regular physician ($p = 0.0467$), birth country ($p = 0.0017$), years lived in the US ($p < 0.001$), and Had family history of cancer with age > 50 years ($p = 0.10$). None of the other variables had an unadjusted p -value < 0.25 . The variables which were significant at a 25% level of significance were entered into MLR analysis. A manual backward elimination approach was used to retain final variables in the multivariable model. The criteria for retaining variables was statistical significance at 10% as recommended by (Bursac et al., 2008).

3. Results

Of the total of 2,115 women approached for participation in the program, 1,966 were eligible and were offered program services and of these 1,675 (85%) completed a screening mammogram and were included in this analysis. Of the 15% who did not complete screening, 81.5% (243) were unable to be scheduled, having been called twice with no response and/or declined to participate for unknown reasons; another 15.7% were not screened due to changes in ineligibility, medical reasons, or geographic relocation.

Table 1 shows the demographic profile of the participants. The mean age of the population was 56.6 years. Ninety-nine percent self-identified as Hispanic and 94% reported Spanish as their preferred language. Eighty-eight percent reported Mexico as their birth country with time living in the US reported to be 24 years on average. The majority (84%) had less than a high school education, 9% worked full-time, 96% reported a lack of regular physician visits and 0.2% of women reported having had a mammogram in the previous 2 years.

Table 2 summarizes the clinical outcomes, the commonest reported breast density type on screening mammogram was scattered fibroglandular (54.5%) followed by fatty type (31.5%). The breast density pattern differed by age, with the highest proportion of heterogeneously and extremely dense breasts occurring in the 50 to 54 age group (Fig. 1). The overall BIRADS designation was 47.8% BIRADS 1, 32.6% BIRADS 2, 0.1%, BIRADS 3, 0.5% BIRADS 4, and 0.2% BIRADS 5. The recall rate (i. e., BIRADS 0) was 18.9%. A greater proportion of those with dense breasts were diagnosed with BIRADS 0 (Fig. 2).

A total of 202 diagnostic mammograms and 439 diagnostic ultrasounds were recommended and 170 (84%) and 374 (85%) were completed respectively. Following these, biopsy was indicated in 51 women (3.0% of the screening sample) and of these 46 were completed. A total of 11 breast cancers were diagnosed (0.66% of the screening sample): one at stage 1, six at stage 2, one at stage 3, two at stage 0, and one whose stage is unknown. Two women had ductal carcinoma in situ, seven had invasive ductal carcinoma, one had invasive tubular carcinoma. One participant was diagnosed with a follicular B cell lymphoma following an axillary lymph node biopsy. Molecular studies were available for only eight of the breast cancers; six were ER+, four were PR+, three were HER2+. Six of the eight had intermediate or high proliferation of Ki67. Three (37.5%) were Luminal A type, three (37.5%) were Luminal B and 2 (25%) were triple negative. As seen in Table 3, the

Table 1
Participant demographic characteristics.

(N = 1675)		
Variable	N	%
Age Mean (SD): 56.6 yrs; SD: 6.8 M yrs: min – Max: 50 – 75.6yrs		
50–54	673	40.2
55–59	558	33.3
60–64	321	19.2
65–69	77	4.6
70+	46	2.7
Language		
Spanish	1571	93.8
English	38	2.3
Both	66	3.9
Race/Ethnicity		
Hispanic	1663	99.3
Non-Hispanic	12	0.7
Education		
< High School	1401	83.6
≥ High School	274	16.4
Married/Living with Partner		
Yes	921	55.0
No	754	45.0
Work Status		
Not working	1064	63.5
Part-Time	460	27.5
Full-Time	151	9.0
Health Status		
Fair/Poor	953	56.9
Excellent/Very Good/Good	722	43.1
Regular Physician		
Yes	70	4.2
No	1605	95.8
Birth Country		
United States	172	10.3
Mexico	1484	88.6
Other	19	1.1
Years Living in U.S. Mean (SD): 23.6 (15.7) Min – Max: 1–67.0		
0–10	420	25.1
11–20	422	25.2
21–30	385	23.0
31–40	215	12.8
41–50	87	5.2
51+	146	8.7
Mammogram History		
Never	206	12.3
< 2yrs.	2	0.1
2–3yrs.	567	33.9
3–4yrs.	900	53.7
Breast Cancer History		
Yes	0	0
Family History Breast Cancer		
Family Member > 50yrs.	195	11.6
Family Member < 50yrs.	112	6.7

average age at time of diagnosis was 57 years. Among women with cancer diagnosed, all self-identified as Hispanic and spoke primarily Spanish. Most had less than a high school education; nine of the 11 women reported Mexico as their birth country with an average of 19.2 years living in the United States. All these women reported having a regular physician. One woman had never had a mammogram while the remaining 10 women had completed a mammogram in the last 2–3 (36.4%) or 3–4 (54.5%) years (Table 3). In multivariable analyses examining the relationship between baseline variables and breast density (Table 4), poor health status, no regular physician, Mexican birth country, less years lived in the US, and a family history of cancer were associated with scattered fibroglandular densities while younger age, poor health status, and lesser years lived in US were associated with heterogeneously dense/extremely dense compared to fatty breast density. We did not determine the relationship between clinical and demographic characteristics with cancer-related outcomes assessed using BIRADS scoring as we had only nine cases of suspicious abnormality (BIRADS 4) and three cases of highly suggestive of malignancy (BIRADS

Table 2
Breast cancer screening and diagnostic test results.

Table 2. Screening Mammogram Results (n = 1675)		
Variable	N	%
Screening Mammogram Results		
Abnormal	327	19.5
Breast Density		
Fatty	528	31.5
Scattered Fibroglandular Densities	913	54.5
Heterogeneously Dense	216	12.9
Extremely Dense	21	1.2
Mammogram findings		
Mass	228	13.6
Focal Asymmetry of Asymmetry	122	7.3
Architectural Distortion	14	0.8
Calcifications	516	30.8
Axillary lymphadenopathy	1	0.1
Fibrocystic	2	0.1
Other	975	58.2
BIRADS Scores		
0	316	18.9
1	800	47.8
2	546	32.6
3	1	0.1
4	9	0.5
5	3	0.2
Diagnostic Mammogram Results		
Normal	117	68.8
Abnormal	53	31.2
Diagnostic Ultrasound Results		
Normal	235	62.8
Abnormal/requiring interval testing	139	37.2
Interval testing recommended		
Breast Cancer	11	0.66
Breast Cancer Stage		
Stage 0	2	
Stage 1	1	
Stage 2	6	
Stage 3	1	
Stage 4	0	
Unknown	1	

5).

4. Discussion

This study is one of the few to demonstrate the clinical outcomes and

results of a community-based breast screening program among Mexican-origin Hispanic women in the USA. It provides useful information about the potential future breast cancer diagnostic testing and cancer burden among a group that represents the largest subpopulation of Hispanic women in the USA. We observed some key differences compared to other general and undefined Hispanic populations in the USA: had a higher recall rate (18.9%) and had a greater proportion of invasive cancer cases (the majority were at stage 2) and triple negative cancers. On the other hand the biopsy rate (3.0%), and the proportion of the screened population with breast cancer (0.66%, n = 11) were similar to other populations.

We also observed that the majority of women undergoing screening in our study had either scattered fibroglandular breast densities (54.5%) or or fatty type, which contrasts with the most common types observed in the majority of women in the US who have either scattered fibroglandular or heterogeneously dense breast tissue (National Cancer Institute PCORI; Sprague et al., 2014). Previous investigations have demonstrated that US-born Hispanics have higher breast density (Oppong, et al., 2018) whereas foreign-born Hispanics have lower breast density (Tehraniifar et al., 2018). Clay published a study among Hispanic women in Connecticut (Clay, 2016) and observed women born outside the US but living in the US for >10 years were more likely to have dense breasts. In our study, the majority of our patient population (88%) was foreign-born and had >10 years living in the US (75%), yet, the proportion with higher breast density was low in our study population and more similar to those who are recent immigrants in other parts of the country. This could be due to the fact that women living on the US-Mexico border reside in high percentage Hispanic neighborhoods and may be less acculturated, as a result of this and their proximity to their birth country which enables them to have stronger ties and more travel back and forth so their lifestyle may more closely reflect those of recent immigrants. Furthermore there is much literature on the advantages for the health of Hispanic individuals (especially the elderly) residing in high percentage Hispanic neighborhoods; a concept named the Hispanic Paradox because health outcomes are better than expected from the socioeconomic conditions; advantages are thought to be due to a positive effect of cultural and informal support (Eschbach et al., 2004). However, we did observe that the proportion of women with heterogeneously dense and extremely dense breast tissue decreased with aging, as is observed among most other women in the USA (Sprague et al., 2014). We were able to examine the relationship between

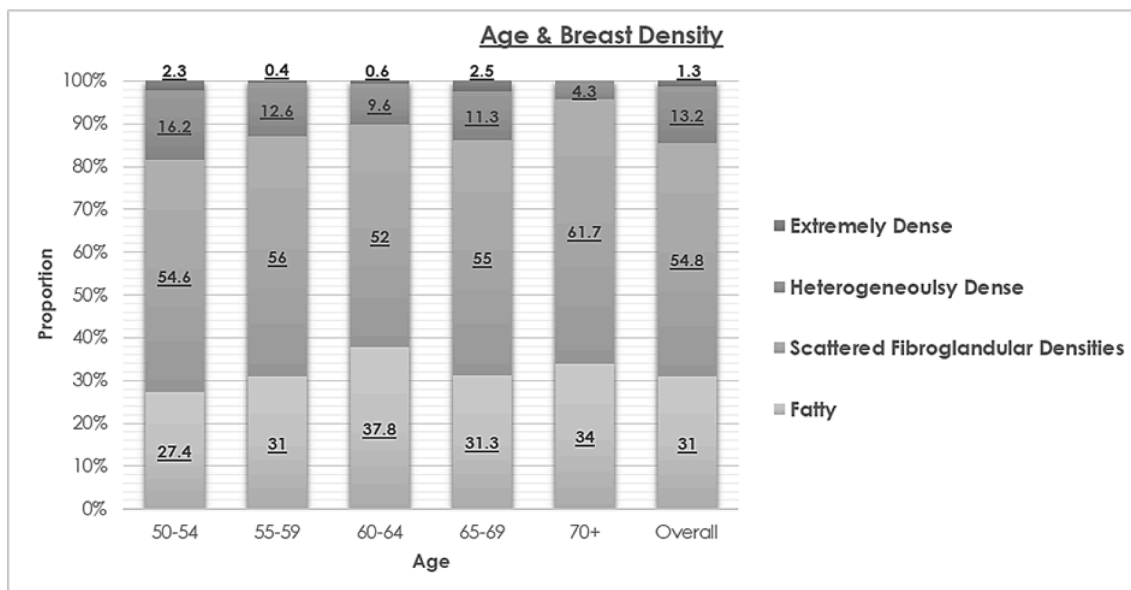


Fig. 1. Breast density on screening mammogram by age group.

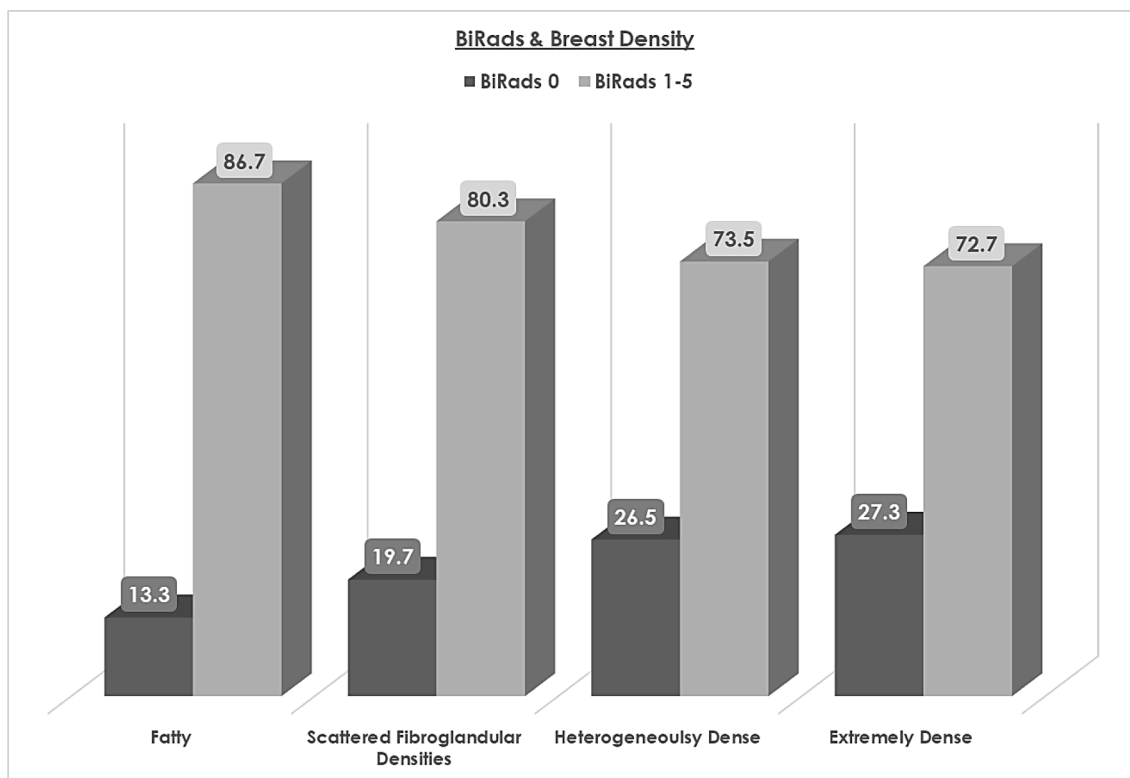


Fig. 2. BIRADS results by breast density on screening mammogram.

demographic variables and the clinical outcomes: not unexpectedly we found younger age to be associated with a higher breast density, however the finding of an association with lower numbers of years residing in the US and poorer self-reported health status warrant further research.

A BIRADS 0 designation indicates the need for further diagnostic testing. Our observed rate was 18.9%. This is similar to the 18% recall rate observed in a study including uninsured Hispanic women in the Washington, DC region (Warren et al., 2006). However, both these rates are much higher than target rates set by the American College of Radiology (Feig et al., 1998) and higher than rates observed in two large national data sources including the National Mammography Database (NMD) (7.6% to 10.4%) (National Radiology Data Registry Support); and the Breast Cancer Surveillance Consortium (BCSC) (11.6%) (National Cancer Institute PCORI, 2007); but closer to the rates observed in the the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) of 12.7%. These differences in rates are likely attributable to the populations that these databases represent; the NMD and BCSC cover populations that reflect the general US population i.e. without regard to ethnicity or insurance coverage and from both rural and urban centers. The NBCCEDP on the other hand covers low-income, uninsured women and consists of 24% Hispanics. Some potential reasons for higher recall rates in uninsured Hispanic women could be the unavailability of prior films because a greater proportion of these women had first time mammograms, and in our case because much of the prior screening may have been done across the border where these services have lower costs.

Despite the higher recall rate observed in our study, the majority of diagnostic mammogram results were comparable to those reported in the studies listed above. We observed 70% findings in our study (70%) compared to 60% in the NBCCEDP (White et al., 2015). The rates of biopsy indication (3.0% in our study) were also similar to those observed by BCSC (2.4%) (Smith-Bindman, 2003) and NBCCEDP (2.6%) (White et al., 2015). These biopsy rates were all slightly higher than those observed in the NMD (1.1–1.5%) (National Radiology Data Registry Support); perhaps as a result of the latter's lower recall rate.

Our breast cancer detection rate (6 per 1,000) was also comparable to that observed in both the BCSC (5.1 per 1,000) (National Cancer Institute PCORI, 2007) and NBCCEDP (5.4 per 1,000) (White et al., 2015). However, all three of these rates are higher than those reported among Hispanics in the SEER/National Program of Cancer Registries (0.9 per 1,000) (Miller et al., 2018). The reason for the lower rate observed in that database is unclear, since both BCSC and SEER gather data from sources which are representative of the general US population. The number of cancers detected was highest in the 50–59 age group which is similar to that observed by the SEER/National Program of Cancer Registries (DeSantis et al., 2019). Most cancers are detected at stage 1 in both the general US population (National Cancer Institute PCORI) and in the Hispanic population (DeSantis et al., 2019; Chlebowski et al., 2005). In our group of women most of the cancers were uninvolved and therefore unable to access screening services. However, similar to participants in the BCSC data (National Cancer Institute PCORI, 2007); the majority of women had invasive breast cancer, unlike the more equal distribution between invasive cancer and carcinoma in situ seen in the screenings by NBCCEDP (White et al., 2015). Our observation of 75% ER +, 50% PR + cancers is also consistent with the findings of other studies in the US population at large (Rosales and Gonzalez, 2013) and among Hispanic women who are mostly, ER and PR positive (Iqbal et al., 2015; DeSantis et al., 2019; Chlebowski et al., 2005; Ooi et al., 2011). Molecular studies were only available for eight of the eleven breast cancers and two (25%) of these were triple negative which is slightly higher than that of US Hispanics previously described in the literature (Serrano-Gómez et al., 2018). As noted in the results, all eleven women who were diagnosed with cancer reported having a regular physician. Although the reasons underlying this or the reasons for 15% not completing mammography are not specifically known in each case, the literature and personal experience suggests multiple barriers to screening and treatment such as competing demands, a lack of recommendation for screening, or a lack of availability of screening and diagnostic services for the uninsured, an inability to navigate the

Table 3
Demographic characteristics of those diagnosed with Cancer (N = 11).

Variable	N	%
Age Mean (SD): 56.8 (4.89) Min – Max: 51 – 67.5		
50–59	9	81.8
60–69	2	18.2
Language		
Spanish	10	90.9
Both	1	9.1
Race/Ethnicity		
Hispanic	11	100
Education		
< High School	7	63.6
≥ High School	4	36.4
Married/Living with Partner		
Yes	5	45.5
No	6	54.5
Work Status		
No	6	54.5
Part-Time	3	27.3
Full-Time	2	18.2
Health Status		
Fair/Poor	7	63.6
Excellent/Very Good/Good	4	36.4
Regular Physician		
Yes	11	100
Birth Country		
United States	2	18.2
Mexico	9	81.8
Years Living in U.S. Mean (SD): 19.2 (14.1) Min – Max: 1–56.0		
0–10	4	36.4
11–20	3	27.3
21–30	3	27.3
50+	1	9.1
Prior Mammogram		
Never	1	9.1
2–3yrs.	4	36.4
3–4yrs.	6	54.5
Family History Breast Cancer		
Family Member > 50yrs.	2	18.2
Physician Ever Recommended Pap		
Yes	4	36.4
No	7	63.6

Table 4
Adjusted associations of baseline cofactors with breast density compared to fatty breast using multinomial logistic regression analyses.

Scattered fibroglandular densities	RRR	95%CI	p-value	
Age (years)	0.98	0.96	1.00	0.103
Health status-Excellent/Very Good/Good	0.70	0.56	0.87	0.002
Regular Physician-yes	0.57	0.34	0.95	0.032
Birth country: USA/others	0.66	0.43	1.01	0.058
Years lived in US	0.99	0.98	1.00	0.014
Had family history of cancer with age > 50 years	1.45	1.02	2.05	0.039
Heterogeneously dense/extremely dense				
Age (years)	0.94	0.91	0.97	<0.001
Health status-Excellent/Very Good/Good	0.68	0.49	0.93	0.017
Regular Physician-yes	0.56	0.24	1.29	0.173
Birth country: USA/others	1.01	0.53	1.93	0.972
Years lived in US	0.97	0.96	0.99	<0.001
Had family history of cancer with age > 50 years	1.01	0.59	1.72	0.973

RRR: relative risk ratio; CI: confidence interval.

system, and cultural barriers and beliefs. This highlights the importance of interventions that comprehensively address a multitude of barriers to screening and testing.

In interpreting the results of this study, it is important to acknowledge some strengths and limitations. Strengths include a large sample of Mexican-origin Hispanic women in the USA undergoing mammography

screening and diagnostic testing with complete testing and cancer information available. Furthermore, availability of demographic information enabled us to examine a comprehensive set of demographic correlates of breast characteristics, and cancer characteristics. Although the large sample size allowed for an examination of screening test outcomes, a larger sample size would be required allow for meaningful comparisons of cancer outcomes with other populations. A potential limitation is that since the program was not able to verify prior mammogram use, it may have included women that were not yet due for mammograms, this may have impacted the outcomes we observed. Another limitation is that although this study provides important information about uninsured Mexican-origin Hispanic women, caution should be applied in generalizing these findings to other Hispanic sub-populations as data indicates that behaviors and patterns of disease may differ (Miller et al., 2018; Shoemaker and White, 2016).

In conclusion, in this population of underserved Mexican origin Hispanic women undergoing screening, the diagnostic test recall rate was relatively high, their cancer rates were not lower than nationally representative populations, were at more advanced stages and comprised a greater proportion of triple negative cancers. This suggests that although the latest available national data suggests that their overall breast cancer incidence and mortality rates are lower than other populations, given similar cancer rates in this screening population, the expected rise in breast cancer burden due to aging and acculturation could occur sooner than expected.

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CRedit authorship contribution statement

Stella Winters: Writing - original draft. **Adam Alomari:** Investigation, Project administration, Data curation, Visualisation, Writing - review & editing. **Gurjeet Shokar:** Writing - review & editing. **Charmaine Martin:** Investigation, Writing - review & editing. **Alok Dwivedi:** Data curation, Formal analysis, Visualisation, Writing - review & editing. **Navkiran K. Shokar:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Supervision, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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