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Reproductive and Hormonal Risk Profile According to Language Acculturation and Country of Residence in the *Ella* Binational Breast Cancer Study

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Abstract

Background: We compared the distribution of breast cancer reproductive and hormonal risk factors by level of acculturation and country of residence in women of Mexican descent.
Methods: To compare the distribution of breast cancer reproductive and hormonal risk factors by level of acculturation and country of residence in women of Mexican descent, taking into account level of education, we analyzed data on 581 Mexican and 620 Mexican American (MA) women with a history of invasive breast cancer from the *Ella* Binational Breast Cancer Study. An eight-item language-based acculturation measure was used to classify MA women. Multivariate logistic regression was used to test associations between language acculturation, country of residence, and reproductive and hormonal risk factors.
Results: After adjustment for age and education, compared to women residing in Mexico, English-dominant MAs were significantly more likely to have an earlier age at menarche (<12 years; odds ratio [OR] = 2.08; 95% confidence interval [CI], 1.30–3.34), less likely to have a late age at first birth (≥30 years; OR = 0.49; 95% CI, 0.25–0.97), and less likely to ever breastfeed (OR = 0.13; 95% CI, 0.08–0.21).
Conclusions: Differences in reproductive and hormonal risk profile according to language acculturation and country of residence are evident; some of these were explained by education. Results support continued efforts to educate Mexican and MA women on screening and early detection of breast cancer along with promotion of modifiable factors, such as breastfeeding.

Introduction

GLOBALLY, BREAST CANCER is the most common cancer in women causing approximately 460,000 deaths in 2008.[1] Since 1980, incidence and mortality rates for breast cancer have been increasing.[2] The most notable increases have occurred in low- and middle-income countries, which accounted for 45% of all newly diagnosed cases of breast cancer in 2009. Although more developed countries have a higher incidence rate (67.8/100,000) than less developed countries (23.8/100,000),[3] there are disproportionately more deaths reported in low-income countries (58% of the total deaths in 2008) than in high-income countries (15% of the total deaths in 2008) among younger women (<50 years of age).[2] Breast cancer mortality rates in women living in Mexico, a middle-income country, increased from 7.67 to 9.20 per 100,000 from 1985–1999 and then leveled off to 9.04 per 100,000 in 2005–2007.[4] Detailed regional mortality analyses show that these increases are expanding beyond developed regions and into underdeveloped parts of Mexico.[5]

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Compared with women living in Mexico, Hispanic/Latina women in the United States (US) have a higher mortality rate (15 per 100,000), which is lower than that of non-Hispanic whites (NHWs) (23 per 100,000).[6] It has also been reported that non-US-born post-menopausal Hispanic women have a lower risk of breast cancer than US-born Hispanic women.[7]

The variation in breast cancer burden among women living in Mexico, Hispanic women in the US, and NHW women in the US might be explained, in part, by differences in each population's breast cancer risk profile[1]; genetic admixture has also been shown to alter breast cancer risk both in Mexican women[8] and US Hispanic/Latinas.[9–11] Reproductive and hormonal factors, including early age at menarche, late age at first birth, nulliparity, and lack of breastfeeding, among others, are known predictors of breast cancer risk;[12] however, growing evidence suggests that specific risk factors correlate with distinct breast cancer tumor subtypes.[13] Understanding differences in patterns of reproductive and hormonal characteristics among different subgroups of Hispanic women (e.g., by culture) might help explain the differences in corresponding breast cancer incidence rates or the tumor subtype distribution.

Acculturation is generally defined as the cultural exchange that occurs when two distinct cultures come in contact for an extended period of time, as occurs in immigration.[14] During extended exposures among different cultures, attitudes, values, behaviors, and the language of each culture are influenced by one another.[15] Acculturation has been used as an explanatory factor for both adverse and beneficial health effects in immigrant populations, including Hispanic/Latinos.[16–19] Many acculturation measures use language as a proxy.[20,21] This approach has been criticized, suggesting that it does not accurately explain the dynamic process of acculturation or identify the contextual factors associated with the outcome of interest.[14,16,22] For example, it could be argued that this proxy measure is primarily an indicator of socioeconomic status (SES). Lacking in the literature, however, are studies considering whether or not measures of SES account for observed associations of acculturation with health outcomes of interest. Furthermore, to our knowledge, a comparison that includes a population residing in the country of origin of the immigrant population has not been reported in the literature.

In this report, we compare the distribution of breast cancer reproductive and hormonal risk factors by level of acculturation and country of residence in women of Mexican descent, taking into account level of education. Education is considered a central component of SES given its relevance to occupational opportunities and earning potential.[23] Compared with income inquiries, the response rate to education questions is high and education is applicable to all adults regardless of age or employment status.[24] This is particularly important in women who may be outside of the labor force due to caregiving responsibilities. An important and unique aspect of this study is the inclusion of a population of women residing in Mexico, the country of origin and cultural nexus for US participants.

Methods

Participants

Details regarding the study design and recruitment for the *Ella* Binational Breast Cancer Study have been previously published.[25] Briefly, the *Ella* Study is a case series of women of self-reported Mexican descent who were age ≥18 years and diagnosed with invasive breast cancer in the previous 24 months prior to enrollment. Participants were recruited from two study sites in the US (University of Arizona in Tucson, Arizona and MD Anderson Cancer Center in Houston, Texas) and three sites in Mexico (Universidad de Sonora in Hermosillo, Sonora; Instituto Tecnológico de Sonora in Ciudad Obregon, Sonora; and Universidad de Guadalajara in Guadalajara, Jalisco). Recruitment took place from March 2007 through June 2011. All recruitment sites used a predominantly clinic-based recruitment strategy; response rates for all aspects of the study (i.e., risk factor questionnaire, medical record access, and tissue collection) ranged from 95%–99%.[25] The dataset for the present analyses includes women who provided risk factor questionnaire and medical record data and who have known data on acculturation, education, and age at diagnosis ($n = 1201$). The Institutional Review Board from each institution approved the study, and all participants provided written informed consent.

Data collection

Risk factor data were collected via an in-person interview at the recruitment site or participant's home, depending on her preference. At the time of the interview, participants also provided consent to abstract their medical records to obtain clinical data. The risk factor questionnaire included information on sociodemographic data, reproductive factors, and other breast cancer risk factors; it also included questions on acculturation, which are described in the subsequent section. Education was based on the highest level achieved by the participant.

Acculturation measure

Methodology regarding the measure used to assess level of acculturation, including reliability of the measure, has been previously published.[26] The cultural orientation scales were language-based and primarily based on Marin and Gamba's (1996) Bidimensional Acculturation Scale,[27] which has been previously validated in Hispanic populations.[20,28,29] The questions included two orthogonal, four-item measures of cultural orientation; one scale assessed degree of English language use/exposure and one scale assessed degree of Spanish language use/exposure. Mexican American (MA) women who completed both scales were placed into one of three acculturation groups using the recommended 2.99 average cutoff for both scales: (1) bilingual (≥3.0 average in both the English and Spanish scales); (2) Spanish-dominant (≥3.0 average in the Spanish scale only); and (3) English-dominant (≥3.0 average in English scale only). The questionnaire was only administered to women residing in the US, since all participating women in Mexico were Spanish speakers. Mexican women were used as a single comparison group to the three groups in the US and were considered to have the lowest level of acculturation.

Statistical methods

Associations between level of acculturation and each breast cancer risk factor were tested using logistic regression, with Mexican women as the reference group, adjusted for age (continuous) and level of education (< high school, high school, and > high school, treated as an ordinal variable). Risk factor categorizations were dichotomized and conducted *a priori* based on existing literature or on the distribution of the variables in the total population; these include: age at menarche (< 12 years),[30] age at first full-term pregnancy (> 30 years),[30] time since last pregnancy (< 10 years),[31] parity (≥ 3 pregnancies), ever breastfeeding, breastfeeding duration (≥ 6 months), ever use of menopausal hormone therapy (HT), and ever use of hormone contraception. All analyses were conducted using Stata 12.1 (StataCorp).

Results

Table 1 shows the distribution of breast cancer reproductive and hormonal risk factors for Mexican women and MA women by level of language acculturation. Mexican women had the highest mean age at breast cancer diagnosis, which decreased as language acculturation increased among MA women. Mexican and Spanish-dominant MA women had lower education levels than bilingual or English-dominant MA women. Across levels of increasing acculturation (from Mexican women to English-dominant MA women), there were trends of decreasing age at menarche and number of full-term pregnancies and decreasing proportions of women with a history of breastfeeding and postmenopausal status.

Level of education was associated with several risk factors (Table 2). Women with less education had older age at menarche, younger mean age at first full-term pregnancy, and a higher mean number of full-term pregnancies than those with higher education. Compared to women with greater than a high school education, women with less than a high school education were much more likely to have breastfed and to breastfeed for longer duration. The percentage of women reporting use of HT increased with education.

After adjustment for age and education, bilingual (odds ratio [OR] = 1.63; 95% confidence interval [CI], 1.12–2.38) and English-dominant (OR = 2.08; 95% CI, 1.30–3.34) women were significantly more likely to have a younger age at menarche than Mexican women (Table 3). Bilingual (OR = 0.50; 95% CI, 0.30–0.83) and English-dominant (OR = 0.49; 95% CI, 0.25–0.97) women had significantly lower odds of having a first full-term pregnancy at age ≥ 30

Table 1. Breast Cancer Reproductive and Hormonal Risk Factors by Level of Acculturation in *Ella* Participants with Known Age at Diagnosis and Level of Education (*n* = 1201)

		Mexican American		
Participant characteristics	*Mexican* (n = *581*)	*Spanish dominant* (n = *202*)	*Bilingual* (n = *295*)	*English dominant* (n = *123*)
Age at diagnosis (years), mean ± standard deviation (SD)	54.5 ± 12.5	51.2 ± 12.0	49.5 ± 11.7	49.2 ± 12.2
Highest level of education, *n* (%)				
Less than high school	389 (67.0)	139 (68.8)	57 (19.3)	17 (13.8)
High school or equivalent	130 (22.4)	51 (25.3)	90 (30.5)	42 (34.2)
Post high school	62 (10.7)	12 (5.94)	148 (50.2)	64 (52.0)
Age at menarche (years), mean ± SD[a]	13.0 ± 1.5	12.9 ± 1.5	12.4 ± 1.7	12.2 ± 1.6
Age at menarche < 12 years, *n* (%)[a]	93 (16.0)	32 (15.9)	84 (28.5)	42 (34.2)
Hormone contraceptive use (ever), *n* (%)[b]	304 (52.3)	99 (49.0)	203 (68.8)	75 (62.0)
Nulliparity, *n* (%)	55 (9.5)	12 (5.9)	32 (10.8)	20 (16.3)
Age at first full-term pregnancy, mean ± SD[c]	22.9 ± 5.5	21.9 ± 5.0	22.9 ± 5.5	23.0 ± 5.8
Age at first full-term pregnancy ≥ 30 years, *n* (%)[c]	73 (13.9)	15 (7.89)	34 (12.9)	13 (12.6)
Number of full-term pregnancies, mean ± SD	3.6 ± 2.6	3.4 ± 2.0	2.7 ± 1.8	2.1 ± 1.5
Number of full-term pregnancies ≥ 3, *n* (%)	302 (72.6)	131 (69.0)	160 (60.8)	51 (49.5)
Ever breastfed (if parous), *n* (%)[d]	466 (89.1)	144 (76.2)	165 (63.2)	53 (51.5)
Lifetime breastfeeding (if parous, months), mean ± SD[d]	30.5 ± 39.9	18.9 ± 23.5	8.4 ± 12.7	4.7 ± 10.7
Lifetime breastfeeding ≥ 6 months (if parous), *n* (%)[d]	391 (74.8)	117 (61.9)	102 (39.1)	23 (22.3)
Time since last pregnancy (if premenopausal, years), mean ± SD[e]	13.5 ± 7.3	12.5 ± 7.7	12.9 ± 8.3	13.2 ± 7.9
Time since last pregnancy ≤ 10 years (if premenopausal), *n* (%)[e]	77 (35.3)	46 (44.2)	60 (40.3)	22 (34.9)
Postmenopausal, *n* (%)[f]	329 (57.3)	88 (44.9)	123 (41.8)	44 (36.4)
Age at natural menopause (years), mean ± SD[g]	49.0 ± 5.2	48.8 ± 5.1	50.1 ± 4.8	50.4 ± 3.4
Age at natural menopause ≥ 50 years, *n* (%)[g]	136 (51.1)	31 (46.3)	39 (55.7)	13 (68.4)
Menopausal hormone therapy use, *n* (%)[h]	63 (11.0)	19 (9.45)	57 (19.4)	20 (16.5)

[a]Missing data for age at menarche for 1 participant.
[b]Missing data for hormone contraceptive use for 2 participants.
[c]Missing data for age at first full-term pregnancy for 1 participant, plus 119 women were nulliparous.
[d]Missing data for breastfeeding for 6 participants, plus 119 women were nulliparous.
[e]Missing data for time since last pregnancy for 67 participants, plus 584 women were postmenopausal, and 16 women had unknown menopausal status.
[f]Missing data for menopausal status for 16 participants.
[g]Missing data for age at menopause for 162 participants who had nonnatural (or unknown cause of) menopause, plus 601 women were premenopausal, and 16 women had unknown menopausal status.
[h]Missing data for menopausal hormone therapy use for 12 participants.

Table 2. Breast Cancer Reproductive and Hormonal Risk Factors by Level of Education in *Ella* Study Participants with Known Age at Diagnosis and Level of Education (n = 1201)

Participant characteristics	*<High school* (n = *602*)	*High school* (n = *313*)	*>High school* (n = *286*)
Age at diagnosis (years), mean ± SD	55.5 ± 12.8	49.9 ± 10.6	47.6 ± 11.4
Age at menarche (years), mean ± SD[a]	13.0 ± 1.6	12.6 ± 1.6	12.3 ± 1.6
Age at menarche < 12 years, *n* (%)[a]	92 (15.3)	69 (22.0)	90 (31.5)
Hormone contraceptive use (ever), *n* (%)[b]	298 (49.5)	195 (62.5)	188 (66.0)
Nulliparity, *n* (%)	44 (7.3)	29 (9.3)	46 (16.1)
Age at first full-term pregnancy, mean ± SD[c]	21.6 ± 5.2	22.8 ± 4.8	25.4 ± 5.7
Age at first full-term pregnancy ≥ 30 years, *n* (%)[c]	53 (9.52)	26 (9.15)	56 (23.3)
Number of full-term pregnancies, mean ± SD	3.9 ± 2.6	2.7 ± 1.7	2.1 ± 1.5
Number of full-term pregnancies ≥ 3, *n* (%)	444 (79.6)	169 (59.5)	111 (46.3)
Ever breastfed (if parous), *n* (%)[d]	464 (83.8)	198 (70.0)	166 (69.5)
Lifetime breastfeeding (if parous, months), mean ± SD[d]	30.5 ± 39.6	11.6 ± 18.2	8.4 ± 12.2
Lifetime breastfeeding ≥ 6 months (if parous), *n* (%)[d]	392 (70.8)	143 (50.5)	98 (41.0)
Time since last pregnancy (if premenopausal, years), mean ± SD[e]	14.6 ± 8.1	12.9 ± 7.0	11.3 ± 7.6
Time since last pregnancy ≤ 10 years (if premenopausal), *n* (%)[e]	75 (34.6)	55 (33.7)	75 (48.7)
Postmenopausal, *n* (%)[f]	356 (59.9)	132 (43.0)	96 (33.8)
Age at natural menopause (years), mean ± SD[g]	48.8 ± 5.4	50.2 ± 4.3	49.5 ± 4.5
Age at natural menopause ≥ 50 years, *n* (%)[g]	142 (50.2)	50 (56.8)	27 (52.9)
Menopausal hormone therapy use, *n* (%)[h]	62 (10.4)	42 (13.6)	55 (19.4)

[a]Missing data for age at menarche for 1 participant.
[b]Missing data for hormone contraceptive use for 2 participants.
[c]Missing data for age at first full-term pregnancy for 1 participant, plus 119 women were nulliparous.
[d]Missing data for breastfeeding for 6 participants, plus 119 women were nulliparous.
[e]Missing data for time since last pregnancy for 67 participants, plus 584 women were postmenopausal, and 16 women had unknown menopausal status.
[f]Missing data for menopausal status for 16 participants.
[g]Missing data for age at menopause for 162 participants who had non-natural (or unknown cause of) menopause, plus 601 women were premenopausal, and 16 women had unknown menopausal status.
[h]Missing data for menopausal hormone therapy use for 12 participants.

years after adjustment for age and education. All three groups of MA women were significantly less likely than Mexican women to report ever breastfeeding (ORs = 0.37, 0.21, and 0.13 for Spanish-dominant, bilingual, and English-dominant, respectively); results for breastfeeding ≥ 6 months were nearly identical, and these did not change after adjustment for age and education. Although the associations were attenuated after adjustment for age and education, bilingual MA women had significantly higher odds of having used HT (OR = 1.84; 95% CI, 1.16–2.93) as well as hormone contraception (OR = 1.59; 95% CI, 1.14–2.22) than Mexican women. English-dominant women had higher odds of being nulliparous in the unadjusted model; however, the ORs were attenuated and nonsignificant after adjustment for age and education.

Discussion

In this binational study of women of Mexican descent, we observed differences in the reproductive risk profile according to language acculturation and country of residence. Across levels of increasing acculturation (from Mexican women to English-dominant MA women), we observed increasing trends for lower age at menarche and decreasing trends for proportion of women with a history of breastfeeding as well as breastfeeding duration, after adjustment for age and education. HT and hormone contraception use was highest in bilingual MA women. In a novel finding, the present study shows that English-dominant women had lower odds of being diagnosed within 10 years of their last birth, a transient high-risk period for developing breast cancer;[32] however, due to the small number in this group, the OR lacked precision.

The *Ella* Binational Breast Cancer Study used a language-based acculturation measure, which was administered to participants living in the US. It has been argued that language-only measures of acculturation are partially indicative of SES, and therefore, studies that seek to examine the unique effects of acculturation should take SES into account.[33] Indeed, in the current study, our conceptualization of acculturation and educational attainment were strongly related. Only 10.7% of Mexican women reported education beyond high school, compared with 52% of MA women who were English dominant. To date, few studies have examined the effects of language-based acculturation while considering the influence of education, making it difficult to untangle the effects of these social-contextual factors. The current study assessed acculturation in relation to reproductive and hormonal breast cancer risk factors while controlling for the influence of education, a commonly used indicator of SES. The analyses identified clear associations between the reproductive and hormonal factors of interest and education for most variables; in some instances, associations between acculturation and reproductive factors were attenuated in the multivariate models that adjusted for education, which helps elucidate risk factors that are influenced by culture independent of education. For example, the association between acculturation and age at menarche was only partly attenuated by education. However, although we observed a significantly lower likelihood of having ≥ 3 pregnancies for bilingual and English-dominant versus Mexican women in the unadjusted

Table 3. Associations Between Level of Acculturation (Independent Variable) and Reproductive and Hormonal Risk Factors (Dependent Variable)

			Odds ratio (95% confidence interval)			
Risk factor	*Acculturation level*	n (%)[a]	*Crude*	*Age-adjusted*	*Education-adjusted*	*Age- and education-adjusted*[b]
Age at menarche, <12 years	Mexican	93 (16.0)	1.00	1.00	1.00	1.00
	Spanish-dominant	32 (15.9)	0.99 (0.64–1.54)	0.99 (0.64–1.53)	1.02 (0.65–1.58)	1.02 (0.66–1.59)
	Bilingual	84 (28.5)	2.09 (1.49–2.92)	2.07 (1.47–2.91)	1.62 (1.11–2.37)	1.63 (1.12–2.38)
	English-dominant	42 (34.2)	2.72 (1.76–4.18)	2.69 (1.74–4.17)	2.08 (1.30–3.33)	2.08 (1.30–3.34)
						$p_{trend} = 0.001$
Nulliparous	Mexican	55 (9.47)	1.00	1.00	1.00	1.00
	Spanish-dominant	12 (5.94)	0.60 (0.32–1.15)	0.58 (0.30–1.11)	0.62 (0.33–1.19)	0.61 (0.32–1.17)
	Bilingual	32 (10.9)	1.16 (0.73–1.84)	1.10 (0.69–1.75)	0.80 (0.48–1.34)	0.79 (0.47–1.33)
	English-dominant	20 (16.3)	1.86 (1.07–3.23)	1.74 (1.00–3.05)	1.25 (0.68–2.29)	1.24 (0.67–2.27)
						$p_{trend} = 0.99$
Age at first full-term pregnancy (if parous), ≥30 years	Mexican	73 (13.9)	1.00	1.00	1.00	1.00
	Spanish-dominant	15 (7.89)	0.53 (0.27–0.95)	0.55 (0.31–0.99)	0.55 (0.30–0.99)	0.59 (0.33–1.07)
	Bilingual	34 (12.9)	0.92 (0.59–1.42)	0.96 (0.62–1.50)	0.50 (0.30–0.82)	0.50 (0.30–0.83)
	English-dominant	13 (12.6)	0.89 (0.58–1.68)	0.95 (0.50–1.79)	0.48 (0.24–0.94)	0.49 (0.25–0.97)
						$p_{trend} = 0.004$
Parity (if parous), ≥3 pregnancies	Mexican	382 (72.6)	1.00	1.00	1.00	1.00
	Spanish-dominant	131 (69.0)	0.84 (0.58–1.20)	0.96 (0.66–1.39)	0.79 (0.54–1.15)	0.89 (0.61–1.30)
	Bilingual	160 (60.8)	0.59 (0.43–0.80)	0.68 (0.49–0.94)	1.15 (0.80–1.65)	1.19 (0.82–1.72)
	English-dominant	51 (59.5)	0.40 (0.24–0.57)	0.44 (0.28–0.69)	0.72 (0.45–1.16)	0.77 (0.48–1.24)
						$p_{trend} = 0.75$
Time since last pregnancy (among parous, premenopausal women), ≤10 years	Mexican	77 (35.3)	1.00	1.00	1.00	1.00
	Spanish-dominant	46 (44.2)	1.45 (0.90–2.34)	0.57 (0.83–2.94)	1.56 (0.96–2.53)	1.76 (0.92–3.35)
	Bilingual	60 (40.3)	1.23 (0.80–1.89)	0.95 (0.53–1.70)	0.94 (0.59–1.50)	0.66 (0.35–1.25)
	English-dominant	22 (34.9)	0.98 (0.55–1.77)	0.67 (0.30–1.47)	0.72 (0.39–1.35)	0.45 (0.19–1.02)
						$p_{trend} = 0.07$
Breastfeeding (if parous), ever	Mexican	466 (89.1)	1.00	1.00	1.00	1.00
	Spanish-dominant	144 (76.2)	0.39 (0.25–0.60)	0.38 (0.24–0.58)	0.39 (0.25–0.60)	0.37 (0.24–0.58)
	Bilingual	165 (63.2)	0.21 (0.14–0.31)	0.20 (0.14–0.29)	0.21 (0.14–0.22)	0.21 (0.14–0.32)
	English-dominant	53 (51.5)	0.13 (0.08–0.21)	0.12 (0.08–0.20)	0.13 (0.08–0.22)	0.13 (0.08–0.21)
						$p_{trend} < 0.001$

(*continued*)

Table 3. (Continued)

Risk factor	Acculturation level	n (%)[a]	Odds ratio (95% confidence interval): Crude	Age-adjusted	Education-adjusted	Age- and education-adjusted[b]
Lifetime breastfeeding (if parous), ≥6 months	Mexican	391 (74.8)	1.00	1.00	1.00	1.00
	Spanish-dominant	117 (61.9)	0.55 (0.39–0.78)	0.57 (0.40–0.81)	0.54 (0.38–0.77)	0.55 (0.39–0.79)
	Bilingual	102 (39.1)	0.22 (0.16–0.30)	0.23 (0.16–0.31)	0.27 (0.19–0.38)	0.27 (0.19–0.39)
	English-dominant	23 (22.3)	0.10 (0.06–0.16)	0.10 (0.06–0.17)	0.12 (0.07–0.21)	0.12 (0.07–0.21)
						$p_{trend} < 0.001$
Age at natural menopause (if postmenopausal), ≥50 years	Mexican	136 (51.1)	1.00	1.00	1.00	1.00
	Spanish-dominant	31 (46.3)	0.82 (0.48–1.41)	0.81 (0.47–1.40)	0.82 (0.48–1.41)	0.81 (0.47–1.40)
	Bilingual	39 (55.7)	1.20 (0.71–2.04)	1.30 (0.76–2.23)	1.19 (0.66–2.15)	1.15 (0.63–2.10)
	English-dominant	13 (68.4)	2.07 (0.76–5.61)	2.23 (0.81–6.14)	2.05 (0.73–5.71)	2.00 (0.71–5.67)
						$p_{trend} = 0.41$
Menopausal hormone therapy use, ever	Mexican	63 (11.0)	1.00	1.00	1.00	1.00
	Spanish-dominant	19 (9.45)	0.85 (0.49–1.45)	1.02 (0.58–1.77)	0.86 (0.50–1.48)	1.07 (0.61–1.88)
	Bilingual	57 (19.4)	1.95 (1.32–2.88)	2.76 (1.82–4.18)	1.61 (1.04–2.50)	1.84 (1.16–2.93)
	English-dominant	20 (16.5)	1.60 (0.93–2.77)	2.25 (1.27–4.00)	1.31 (0.72–2.35)	1.45 (0.78–2.70)
						$p_{trend} = 0.04$
Hormone contraception use, ever	Mexican	304 (52.3)	1.00	1.00	1.00	1.00
	Spanish-dominant	99 (49.0)	0.88 (0.64–1.21)	0.77 (0.55–1.07)	0.89 (0.64–1.23)	0.78 (0.56–1.08)
	Bilingual	203 (68.8)	2.01 (1.50–2.70)	1.72 (1.27–2.34)	1.65 (1.19–2.28)	1.59 (1.14–2.22)
	English-dominant	75 (62.0)	1.48 (0.99–2.22)	1.25 (0.83–1.88)	1.19 (0.77–1.84)	1.14 (0.73–1.77)
						$p_{trend} = 0.12$

[a]Number (and percent) of women within each acculturation group for each risk factor.
[b]Age treated as a continuous variable and education as an ordinal variable with categories coded as 0 (<high school), 1 (high school), and 2 (>high school).

model, this was largely explained by education; similar attenuation was observed for nulliparity in English-dominant MA women. Conversely, our findings suggest that the association between breastfeeding and acculturation is not attributable to education, suggesting that this behavior may be largely culturally driven. Thus, our study contributes to the existing literature on acculturation in helping to understand its influence beyond the effects of education as an indicator of SES.

One unexpected finding in our study is the observation that after adjustment for education, MA bilingual and English-dominant women were significantly less likely to have had a first birth after age 30 compared to women in Mexico. However, the results also show that Spanish-dominant women have the lowest proportion of these later births, although the association became non-significant once education was taken into account. These results are not related to the choice of the age cut-point given that when we dichotomized the variable at 25 instead of 30 years, we observed similar results (data not shown). This association needs to be examined in future studies similar to ours.

It is difficult to place our results in context of existing literature, since there is a paucity of data on the association between breast cancer hormonal and reproductive factors and acculturation from studies that include participants residing in the country of origin, and because few studies assessed the spectrum of risk factors examined here. Two published reports[34,35] showed that US-born Hispanics in California had a higher prevalence of breast cancer risk factors (i.e., hormonal, reproductive factors and obesity) than their foreign-born counterparts. Keegan et al.,[34] further noted that this pattern is consistent with the corresponding differences in breast cancer incidence rates in the state. Our results are consistent with published reports on breastfeeding, which show that women born outside the US are more likely to breastfeed than those who are born in the US[36–41] and that language acculturation also plays a role in whether women choose to breastfeed, particularly among MAs. Results of studies that considered SES variables in their models show that less-acculturated women are more likely to breastfeed than those who are more acculturated.[39,42–44] Our findings show a substantially lower prevalence and duration of breastfeeding in MA women versus women residing in Mexico, and we also observed a gradient of decreasing breastfeeding with increasing language acculturation in MA women. Our results are also largely in agreement with those of John et al., who assessed migration history, acculturation, and breast cancer risk among Hispanic women (predominantly of Mexican descent).[35] Their study found that less-acculturated, Spanish-dominant women had a lower breast cancer risk than their more acculturated, English-speaking counterparts and attributed these differences to adoption of a ''Western lifestyle'' by the highly acculturated women, which has also been suggested elsewhere in the literature.[45] Factors contributing to this trend include higher education, no or limited breastfeeding, early age at menarche, low parity, and later age at first pregnancy.[33] In the Multiethnic Cohort study, Pike et al.[7] showed that the breast cancer risk factor distribution resulted in a predicted multivariate relative risk (RR) of 0.81 for U.S-born Hispanic and 0.72 for non-US-born Hispanic women, compared with NHWs. The models took into account reproductive and hormonal factors as well as body weight and alcohol. In fact, the observed multivariate-adjusted RR for US-born Hispanic women explained nearly all the difference (RR = 0.95); however, for non-US-born Hispanics, the adjusted RR was 0.84, suggesting additional contributing factors. It is important to note that no breastfeeding information was available in this multiethnic study, which could be a key explanatory variable for the lower risk in non-US-born Hispanic women.

Strengths and limitations

Among the strengths of our study is the inclusion of women from the country of origin as a comparison group to assess possible cultural effects; we could not find such a comparison in the literature. Furthermore, by including only women of Mexican descent in our study, we are able to exclude heterogeneity that is present in some studies of Hispanics in the US, which assume the existence of a homogeneous culture across all sub-groups. Our clinic-based study was completed with very high response rates ($>90\%$)[25] minimizing sampling bias. As noted previously, adjustment for education is also a strength of our analytical approach. Even though we did not collect other SES variables, such as income, education is a commonly used variable, which is considered a fundamental aspect of SES.[46,47] From the perspective of understanding associations of SES with health, education provides cognitive resources that may increase receptivity to health promotion messages and foster better access to health services. However, we recognize that education does not fully capture all aspects of SES. For example, income may provide additional information regarding access to tangible resources and health promoting environments, which may be relevant to understanding breast cancer risk and other aspects of health.[48,49] Further, little is known about the use of education or other markers of SES in low- or middle-resource countries.[24] Future research that takes a more comprehensive view to conceptualizing SES in efforts to understand its influence on health among women born outside of the US, or to examine the impact of acculturation across women of Mexican descent, may be informative. Similarly, although language is a common indicator of acculturation, it does not fully capture all aspects of this complex process. An additional limitation of the study includes the cross-sectional design, which does not allow for assessment of temporality between acculturation and risk factors. As well, our study had a modest number of English-dominant MA women ($n = 123$), resulting in less precise estimates of association for this group. Furthermore, the *Ella* Study is a case-only study, which does not permit us to test associations in a non-diseased population or calculate risk of developing breast cancer. Rather, our study provides a framework for an analytical approach for use in binational studies. However, given that we have adequate annotation of the tumor marker profiles[25,31] we will be able to assess the role of reproductive and hormonal factors in relation to breast tumor subtypes in the context of acculturation in future studies.

Conclusions

Results of the present study show that education, language acculturation, and country of residence are associated with several key risk or protective factors for breast cancer. By considering education in the analysis, our study addresses some of the criticisms of research concerning language-based acculturation measures, which assert that this metric primarily captures SES. Measuring culture, particularly related to health behavior and outcomes, is complex but clearly relevant to understanding disease prevention and outcome. If our results are replicated in a disease-free population, the continued assessment of sociocultural contextual factors (SES, nativity, acculturation) related to breast cancer risk for women of Mexican descent, both in Mexico and in the US, will be important in understanding the factors underlying breast cancer risk in this population. In addition, the findings support the utility of educational interventions focused on MA women to promote the protective behavior of breastfeeding associated with more traditional Mexican culture.

Given the continued rise in globalization in Mexico and other low- and middle-resource countries, more women will continue to enter the workforce, resulting in more reproductive control by these women, delayed childbearing and lower breastfeeding rates. National survey data for Mexico show that breastfeeding rates are dropping substantially, including in rural areas.[50] Such changes, along with longer life expectancy and continued low breast cancer screening rates, will undoubtedly further increase the breast cancer burden in Mexico and other less developed countries. As has been suggested previously,[45] early detection of breast cancer must be a primary goal worldwide. Simultaneously, population-wide educational efforts must be implemented towards meeting this goal along with risk reduction to consider modifiable risk factors, such as promotion of breastfeeding.

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Disclosure Statement

No competing financial interests exist for any of the authors.

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