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Examination of ancestral informative markers and self-reported race with tumor characteristics of breast cancer among black and white women

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Abstract

Background—African American (AA) women have a higher mortality from breast cancer (BC) compared to European American (EA) women. This may be due to the higher proportion of AA women with tumors that are diagnosed at more advanced stages and are characterized as being estrogen receptor negative (ER-)/ progesterone receptor negative (PR-). Our study sought to determine whether self-reported race and percent African ancestry were associated with BC tumor characteristics.

Methods—In a multi-center, population-based case-control study of BC, we determined percent African ancestry using ancestry informative markers (AIM) among women self-reporting race as AA or Black.

Results—BC tumor characteristics were associated with self-reported race (including a 30% reduction in ER+/PR+ tumors [95% confidence interval [CI]: 0.6-0.9] and a 1.5-fold increased risk of high grade [95% CI: 1.2-1.9] for AA women compared to EA women). AIMs among AA women were not associated with BC tumor characteristics (AA women with 95% versus < 80% African ancestry, odds ratio [OR]=1.0 for ER+/PR+ [95% CI: 0.6-1.8] and OR=0.9 for high-grade tumors [95% CI: 0.6-1.4]). Similar findings were observed for BC stage.

Conclusion—While BC subtypes were associated with self-reported race, BC subtypes were not associated with percent African ancestry.

Impact—These study results suggest that subtle differences in percent African ancestry are less important than the overall presence of African ancestry in relation to BC tumor characteristics.

Introduction

African American (AA) women in the U.S. experience lower incidence overall but higher mortality rates from breast cancer (BC) compared to European American (EA) women[1]. It is yet unclear to what extent these differences are due to genetic or environmental factors [2]. Accounting in part for the observed racial patterns is the diagnosis in AA women of more aggressive BC, including a larger percentage of estrogen-receptor (ER) negative and progesterone receptor (PR) negative tumors, tumors with more advanced stage, and higher grade tumors [3-5]. Studies reporting a relatively high proportion of aggressive triple negative (ER-, PR-, and HER-) tumors among West African women, the ancestral population for many AA women, have provided some support for a genetic component to the observed racial patterns [6]. However, many studies have demonstrated that racial differences in mammographic screening rates, as well as other factors related to access and utilization of health care, may contribute to differences in survival between EA and AA women, likely due in part to the impact of these factors on stage at diagnosis [7-10]. In addition, other social, lifestyle, and economic factors, including the impact of poverty, may contribute to racial differences in BC survival, [11, 12] although it is less clear how these lifestyle factors would affect tumor subtypes.

Few studies have evaluated whether genetic admixture predisposes women to certain types of BC. Recently, Fejerman et al. reported through use of ancestry informative markers (AIM) that higher percent European ancestry within AA women is associated with an increased likelihood of ER+/PR+ versus ER-/PR- BC, as well as increased chance of localized versus non-localized BC [13]. However, this group observed no associations in the admixture-based genome-wide association analysis, concluding that the association observed with the AIMs data may be a result of racial differences in non-genetic factors or a result of multiple genetic variants each with modest associations to BC. Further information on the extent to which genetic admixture impacts the risk of BC subtypes would be valuable in understanding the contribution of genetic factors to observed racial differences in BC. Our analysis sought to examine whether genetic admixture or self-reported race was related to BC subtypes in our multi-site case-control study of BC.

Methods

Study Design

The Women's Contraceptive And Reproductive Experiences (CARE) study was a population-based case-control study of incident, invasive BC conducted in five geographic

regions: Atlanta, Georgia; Detroit, Michigan; Los Angeles, California; Philadelphia, Pennsylvania; and Seattle, Washington [14]. Eligible cases were women age 35–64 years who were diagnosed with BC between July 1, 1994 and April 30, 1998, were born in the U.S., and resided in one of the five geographic areas. Case ascertainment was conducted by field center staff, and at four of the study centers (excluding Philadelphia) cases were confirmed through the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) registry. Younger women and AA women were over-sampled to approximate a uniform distribution across age strata. Sampling for cases and controls was density-based [15]. Potential controls were identified from the same geographic region as cases using random digit dialing with unclustered, equal-probability sampling of phone numbers [16]. Women were asked which of the following categories best described them: 'White,' 'Black or African American,' 'Asian or Pacific Islander,' 'American Indian or Aleut or Eskimo,' or 'Other.' The study was restricted to women who reported their race as 'White' or 'Black or African American' (for ease, henceforth referred to as self-reported AA race).

Blood samples were sought from all participants with a first degree family history of BC and from a random sample of those without such family history [17]. This analysis included 2,146 EA women (995 controls; 1,151 cases), and 949 AA women (456 controls; 493 cases). This study was approved by the Institutional Review Board at each participating institution. All women gave written informed consent.

Pathology

Pathology data, including ER and PR status, grade, and stage, were obtained from review of pathology reports, medical records, and hospital registry abstracts, and at four of the study sites from SEER files.

Ancestry Informative Markers

Percent African ancestry was estimated using 128 AIMs described by Kosoy et al. [18] in all women who self-identified as AA in our study. Using the AIMs genotypes, we estimated the population structure in AA women (of whom 863 of 949 had data available for analysis) with the Yoruban (YRI) and CEPH (Centre d'Etude du Polymorphisme Humain) from Utah (CEU) hapmap populations as anchors (STRUCTURE v2.3) [19, 20]. The estimation of percent African ancestry from the STRUCTURE analysis was consistent with results from eigenstrat analysis. Furthermore, this classification was assessed for its comparability with results based on self-reported AA race.

Statistical Analysis

Percent African ancestry and percent European ancestry across the genome were estimated from AIMs. All analyses accounted for sampling weights using the svy command in Stata. Linear regression was used to estimate whether geographic site contributed to the variance in percent ancestry.

Our primary analysis used polytomous logistic regression to examine associations for BC subtypes with percent African ancestry and with self-reported race. We chose to compare BC subtypes to controls so as to get an estimate of the risk of BC subtypes relative to unaffected controls rather than relative to another affected group. We modeled percent African ancestry as both a categorical variable (<80%, 80–<95%, 95%–100%) with <80% as the referent category; and alternately, as a continuous variable comparing 10% differences in percent African ancestry. To avoid the impact on our model of sparse data for those with <40% African ancestry (10 controls; 6 cases), we restricted this analysis to women with 40% African ancestry.

In a case-only analysis performed to assess comparability with Fejerman's analysis [13], logistic regression was used to compare ER+/PR+ versus ER-/PR-; localized versus regional/distant stage; well/moderate versus poor/undifferentiated grade. Percent European ancestry was modeled as a continuous variable ranging from 0 to 1. The reduced model included family history, age, and study site. The fully adjusted models (for comparability with Fejerman's analysis) included number of live births, age at first birth, age at menarche, menopausal hormone therapy use, menopausal status, body mass index (BMI), family history, age, and study site.

Results

Demographic characteristics of the 3,095 women within this analysis are presented in Table 1. As published previously, among BC cases we observed significant differences between White and AA women, such that a greater percentage of White women had first-degree family history of breast cancer, were ever users of estrogen-progestin therapy (EPT) or estrogen-alone therapy (ET), had their first child at age 30 years or older, were menopausal at the time of study, were college graduates, and had a BMI less than 25 [21].

The mean percent African ancestry in the 863 AA women was 85.7%. Figure 1 provides the mean percent African ancestry stratified by study site and BC tumor characteristics. The percentage of African ancestry observed for AA women differed slightly by geographic study site (p -value = 0.02). We observed narrower interquartile ranges of percent African ancestry in Detroit and Philadelphia compared to Seattle and Los Angeles.

When investigating the impact of race on risk of BC subtypes, we first compared women self-reporting as AA to those self-reporting as White (adjusted for age at diagnosis, geographic study site, and family history of breast cancer). For this, we observed self-reported AA women to be at a decreased risk of ER+/PR+ BC (OR = 0.7 [95% CI: 0.6-0.9]) while at a non-significantly increased risk of ER-/PR- BC (OR = 1.3 [95% CI: 0.9-1.7]) compared to women self-reporting as White (Table 2). We observed self-reported AA women to be at a 1.4-fold increased risk of regional/distant stage (95% CI: 1.1-1.7) and a 1.5-fold increased risk of poor/undifferentiated grade (95% CI: 1.2-1.9). In the fully adjusted model (adjusted for age at diagnosis, geographic study site, and family history of breast cancer, age at first live birth, parity, menopausal status, ever use of menopausal hormones, and BMI), we observed no substantial change in ORs. AA women were still at a 30% reduced risk of ER+/PR+ BC (95% CI: 0.6-0.99; p =0.046), a 1.3-fold increased risk of regional/distant stage (95% CI: 1.0-1.8; p =0.048) and a 1.6-fold increased risk of poor/undifferentiated grade (95% CI: 1.2-2.1).

Next, restricting the analysis to AA women, we investigated whether the percent African ancestry (based on AIMs) was associated with BC tumor characteristics. We observed no association for percent African ancestry with ER/PR subtypes, stage, or grade when AIMs were modeled categorically or continuously (Table 2).

In the case-only analysis, we did not observe a statistically significant association with percent European ancestry among self-reported AA women for ER+/PR+ versus ER-/PR- (OR = 0.4 [95% CI: 0.1-2.7] in the fully adjusted model; Table 3). Percent European ancestry in AA women was not significantly associated with localized versus regional/distant stage (OR = 1.6 [95% CI: 0.2-12.2]); well/moderate versus poor/undifferentiated grade was not associated with percent European ancestry in AA women (OR = 1.1 [95% CI: 0.2-5.5]). However, when examined using self-reported data in cases, AA race was associated with a 40% reduction in risk of ER+/PR+ versus ER-/PR- tumors (95% CI: 0.4-0.9), and a 50% reduction in well/moderate versus poor/undifferentiated grade (95% CI:

0.4-0.8) but not with localized versus regional/distant stage (OR = 0.7 [95% CI: 0.5-1.0]; all in fully-adjusted models; data not shown).

Discussion

While our findings are consistent with previous studies reporting an increased risk of ER-/PR- BC and a decreased risk of an ER+/PR+ BC in AA women relative to EA women [3, 4], further delineation among AA women according to percent African ancestry based on AIMs did not distinguish any within-race variation in risk of ER/PR subtypes, stage, or grade. In other words, among AA women in our study the risk of BC subtypes was not sensitive to the finer classification of percent African ancestry.

Specifically, we report no association between percent African ancestry and risk of BC subtypes (Table 2), nor any difference in the proportion of breast cancer associated with percent European ancestry (Table 3). The point estimate less than one (OR=0.4) for ER+/PR+ in relation to percent European ancestry (Table 3) is somewhat surprising given the increased risk of ER-/PR- for self-reported AA women here and in prior findings [3, 4]. But this estimate has corresponding wide confidence intervals, and furthermore, is consistent with our nearly significant finding (OR=0.9 [0.7-1.0]) of a 10% decrease in risk of ER-/PR- BC for every 10% increase in African ancestry reported in Table 2.

Our AIMs findings are not, however, in full agreement with results from a prior study by Fejerman et al, that used approximately 2,400 AIMs genotyped in 1,484 AA women residing in the US (note, of the 384 AA women from the Los Angeles site of the CARE study included in the Fejerman study, 310 were also included in the current analysis) [13]. Fejerman et al reported an association between percent European ancestry and ER/PR status in which AA women with higher European ancestry had an increased odds of having ER+/PR+ versus ER-/PR- breast tumors (OR=2.84 [95% CI: 1.13-7.14] for a 0% to 100% change in European ancestry) and localized versus non-localized stage (OR = 2.65 [95% CI: 1.11-6.35]), but not grade (OR=1.21[95% CI: 0.48-3.08]) after adjusting for known confounders [13]. Our report of no association between percent European ancestry and BC grade are consistent with Fejerman's findings. However, in our analysis of stage and European ancestry we didn't observe a significant increased risk (although the 95% CI overlaps the findings by Fejerman et al). In addition in our analysis of ER+/PR+ BC, the 95% CI excludes their point estimate of 2.8, indicating that our results fail to replicate their finding. Furthermore, our lack of an association with percent European ancestry is consistent with our findings reported here in Table 2 for percent African ancestry using a different analytic approach (i.e. comparison of BC tumor characteristics to controls).

In reconciling our results with those of Fejerman's study, it is important to note a few differences between our analyses. First, we observed a lower mean percent of European ancestry (14%) and less variability than reported in Fejerman et al's data (mean of 23% European ancestry), indicating that we have a smaller range of percent African ancestry in our sample in which to observe associations with breast cancer tumor characteristics. This difference is likely due to the fact that the cases in Fejerman's study were primarily recruited from the western U.S, while nearly 60% of our study's cases were from the Eastern U.S. As we reported above, we observed greater variability in percent African ancestry from the West coast sites compared to Eastern U.S. sites. The reduced variability in percent ancestry in our sample could hamper our ability to detect an association, if in particular, those individuals with higher percent European ancestry are driving the associations observed between ancestry and BC subtypes.

Secondly, the two analyses used different analysis methods to estimate the percent African ancestry. We used STRUCTURE and eigenstrat to estimate the percent African ancestry while Fejerman et al used ANCESTRYMAP for their analysis likely due to the greater number of markers genotyped in their study. The main difference between these two analytic methods is that ANCESTRYMAP estimates ancestry based on admixture mapping (e.g. local estimates of ancestry)[22], while STRUCTURE and eigenstrat estimate ancestry more globally. However, Patterson et al indicates that the underlying methods of STRUCTURE and ANCESTRYMAP are similar [22]. In addition, our sample was smaller than Fejerman's sample (and was smaller than the sample used in our analysis on self-reported race reported here). However, we calculated that with 456 controls and 493 cases our study has sufficient statistical power to detect a minimum odds ratio of 1.7 per decile African ancestry.

Lastly, we used a subset of the AIMs used in Fejerman's analysis. However, previous studies indicate that this subset of markers yields admixture proportions consistent with the larger set of markers among African Americans, including in a validation study reporting that subsets of 30 to 200 markers were sufficient to characterize ancestry (with correlations of 0.89 and 0.98, respectively, to the larger panel) [23-25]. With respect to BC grade, our results were consistent with Fejerman's report. However, our findings of no association between percent African ancestry and ER/PR BC are in opposition to Fejerman's findings. Although it is possible that the differences between our studies' methods explain this discrepancy, it is also possible that the percent of African ancestry is perhaps more modestly associated with ER/PR subtypes.

It is also possible that unmeasured, non-genetic characteristics associated with race account in part for the racial patterns in risk of aggressive BC. As Fejerman et al acknowledged in light of the lack of associations observed in their genome-wide association analysis, the associations they observed between AIMs and BC tumor characteristics may be a result of racial differences in BC risk factors. While their estimates remained significant after controlling for known risk factors (i.e. reproductive factors, BMI, and family history), they acknowledged that unmeasured factors which correlate with race could explain in part the associations they observed.

As some social and economic factors cluster among AA women, such as stress associated with poverty and discrimination, these factors may contribute to the observed patterns of incidence in BC subtypes [11, 12]. Previous studies have suggested that elevated cortisol levels associated with social isolation, for example, may have a direct role in the etiology of BC among AA women [26, 27]. Thus, it is plausible that factors related to African American women's experience will impact BC development [12]. Therefore the experience of being AA, as reflected through self-reported race, could be more relevant than genetic contributions to BC tumor characteristics. While on the surface, this is not supported by the finding that indigenous African women and AA women have similarities in BC pathology [6] but do not share environmental factors, in the context of social factors, it is plausible that some social factors, such as poverty-related barriers or stress [12], would also be present for indigenous African women.

Our findings of an association with self-reported race but not ancestry informative markers need to be interpreted with caution. While these findings suggest that social factors may contribute to racial patterns of BC to a greater extent than genetic factors, before conclusions are drawn more research is needed to investigate contributors to the observed racial differences in BC subtypes.

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1

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Figure 1. Percent African ancestry among African American women

Legend: Boxplot showing the 50th, 25th and 75th percentiles (middle, bottom, and top lines of the boxes, respectively) and values outside the 95th percentile (shown as dots) (1) geographic site, (2) hormone receptor status, (3) stage, and (4) grade.

Table 1

Characteristics of breast cancer cases and controls by race

	Case ¹			Control ¹		
	All women n (%) n = 1647	AA women n (%) n = 493	White women n (%) n = 1151	All women n (%) n = 1451	AA women n (%) n = 456	White women n (%) n = 995
Age Group						
35-39	309 (15.1)	91 (13.8)	218 (15.8)	232 (14.2)	71 (13.0)	161 (14.9)
40-44	247 (16.5)	83 (17.8)	164 (15.8)	248 (17.8)	79 (18.4)	169 (17.4)
45-49	263 (17.2)	83 (18.4)	180 (16.5)	239 (18.2)	74 (18.8)	165 (17.9)
50-54	296 (18.4)	87 (18.7)	209 (18.3)	234 (17.6)	75 (18.3)	159 (17.3)
55-59	271 (16.6)	90 (16.8)	181 (16.9)	269 (17.1)	84 (17.3)	185 (17.0)
60-64	261 (16.0)	62 (14.5)	199 (16.8)	229 (15.0)	73 (14.3)	156 (15.4)
Race						
White	1151 (64.6)	-	-	995 (64.6)	-	-
African American	493 (35.4)	-	-	456 (35.4)	-	-
Study Center						
Atlanta	318 (19.3)	108 (19.8)	210 (18.9)	308 (19.1)	117 (20.7)	191 (18.3)
Detroit	214 (14.8)	83 (17.1)	131 (13.6)	251 (16.6)	96 (20.1)	155 (14.8)
Los Angeles	440 (27.2)	184 (35.2)	256 (22.7)	356 (26.8)	150 (32.6)	206 (23.7)
Philadelphia	184 (15.4)	89 (24.0)	95 (10.8)	149 (15.6)	67 (22.3)	82 (11.4)
Seattle	491 (23.3)	32 (3.8)	459 (34.0)	387 (21.8)	26 (3.3)	361 (31.9)
First-degree relative with breast cancer						
Yes	616 (17.8)	147 (15.2)	469 (19.2)	344 (9.9)	88 (8.6)	256 (10.5)
No	978 (82.2)	331 (84.8)	647 (80.8)	1067 (90.1)	354 (91.4)	713 (89.5)
Unknown	53	18	35	40	14	26
EPT ²						
Never	200 (37.0)	87 (59.4)	113 (24.6)	192 (34.2)	87 (51.3)	105 (24.6)
Former	76 (14.8)	23 (11.2)	53 (11.9)	80 (17.5)	28 (17.2)	52 (13.8)
Current	334 (48.2)	47 (29.4)	287 (63.5)	302 (48.2)	54 (31.5)	248 (61.6)
Unknown	11		9	13	3	8

	Case ¹			Control ¹		
	All women	AA women	White women	All women	AA women	White women
	n (%) n = 1647	n (%) n = 493	n (%) n = 1151	n (%) n = 1451	n (%) n = 456	n (%) n = 995
ET ²						
Never	427 (64.0)	118 (76.6)	309 (67.8)	367 (58.8)	119 (73.0)	248 (62.3)
Former	76 (15.0)	21 (11.1)	55 (14.0)	78 (14.8)	21 (11.9)	57 (13.3)
Current	107 (21.0)	18 (12.3)	89 (18.2)	129 (26.4)	29 (15.0)	100 (24.4)
Unknown	11		9	13	3	8
Age at first live birth						
< 30	1089 (67.5)	378 (75.4)	711 (63.2)	1009 (71.9)	365 (81.7)	644 (66.5)
30+	194 (11.5)	36 (7.7)	158 (13.6)	172 (10.4)	29 (5.5)	143 (13.2)
No births/unknown	364 (21.0)	82 (16.9)	282 (23.2)	270 (17.7)	62 (12.5)	208 (20.3)
Menopausal Status						
Not menopausal	973 (58.7)	308 (60.8)	665 (57.6)	793 (55.9)	244 (56.0)	549 (55.9)
Known natural menopause	303 (19.2)	97 (21.3)	206 (18.1)	274 (19.1)	94 (20.5)	180 (18.3)
Known induced menopause	118 (7.3)	36 (7.5)	82 (7.8)	154 (10.6)	54 (11.1)	100 (10.2)
Known menopause, but type unclear	25 (1.5)	2 (0.5)	23 (2.0)	29 (1.7)	7 (1.3)	22 (2.0)
Assumed natural menopause	225 (13.3)	50 (9.8)	175 (15.2)	201 (12.7)	57 (11.1)	149 (13.6)
Education						
High school or less	588 (38.1)	234 (49.3)	354 (31.9)	540 (39.0)	211 (47.6)	329 (34.3)
Some college	531 (32.3)	157 (29.8)	374 (33.6)	468 (31.1)	161 (34.0)	307 (29.5)
College grad or greater	528 (29.7)	105 (20.9)	423 (34.5)	443 (29.9)	84 (18.5)	359 (36.2)
BMI (kg/m ²)						
< 25	937 (54.9)	179 (35.7)	758 (65.4)	776 (52.0)	168 (36.0)	608 (60.7)
25-29	441 (27.8)	177 (35.3)	264 (23.7)	388 (26.5)	156 (31.8)	232 (23.5)
30+	263 (17.3)	136 (29.1)	127 (10.8)	285 (21.6)	132 (32.2)	153 (15.8)
Unknown	6	4	2	2	0	2

EPT: Estrogen-progestin therapy; ET: Estrogen-alone therapy

¹ Percentages are adjusted for sampling weights, and may not sum to 1 due to rounding

² Among post-menopausal women

Table 2
Associations between BC tumor characteristics and race as measured by self-report and ancestry informative markers

Race	Breast Cancer Subtype							
	Control ¹ n (%) ⁴	Case ¹ n (%) ⁴	OR ²	95% CI	Case ¹ n (%) ⁴	OR ²	95% CI	p-value ³
All women	ER+/PR+				ER-/PR-			
Self-reported								
White	995 (64.6)	634 (73.5)	1.0	(ref)	239 (61.1)	1.0	(ref)	0.005
African American	456 (35.4)	178 (26.5)	0.7	0.6-0.9	133 (38.9)	1.3	0.9-1.7	
Self-reported	Local Stage				Regional/distant Stage			
White	995 (64.6)	762 (68.6)	1.0	(ref)	377 (58.2)	1.0	(ref)	0.006
African American	456 (35.4)	267 (31.4)	0.9	0.7-1.1	214 (41.8)	1.4	1.1-1.7	
Self-reported	Well/Moderate Grade				Poor/Undifferentiated			
White	995 (64.6)	521 (69.9)	1.0	(ref)	425 (59.4)	1.0	(ref)	0.003
African American	456 (35.4)	172 (30.1)	0.8	0.6-1.0	231 (40.6)	1.5	1.2-1.9	
Among AA women	ER+/PR+				ER-/PR-			
% African Ancestry								
<80%	106 (27.6)	48 (30.1)	1.0	(ref)	35 (29.0)	1.0	(ref)	0.78
80%-<95%	145 (35.2)	56 (28.7)	0.8	0.4-1.3	50 (39.2)	1.0	0.6-1.8	
95%-100%	141 (37.2)	65 (41.2)	1.0	0.6-1.8	40 (31.8)	0.9	0.5-1.6	
10% difference ⁵	86.9 (0.01)	86.1 (0.01)	1.0	0.8-1.1	84.8 (0.01)	0.9	0.7-1.0	0.51
% African Ancestry	Local Stage				Regional/distant Stage			
<80%	106 (27.6)	81 (31.0)	1.0	(ref)	46 (23.2)	1.0	(ref)	0.58
80%-<95%	145 (35.2)	90 (34.5)	0.9	0.6-1.4	83 (39.5)	1.4	0.8-2.3	
95%-100%	141 (37.2)	84 (34.5)	0.9	0.5-1.4	72 (37.4)	1.3	0.8-2.1	
10% difference ⁵	86.9 (0.01)	85.4 (0.01)	0.9	0.8-1.1	87.2 (0.01)	1.0	0.9-1.2	0.31
% African Ancestry	Well/Moderate Grade				Poor/Undifferentiated			
<80%	106 (27.6)	50 (30.0)	1.0	(ref)	64 (29.6)	1.0	(ref)	0.98

Race	Breast Cancer Subtype					
	Control ¹ n (%) ⁴	Case ¹ n (%) ⁴	OR ²	95% CI	Case ¹ n (%) ⁴	OR ² 95% CI p-value ³
80%–<95%	145 (35.2)	56 (34.1)	1.0	0.6–1.7	84 (36.9)	1.0 0.6–1.6
95%–100%	141 (37.2)	58 (35.9)	0.9	0.5–1.5	69 (33.5)	0.9 0.6–1.4
10% difference ⁵	86.9 (0.01)	85.8 (0.01)	0.9	0.8–1.1	85.6 (0.01)	0.9 0.8–1.1 0.58

¹ Percentages are adjusted for sampling weights, and may not sum to 1 due to rounding

² Models adjusted for age at diagnosis, geographic study site, and family history of breast cancer

³ Overall test of the race variable (self-reported or percent African ancestry) in the polytomous regression model

⁴ n (%) except where noted

⁵ Mean (standard error), using a continuous variable to measure a 10% difference in percent African ancestry (e.g. comparing 80% versus 90% African ancestry).

Associations between BC tumor characteristics and percent European ancestry among African American women in case-only analysis

Table 3

Percent European Ancestry		Reduced Model		Fully adjusted model		Finding by Fejerman, et al	
Mean % (SE)	Mean % (SE)	OR ¹	95% CI	OR ²	95% CI	OR ²	95% CI
<i>Hormone receptors</i>							
ER+/PR-							
14.0 (0.01)	15.1 (0.01)	0.6	0.1-3.6	0.4	0.1-2.7	2.8	1.1-7.1
<i>Stage</i>							
Localized							
14.6 (0.01)	13.9 (0.01)	2.0	0.3-11.3	1.6	0.2-12.2	2.6	1.1-6.4
<i>Grade</i>							
Well/moderate							
14.5 (0.01)	14.5 (0.01)	1.0	0.2-4.3	1.1	0.2-5.5	1.2	0.5-3.1
Poor/undifferentiated							

¹ Adjusted for age, study site, first degree family history of breast cancer

² Adjusted for age, study site, first degree family history of breast cancer, parity, age at menarche, age at first live birth, hormone therapy use, menopausal status, and BMI