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Research Article

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Family History of Cancer in Relation to Breast Cancer Subtypes in African American Women

Traci N. Bethea[1], Lynn Rosenberg[1], Nelsy Castro-Webb[1], Kathryn L. Lunetta[2], Lara E. Sucheston-Campbell[3], Edward A. Ruiz-Narváez[1], Marjory Charlot[4], Song-Yi Park[5], Elisa V. Bandera[6], Melissa A. Troester[7], Christine B. Ambrosone[3], and Julie R. Palmer[1]

Abstract

Background: The evidence on the relation of family history of cancers other than breast cancer to breast cancer risk is conflicting, and most studies have not assessed specific breast cancer subtypes.

Methods: We assessed the relation of first-degree family history of breast, prostate, lung, colorectal, ovarian, and cervical cancer and lymphoma or leukemia, to the risk of estrogen receptor–positive (ER^+), ER^-, and triple-negative breast cancer in data from the African American Breast Cancer Epidemiology and Risk Consortium. Multivariable logistic regression models were used to calculate ORs and 95% confidence intervals (CI).

Results: There were 3,023 ER^+ and 1,497 ER^- breast cancer cases (including 696 triple-negative cases) and 17,420 controls. First-degree family history of breast cancer was associated with increased risk of each subtype: OR = 1.76 (95% CI, 1.57–1.97) for ER^+, 1.67 (1.42–1.95) for ER^-, and 1.72 (1.38–2.13) for triple-negative breast cancer. Family history of cervical cancer was associated with increased risk of ER^- (OR = 2.39; 95% CI, 1.36–4.20), but not ER^+ cancer. Family history of both breast and prostate cancer was associated with increased risk of ER^+ (3.40; 2.42–4.79) and ER^- (2.09; 1.21–3.63) cancer, but family history of both breast and lung cancer was associated only with ER^- cancer (2.11; 1.29–3.46).

Conclusions: A family history of cancers other than breast may influence the risk of breast cancer, and associations may differ by subtype.

Impact: Greater surveillance and counseling for additional screening may be warranted for women with a family history of cancer. *Cancer Epidemiol Biomarkers Prev; 25(2); 366–73. ©2015 AACR.*

Introduction

Having a mother, sister, or daughter with a breast cancer diagnosis is a well-known risk factor for breast cancer (1). Among African American women, estimates of the relative risk for first-degree family history of breast cancer range from 1.65 to 1.78 (2, 3), similar to findings from studies of European American and Asian women (1, 4, 5). Among studies that reported results separately for estrogen receptor (ER)–positive and ER^- breast cancer, most reported similar associations by subtype (3, 6–11), whereas one reported a stronger association with ER^+ cancer (12) and two reported a stronger relation for ER^- breast cancer (13, 14). Only the Black Women's Health Study (BWHS) reported on family history separately for ER^+ and ER^- breast cancer in African American women, with similar increases by subtype, but findings were based on small numbers (3).

A first-degree family history of cancers other than breast cancer may also increase breast cancer risk. Family history of prostate (15, 16), lung (17), ovarian (18), and colon or colorectal cancer (3, 16) have been associated with greater risk of breast cancer in some, but not all studies that examined specific other cancers. In studies that examined combinations of cancers, risk of breast cancer was elevated for family history of breast and prostate cancers (15), breast and ovarian cancers (19, 20), and breast and colorectal cancers (16, 21, 22). Among African American women, family histories of lung cancer (23), colon cancer (3), or both breast and prostate cancer (16) were associated with increased risk of breast cancer.

The objective of this study was to investigate the relation of first-degree family history of breast and other cancers to the risk of ER^+, ER^-, and triple-negative breast cancer in African American women.

Materials and Methods

The African American Breast Cancer Epidemiology and Risk (AMBER) Consortium has been described in detail elsewhere (24). The AMBER Consortium pools data on African American women from two cohort studies, the BWHS and the Multiethnic Cohort Study (MEC), and two case–control studies, the Carolina Breast Cancer Study (CBCS) and the Women's Circle of Health Study (WCHS). Informed consent was provided to each study by its participants. Each study and the consortium were approved by the relevant Institutional Review Boards.

The BWHS is a prospective cohort study that enrolled 59,000 African American women across the United States in 1995 (25). Participants were 21 to 69 years old at baseline when they

[1]Slone Epidemiology Center at Boston University, Boston, Massachusetts. [2]Boston University School of Public Health, Boston, Massachusetts. [3]Roswell Park Cancer Institute, Buffalo, New York. [4]Boston University School of Medicine, Boston, Massachusetts. [5]University of Hawaii Cancer Center, Honolulu, Hawaii. [6]Rutgers Cancer Institute of New Jersey, New Brunswick, New Jersey. [7]University of North Carolina at Chapel Hill Gillings School of Global Public Health, Chapel Hill, North Carolina.

Corresponding Author: Traci N. Bethea, Boston University, 1010 Commonwealth Avenue, Boston, MA 02215-1201. Phone: 617-734-6006; Fax: 617-738-5119; E-mail: tnb@bu.edu

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completed an extensive health questionnaire and are followed with biennial questionnaires for data on incident diagnoses and other factors. Incident breast cancers were identified through self-report on questionnaires or through linkage to state cancer registries. For the AMBER Consortium, a nested case–control study was created; cohort participants without breast cancer were frequency-matched to cases based on age (5-year categories), geographic region, and the most recent completed questionnaire.

The MEC is a prospective cohort study that enrolled men and women in Los Angeles county and Hawaii from 1993 through 1996 (26). Participants were 45 to 75 years at baseline when they completed an extensive questionnaire and have been followed with questionnaires in 1999, 2003, and 2010 to update information. Breast cancer diagnoses are identified through linkage with the Los Angeles County Cancer Surveillance Program and the California Cancer Registry. A nested case–control study of African American women was created to pool MEC data with the AMBER Consortium. Controls, selected from women who had not developed breast cancer, were frequency-matched to cases on age (5-year categories) and the most recent completed questionnaire.

The CBCS is a case–control study that enrolled women in North Carolina from 1993 through 2001 (27). Participants were 20 to 74 years old and were interviewed inperson. Cases were identified through the North Carolina Central Cancer Registry, while controls were identified through Division of Motor Vehicle lists or Health Care Financing Administration lists. Controls were frequency-matched to cases on the basis of age (5-year categories).

The WCHS is a case–control study that enrolled women in New York from 2003 through 2008 and in New Jersey beginning in 2006 (28). Recruitment in New Jersey is ongoing. Participants were 20 to 75 years old and were interviewed in person for data collection. Cases were identified through New York City hospitals and the New Jersey State Cancer Registry, while controls were identified through random digit dialing and community-based recruitment (29). Controls were frequency-matched to cases on the basis of age (5-year categories).

Each study confirmed incident breast cancer cases with data on ER, progesterone receptor (PR), and HER2 obtained from medical records and/or state cancer registries (24). Cases were classified as ER^+, ER^-, and triple-negative ($ER^-/PR^-/HER2^-$). Of the 5,736 potential cases, ER status was available for 4,520 cases (79%) at the time of this analysis. PR status was available for 4,301 cases (75%); HER2 status was available for fewer cases (2,927; 51%), due to more recent inclusion of HER2 in routine testing. There were no statistically significant differences between women with and without known receptor status by age or family history of breast cancer. In total, there were 3,023 ER^+ cases, 1,497 ER^- cases (including 696 triple-negative cases), and 17,420 controls.

Participants were asked whether any parent, sibling, or child (first-degree relative) had been diagnosed with breast cancer and whether the relative was diagnosed before age 50. Participants were also asked about first-degree family history of ovarian, colorectal, prostate, lung, and cervical cancer and lymphoma or leukemia.

Each study obtained detailed data on most known and suspected risk factors for breast cancer. Variables were centrally harmonized and evaluated as risk factors for breast cancer overall and for ER^+, ER^-, and triple-negative breast cancer (24, 30–33).

Statistical analysis

Multinomial logistic regression models were used to calculate ORs and 95% confidence intervals (CI) for the relation of family history of cancer to the risk of ER^+, ER^-, and triple-negative breast cancer. Multivariable models adjusted for the design variables, age (5-year categories), study (BWHS, CBCS, MEC, and WCHS), geographic region (Northeast excluding New Jersey, New Jersey, South, Midwest, and West), and questionnaire time period (1993–1998, 1999–2005, and 2006–2014), and recency of mammogram (never had a mammogram, mammogram within past 2 years, and last mammogram more than 2 years ago). Additional variables were also assessed as potential covariates but were not associated with family history of cancer and did not appreciably change the effect estimates: years of education (<12, 12, 13–15, 16, and >16 years), menopausal status and age at menopause (premenopausal; <45, 45–49, 50–54, and ≥55 years), years of use of postmenopausal estrogen together with progesterone (never used; <5, and ≥5 years), age at menarche (<11, 11–12, 13–14, 15–16, and ≥17 years), body mass index (<18.5, 18.5–24.9, 25–29.9, 30–34.9, 35–39.9, and ≥40 kg/m^2), years of oral contraceptive use (never used; <1, 1–9, and ≥10 years), parity (nulliparous; 1, 2, 3, and ≥4 births), age at first birth (<25 and ≥25 years), lactation (parous and never breastfed, parous and ever breastfed), pack years of cigarette smoking (never smoked; <20 and ≥20 pack years), and alcohol consumption (never drinker, former drinker, current drinker of <7 drinks/week, and current drinker of ≥7 drinks/week). The missing indicator method was used to handle missing values for covariates. To test for interaction between family history of cancer at different cancer sites, interactions were examined by introducing cross-product terms into the models (34). Analyses were conducted using SAS 9.3 statistical package (SAS Institute Inc). Random effects meta-analyses of study-specific results were conducted using Stata/SE 11.2 statistical software (StataCorp LP), with results tested for heterogeneity by the Cochran Q statistic (35).

Results

The prevalences of first-degree family history of breast cancer and of cancers other than breast cancer were largely similar across studies (Table 1); the differences were statistically significant due to the large sample size. Among controls, 9.3% had a first-degree relative with breast cancer, and 22.7% had a first-degree relative with a cancer other than breast cancer. Few controls had first-degree family history of both breast cancer and another cancer site (2.9%). Lung cancer was the most common other cancer among first-degree relatives (7.7%), followed by prostate (7.6%) and colorectal cancer (6.2%).

The ORs for a first-degree family history of breast cancer were similar by subtype: ER^+ cancer (1.76; 95% CI, 1.57–1.97), ER^- cancer (1.67; 95% CI, 1.42–1.95), and triple-negative cancer (1.72; 95% CI, 1.38–2.13; Table 2). For each subtype, the ORs were higher if the relative was diagnosed before age 50. For example, for ER^- cancer, the OR was 1.96 (95% CI, 1.56–2.46) for having a relative diagnosed with breast cancer before age 50 and 1.46 (95% CI, 1.15–1.86) for a relative diagnosed at 50 or older. The ORs were also somewhat higher if the participant herself was diagnosed with breast cancer before age 45: the ORs for the association of having a first-degree relative diagnosed with breast cancer before age 50 with the risk of breast cancer before age 45 were all greater than 3 for ER^+, ER^-, and triple-negative breast cancer.

In assessing the relation of family history of other cancers to breast cancer risk, we looked first at the risk of overall breast

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Table 1. Characteristics of cases and controls in the AMBER Consortium, by study

	BWHS		CBCS		MEC		WCHS		Total	
Characteristics	**Cases *N* (%)**	**Controls *N* (%)**	**Cases *N* (%)**	**Controls *N* (%)**	**Cases *N* (%)**	**Controls *N* (%)**	**Cases *N* (%)**	**Controls *N* (%)**	**Cases *N* (%)**	**Controls *N* (%)**
Age, years[a,b]										
<45	327 (19)	2,549 (24)	236 (29)	216 (27)	0 (0)	0 (0)	267 (25)	307 (25)	830 (18)	3,072 (18)
45–55	572 (33)	3,521 (33)	247 (31)	275 (35)	59 (6)	341 (7)	334 (31)	439 (36)	1,212 (26)	4,576 (26)
55–64	529 (30)	3,005 (28)	175 (22)	159 (20)	222 (23)	1,131 (24)	335 (31)	375 (31)	1,261 (28)	4,670 (27)
≥65	312 (18)	1,710 (16)	148 (18)	138 (18)	674 (71)	3,188 (68)	149 (14)	100 (8)	1,283 (28)	5,136 (29)
First-degree family history of breast cancer[b]	270 (15)	1,008 (9)	132 (16)	88 (11)	140 (15)	385 (8)	184 (17)	141 (12)	726 (16)	1,622 (9)
First-degree family history of cancers other than breast cancer										
Prostate cancer[a,b]	180 (10)	799 (7)	45 (6)	59 (8)	93 (10)	365 (8)	143 (13)	107 (9)	461 (10)	1,330 (8)
Lung cancer[b]	154 (9)	857 (8)	66 (8)	59 (8)	90 (9)	340 (7)	109 (10)	93 (8)	419 (9)	1,349 (8)
Colorectal cancer[a,b]	119 (7)	608 (6)	48 (6)	45 (6)	76 (8)	363 (8)	71 (7)	69 (6)	314 (7)	1,085 (6)
Ovarian cancer[a,b]	62 (4)	331 (3)	18 (2)	16 (2)	26 (3)	182 (4)	22 (2)	31 (3)	128 (3)	559 (3)
Lymphoma or leukemia[a,b]	22 (1)	88 (1)	32 (4)	17 (2)	22 (2)	87 (2)	28 (3)	33 (3)	103 (2)	224 (1)
Cervical cancer[a,b]	6 (0)	25 (0)	20 (3)	18 (2)	10 (1)	28 (1)	19 (2)	19 (2)	55 (1)	90 (1)

[a]χ^2 test for difference between studies among cases, $P < 0.05$.
[b]χ^2 test for difference between studies among controls, $P < 0.05$.

cancer. A first-degree family history of breast cancer alone (with no other cancers among first-degree relatives) was associated with a 1.58-fold risk (95% CI, 1.38–1.82; Table 3). The ORs for family history of each of the other cancers alone were close to 1, with the exception of cervical cancer, for which the OR for the association with overall breast cancer risk was 1.53 (0.94–2.47). The risk of breast cancer was tripled in women who had a family history of both breast and prostate cancer (OR = 3.02; 95% CI, 2.19–4.16; $P_{interaction} < 0.01$). The OR for a family history of both breast and cervical cancer was 3.56 (95% CI, 0.99–12.85), but this estimate was based on only 7 exposed breast cancer cases. The risk of breast cancer was significantly increased for women with a family history of three or more cancer sites, but only when breast cancer was one of the sites.

Next, we considered the family history of a cancer diagnosis in relation to the risk of specific breast cancer subtypes. The ORs for first-degree family history of breast cancer alone were similar for ER^+, ER^-, and triple-negative breast cancer (Table 4). A family history of cervical cancer was associated with ER^- (OR = 2.56; 95% CI, 1.44–4.53) and triple-negative (OR = 3.04; 95% CI, 1.57–5.87) breast cancer, but not with ER^+ cancer. A family history of lung cancer was associated with a 20% increase in the risk of ER^+ cancer (95% CI, 1.04–1.48), whereas a family history of prostate cancer was associated with a 24% increase in the risk of ER^+ cancer (95% CI, 1.00–1.44). There were no significant associations with family history of any of the other sites, although the OR for the association of family history of ovarian cancer with the risk of triple-negative breast cancer was elevated (OR = 1.53;

Table 2. Family history of breast cancer in relation to the risk of breast cancer, overall and by subtype

		Breast cancer			ER^+			ER^-			Triple-negative		
First-degree family history of breast cancer	**Controls *N***	**Cases *N***	**OR[a]**	**(95% CI)**	**Cases *N***	**OR[a]**	**(95% CI)**	**Cases *N***	**OR[a]**	**(95% CI)**	**Cases *N***	**OR[a]**	**(95% CI)**
No	15,798	3,794	1.00	Reference	2,525	1.00	Reference	1,269	1.00	Reference	584	1.00	Reference
Yes	1,622	726	1.73	(1.56–1.92)	498	1.76	(1.57–1.97)	228	1.67	(1.42–1.95)	112	1.72	(1.38–2.13)
Number of first-degree relatives													
1	1,547	690	1.73	(1.56–1.92)	473	1.76	(1.56–1.97)	217	1.66	(1.41–1.95)	106	1.70	(1.36–2.13)
≥2	75	36	1.85	(1.21–2.84)	25	1.86	(1.15–3.01)	11	1.81	(0.93–3.51)	6	2.02	(0.84–4.89)
Age of relative at diagnosis													
<50 years	618	304	2.00	(1.74–2.30)	200	1.95	(1.64–2.33)	104	1.96	(1.56–2.46)	46	1.83	(1.32–2.54)
≥50 years	625	297	1.56	(1.35–1.80)	207	1.64	(1.38–1.95)	90	1.46	(1.15–1.86)	44	1.40	(1.01–1.96)
Unknown age	379	125	1.60	(1.31–1.95)	91	1.66	(1.31–2.11)	34	1.54	(1.07–2.21)	22	2.41	(1.54–3.78)
Among participants age <45 years													
No	2,861	714	1.00	Reference	406	1.00	Reference	308	1.00	Reference	147	1.00	Reference
Yes	211	116	2.02	(1.54–2.65)	67	2.05	(1.49–2.83)	49	1.97	(1.36–2.83)	22	1.75	(1.05–2.93)
Age of relative at diagnosis													
<50 years	95	80	3.09	(2.23–4.27)	43	3.45	(2.29–5.21)	37	3.79	(2.43–5.91)	16	3.48	(1.86–6.49)
≥50 years	76	31	1.31	(0.87–1.98)	22	1.32	(0.78–2.25)	9	0.68	(0.32–1.43)	4	0.53	(0.18–1.52)
Unknown age	40	5	0.81	(0.36–1.81)	2			3			2		
Among participants age ≥45 years													
No	12,937	3,080	1.00	Reference	2,119	1.00	Reference	961	1.00	Reference	437	1.00	Reference
Yes	1,411	610	1.69	(1.52–1.86)	431	1.71	(1.52–1.94)	179	1.60	(1.35–1.91)	90	1.72	(1.35–2.18)
Age of relative at diagnosis													
<50 years	523	224	1.80	(1.53–2.10)	157	1.73	(1.42–2.10)	67	1.59	(1.21–2.09)	30	1.53	(1.03–2.26)
≥50 years	549	266	1.59	(1.37–1.86)	185	1.68	(1.39–2.02)	81	1.63	(1.26–2.10)	40	1.62	(1.14–2.31)
Unknown age	339	120	1.68	(1.37–2.06)	89	1.76	(1.38–2.25)	31	1.57	(1.07–2.30)	20	2.38	(1.48–3.81)

[a]Multivariable models adjust for age, study, geographic region, questionnaire time period, and recency of mammogram.

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Table 3. Family history of breast cancer and cancer at six other sites in relation to the risk of breast cancer

First-degree family history of	Controls	Cases	OR[a]	(95% CI)
No cancer	9,735	2,374	1.00	Reference
One cancer site				
Breast cancer	914	393	1.58	(1.38–1.82)
Lung cancer	869	250	1.19	(1.01–1.39)
Prostate cancer	863	244	1.16	(0.99–1.36)
Colorectal cancer	624	171	1.17	(0.97–1.41)
Ovarian cancer	323	61	0.90	(0.68–1.21)
Lymphoma or leukemia	137	52	1.25	(0.88–1.78)
Cervical cancer	52	34	1.53	(0.94–2.47)
Two cancer sites				
Breast/prostate	105	76	3.02	(2.19–4.16)
Breast/lung	126	52	1.60	(1.13–2.27)
Breast/colorectal	83	32	1.40	(0.89–2.22)
Breast/ovarian	51	11	1.21	(0.62–2.37)
Breast/lymphoma or leukemia	16	10	1.42	(0.60–3.33)
Breast/cervical	5	7	3.56	(0.99–12.85)
Prostate/colorectal	119	37	1.52	(1.03–2.24)
Prostate/lung	73	25	1.54	(0.95–2.50)
Prostate/ovarian	28	12	1.95	(0.94–4.02)
Prostate/lymphoma or leukemia	17	9	2.39	(1.02–5.60)
Lung/colorectal	91	17	0.91	(0.53–1.55)
Colorectal/ovarian	27	10	1.73	(0.81–3.70)
2 sites other than breast	88	24	0.94	(0.58–1.54)
Three or more cancer sites				
Breast/prostate/lung	17	11	3.05	(1.35–6.89)
Breast/lung/colorectal	17	9	2.60	(1.12–6.03)
Breast and 2 other sites[b]	74	38	2.39	(1.57–3.64)
≥3 sites other than breast	47	15	1.37	(0.74–2.54)

[a]Multivariable model adjusts for age, study, geographic region, questionnaire time period, and recency of mammogram.
[b]Other than the listed combinations of cancer sites.

95% CI, 0.89–2.65). The OR for a family history of both breast and prostate cancer was 3.40 (95% CI, 2.42–4.79) for ER^+ cancer, as compared with 1.62 for breast alone ($P_{interaction} = 0.02$), and was 2.09 (95% CI, 1.21–3.63) for ER^- cancer, as compared with 1.50 for breast alone ($P_{interaction} = 0.11$); for triple-negative breast cancer, the corresponding OR was 1.60, as compared with 1.54 for breast alone ($P_{interaction} = 0.62$). The ORs for breast and lung and for breast and colorectal cancer were also higher, although not significantly higher, than for breast cancer alone for some subtypes. Having a family history of breast cancer and two or more

Table 4. Family history of breast cancer and six other sites in relation to the risk of breast cancer subtypes

		ER^+			ER^-			Triple-negative		
	Controls	Cases			Cases			Cases		
First-degree family history of	*N*	*N*	OR[a]	(95% CI)	*N*	OR[a]	(95% CI)	*N*	OR[a]	(95% CI)
No cancer	9,735	1,579	1.00	Reference	795	1.00	Reference	393	1.00	Reference
One cancer site										
Breast cancer	914	270	1.62	(1.39–1.89)	123	1.50	(1.21–1.86)	65	1.55	(1.17–2.06)
Lung cancer	869	173	1.20	(1.00–1.44)	77	1.14	(0.89–1.48)	40	1.20	(0.85–1.69)
Prostate cancer	863	179	1.24	(1.04–1.48)	65	0.98	(0.75–1.28)	30	0.92	(0.62–1.35)
Colorectal cancer	624	119	1.19	(0.96–1.47)	52	1.12	(0.83–1.52)	21	0.92	(0.58–1.46)
Ovarian cancer	323	37	0.79	(0.56–1.13)	24	1.15	(0.74–1.78)	15	1.53	(0.89–2.65)
Lymphoma or leukemia	137	34	1.23	(0.83–1.84)	18	1.29	(0.77–2.19)	10	1.37	(0.70–2.70)
Cervical cancer	52	13	0.95	(0.50–1.80)	21	2.56	(1.44–4.53)	14	3.04	(1.57–5.87)
Two cancer sites										
Breast/prostate	105	60	3.40	(2.42–4.79)	16	2.09	(1.21–3.63)	6	1.60	(0.69–3.74)
Breast/lung	126	31	1.37	(0.91–2.08)	21	2.11	(1.29–3.46)	16	3.32	(1.89–5.84)
Breast/colorectal	83	26	1.67	(1.03–2.71)	6	0.80	(0.33–1.92)	3	0.74	(0.22–2.45)
Breast/ovarian	51	9	1.43	(0.69–2.96)	2	0.70	(0.17–2.93)	1	0.79	(0.11–5.82)
Prostate/colorectal	119	29	1.64	(1.07–2.51)	8	1.19	(0.57–2.46)	5	1.70	(0.68–4.26)
Prostate/lung	73	19	1.61	(0.95–2.74)	6	1.34	(0.57–3.15)	4	1.89	(0.67–5.30)
Lung/colorectal	91	11	0.80	(0.42–1.52)	6	1.20	(0.52–2.80)	2	0.85	(0.21–3.53)
2 other sites[b]	181	47	1.41	(1.00–1.98)	25	1.55	(0.99–2.43)	10	1.19	(0.61–2.33)
Three or more cancer sites										
Breast/≥2 sites other than breast	108	40	2.42	(1.65–3.56)	18	2.78	(1.65–4.68)	8	2.65	(1.26–5.60)
≥3 sites other than breast	47	8	1.04	(0.48–2.26)	7	2.23	(0.97–5.12)	2	1.39	(0.33–5.92)

[a]Multivariable models adjust for age, study, geographic region, questionnaire time period, and recency of mammogram.
[b]Other than the listed combinations of cancer sites.

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other cancer sites was associated with an increased risk of each subtype, with the ORs ranging from 2.42 for ER^+ to 2.78 for ER^- cancer.

The results were similar across the four studies. For example, the ORs for first-degree family history of breast cancer in relation to breast cancer risk were 1.74 (95% CI, 1.51–2.02) in BWHS, 1.59 (95% CI, 1.19–2.14) in CBCS, 1.88 (95% CI, 1.50–2.35) in MEC, and 1.55 (95% CI, 1.22–1.97) in WCHS ($P_{heterogeneity} = 0.65$). To assess the possibility of recall bias, we examined the associations separately in the case–control and cohort studies. The ORs for first-degree family history of breast cancer in relation to the risk of breast cancer were 1.57 (95% CI, 1.31–1.90) in the case–control studies and 1.80 (95% CI, 1.60–2.03) in the cohort studies ($P_{heterogeneity} = 0.23$).

Discussion

This large study provides convincing evidence that first-degree family history of breast cancer is associated with ER^+, ER^-, and triple-negative breast cancer in African American women and that having a relative diagnosed with breast cancer at a young age is a strong predictor of risk. Having a history of breast cancer together with prostate cancer was associated with a further increase in the risk of each subtype. Family history of ovarian cancer was not associated with an increased risk of ER^+ or ER^- cancer, but there was some evidence of a positive association with triple-negative breast cancer. In addition, we observed an unexpected association of family history of cervical cancer with an increased risk of ER^- breast cancer.

Previous studies with data on African American women have also shown family history of breast cancer to be a strong risk factor for breast cancer (2, 3, 16, 36–39). Only the BWHS and the Women's CARE study also considered the age of the relative at diagnosis, and both observed a greater risk of breast cancer when the relative was diagnosed at a younger age (2, 3). In the only study to present data in African American women by subtype, the BWHS, a similar increase was observed across subtypes (3).

Findings according to the subtype from other populations have been mixed. The association with family history of breast cancer has been similar across breast cancer subtypes (3, 6–11, 40), stronger for ER^+ breast cancer (12, 41), and stronger for ER^- or triple-negative breast cancer (13, 14, 42). The strongest evidence comes from a pooled analysis of 12 studies in the Breast Cancer Association Consortium, where an association with family history of breast cancer was present across subtypes, but with a stronger association for basal-like breast cancer (40).

Only a few studies of African Americans have examined the relation of family history of cancers other than breast cancer to the risk of breast cancer (3, 16). In the BWHS, a family history of colon cancer was associated with an increased risk of breast cancer, with a relative risk estimate of 1.35, but the study did not consider whether participants also had a family history of breast cancer (3). In the Women's Health Initiative, having a family history of both breast and prostate cancers was associated with a 2.34-fold increase in the risk of breast cancer (16). Neither of these studies presented data by breast cancer subtype. Limited data by subtype are available from other populations. In a predominantly European American population from the Iowa Women's Health Study, a family history of prostate cancer was associated with an increased risk of both ER^+/PR^+ and ER^-/PR^- breast cancer (43). A family history of lung cancer was associated with increased risk of hormone receptor–positive breast cancer in a case–control study in China (44). No previous study has reported an association of family history of cervical cancer with an increased risk of breast cancer.

Associations with family history of cancer could be explained in part by environmental or genetic factors shared within families. A family may have similar reproductive habits (45–47), dietary patterns (48), physical activity (49, 50), or body size (51, 52), each of which influences the risk of various cancers (53). Although knowledge of a family history of cancer influences cancer screening, individuals with a family history of cancer do not differ in lifestyle from individuals without knowledge of a family history (54–56). Genetics play a role in breast cancer etiology (57, 58). Heritable mutations in *BRCA1* or *BRCA2* genes are associated with an increased risk of both breast cancer and ovarian cancer (59, 60). Germline mutations in the *BRCA1* and *BRCA2* genes have also been associated with an increased risk of prostate and colorectal cancers (59–61), whereas germline mutations in the *CHEK2* gene increase risk of breast, prostate, and colon cancers (62).

Our observation of a strong increase in risk among participants with a family history of both breast and prostate cancer may relate to recent genetic findings. A family history of prostate cancer has been associated with mutation in the *RNASEL* gene in African Americans (63). Mutations in this gene have also been associated with the risk of breast and cervical cancers (64). A potential mechanism linking the *RNASEL* gene and ER^- breast cancer is inflammation. Inflammatory markers have been elevated in studies of hormone-negative cancers (65–67). *RNASEL* variants have been associated with elevated inflammatory biomarkers (68), and the enzyme encoded by the *RNASEL* gene has proinflammatory functions (69).

Analyses of data from The Cancer Genome Atlas and other genomic data suggest that there are etiologic links between ovarian cancer and basal-like breast cancer (70–73), which is primarily composed of triple-negative tumors. Consistent with those data, we observed a nonsignificant 53% increase in the risk of triple-negative breast cancer associated with a first-degree family history of ovarian cancer. Genomic analyses also suggest that there are biologic similarities between basal-like breast cancer and lung cancer (72, 73). In our data, the risk of triple-negative breast cancer was significantly increased for a first-degree family history of lung cancer only in the presence of a first-degree family history of breast cancer.

African American women experience a higher prevalence of early-onset breast cancer and of ER^- breast cancer compared with European American women (74–76). Because of the large sample size, we were able to informatively assess breast cancer risk by age and for breast cancer subtypes. We were also able to assess family history of cancers other than breast cancer. We controlled for multiple potential confounding factors. The self-report of family history of participants may have been incomplete and could have been subject to recall bias in the case–control studies. However, previous validation studies have shown that self-reported family cancer histories for first-degree relatives are accurate for breast cancer (77), and the results were similar across our studies, which included cohort studies in which family history data were provided before the participant was diagnosed with breast cancer. In addition, the prevalence of family history of breast cancer among controls in the AMBER Consortium (9.3%) was similar to the prevalence in other studies (78, 79). We did not have data on all

cancer sites that may be of interest, such as the endometrium and pancreas.

In summary, the present findings suggest that family history of cancers other than the breast cancer may indicate a higher inherited genetic susceptibility to breast cancer. Women who had both breast and prostate cancer–affected family members had a particularly high risk of both ER^+ and ER^- breast cancer. Greater surveillance and counseling for additional screening may be warranted.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

Disclaimer

The results do not necessarily represent the views of or an official position held by the sponsors.

Authors' Contributions

Conception and design: T.N. Bethea, L. Rosenberg, J.R. Palmer
Development of methodology: T.N. Bethea, L. Rosenberg, J.R. Palmer
Acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.): L. Rosenberg, E.V. Bandera, C.B. Ambrosone, J.R. Palmer
Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis): T.N. Bethea, L. Rosenberg, N. Castro-Webb, K.L. Lunetta, L.E. Sucheston-Campbell, E.A. Ruiz-Narváez, M.A. Troester, C.B. Ambrosone, J.R. Palmer
Writing, review, and/or revision of the manuscript: T.N. Bethea, L. Rosenberg, K.L. Lunetta, L.E. Sucheston-Campbell, E.A. Ruiz-Narváez, M. Charlot, S.-Y. Park, E.V. Bandera, M.A. Troester, C.B. Ambrosone, J.R. Palmer
Administrative, technical, or material support (i.e., reporting or organizing data, constructing databases): T.N. Bethea, N. Castro-Webb, M. Charlot
Study supervision: K.L. Lunetta, J.R. Palmer

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References

1. Collaborative Group on Hormonal Factors in Breast C. Familial breast cancer: collaborative reanalysis of individual data from 52 epidemiological studies including 58,209 women with breast cancer and 101,986 women without the disease. Lancet 2001;358:1389–99.
2. Simon MS, Korczak JF, Yee CL, Daling JR, Malone KE, Bernstein L, et al. Racial differences in the familial aggregation of breast cancer and other female cancers. Breast Cancer Res Treat 2005;89:227–35.
3. Palmer JR, Boggs DA, Adams-Campbell LL, Rosenberg L. Family history of cancer and risk of breast cancer in the Black Women's Health Study. Cancer Causes Control 2009;20:1733–7.
4. Colditz GA, Kaphingst KA, Hankinson SE, Rosner B. Family history and risk of breast cancer: nurses' health study. Breast Cancer Res Treat 2012;133:1097–104.
5. Egan KM, Stampfer MJ, Rosner BA, Trichopoulos D, Newcomb PA, Trentham-Dietz A, et al. Risk factors for breast cancer in women with a breast cancer family history. Cancer Epidemiol Biomarkers Prev 1998;7:359–64.
6. Mavaddat N, Pharoah PD, Blows F, Driver KE, Provenzano E, Thompson D, et al. Familial relative risks for breast cancer by pathological subtype: a population-based cohort study. Breast Cancer Res 2010;12:R10.
7. Song Q, Huang R, Li J, Fan J, Zheng S, Zhang B, et al. The diverse distribution of risk factors between breast cancer subtypes of ER, PR and HER2: a 10-year retrospective multi-center study in China. PLoS One 2013;8:e72175.
8. Setiawan VW, Monroe KR, Wilkens LR, Kolonel LN, Pike MC, Henderson BE. Breast cancer risk factors defined by estrogen and progesterone receptor status: the multiethnic cohort study. Am J Epidemiol 2009;169:1251–9.
9. Tazzite A, Jouhadi H, Saiss K, Benider A, Nadifi S. Relationship between family history of breast cancer and clinicopathological features in Moroccan patients. Ethiop J Health Sci 2013;23:150–7.
10. Phipps AI, Buist DS, Malone KE, Barlow WE, Porter PL, Kerlikowske K, et al. Family history of breast cancer in first-degree relatives and triple-negative breast cancer risk. Breast Cancer Res Treat 2011;126:671–8.
11. Malone KE, Daling JR, Doody DR, O'Brien C, Resler A, Ostrander EA, et al. Family history of breast cancer in relation to tumor characteristics and mortality in a population-based study of young women with invasive breast cancer. Cancer Epidemiol Biomarkers Prev 2011;20:2560–71.
12. Welsh ML, Buist DS, Aiello Bowles EJ, Anderson ML, Elmore JG, Li CI. Population-based estimates of the relation between breast cancer risk, tumor subtype, and family history. Breast Cancer Res Treat 2009;114:549–58.
13. Zhou W, Pan H, Liang M, Xia K, Liang X, Xue J, et al. Family history and risk of ductal carcinoma in situ and triple negative breast cancer in a Han Chinese population: a case-control study. World J Surg Oncol 2013;11:248.
14. Jiang X, Castelao JE, Chavez-Uribe E, Fernandez Rodriguez B, Celeiro Munoz C, Redondo CM, et al. Family history and breast cancer hormone receptor status in a Spanish cohort. PLoS One 2012;7:e29459.
15. Sellers TA, Potter JD, Rich SS, Drinkard CR, Bostick RM, Kushi LH, et al. Familial clustering of breast and prostate cancers and risk of postmenopausal breast cancer. J Natl Cancer Inst 1994;86:1860–5.
16. Beebe-Dimmer JL, Yee C, Cote ML, Petrucelli N, Palmer N, Bock C, et al. Familial clustering of breast and prostate cancer and risk of postmenopausal breast cancer in the Women's Health Initiative Study. Cancer 2015;121:1265–72.
17. Schwartz AG, Rothrock M, Yang P, Swanson GM. Increased cancer risk among relatives of nonsmoking lung cancer cases. Genet Epidemiol 1999;17:1–15.
18. Jishi MF, Itnyre JH, Oakley-Girvan IA, Piver MS, Whittemore AS. Risks of cancer among members of families in the Gilda Radner Familial Ovarian Cancer Registry. Cancer 1995;76:1416–21.
19. Sellers TA, Gapstur SM, Potter JD, Kushi LH, Bostick RM, Folsom AR. Association of body fat distribution and family histories of breast and ovarian cancer with risk of postmenopausal breast cancer. Am J Epidemiol 1993;138:799–803.
20. Lindor NM, McMaster ML, Lindor CJ, Greene MH, National Cancer Institute Division of Cancer Prevention Community Oncology, Prevention Trials Research Group. Concise handbook of familial cancer susceptibility syndromes - second edition. J Natl Cancer Inst Monogr 2008:1–93.
21. Foulkes WD, Bolduc N, Lambert D, Ginsburg O, Olien L, Yandell DW, et al. Increased incidence of cancer in first degree relatives of women with double primary carcinomas of the breast and colon. J Med Genet 1996;33:534–9.
22. Planck M, Anderson H, Bladstrom A, Moller T, Wenngren E, Olsson H. Increased cancer risk in offspring of women with colorectal carcinoma: a Swedish register-based cohort study. Cancer 2000;89:741–9.

Published OnlineFirst December 31, 2015; DOI: 10.1158/1055-9965.EPI-15-1068

23. Naff JL, Cote ML, Wenzlaff AS, Schwartz AG. Racial differences in cancer risk among relatives of patients with early onset lung cancer. Chest 2007;131:1289–94.
24. Palmer JR, Ambrosone CB, Olshan AF. A collaborative study of the etiology of breast cancer subtypes in African American women: the AMBER consortium. Cancer Causes Control 2014;25:309–19.
25. Rosenberg L, Adams-Campbell L, Palmer JR. The Black Women's Health Study: a follow-up study for causes and preventions of illness. J Am Med Womens Assoc 1995;50:56–8.
26. Kolonel LN, Henderson BE, Hankin JH, Nomura AM, Wilkens LR, Pike MC, et al. A multiethnic cohort in Hawaii and Los Angeles: baseline characteristics. Am J Epidemiol 2000;151:346–57.
27. Millikan RC, Newman B, Tse CK, Moorman PG, Conway K, Dressler LG, et al. Epidemiology of basal-like breast cancer. Breast Cancer Res Treat 2008;109:123–39.
28. Ambrosone CB, Ciupak GL, Bandera EV, Jandorf L, Bovbjerg DH, Zirpoli G, et al. Conducting Molecular Epidemiological Research in the Age of HIPAA: A Multi-Institutional Case-Control Study of Breast Cancer in African-American and European-American Women. J Oncol 2009;2009: 871250.
29. Bandera EV, Chandran U, Zirpoli G, McCann SE, Ciupak G, Ambrosone CB. Rethinking sources of representative controls for the conduct of case-control studies in minority populations. BMC Med Res Methodol 2013;13:71.
30. Palmer JR, Viscidi E, Troester MA, Hong CC, Schedin P, Bethea TN, et al. Parity, lactation, and breast cancer subtypes in African American women: results from the AMBER Consortium. J Natl Cancer Inst 2014;106:1–8.
31. Bethea TN, Rosenberg L, Hong CC, Troester MA, Lunetta KL, Bandera EV, et al. A case-control analysis of oral contraceptive use and breast cancer subtypes in the African American Breast Cancer Epidemiology and Risk Consortium. Breast Cancer Res 2015;17:22.
32. Bandera EV, Chandran U, Hong CC, Troester MA, Bethea TN, Adams-Campbell LL, et al. Obesity, body fat distribution, and risk of breast cancer subtypes in African American women participating in the AMBER Consortium. Breast Cancer Res Treat 2015;150:655–66.
33. Ambrosone CB, Zirpoli G, Hong CC, Yao S, Troester MA, Bandera EV, et al. Important role of menarche in development of estrogen receptor-negative breast cancer in African American Women. J Natl Cancer Inst 2015;107:1–7.
34. Jewell NP. Statistics for epidemiology. Boca Raton, FL: Chapman & Hall/CRC; 2004.
35. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. Stat Med 2002;21:1539–58.
36. Schatzkin A, Palmer JR, Rosenberg L, Helmrich SP, Miller DR, Kaufman DW, et al. Risk factors for breast cancer in black women. J Natl Cancer Inst 1987;78:213–7.
37. Amos CI, Goldstein AM, Harris EL. Familiality of breast cancer and socioeconomic status in blacks. Cancer Res 1991;51:1793–7.
38. Chaudru V, Laing A, Dunston GM, Adams-Campbell LL, Williams R, Lynch JJ, et al. Interactions between genetic and reproductive factors in breast cancer risk in a population-based sample of African-American families. Genet Epidemiol 2002;22:285–97.
39. Mayberry RM, Stoddard-Wright C. Breast cancer risk factors among black women and white women: similarities and differences. Am J Epidemiol 1992;136:1445–56.
40. Yang XR, Chang-Claude J, Goode EL, Couch FJ, Nevanlinna H, Milne RL, et al. Associations of breast cancer risk factors with tumor subtypes: a pooled analysis from the Breast Cancer Association Consortium studies. J Natl Cancer Inst 2011;103:250–63.
41. Gaudet MM, Press MF, Haile RW, Lynch CF, Glaser SL, Schildkraut J, et al. Risk factors by molecular subtypes of breast cancer across a population-based study of women 56 years or younger. Breast Cancer Res Treat 2011;130:587–97.
42. Anderson K, Thompson PA, Wertheim BC, Martin L, Komenaka IK, Bondy M, et al. Family history of breast and ovarian cancer and triple negative subtype in hispanic/latina women. Springerplus 2014;3:727.
43. Tutera AM, Sellers TA, Potter JD, Drinkard CR, Wiesner GL, Folsom AR. Association between family history of cancer and breast cancer defined by estrogen and progesterone receptor status. Genet Epidemiol 1996;13: 207–21.
44. Zhou W, Ding Q, Pan H, Wu N, Liang M, Huang Y, et al. Risk of breast cancer and family history of other cancers in first-degree relatives in Chinese women: a case control study. BMC Cancer 2014;14:662.
45. Hardy JB, Astone NM, Brooks-Gunn J, Shapiro S, Miller TL. Like mother, like child: intergenerational patterns of age at first birth and associations with childhood and adolescent characteristics and adult outcomes in the second generation. Dev Psychol 1998;34:1220–32.
46. Kolk M, Cownden D, Enquist M. Correlations in fertility across generations: can low fertility persist? Proc Biol Sci 2014;281:20132561.
47. Kim K. Intergenerational transmission of age at first birth in the United States: evidence from multiple surveys. Popul Res Policy Rev 2014;33: 649–71.
48. Vachon CM, Sellers TA, Kushi LH, Folsom AR. Familial correlation of dietary intakes among postmenopausal women. Genet Epidemiol 1998; 15:553–63.
49. Simonen RL, Perusse L, Rankinen T, Rice T, Rao DC, Bouchard C. Familial aggregation of physical activity levels in the Quebec Family Study. Med Sci Sports Exerc 2002;34:1137–42.
50. Aarnio M, Winter T, Kujala UM, Kaprio J. Familial aggregation of leisure-time physical activity – a three generation study. Int J Sports Med 1997;18:549–56.
51. Maes HH, Neale MC, Eaves LJ. Genetic and environmental factors in relative body weight and human adiposity. Behav Genet 1997;27:325–51.
52. Rotimi C, Cooper R. Familial resemblance for anthropometric measurements and relative fat distribution among African Americans. Int J Obes Relat Metab Disord 1995;19:875–80.
53. Schottenfeld D, Fraumeni JF, editors. Cancer Epidemiology and Prevention. New York, NY: Oxford University Press, Inc.; 2006.
54. Madlensky L, Vierkant RA, Vachon CM, Pankratz VS, Cerhan JR, Vadaparampil ST, et al. Preventive health behaviors and familial breast cancer. Cancer Epidemiol Biomarkers Prev 2005;14:2340–5.
55. Bostean G, Crespi CM, McCarthy WJ. Associations among family history of cancer, cancer screening and lifestyle behaviors: a population-based study. Cancer Causes Control 2013;24:1491–503.
56. Townsend JS, Steele CB, Richardson LC, Stewart SL. Health behaviors and cancer screening among Californians with a family history of cancer. Genet Med 2013;15:212–21.
57. Apostolou P, Fostira F. Hereditary breast cancer: the era of new susceptibility genes. Biomed Res Int 2013;2013:747318.
58. Brewster AM, Chavez-MacGregor M, Brown P. Epidemiology, biology, and treatment of triple-negative breast cancer in women of African ancestry. Lancet Oncol 2014;15:e625–34.
59. Ford D, Easton DF, Bishop DT, Narod SA, Goldgar DE. Risks of cancer in BRCA1-mutation carriers. Breast Cancer Linkage Consortium. Lancet 1994;343:692–5.
60. Struewing JP, Hartge P, Wacholder S, Baker SM, Berlin M, McAdams M, et al. The risk of cancer associated with specific mutations of BRCA1 and BRCA2 among Ashkenazi Jews. N Engl J Med 1997;336:1401–8.
61. Breast Cancer Linkage C. Cancer risks in BRCA2 mutation carriers. J Natl Cancer Inst 1999;91:1310–6.
62. Cybulski C, Gorski B, Huzarski T, Masojc B, Mierzejewski M, Debniak T, et al. CHEK2 is a multiorgan cancer susceptibility gene. Am J Hum Genet 2004;75:1131–5.
63. Rennert H, Zeigler-Johnson CM, Addya K, Finley MJ, Walker AH, Spangler E, et al. Association of susceptibility alleles in ELAC2/HPC2, RNASEL/HPC1, and MSR1 with prostate cancer severity in European American and African American men. Cancer Epidemiol Biomarkers Prev 2005;14: 949–57.
64. Madsen BE, Ramos EM, Boulard M, Duda K, Overgaard J, Nordsmark M, et al. Germline mutation in RNASEL predicts increased risk of head and neck, uterine cervix and breast cancer. PLoS One 2008;3:e2492.
65. Gwak JM, Jang MH, Kim DI, Seo AN, Park SY. Prognostic value of tumor-associated macrophages according to histologic locations and hormone receptor status in breast cancer. PLoS One 2015;10:e0125728.
66. Campbell MJ, Tonlaar NY, Garwood ER, Huo D, Moore DH, Khramtsov AI, et al. Proliferating macrophages associated with high grade, hormone receptor negative breast cancer and poor clinical outcome. Breast Cancer Res Treat 2011;128:703–11.
67. Chavey C, Bibeau F, Gourgou-Bourgade S, Burlinchon S, Boissiere F, Laune D, et al. Oestrogen receptor negative breast cancers exhibit high cytokine content. Breast Cancer Res 2007;9:R15.

Published OnlineFirst December 31, 2015; DOI: 10.1158/1055-9965.EPI-15-1068

68. Meyer MS, Penney KL, Stark JR, Schumacher FR, Sesso HD, Loda M, et al. Genetic variation in RNASEL associated with prostate cancer risk and progression. Carcinogenesis 2010;31:1597–603.
69. Ezelle HJ, Hassel BA. Pathologic effects of RNase-L dysregulation in immunity and proliferative control. Front Biosci 2012;4:767–86.
70. Cancer Genome Atlas Network. Comprehensive molecular portraits of human breast tumours. Nature 2012;490:61–70.
71. Iglesia MD, Vincent BG, Parker JS, Hoadley KA, Carey LA, Perou CM, et al. Prognostic B-cell signatures using mRNA-Seq in patients with subtype-specific breast and ovarian cancer. Clin Cancer Res 2014;20: 3818–29.
72. Hoadley KA, Yau C, Wolf DM, Cherniack AD, Tamborero D, Ng S, et al. Multiplatform analysis of 12 cancer types reveals molecular classification within and across tissues of origin. Cell 2014;158: 929–44.
73. Prat A, Adamo B, Fan C, Peg V, Vidal M, Galvan P, et al. Genomic analyses across six cancer types identify basal-like breast cancer as a unique molecular entity. Sci Rep 2013;3:3544.
74. Clarke CA, Keegan TH, Yang J, Press DJ, Kurian AW, Patel AH, et al. Age-specific incidence of breast cancer subtypes: understanding the black-white crossover. J Natl Cancer Inst 2012;104:1094–101.
75. Kurian AW, Fish K, Shema SJ, Clarke CA. Lifetime risks of specific breast cancer subtypes among women in four racial/ethnic groups. Breast Cancer Res 2010;12:R99.
76. Howlader N, Altekruse SF, Li CI, Chen VW, Clarke CA, Ries LA, et al. US incidence of breast cancer subtypes defined by joint hormone receptor and HER2 status. J Natl Cancer Inst 2014;106:1–8.
77. Murff HJ, Spigel DR, Syngal S. Does this patient have a family history of cancer? An evidence-based analysis of the accuracy of family cancer history. JAMA 2004;292:1480–9.
78. Mai PL, Wideroff L, Greene MH, Graubard BI. Prevalence of family history of breast, colorectal, prostate, and lung cancer in a population-based study. Public Health Genomics 2010;13:495–503.
79. Pinsky PF, Kramer BS, Reding D, Buys S, Team PP. Reported family history of cancer in the prostate, lung, colorectal, and ovarian cancer screening trial. Am J Epidemiol 2003;157:792–9.

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Traci N. Bethea, Lynn Rosenberg, Nelsy Castro-Webb, et al.

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