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Cancer Epidemiology, Biomarkers & Prevention

Short Communication

Bra Wearing Not Associated with Breast Cancer Risk: A Population-Based Case–Control Study

Lu Chen, Kathleen E. Malone, and Christopher I. Li

Abstract

Despite the widespread use of bras among U.S. women and concerns in the lay media that bra wearing may increase breast cancer risk, there is a scarcity of credible scientific studies addressing this issue. The goal of the study was to evaluate the relationship between various bra-wearing habits and breast cancer risk among postmenopausal women. We conducted a population-based case–control study of breast cancer in the Seattle–Puget Sound metropolitan area that compared 454 invasive ductal carcinoma (IDC) cases and 590 invasive lobular carcinoma (ILC) cases diagnosed between 2000 and 2004 with 469 control women between 55 to 74 years of age. Information on bra-wearing habits and other breast cancer risk factors was collected from study participants through in-person interviews. Multivariate adjusted odds ratios (OR) and their associated 95% confidence intervals (CI) were estimated using polytomous logistic regression. No aspect of bra wearing, including bra cup size, recency, average number of hours/day worn, wearing a bra with an underwire, or age first began regularly wearing a bra, was associated with risks of either IDC or ILC. Our results did not support an association between bra wearing and increased breast cancer risk among postmenopausal women. *Cancer Epidemiol Biomarkers Prev; 1–5.* ©*2014 AACR.*

Introduction

There has been some suggestion in the lay media that bra wearing may be a risk factor for breast cancer based on the potential for bras to impede lymph circulation and drainage and thus interfere with the process of waste and toxin removal (1). However, there is a scarcity of credible scientific studies addressing this issue. To our knowledge, the only epidemiologic evidence on bra wearing and breast cancer risk comes from a case–control study published in 1991, which reported a non-statistically significant two-fold higher risk among premenopausal women who wore a bra versus those who did not, but no elevation in risk was observed for postmenopausal women (2). Given that questions in the lay media have been raised about breast cancer risk and bra wearing, we evaluated relationships between various aspects of bra wearing and breast cancer risk among postmenopausal women enrolled in a population-based case–control study.

Division of Public Health Sciences, Fred Hutchinson Cancer Research Center, Seattle, Washington.

Corresponding Author: Lu Chen, Division of Public Health Sciences, Fred Hutchinson Cancer Research Center, 1100 Fairview Avenue North, Mail Stop M4-C308, Seattle, WA 98109-1024. Phone: 206-667-5028; Fax: 206-667-5948; E-mail: luchen78@uw.edu

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Materials and Methods

Study population

We used data from a population-based case–control study involving postmenopausal women living in the three-county Seattle-Puget Sound metropolitan area (King, Pierce, and Snohomish Counties). The study was originally designed to evaluate differences in risk factors for the two most common histologic subtypes of breast cancer, invasive ductal carcinoma (IDC) and invasive lobular carcinoma (ILC). The details of subject recruitment and data collection have been published previously (3). Briefly, cases were women between 55 and 74 years of age first diagnosed with invasive breast cancer between January 1, 2000, and March 31, 2004, while residing in the Seattle-Puget Sound area. The Cancer Surveillance System, the region's population-based cancer registry also participating in the Surveillance, Epidemiology, and End Results program of the National Cancer Institute, was used to identify cases. All ILC cases (identified using ICD-O histology codes of 8520, 8522, and 8524) and a random sample of 25% of the IDC cases (identified using ICD-O histology code of 8500) were targeted for recruitment to enroll equal numbers of ILC and IDC cases. A total of 1,044 out of 1,251 eligible cases were interviewed (83%), consisting of 454 IDC and 590 ILC cases. A common control group, frequency matched 1:1 to the ILC cases within 5-year age groups, was selected from the general population of women living in the three-county area by random-digit dialing. We called a total of 29,735 telephone numbers of which 9,876 were verified as residential. Of these residential

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Table 1. Distribution of selected characteristics among controls, ductal cases, and lobular cases

Characteristic	Controls ($n = 469$) *n* (%)	Ductal cases ($n = 454$) *n* (%)	Lobular cases ($n = 590$) *n* (%)
Age, y			
55–59	137 (29.2)	126 (27.8)	178 (30.2)
60–64	121 (25.8)	109 (24.0)	155 (26.3)
65–69	113 (24.1)	117 (25.8)	141 (23.9)
70–74	98 (20.9)	102 (22.5)	116 (19.7)
Race/ethnicity			
Non-Hispanic White	423 (90.2)	406 (89.6)	546 (92.5)
African American	8 (1.7)	10 (2.2)	9 (1.5)
Asian/Pacific Islander	9 (1.9)	16 (3.5)	11 (1.9)
Native American	10 (2.1)	11 (2.4)	11 (1.9)
Hispanic White	19 (4.1)	10 (2.2)	13 (2.2)
Missing	0	1	0
Education			
High school or less	150 (32.0)	154 (33.9)	188 (31.9)
Some college	182 (38.8)	163 (35.9)	198 (33.6)
College graduates	87 (18.6)	88 (19.4)	124 (21.0)
Postgraduates	50 (10.7)	49 (10.8)	80 (13.6)
Annual income			
<$20,000	38 (9.6)	54 (14.1)	62 (12.5)
$20,000–34,999	76 (19.3)	72 (18.8)	106 (21.4)
$35,000–69,999	159 (40.4)	136 (35.5)	160 (32.3)
$70,000–89,999	47 (11.9)	44 (11.5)	78 (15.7)
≥$90,000	74 (18.8)	77 (20.1)	90 (18.1)
Missing	75	71	94
BMI at 30 years of age (kg/m^2)			
<25.0	378 (82.0)	369 (81.8)	504 (86.7)
25.0–29.9	66 (14.3)	68 (15.1)	58 (10.0)
≥30.0	17 (3.7)	14 (3.1)	19 (3.3)
Missing	8	3	9
BMI 1 month before reference date (kg/m^2)			
<25.0	146 (31.2)	158 (34.8)	212 (36.1)
25.0–29.9	163 (34.8)	144 (31.7)	195 (33.2)
≥30	159 (34.0)	152 (33.5)	180 (30.7)
Missing	1	0	3
Menopausal hormone therapy use			
Never	118 (25.3)	141 (31.2)	125 (21.2)
Former	107 (23.0)	70 (15.5)	81 (13.8)
Current estrogen only	146 (31.3)	110 (24.3)	142 (24.1)
Current estrogen + progestin	95 (20.4)	131 (29.0)	241 (40.9)
Missing	3	2	1
First-degree family history of breast cancer			
No	380 (84.3)	334 (77.9)	440 (76.5)
Yes	71 (15.7)	95 (22.1)	135 (23.5)
Missing	18	25	15
Had a mammogram within the past 2 years			
No	51 (10.9)	37 (8.1)	44 (7.5)
Yes	418 (89.1)	417 (91.9)	546 (92.5)

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Table 1. Distribution of selected characteristics among controls, ductal cases, and lobular cases (Cont'd)

Characteristic	Controls ($n = 469$) *n* (%)	Ductal cases ($n = 454$) *n* (%)	Lobular cases ($n = 590$) *n* (%)
Menopausal status			
Natural	266 (58.0)	302 (67.7)	391 (68.2)
Induced[a]	68 (14.8)	49 (11.0)	71 (12.4)
Simple hysterectomy	125 (27.2)	95 (21.3)	111 (19.4)
Missing	10	8	17
Parous			
No	36 (7.7)	60 (13.2)	81 (13.7)
Yes	433 (92.3)	394 (86.8)	509 (86.3)

[a]Women who had bilateral oophorectomy were classified as having an induced menopause.

numbers, 87% were successfully screened for study eligibility. Four hundred and sixty-nine out of 660 telephone-screened eligible controls (71%) completed the interview.

Data collection

The study protocol was approved by the Fred Hutchinson Cancer Research Center Institutional Review Board and written consent was obtained from all study participants. In-person interviews were conducted with both cases and controls to collect information on reproductive history, body size, medical history, family history of cancer, use of hormonal replacement therapy, other potential breast cancer risk factors, and demographic characteristics. Women were asked a series of structured questions to assess lifetime patterns of bra wearing, including bra cup sizes and band sizes, age at which they started regularly wearing a bra, whether they wore a bra with an underwire, number of hours per day, and number of days per week they wore a bra at different times in their life, and if these patterns ever changed. Through these questions, we quantified both lifetime and recent bra-wearing habits. Data on bra-wearing habits were limited to those practiced before each participant's reference date. Date of breast cancer diagnosis was the reference date used for cases, and for controls, a reference date was assigned to reflect the distribution of reference dates among the cases.

Statistical analysis

Various bra-wearing characteristics were categorized on the basis of their distributions in our study population, including bra cup sizes 1 year before the reference date (A, B, C, and D or above), current and lifetime average hours/day wore a bra (categorized into quartiles based on the control distribution), ever and current use of an underwire bra (yes/no), current average hours/day wore a bra with and without an underwire (categorized into quartiles based on the control distribution), and age first began regularly wearing a bra (12 years or younger, 13–14 years, and 15 years or older). There was one participant who reported that she never wore a bra and she was excluded from the analysis. There were seven women who did not currently wear a bra and they were included in our lifetime bra wearing analyses but excluded from the analyses of current bra-wearing habits.

We used polytomous logistic regression to estimate odds ratios (OR) and their associated 95% confidence intervals (CI) comparing IDC and ILC cases with controls (4). *P* values for trend were computed across categories of bra-wearing duration and age first began wearing a bra. All analyses were conducted using Stata/SE version 13.1 (StataCorp LP). All models were adjusted for age at the reference date (5-year categories), reference year (continuous), and county as controls were frequency matched to cases on these three factors. Several covariates were evaluated as potential confounders, including race/ethnicity, education, annual household income, body mass index (BMI) at age 30 and BMI 1 month before the reference date, bra band size, age at first full-term pregnancy, use of hormone therapy, types of menopause, parity, family history of breast cancer, and mammogram screening in the past 2 years. BMI at the age of 30 was used as a proxy for women's weight status at a young age due to the lack of weight and height information for women when they were adolescents. None of the above variables changed the ORs of interest by more than 10% and, thus, none were included in the final statistical models. In addition, none of the covariates were found to modify the relationships between various bra-wearing characteristics and breast cancer risk based on likelihood ratio tests, including bra cup sizes, BMI, use of hormone therapy, and mammogram screening in the past 2 years (all $P_{interaction} > 0.05$). A sensitivity analysis restricted to women who did not change bra-wearing habit during their lifetime was performed and the results were similar to those based on the whole sample (data not shown).

Results

Compared with controls, IDC and ILC cases were somewhat more likely to have a current BMI <25 kg/m^2, to be current users of combined estrogen and progestin hormone therapy, to have a first-degree family history of

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Table 2. Associations between bra-wearing characteristics and breast cancer risk

	Controls ($n = 469$)	Ductal cases ($n = 454$)		Lobular cases ($n = 590$)	
Bra-wearing characteristic	***n* (%)**	***n* (%)**	**OR (95% CI)**	***n* (%)**	**OR (95% CI)**
Lifetime average hours/day wore a bra, quartiles					
≤10.0	112 (25.1)	117 (27.1)	Ref	152 (27.3)	Ref
10.1–11.5	113 (25.3)	99 (22.9)	0.9 (0.6–1.3)	115 (20.6)	0.7 (0.5–1.0)
11.6–13.9	107 (24.0)	117 (27.1)	1.1 (0.7–1.6)	151 (27.1)	0.9 (0.7–1.4)
≥14	114 (25.6)	99 (22.9)	0.9 (0.6–1.3)	139 (25.0)	0.8 (0.6–1.2)
P for trend			0.801		0.609
Current average hours/day wore a bra, quartiles					
≤10.0	131 (29.5)	116 (26.9)	Ref	165 (29.6)	Ref
10.1–12.0	123 (27.5)	113 (26.2)	1.1 (0.8–1.6)	136 (24.4)	0.8 (0.6–1.2)
12.1–15.9	79 (17.7)	99 (22.9)	1.6 (1.0–2.3)	118 (21.2)	1.1 (0.7–1.6)
≥16	113 (25.3)	104 (24.1)	1.2 (0.8–1.8)	138 (24.8)	0.9 (0.6–1.3)
P for trend			0.207		0.855
Ever regularly wore a bra with an underwire					
No	251 (56.4)	233 (54.1)	Ref	331 (59.6)	Ref
Yes	194 (43.6)	198 (45.9)	1.2 (0.9–1.6)	224 (40.4)	0.8 (0.6–1.1)
Currently wore a bra with an underwire					
No	283 (63.6)	273 (63.3)	Ref	365 (65.8)	Ref
Yes	162 (36.4)	158 (36.7)	1.0 (0.8–1.4)	190 (34.2)	0.9 (0.7–1.1)
Current average hours/day wore a bra without underwire, quartiles					
≤10.0	96 (33.9)	87 (31.9)	Ref	128 (35.1)	Ref
10.1–12.0	87 (30.7)	80 (29.3)	1.1 (0.7–1.7)	97 (26.6)	0.8 (0.5–1.2)
12.1–15.9	41 (14.5)	51 (18.7)	1.6 (0.9–2.7)	70 (19.2)	1.1 (0.7–1.9)
≥16	59 (20.8)	55 (20.1)	1.2 (0.7–2.1)	70 (19.2)	0.8 (0.5–1.3)
P for trend			0.281		0.713
Current average hours/day wore a bra with an underwire, quartiles					
<9.5	40 (24.7)	40 (25.3)	Ref	48 (25.3)	Ref
9.5–12.0	50 (30.9)	37 (23.4)	0.8 (0.4–1.5)	48 (25.3)	0.9 (0.5–1.6)
12.1–15.0	33 (20.4)	41 (25.9)	1.3 (0.7–2.4)	40 (21.1)	1.0 (0.5–1.8)
≥15.1	39 (24.1)	40 (25.3)	1.2 (0.6–2.2)	54 (28.4)	1.2 (0.6–2.2)
P for trend			0.389		0.541
Age first began wearing a bra, y					
≤12	162 (34.5)	145 (31.9)	Ref	185 (31.4)	Ref
13–14	217 (46.3)	213 (46.9)	1.1 (0.8–1.4)	303 (51.4)	1.2 (0.9–1.6)
≥15	90 (19.2)	96 (21.1)	1.2 (0.8–1.7)	102 (17.3)	1.0 (0.7–1.4)
P for trend			0.426		0.903
Bra cup size 1 year before the reference date					
A	17 (3.7)	34 (7.6)	1.9 (1.0–3.6)	43 (7.4)	1.8 (1.0–3.3)
B	152 (32.7)	144 (32.1)	Ref	203 (34.9)	Ref
C	166 (35.7)	157 (35.0)	1.0 (0.7–1.3)	176 (30.3)	0.8 (0.6–1.1)
D or above	130 (28.0)	113 (25.2)	0.9 (0.7–1.3)	159 (27.4)	0.9 (0.7–1.3)
P for trend			0.138		0.095

NOTE: All analysis adjusted for age at the reference date, reference year, and county.
The numbers in the column may not add up to the total case/control numbers due to missingness in some of the bra wearing variables.

breast cancer, to have had a mammogram in the past 2 years, to have experienced a natural menopause, and to be nulliparous (Table 1).

No aspect of bra wearing, including bra cup size, recency, average number of hours/day worn, wearing a bra with an underwire, or age first began regularly wearing a bra, was associated with risks of either IDC or ILC breast cancer (Table 2). Although there was some suggestion that women who wore an A-cup bra had increased risks of both IDC (OR, 1.9; 95% CI, 1.0–3.6; $P = 0.039$) and ILC (OR, 1.8; 95% CI, 1.0–3.3; $P = 0.057$), neither these trends nor trends for any of the

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other continuous variables assessed were statistically significant.

Discussion

This population-based case–control study of postmenopausal women found no evidence that any aspect of bra wearing is associated with risk of either IDC or ILC breast cancer. In particular, the risk did not vary by daily duration of wearing a bra, age when women started wearing a bra, bra cup size, or whether women wore a bra with an underwire. Our findings are consistent with the only identified prior study of these relationships in postmenopausal women (2). However, in this earlier study, participants were interviewed and simply classified as either bra users or nonusers, with no further assessment about the types of bras women wore and duration of bra use. Results from the current study strengthen the existing evidence by evaluating various aspects of bra-wearing habits and considering a number of potential confounders using a contemporary study population.

It is important to acknowledge some of the limitations of this study. Data on bra-wearing habits were all self-reported, which are subject to recall bias and/or nondifferential misclassification. This said, there is no more reliable measure of this exposure other than self-report. We also observed bra-wearing habits to be relatively stable over a woman's lifetime (e.g., 47.6% of women reported that their bra-wearing habits never changed over their lifetime), which may make the recall task less complex and, thus, improve accuracy in self-reporting these data. Because bra wearing was ubiquitous among our participants, we were unable to compare risks among women who never wore a bra to those who regularly wore a bra, and instead, our primary comparison was based on average number of hours per day women wore a bra.

This is the first study to characterize various bra-wearing habits in relation to breast cancer risk using a rigorous epidemiologic study design. The findings provided reassurance to women that wearing a bra does not seem to increase the risk of the most common histologic types of postmenopausal breast cancer.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

Disclaimer

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Authors' Contributions

Conception and design: L. Chen, C.I. Li
Development of methodology: C.I. Li
Acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.): C.I. Li
Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis): L. Chen, C.I. Li
Writing, review, and/or revision of the manuscript: L. Chen, K.E. Malone, C.I. Li
Administrative, technical, or material support (i.e., reporting or organizing data, constructing databases): L. Chen, C.I. Li
Study supervision: C.I. Li

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