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Citation	Irvin, V. L., Breen, N., Meissner, H. I., Liu, B., & Kaplan, R. M. (2015). Non-normal Screening Mammography Results, Lumpectomies, and Breast Cancer Reported by California Women, 2001–2009. Women's Health Issues, 25(4), 331-340. doi:10.1016/j.whi.2015.03.003
DOI	10.1016/j.whi.2015.03.003
Publisher	Elsevier
Version	Version of Record
Terms of Use	http://cdss.library.oregonstate.edu/sa-termsofuse

Women's Health Issues 25-4 (2015) 331–340

WOMEN'S HEALTH ISSUES
www.whijournal.com

Original article

Non-normal Screening Mammography Results, Lumpectomies, and Breast Cancer Reported by California Women, 2001–2009

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Article history: Received 14 May 2014; Received in revised form 9 January 2015; Accepted 9 March 2015

A B S T R A C T

Background: Although screening mammography may contribute to decreases in breast cancer mortality in a population, it may also increase the risk of false positives, anxiety, and unnecessary and costly medical procedures in individuals. We report trends in self-reported non-normal screening mammography results, lumpectomies, and breast cancer in a representative sample of California women.
Methods: Data were obtained from the 2001, 2005, and 2009 cross-sectional California Health Interview Surveys (CHIS) and weighted to the California population. CHIS employed a multistage sampling design to administer telephone surveys in 6 languages. Our study sample was restricted to women 40 years and older who reported a screening mammogram in the past 2 years. Sample sizes were 13,974 in 2001, 12,069 in 2005, and 15,552 in 2009. Women reporting non-normal results were asked whether they had an operation to remove the lump and, if so, whether the lump was confirmed as malignant.
Findings: Between 2001 and 2009, the percent of California women who reported having been diagnosed with breast cancer was relatively stable. For each of the three age groups studied, the percentage of non-normal mammography results increased and the percentages of lumpectomies decreased and, for every woman reporting a diagnosis of breast cancer, three women reported a lumpectomy that turned out not to be cancer. This ratio was greater for younger women and less for older women.
Conclusions: Despite relatively constant rates of breast cancer diagnosis from 2001 to 2009, the percentage of non-normal mammography results increased and lumpectomies declined.

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Evidence from clinical trials suggests that regular mammography use is associated with earlier stage diagnosis and improved breast cancer survival (Fletcher, Black, Harris, Rimer & Shapiro, 1993; Humphrey, Helfand, Chan, & Woolf, 2002; Shapiro, Venet, Strax, Venet, & Roeser, 1982). Although the magnitude of the mortality benefit associated with mammography has been debated for many years (Gotzsche & Olsen, 2000; Gotzsche & Nielsen, 2011), most evidence-based guidelines continue to recommend regular screening for women starting at age 40 or 50 (Humphrey et al., 2002; Nelson et al., 2009; Smith, Brooks, Cokkinides, Saslow, & Brawley, 2013). From 1987 to 2003, mammography use increased in the United States, after which

Funding Source: This research was supported in part by the Intramural Research Program of the Clinical Center, Department of Rehabilitation Medicine; and the Division of Cancer Control and Population Sciences at the National Cancer Institute, which are all part of the National Institutes of Health. The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript. The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the National Institutes of Health or the United States government.
Financial Disclosures: None to report.

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1049-3867/$ - see front matter Published by Elsevier Inc.
http://dx.doi.org/10.1016/j.whi.2015.03.003

the biennial rate leveled off at about 70% for women 50 and older (Breen, Wagener, Brown, Davis, & Ballard-Barbash, 2001, Breen, Gentleman, & Schiller, 2011; Brown et al., 2014; Centers for Disease Control and Prevention [CDC], 2012).

The goal of screening is to find cancer before symptoms appear with few false-negative or false-positive test results (National Cancer Institute, 2013). In this article, we use information reported by women to quantify the number of screening mammographies and follow-up procedures. We especially focus on false-positive results, because they can lead to unnecessary diagnostic evaluation, which is financially and psychologically costly (Alcusky, Philpotts, Bonafede, Clarke, & Skoufalos, 2014; Brodersen & Siersma, 2013; Pelletier et al., 2012). A high-quality cancer screening program should have few false-positive or false-negative test results and should be able to discriminate between healthy women and women having breast cancer (National Cancer Institute, 2013).

Recall for follow-up is the first step subsequent to non-normal screening results. Recall rates, in combination with sensitivity and specificity, are important indicators of the accuracy and performance of a screening test, and they can vary across screening facilities and programs. To compare recall rates in the United States and the UK, a consecutive sample of screening mammograms was obtained in women aged 50 and older from 1996 to 1999 who participated in the Breast Cancer Surveillance Consortium in the United States (n = 978,591) and the National Health Service Breast Cancer Screening Program in the UK (n = 3.94 million). Recall rates were defined as the percentage of screening mammograms with a recommendation for further evaluation. The comparison found that cancer detection rates of both invasive and ductal carcinoma in the two countries were similar despite striking differences in recall rates. Recall rates were two to three times higher in the United States than in the U.K., and rates of open surgical biopsies were also higher in the United States (Smith-Bindman, Ballard-Barbash, Miglioretti, Patrick, & Kerlikowske, 2005). A recent study by Alcusky et al. (2014) analyzed U.S. commercial and Medicare supplemental databases to identify women ages 40 to 75 who underwent screening mammography. The study authors reported that approximately 15% of women were recalled after mammography screening.

We know from surveys that most age-eligible women in the United States receive screening mammograms (Breen et al., 2011; CDC, 2012). However, we do not know what proportion of those women received abnormal results, underwent additional evaluation, and were subsequently diagnosed with cancer. The California Health Interview Survey (CHIS) asked adult female respondents questions about follow-up to mammography. Using CHIS data, we examine trends in self-reported non-normal results, lumpectomies, and breast cancer diagnoses by age at screen.

Methods

We analyzed data from 2001, 2005, and 2009 CHIS. These are independent, cross-sectional surveys administered by telephone to residents of California in five languages using a multistage probability design. Telephone numbers were selected through random-digit dialing (RDD) within geographic strata. In addition, race and ethnic supplemental samples were oversampled using surname lists. The 2009 survey also included a separate RDD of cell phone numbers (Lee, Brick, Brown, & Grant, 2010). Methodology and response rates are reported elsewhere (CHIS, 2002, 2007, 2011). The CHIS is a useful data source because of its survey methodologies to culturally and linguistically adapt a population-based survey to many cultures and languages (Ponce et al., 2004). Because of their sampling methodologies to increase robust numbers of underrepresented racial and ethnic minority groups, CHIS data are included in the annual national health care disparity reports prepared by the Agency for Healthcare Research and Quality (Agency for Healthcare Research and Quality, 2010, 2011, 2012, 2013, 2014; Ponce et al., 2004). The CHIS received human subjects' approval for participant recruitment and data collection from UCLA. The study was exempted from review by the Office of Human Subjects Research Protection.

Our study sample included women age 40 and over to assess the percentage who ever had a mammogram. When we analyzed the trend in non-normal mammogram results, lumpectomies, and resulting cancer outcome, we restricted our study sample to women 40 years and older who had a screening mammogram as part of a routine examination within 2 years before the interview. Exclusion criteria for this subsample included: never had a mammogram; last mammogram was more than 2 years ago; last mammogram occurred after age 40; or the mammogram was ordered because of family history or a specific breast problem. Final sample sizes are reported in Table 1.

Variable Definitions

Mammogram outcomes

Participants were asked, "Have you ever had a mammogram?" and were dichotomized as ever or never. Participants who ever had a mammogram were asked, "How long ago did you have your most recent mammogram?" Respondents who reported a screening mammogram in the past 2 years were dichotomized as having a non-normal mammogram or not based on their responses to the question, "Have you ever had a mammogram where the results were not normal?" Women with a non-normal mammogram were asked, "Have you ever had an operation to remove a lump from your breast?" These women were dichotomized as having reported a lumpectomy or not. Women who had a lumpectomy were asked, "Did the lump turn out to be cancer?" These women were dichotomized as being diagnosed with breast cancer or not (positive biopsy).

Frequency of mammogram

Respondents whose most recent mammogram was more than 2 years ago were excluded. The remaining participants were dichotomized as most recent mammogram within the last year (annual) or most recent mammogram more than 1 year up to 2 years ago (biennial).

Age at screening

If a woman reported a mammogram within the past year, her age at screen was her age at interview. If she reported a mammogram within 1 to 2 years, 1 year was subtracted from her age at interview to compute her age at screen. Age at screen was categorized as 40 to 49, 50 to 59, 60 to 69, or 70 years and older.

Covariates

Respondents reported their race, ethnicity, highest educational degree attained, and whether female family members had been diagnosed with breast cancer. Women who reported having a family history of breast cancer (mother or sister) and a

Table 1
Female Participants, Unweighted Data

	2001	2005	2009
Women ≥40 in California Health Interview Surveys	21,647	18,545	23,025
Ever had mammogram, *n* (%)			
Yes	19,519 (90.2)	17,165 (92.6)	21,778 (94.6)
No*	2,092 (9.7)	1,380 (7.4)	1,247 (5.4)
Missing*	36 (0.1)	0	0
Mammogram past 2 years (screening and diagnostic), *n* (%)			
Yes	16,487 (84.5)	14,736 (85.8)	18,587 (85.3)
No*	2,906 (14.9)	1,882 (11.0)	2,381 (10.9)
Missing/do not remember*	126 (0.6)	547 (3.2)	810 (3.7)
Mammogram in past 2 years occurred >40 was for screening purposes only, *n* (%)			
Yes	14,074 (85.4)	12,069 (81.9)	15,552 (83.7)
No*	2,305 (14.0)	2,626 (17.8)	3,035 (16.3)
Missing*	108 (0.6)	41 (0.3)	0
Missing response to had a non-normal result, lumpectomy or cancer*	50	0	0
Consistent cohort (final sample used in analyses)†	13,974	12,069	15,552
When was last screen, *n* (%)			
A year ago or less (annual)	11,236 (80.4)	9,714 (80.5)	12,600 (81.0)
Last 1–2 years (biannual)	2,738 (19.6)	2,355 (19.5)	2,952 (19.0)
Missing	0	0	0
Age at screen, *n* (%)			
40–49 y	3,976 (28.5)	2,911 (24.1)	2,759 (17.7)
50–59 y	3,886 (27.8)	3,582 (29.7)	4,210 (27.1)
60–69 y	2,714 (19.4)	2,622 (21.7)	4,081 (26.2)
≥70 y	3,398 (24.3)	2,954 (24.5)	4,502 (28.9)
Missing	0	0	0
Race/ethnicity, *n* (%)			
Latina	1,389 (9.9)	1,037 (8.6)	1,296 (8.3)
Asian and Pacific Islander	955 (6.8)	968 (8.0)	1,403 (9.0)
African American	716 (5.1)	571 (4.7)	731 (4.7)
White	10,434 (74.7)	9,107 (75.4)	11,275 (72.5)
American Indians/Alaskan Natives	167 (1.2)	123 (1.0)	145 (0.9)
Multiple or other races	313 (2.2)	263 (2.2)	702 (4.5)
Missing	0	0	0
Education completed, *n* (%)			
Less than high school	1,685 (12.1)	1,049 (8.7)	1,358 (8.7)
High school graduate	3,673 (26.3)	2,794 (23.2)	3,175 (20.4)
Some college (BA, BS)	4,322 (30.9)	3,612 (29.9)	4,599 (29.6)
College graduate	4,294 (30.7)	4,614 (38.2)	6,420 (41.3)
Missing	0	0	0
Mother or sister with breast cancer			
No	12,398 (88.7)	11,345 (94.0)	13,937 (89.6)
Yes	1,576 (11.3)	724 (6.0)	1,615 (10.4)
Missing	0	0	0

* Women who responded "no" or did not respond were not included in the subsequent set of questions. For instance, women who have never had a mammogram were not asked if their mammogram was in the past 2 years. They are included in the total *n* for ever having a mammogram but not for having a mammogram in the past 2 years.

† For the analyses concerning trend in non-normal results, lumpectomies, and resulting cancer outcomes, the sample was restricted to these women. Frequencies for age at screen, race/ethnicity, education, and family history are reported only for this subset of women.

mammogram for routine screening were dichotomized as having a mother or sister with breast cancer or not. Women with a family history of breast cancer (mother or sister) were not excluded as long as they reported their mammogram was for routine screening.

Analyses

Descriptive analyses included frequencies and percentages. Confidence intervals for the percentages were calculated using the Clopper–Pearson statistic. Pairwise two-tailed *t*-tests were performed to test whether the percentage changed significantly between survey years or between age groups at the significance level of .05. To evaluate the change in each outcome over time, we conducted trend analysis using simple logistic regression modeling. First, we combined the cross-sectional surveys. Then we regressed each outcome on survey year. Weighted logistic regression was conducted using the replicate weight jackknife method in SAS, SUDAAN, v10.0.1. Odds ratios and confidence intervals are reported for survey year. We defined a significant trend across time if the odds ratio for survey year was greater than 1.0 and was not bound by the 95% CIs.

Analyses were weighted to the California population using the sample weights provided by CHIS. Because there were few differences between unweighted and weighted analyses, only weighted results are reported.

Percentages for women in our study are reported using two different denominators. Our first set of analyses uses the denominator of women age 40 or older who had a screening mammogram in the past 2 years and is entitled, California women 40 or older screened in the past 2 years. Our second set of analyses uses the denominator of all women age 40 or older and is entitled, California women 40 or older regardless of screening status. For each set of analyses, we report percentages of non-normal mammogram results, percentage of lumpectomies, and the percentages of women who had cancer. These percentages

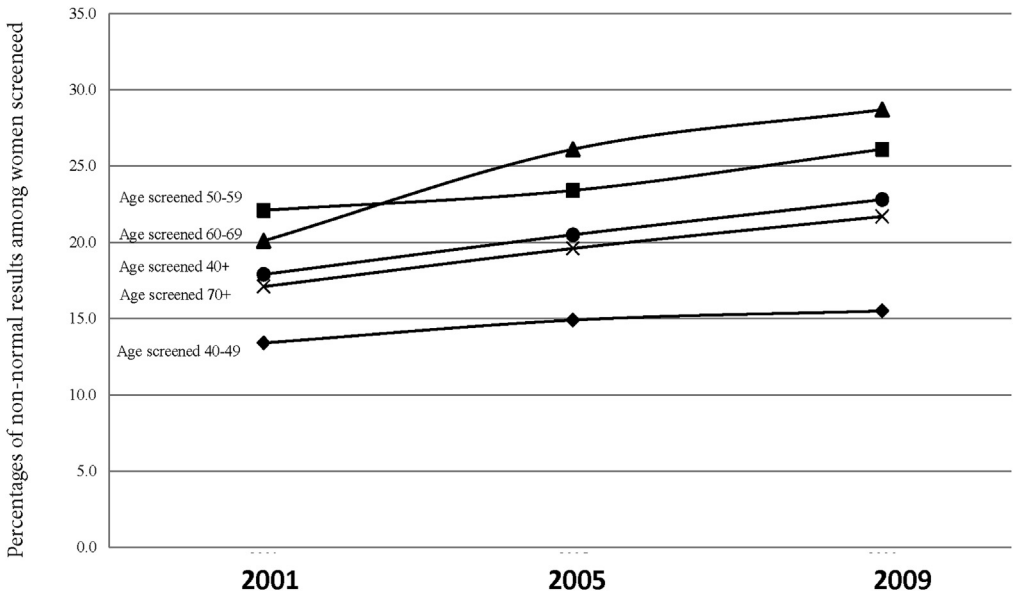

Figure 1. Percentages of non-normal results among women screened by age at mammogram, California Health Interview Surveys years 2001, 2005, and 2009. Data tables display weighted percentages and 95% CI.

were calculated for four age groups of women: 40 to 49, 50 to 49, 60 to 69, and 70 years and older.

Findings

Table 1 reports overall unweighted sample sizes for women aged 40 and older who participated in the CHIS interviews, who ever had a mammogram, and who had a screening mammogram in the past 2 years, as well as characteristics of the sample used in analyses. Across all survey years, more than 90% of women aged 40 or older had a mammogram in their lifetime and approximately 85% had a mammogram in the past 2 years. Approximately 80% of women screened received their most recent mammogram 1 year ago or less.

We present percentages and CIs for non-normal mammograms, lumpectomies, and resulting cancer diagnoses among California women 40 and older. The first set of results, for women who reported being screened in past 2 years, are displayed in Figures 1–3, respectively. Exact numbers for Figures 1–3 are available from the corresponding author upon request. Table 2

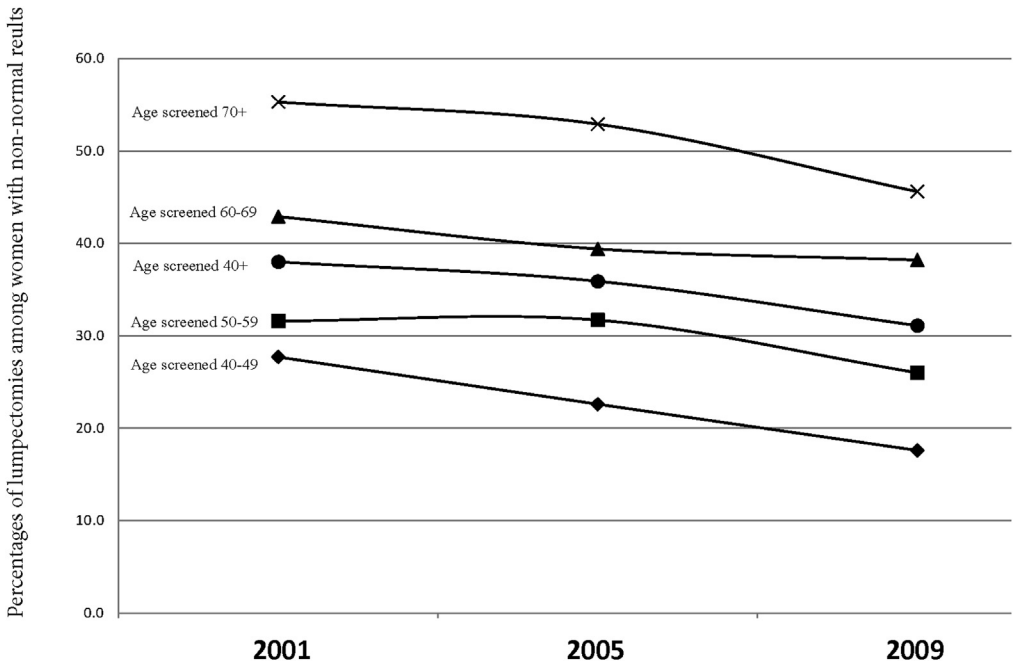

Figure 2. Percentages of lumpectomies among women with non-normal results by age at mammogram, California Health Interview Surveys years 2001, 2005, and 2009. Data tables display weighted percentages and 95% CI.

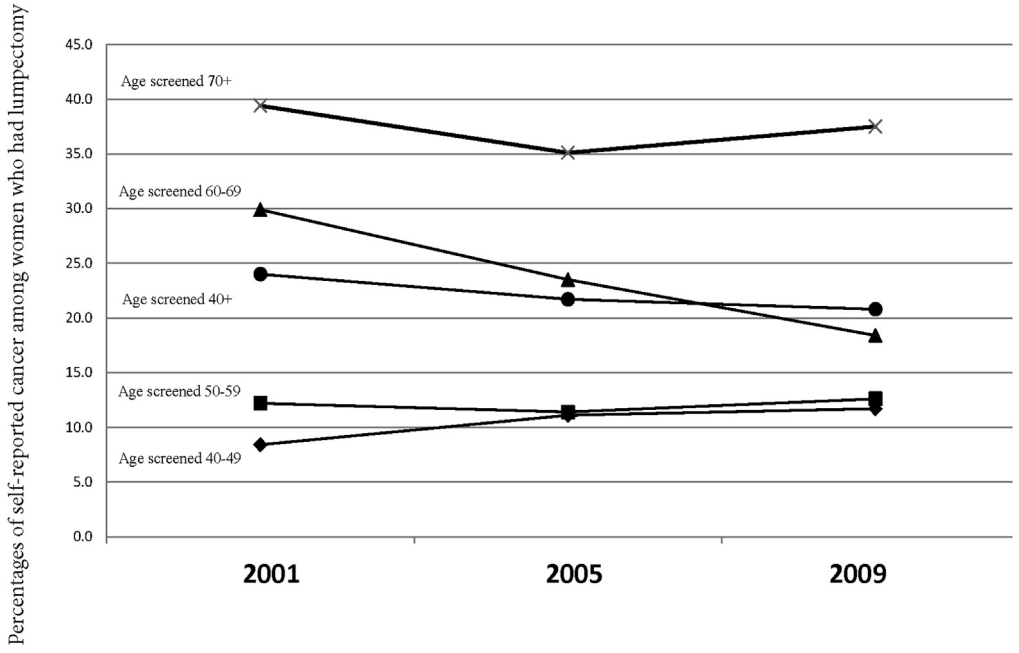

Figure 3. Percentages of women who reported a cancer diagnosis after a lumpectomy as result of a non-normal screening results by age at mammogram, California Health Interview Surveys years 2001, 2005, and 2009. Data tables display weighted percentages and 95% CI.

reports estimates, standard errors and *p*-values for the trend analysis using logistic regressions.

Non-normal Results among California Women Aged 40 or Older Who Reported Screening Mammography in the Past 2 Years

Figure 1 shows percentages of non-normal mammography increased over time for all age groups. Results from the regression analyses showed statistically significant increases between 2001 and 2009 for women in age groups 50 to 59, 60 to 69, and 70 years and older. For women screened aged 40 to 49, percentage of screening mammograms with non-normal results ranged from 13% to 15% across years and was significantly lower than the percentages for all other age groups. Women screened aged 70 years or older reported the second lowest rate of non-normal results ranging from 17% to 21% across all years. These percentages were significantly higher than women screened aged 40 to 49 and significantly lower than women screened aged 50 to 59 and 60 to 69. Women screened aged 50 to 59 and 60 to 69 reported the highest rates of non-normal mammograms, from 20% to 28%; differences were not significant between the two age groups.

Lumpectomies

Figure 2 shows the percentage of women reporting a lumpectomy after a non-normal result which declined between 2001 and 2009 for all age groups. The decreases were statistically significant only for screened women ages 40 to 49 and 70 years and older. Declines in percentages of lumpectomies were approximately 10% for women screened aged 40 to 49 and aged 70 and older and approximately 5% for women screened aged 50 to 69. The percentages of women reporting a lumpectomy increased with age at screen. Women screened between the ages of 40 to 49 reported significantly lower percentages of lumpectomies than all other ages, except in 2001, when the rates were

Table 2
Logistic Regressions for the Primary Outcomes Regressed on Survey Year, California Health Interview Surveys 2001–2009*

	40–49		50–59		60–69		≥70		≥40	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Among California women ≥40 screened in past 2 years										
Non-normal results	1.08	0.98–1.19	1.14†	1.04–1.25	1.23†	1.12–1.35	1.16†	1.08–1.25	1.16†	1.11–1.22
Lumpectomy	0.75†	0.61–0.93	0.87	0.72–1.04	0.90	0.78–1.05	0.82†	0.72–0.94	0.85†	0.78–0.93
Positive biopsy	1.19	0.66–2.14	1.04	0.73–1.47	0.73	0.58–0.93	0.96	0.79–1.16	0.91	0.79–1.06
Among California women aged ≥40 regardless of screening status										
Ever had mammogram	1.10†	1.01–1.19	1.39†	1.18–1.62	1.62†	1.37–1.92	1.40†	1.19–1.64	1.24†	1.17–1.32
Screening mammogram past 2 years	1.07	0.99–1.16	1.00	0.93–1.08	0.99	0.91–1.07	0.89†	0.83–0.95	1.01	0.97–1.05
Non-normal results	1.12†	1.02–1.24	1.15†	1.05–1.25	1.24†	1.13–1.35	1.12†	1.05–1.21	1.18†	1.12–1.23
Lumpectomy	0.89	0.73–1.08	1.01	0.85–1.20	1.13†	1.00–1.28	1.01	0.91–1.12	1.04	0.97–1.12
Positive Biopsy	1.05	0.61–1.79	1.04	0.78–1.41	0.89	0.73–1.08	0.98	0.83–1.16	0.97	0.86–1.10

* Each cell represents a unique logistic regression model conducted for each outcome variable for the specific age categories. The numbers in the cells represent the odds ratio and 95% CIs for the variable survey year in each of the models.

† The *p* value for the OR was <.05 and shows a significant trend across survey years.

not statistically different from women aged 50 to 59. Women screened between the ages of 50 and 59 reported significantly lower percentages of lumpectomies than women screened between the ages of 60 and 69. Women screened at age 70 or older reported significantly higher percentages of lumpectomies than the other age groups.

Positive Biopsy

Figure 3 shows that breast cancer rates were relatively stable across years, with one exception. The percentage of women whose lump turned out to be cancer significantly decreased between 2001 and 2009 only for women screened between the ages of 60 and 69. The percentage of lumps that turned out to be cancer increased with age at screen. Women who were screened between the ages of 40 and 49 and ages 50 and 59 reported similar percentages of lumps that were cancerous (8%–12%). Women screened between the ages of 60 and 69 reported significantly higher percentages of malignant lumps than women screened between the ages of 40 and 59 in survey years 2001 and 2005, but in 2009 percentages were no longer different. Women screened at age 70 or older reported the highest percentage of malignant lumps; these were significantly higher than woman screened aged 40 to 59 throughout the period under study, but were only statistically different from women screened aged 60 to 69 in 2005 and 2009.

For California women aged 40 and older who reported a screening mammogram in the past 2 years, we calculated the number of women who reported a lumpectomy that turned out to not be cancer for every case of breast cancer. For all ages, about 3.5 women had a lumpectomy that turned out not to be cancer for every lump that was malignant. This ratio decreased with the age at which the woman was screened. For every woman with a lump that turned out to be breast cancer, approximately 8.8 women aged 40 to 49, 7.3 women aged 50 to 59, 3.3 women aged 60 to 69, and 1.7 women 70 years or older had a lumpectomy that turned out to not be cancer. (Exact numbers by year are available from the corresponding author upon request.)

Annual versus Biennial Examinations

Women whose most recent mammogram was 1 year ago or less reported significantly higher rates of non-normal results than women whose examination was 1 to 2 years ago (data not shown) and this difference was observed across each survey year (19%–23% of annual screens reported non-normal results versus 12% to 15% for biennial screens). Percentages of lumpectomies did not differ whether the examination was conducted annually or biennially. Percentages of lumps diagnosed as cancer did not statistically differ between an annual or biennial examination for survey years 2001 and 2009 (the percentage of lumpectomies that were confirmed cancer were 21% to 25% of annual screens versus 17% to 18% for biennial screens). However the percentages were significantly different in survey year 2005, where 24.3% of lumpectomies were malignant for women screened within the last year compared with 6.6% malignant for women screened 1 to 2 years ago.

The second set of results is for women age 40 and over regardless of their screening status. Percentages and confidence intervals for ever had a mammogram, ever had a screening mammogram in past 2 years, non-normal mammograms, lumpectomies and resulting cancer diagnoses among California women 40 and older regardless of screening status are displayed in Figure 4. Exact numbers for Figure 4 are available from the corresponding author upon request.

Non-normal Results among California Women Aged 40 or Older Regardless of Screening Status

Figure 4 shows that lifetime prevalence of mammography was high and significantly increased between 2001 and 2009 for all age groups. Having a screening mammogram in the last 2 years significantly decreased between 2001 and 2009 for women ages 70 and older.

Non-normal Mammogram Results

The percentage of women in the population with non-normal results significantly increased between 2001 and 2009 for all age groups. Percentages of non-normal results were significantly lower for women aged 40 and 49 and significantly higher for women 70 and older compared with other age groups. Percentages of non-normal results were not statistically different between women aged 50 and 59 years and 60 and 69 years.

Lumpectomy

The percentages of lumpectomy were low and stable across the years. The percentages of lumpectomies significantly increased only for women aged 60 to 69 between 2001 and 2009. The percentage of lumpectomies was significantly lower among women aged 40 to 49 compared with all other age groups across all years. The percentage of lumpectomies among women aged 50 to 59 was significantly lower than women aged 60 to 69 in 2005 and 2009, but was significantly lower than women aged 70 years and older only for years 2001 and 2005. The percentage of lumpectomies among women aged 60 to 69 was significantly higher only than among women aged 70 and older in 2009.

Positive Biopsy

The percentages of lumps diagnosed as cancer were low and did not change statistically across years. The percentage of lumps diagnosed as cancer was less than 1% for women aged 40 to 59 and was significantly different from one another and significantly lower than for women aged 60 or older. Cancer percentages did not significantly differ between women aged 60 and 69 and aged 70 or older, except in 2009.

Discussion

This article examines the steps between having a screening mammogram and a breast cancer diagnosis as reported by California women 40 and older. To our knowledge, this is the first quantitative analysis of self-reported non-normal results, follow-up, and cancer diagnosis after screening mammography for any population of women in the United States. It also may be the first to examine these factors over time using the same cross-sectional survey.

The percentage of California women who reported a diagnosis of breast cancer was relatively constant between 2001 and -2009. There was an increase in the percentage of women reporting non-normal results and a decrease in the percentage reporting that they had undergone a lumpectomy. During this same period, the increased percentage of non-normal mammograms is unlikely to be attributable to greater use of

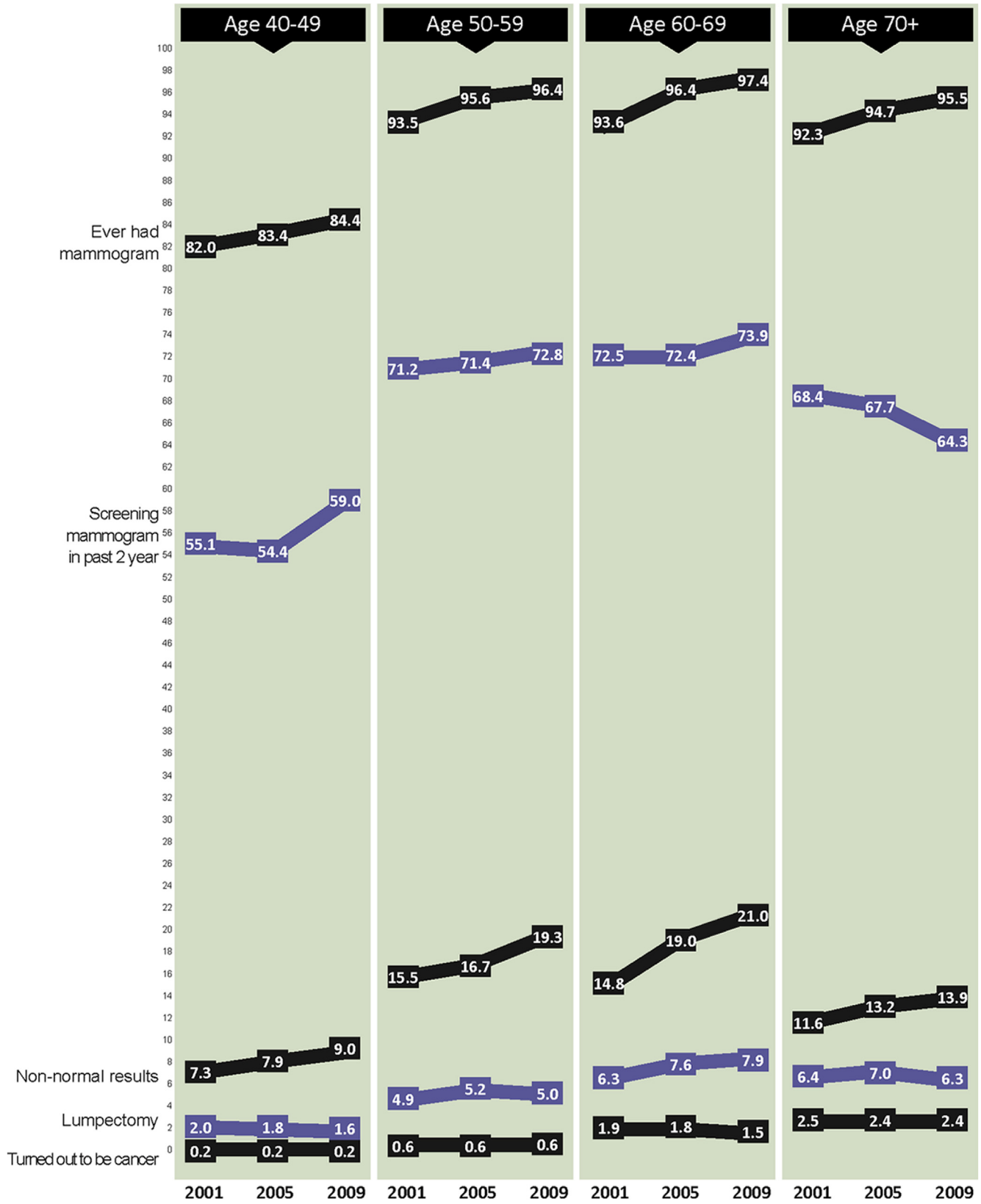

Figure 4. Percentages of women in CHIS with outcomes indicated below; denominator is all women ≥40 in California, regardless of having a screen; data are weighted to the California population under study.

mammography because mammography use was nearly universal (>90%) among women in the high-risk age groups (>50 years). The decrease in lumpectomies may have been attributed to the increase in use of needle biopsies (Williams et al., 2011; Zimmerman et al., 2013).

Recall rates of 10% for first and 6.7% for subsequent mammograms are recommended targets for breast cancer screening programs (Schell et al., 2007). In our sample, the percentages of non-normal results exceeded 10% and were 20% to 28% for women aged 50 to 69 years. Moreover, percentages of women with non-normal results significantly increased from 2001 to 2009 for women age 50 and older. A study that compared protocols between the United States and the UK suggested that breast cancer outcomes after mammography were comparable, but US women were two to three times more likely to be recalled after initial screening and were significantly more likely to experience surgical biopsy (Smith-Bindman et al., 2005). It is possible that clinicians were more likely to recall a woman with a questionable finding in 2009 as compared with 2001; however, the UK and US comparison suggests that rates are simply too high in the United States.

As a society, we may overestimate the risk of being diagnosed and dying from breast cancer, as well as overestimate the benefit of breast cancer screening (Fletcher, 2011; Harris, 2011; Hoffman et al., 2010). In our analysis based on self-reported data, we found that for every woman with a lump that turned out to be breast cancer, approximately 8.8 women aged 40 to 49, 7.3 women aged 50 to 59, 3.3 women aged 60 to 69, and 1.7 women 70 years or older had a lumpectomy that turned out not to be malignant. This ratio was highest for women screened between ages 40 and 49. Our findings are consistent with registry findings that have led to recommendations to screen women ages 40 to 49 less often or not at all (Kerlikowske, 2012; U.S. Preventive Services Task Force [USPSTF], 2009).

We also may be getting mammograms too frequently (Elmore & Fletcher, 2012). Consistent with other studies (Hubbard et al., 2011), we found that women whose most recent mammogram was a year ago or less reported significantly higher rates of non-normal results than women whose examination was 1 to 2 years ago and we observed this for each survey year we studied (19%–23% of annual screens reported non-normal results versus 12%–15% for biennial screens).

Limitations

The CHIS is a telephone survey with low response rates. However, low response rates have not resulted in significant nonresponse bias and have not substantially diminished the representativeness of CHIS data (Lee, Brown, Grant, Belin, & Brick, 2009). The CHIS does not provide stage of tumor or mortality data. In addition, we cannot confirm that the non-normal results reported were for the participant's most recent mammogram. Women were asked how long ago they had their most recent mammogram. If the woman's mammogram was within the last 2 years, she was asked the main reason for the mammogram: routine examination, because of specific breast-problem or follow-up, or because of family history. She was then asked if she ever had a mammogram where the results were not normal. Although the non-normal question did not specify the most recent mammogram, we assumed that the non-normal result was from her most recent mammogram because, if the respondent had been diagnosed with breast cancer or had a non-normal result from an earlier screen, we would have expected her to report subsequent mammograms not as routine but because of a breast problem.

Rates of screening mammography are likely overreported (Cronin et al., 2009; Ferrante et al., 2008; McPhee et al., 2002; Rauscher, Johnson, Cho, & Walk, 2008; Zapka et al., 1996). Mammography rates from the Breast Cancer Surveillance Consortium were selected as the gold standard and compared with self-reported rates in the National Health Interview Survey (NHIS). Self-reported rates were 14 to 27 percentage points higher than actual screening rates across age groups (Cronin et al., 2009). However, the CHIS and NHIS are the only population-based data that bridge the continuum from breast cancer screening to cancer diagnosis. The CHIS and NHIS both ask the same question on self-reported mammography screening and these data have been published routinely as population-level data on screening mammography both among small subsamples as well as national data reported by the CDC (Bleyer & Welch, 2012; Bostean, Crespi, & McCarthy, 2013; CDC, 2012; Courtney-Long, Armour, Frammartino, & Miller, 2011; Eberth, Huber, & Rene, 2010; Ponce et al., 2012; Ryu, Crespi, & Maxwell, 2013). Studies comparing the validity of self-reported mammography with medical records report low incongruences (Bancej, Maxwell, & Snider, 2004) and find that women tend to over-report mammography use, especially racial and ethnic minorities (Ferrante et al., 2008; McPhee et al., 2002; Rauscher et al. 2008; Zapka et al., 1996). Overreporting of mammography screening is most likely related to telescoping of dates, when women remember the screen as being more recent than it actually was (Rauscher et al., 2008). In terms of the accuracy of the additional variables analyzed, a study by Zapka et al. (1996) reported that women could report accurately the reason for having the mammography as well as the findings of the screen. We feel confident that women could recall accurately being told they had a non-normal mammogram, lumpectomy, or a cancer diagnosis. Our report of a decrease in the number of lumpectomies may be confounded by the movement of clinical practices away from lumpectomy and toward needle biopsy (Williams et al., 2011; Zimmerman et al., 2013). However, the CHIS does not ask about needle biopsies, so this information was not captured. This study cannot confirm whether the decrease in lumpectomies is owing to a decrease in procedures overall or a change in techniques.

Our population estimates for breast cancer ranged from 0.2% to 2.5% and are lower than those reported in the California Surveillance, Epidemiology, and End Results (SEER) cancer registries. The California SEER cancer registry estimated the 2012 age-adjusted prevalence of breast cancer at 1.57% of women (NCI, 2012). We suspect this is because women diagnosed with a later stage cancer or who died as a result of cancer would not have participated in the survey. However, the trends of low and stable breast cancer rates we found using CHIS data are consistent with stable incidence rates for women in SEER cancer registries between 2000 and 2009 (Jemal et al., 2013; Johnson, Chien, & Bleyer, 2013). Both registry and survey data are needed to accurately capture cancer screening, follow-up procedures, and breast cancer diagnoses to truly understand population screening programs.

Implications for Practice and/or Policy

Our study suggests that survey data offer a reasonable way to bridge data on cancer screening and follow-up in the general population by supporting and confirming previous studies. The

USPSTF (2009) found the most effective population strategy is biennial screening for women ages 50 to 74. Our study supports their recommendation by showing that non-normal results were greatest among women screened aged 50 to 69 and least among women aged 40 to 49 and aged 70 and older. Our results add to evidence that screening mammograms for women 40 to 49 may increase their risk of false-positives (USPSTF, 2009) For every woman screened aged 40 to 49 with a malignant lump, almost nine women had a non-cancerous lump removed, highest of all the age groups we studied. Risks of overdiagnosis might be mitigated by raising thresholds for recall and biopsy (Esserman, Thompson, & Reid, 2013) or by initiating cancer screening at an older age (USPSTF, 2009). Our findings also support published findings showing that breast cancer is highest among women ages 70 or older (Kerlikowske et al., 2013). We found that women screened at age 70 or older reported rates of lumpectomies twice as high as women screened age 40 to 49 but a higher percentage of their lumpectomies turned out to be cancer. Our findings suggest that informed decision making before screening mammograms is needed so that women understand both potential benefits and harms.

References

Agency for Healthcare Research and Quality. (2014). National healthcare disparities report. Rockville, MD. AHRQ Publication No. 14–0006. Available: http://www.ahrq.gov/research/findings/nhqrdr/nhdr13/2013nhdr.pdf. Accessed December 16, 2014.

Agency for Healthcare Research and Quality. (2013). National Healthcare Disparities Report. Rockville, MD. AHRQ Publication No. 13–0003. Available: http://www.ahrq.gov/research/findings/nhqrdr/nhdr12/2012nhdr.pdf. Accessed December 16, 2014.

Agency for Healthcare Research and Quality. (2012). National Healthcare Disparities Report. Rockville, MD. AHRQ Publication No. 12–0006. Available: http://www.ahrq.gov/research/findings/nhqrdr/nhdr11/nhdr11.pdf. Accessed December 16, 2014.

Agency for Healthcare Research and Quality. (2011). National Healthcare Disparities Report. Rockville, MD. AHRQ Publication No. 11–0005. Available: http://www.ahrq.gov/research/findings/nhqrdr/nhdr10/. Accessed December 16, 2014.

Agency for Healthcare Research and Quality. (2010). National Healthcare Disparities Report. Rockville, MD. AHRQ Publication No. 10–0004, 2010. Available: http://www.handgienecorp.com/pdf/nhdr09.pdf. Accessed December 16, 2014.

Alcusky, M., Philpotts, L., Bonafede, M., Clarke, J., & Skoufalos, A. (2014). The patient burden of screening mammography recall. *Journal of Women's Health*, 23(S1), S11–S19.

Bancej, C. M., Maxwell, C. J., & Snider, J. (2004). Inconsistent self-reported mammography history: Findings from the National Population Health Survey longitudinal cohort. *BMC Health Services Research*, 4, 32–39.

Bleyer, A., & Welch, H. G. (2012). Effect of three decades of screening mammography on breast-cancer incidence. *New England Journal of Medicine*, 367(21), 1998–2005.

Bostean, G., Crespi, C. M., & McCarthy, W. J. (2013). Associations among family history of cancer, cancer screening and lifestyle behaviors: A population-based study. *Cancer Causes and Control*, 24, 1491–1503.

Breen, N., Gentleman, J. F., & Schiller, J. S. (2011). Update on mammography trends: Comparison of rates in 2000, 2005, and 2008. *Cancer*, 117(10), 2209–2218.

Breen, N., Wagener, D. K., Brown, M. L., Davis, W. W., & Ballard-Barbash, R. (2001). Progress in cancer screening over a decade: Results of cancer screening from the 1987, 1992, and 1998 National Health Interview Surveys. *Journal of the National Cancer Institute*, 93, 1704–1713.

Brodersen, J., & Siersma, V. D. (2013). Long-term psychosocial consequences of false-positive screening mammography. *Annals of Family Medicine*, 11(2), 106–115.

Brown, M. L., Klabunde, C. N., Cronin, K. A., White, M. C., Richardson, L. C., & McNeel, T. S. (2014). Challenges in Meeting Healthy People 2020 objectives for cancer-related preventive services, National Health Interview Survey, 2008 and 2010. *Preventing Chronic Disease*, 11, E29.

California Health Interview Survey. (2002). *CHIS 2001 methodology series: Report 4 – response rates*. Los Angeles: UCLA Center for Health Policy Research. Available: http://healthpolicy.ucla.edu/chis/design/Documents/CHIS2001_method4.pdf. Accessed December 16, 2014.

California Health Interview Survey. (2007). *CHIS 2005 methodology series: Report 4 – Response rates*. Los Angeles: UCLA Center for Health Policy Research. Available: http://healthpolicy.ucla.edu/chis/design/Documents/CHIS2005_method4.pdf. Accessed December 16, 2014.

California Health Interview Survey. (2011). *CHIS 2009 methodology series: Report 4 – Response rates*. Los Angeles: UCLA Center for Health Policy Research. Available: http://healthpolicy.ucla.edu/Documents/Newsroom%20PDF/CHIS2009_method4.pdf. Accessed December 16, 2014.

Centers for Disease Control and Prevention (CDC). (2012). Cancer screening – United States, 2010. *Morbidity and Mortality Weekly Reports*, 61(03), 41–45.

Courtney-Long, E., Armour, B., Frammartino, B., & Miller, J. (2011). Factors associated with self-reported mammography use for women with and women without a disability. *Journal of Women's Health*, 20, 1279–1286.

Cronin, K. A., Miglioretti, D. L., Krapcho, M., Yu, B., Geller, B. M., Carney, P. A., … Ballard-Barbash, R. (2009). Bias associated with self-report of prior screening mammography. *Cancer Epidemiology, Biomarkers & Prevention*, 18(6), 1699–1705.

Eberth, J. M., Huber, J. C., & Rene, A. (2010). Breast cancer screening practices and correlates among American Indian and Alaska Native women in California, 2003. *Women's Health Issues*, 20(2), 139–145.

Elmore, J. G., & Fletcher, S. W. (2012). Overdiagnosis in breast cancer screening: Time to tackle an underappreciated harm. *Annals of Internal Medicine*, 156(7), 536–537.

Esserman, L. J., Thompson, I. M., & Reid, B. (2013). Overdiagnosis and overtreatment in cancer: An opportunity for improvement. *JAMA*, 310(8), 797–798.

Ferrante, J. M., Ohman-Strickland, P., Hahn, K. A., Hudson, S. V., Shaw, E. K., Crosson, J. C., … Crabtree, B. F. (2008). Self-report versus medical records for assessing cancer-prevention services delivery. *Cancer Epidemiology, Biomarkers and Prevention*, 17, 2087–2094.

Fletcher, S. W. (2011). Breast cancer screening: a 35-year perspective. *Epidemiology Reviews*, 33(1), 165–175.

Fletcher, S. W., Black, W., Harris, R., Rimer, B. K., & Shapiro, S. (1993). Report of the International Workshop on Screening for Breast Cancer. *Journal of the National Cancer Institute*, 85, 1644–1656.

Gotzsche, P. C., & Olsen, O. (2000). Is screening for breast cancer with mammography justifiable? *Lancet*, 355, 129–134.

Gotzsche, P. C., & Nielsen, M. (2011). Screening for breast cancer with mammography. *Cochrane Database of Systematic Reviews*(19), CD001877.

Harris, R. (2011). Overview of screening: Where we are now and where we may be headed. *Epidemiology Reviews*, 33(1), 1–6.

Hoffman, R. M., Lewis, C. L., Pignone, M. P., Couper, M. P., Barry, M. J., Elmore, J. G., … Zikmund-Fisher, B. J. (2010). Decision-making processes for breast, colorectal, and prostate cancer screening: The DECISIONS Survey. *Medical Decision Making*, 30, 53S–64S.

Hubbard, R. A., Kerlikowske, K., Flowers, C. I., Yankaskas, B. C., Zhu, W., & Miglioretti, D. L. (2011). Cumulative probability of false-positive recall or biopsy recommendation after 10 years of screening mammography: A cohort study. *Annals of Internal Medicine*, 155(8), 481–492.

Humphrey, L. L., Helfand, M., Chan, B. K., & Woolf, S. H. (2002). Breast cancer screening: A summary of evidence for the U.S. Preventive Services Task Force. *Annals of Internal Medicine*, 137, 347–360.

Jemal, A., Simard, E. P., Dorell, C., Noone, A. M., Markowitz, L. E., Kohler, B., … Edwards, B. K. (2013). Annual report to the nation on status of cancer, 1975-2009, featuring the burden of trends in human papillomavirus (HPV) – Associated cancers and HPV vaccination coverage levels. *Journal of the National Cancer Institute*, 105(3), 175–201.

Johnson, R. H., Chien, F. L., & Bleyer, A. (2013). Incidence of breast cancer with distant involvement among women in the United States, 1976-2009. *JAMA*, 309(8), 800–805.

Kerlikowske, K. (2012). Screening mammography in women less than age 50 years. *Current Opinion in Obstetrics and Gynecology*, 24(1), 38–43.

Kerlikowske, K., Zhu, W., Hubbard, R. A., Geller, B., Dittus, K., Braithwaite, D., … Breast Cancer Surveillance Consortium (2013). Outcomes of screening mammography by frequency, breast density, and postmenopausal hormone therapy. *JAMA Internal Medicine*, 173(9), 807–816.

Lee, S., Brown, E. R., Grant, D., Belin, T. R., & Brick, J. M. (2009). Exploring nonresponse bias in a health survey using neighborhood characteristics. *American Journal of Public Health*, 99(10), 1811–1817.

Lee, S., Brick, J. M., Brown, R., & Grant, D. (2010). Growing cell-phone population and noncoverage bias in traditional random digit dial telephone health surveys. *Health Services Research*, 45(4), 1121–1139.

McPhee, S. J., Nguyen, T. T., Shema, S. J., Nguyen, B., Somkin, C., Vo, P., & Pasick, R. (2002). Validation of recall of breast and cervical cancer screening by women in an ethnically diverse population. *Preventive Medicine*, 35, 463–473.

National Cancer Institute (NCI). (2012). State cancer profiles. Prevalence projections reported by state. Complete prevalence age-adjusted percents for breast cancer. Available: http://statecancerprofiles.cancer.gov/prevalence/index.php. Accessed December 16, 2014.

National Cancer Institute. (2013). Cancer screening overview. What are the goals of screening tests? Available: www.cancer.gov/cancertopics/pdq/screening/overview/patient/page2. Accessed December 16, 2014.

Nelson, H. D., Tyne, K., Naik, A., Bougatsos, C., Chan, B. K., & Humphrey, L. (2009). Screening for breast cancer: Systematic evidence review update for the U.S. Preventive Services Task Force. *Annals of Internal Medicine*, 151, 727–737, W237-W242.

Pelletier, M., Knauper, B., Loiselle, C. G., Perreult, R., Mizrahi, C., & Dube, L. (2012). Moderators of psychological recovery from benign cancer screening results. *Current Oncology*, 19(3), e191–e200.

Ponce, N. A., Lavarreda, S. A., Yen, W., Brown, E. R., DiSogra, C., & Satter, D. E. (2004). The California Health Interview Survey 2001: Translation of a major survey for California's Multiethnic population. *Public Health Reports*, 119, 388–395.

Ponce, N. A., Tsui, J., Knight, S. J., Afable-Munsuz, A., Ladabaum, U., Hiatt, R., & Hass, J. S. (2012). Disparities in cancer screening in individuals with a family history of breast or colorectal cancer. *Cancer*, 118, 1656–1663.

Rauscher, G. H., Johnson, T. P., Cho, Y. I., & Walk, J. A. (2008). Accuracy of self-reported cancer-screening histories: A meta-analysis. *Cancer Epidemiology, Biomarkers and Prevention*, 17, 748–757.

Ryu, S. Y., Crespi, C. M., & Maxwell, A. E. (2013). What factors explain disparities in mammography rates among Asian-American immigrant women? A population-based study in California. *Women's Health Issues*, 23(6), e403–410.

Schell, M. J., Yankaskas, B. C., Ballard-Barbash, R., Qaqish, B. F., Barlow, W. E., Rosenberg, R. D., & Smith-Bindman, R. (2007). Evidence-based target recall rates for screening mammography. *Radiology*, 243, 681–689.

Shapiro, S., Venet, W., Strax, P., Venet, L., & Roeser, R. (1982). Ten-to-fourteen-year effect of screening on breast cancer mortality. *Journal of the National Cancer Institute*, 69, 349–355.

Smith, R. A., Brooks, D., Cokkinides, V., Saslow, D., & Brawley, O. W. (2013). Cancer screening in the United States, 2013. *CA: A Cancer Journal for Clinicians*, 63(2), 88–105.

Smith-Bindman, R., Ballard-Barbash, R., Miglioretti, D. L., Patrick, J., & Kerlikowske, K. (2005). Comparing the performance of mammography screening in the USA and the UK. *Journal of Medical Screening*, 12, 50–54.

Williams, R. T., Yao, K., Stewart, A. K., Winchester, D. J., Turk, M., Gorchow, A., … Winchester, D. P. (2011). Needle versus excisional biopsy for noninvasive and invasive breast cancer: Report from the National Cancer Data Base, 2003-2008. *Annals of Surgical Oncology*, 18(13), 3802–3810.

U.S. Preventive Services Task Force (USPSTF). (2009). Screening for breast cancer: U.S. Preventive Services Task Force Recommendation Statement. *Annals of Internal Medicine*, 151, 716–726.

Zapka, J. G., Bigelow, C., Hurley, T., Ford, L. D., Egelhofer, J., Cloud, W. M., & Sachsse, E. (1996). Mammography use among sociodemographically diverse women: The accuracy of self-report. *Am J Public Health*, 86, 1016–1021.

Zimmerman, C. J., Sheffield, K. M., Duncan, C. B., Han, Y., Cooksley, C. D., Townsend, C. M., Jr., & Riall, T. S. (2013). Time trends and geographic variation in use of minimally invasive breast biopsy. *Journal of the American College of Surgeons*, 216(4), 814–824.

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