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Prevalence and Correlates of Recent and Repeat Mammography Among California Women Ages 55–79

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Abstract

Objective—Data on repeat mammography rates are less available than for recent screening. Two large, population-based state surveys provide the opportunity to investigate repeat and recent mammography prevalence and correlates among California's diverse population.

Methods—Data were from women aged 55–79, using the 2001 and 2005 California Health Interview Surveys. The study assessed the prevalence and correlates of recent mammography (within the past two years) and repeat mammography (mammogram within the past two years and 3–11 mammograms within the past 6 years).

Results—Prevalence was 82.4% (recent) and 73.8% (repeat) in 2001, and 87.1% (recent) and 77.5% (repeat) in 2005. Correlates of lower rates were insurance status, no usual source of care, being a smoker, age 65–79, being Asian with no English proficiency, being never married, and lower absolute risk for breast cancer. Especially low ratios of repeat-to-recent mammography existed for the uninsured, and those using the emergency room or with no source of care. Unexpected findings in which unadjusted results were inconsistent with multivariable adjusted results occurred for Latinas with no English proficiency and women at 200–299% of poverty level.

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Conflict of Interest statement

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Conclusions—Several groups of women in California remain at-risk of lower mammography utilization. However, investigators should also be alert for instances where multivariable analyses seem particularly discrepant with crude rates.

Medical Subject Headings (MeSH) Keywords

mammography; behavioral science; women's health; preventive health services; cancer screening

1. Introduction

Breast cancer is the most common cancer among women in California, excluding non-melanoma skin cancer. Breast cancer is also the second leading cause of mortality after lung cancer [1]. Yet there is reason for optimism. Breast cancer incidence has been relatively stable since 1988, and mortality has declined 28% because more cancers are being diagnosed and treated at an earlier stage [1]. For mortality to continue to decline, it is important to identify groups with low rates of mammography utilization, especially repeat use, because regular on-schedule screening is expected to have the greatest population-level benefits for breast cancer morbidity and mortality.

This paper uses "repeat mammography" to mean two or more consecutive, on-schedule examinations at a specified interval (e.g., at least every 2 years). "Recent mammography" refers to having the examination (or not) in the time interval immediately prior to data collection (e.g., within the past two years). Repeat mammography is therefore a subset of recent mammography. A review of early data on repeat mammography [2] calculated a weighted average of 53.2% (95% CI= 44.7%, 61.8%), based on published reports from 11 studies with data collected between 1995 and 2001. However, the repeat mammography estimates ranged widely, from as low as 28% [3,4] to as high as 92% [5]; none of these studies used national- or state-level probability samples, they employed different data collection methodologies, and their sampling frames varied. Subsequent studies have continued to find widely varying rates of repeat mammography: 29.9% and 35.8% [6]; 16%, 42%, and 63% [7]; a range of 33% to 67.5% across six samples [8]; 41% [9,10]; 45% and 49% [11]; 44% and 65% [12]; 67% and 74% [13]; 73.4% [14]; 79.8% [15]; 72.4% and 81.5% [16]. Differences in estimates within and between studies are most likely due to their different samples and sampling frames, different definitions of repeat mammography, and different intervals allowed between exams.

National-level data are useful for setting national goals and policies, but national population-based probability samples for repeat mammography are rare. Two important exceptions are the 2000 NHIS and the 2003 HINTS. A national-level analysis of the Year 2000 National Health Interview Survey [17] found a repeat mammography rate of 49% based on a 12-month interval between exams, and 64.1% using a 24-month interval. Latinas had crude rates 12% and 14% lower than Non-Hispanic whites, depending on the screening interval (12-months, 24-months, respectively). Non-Hispanic Blacks were about 4% lower than Whites for both intervals. An analysis of the 2003 Health Information and National Trends Survey [18], found a national-level prevalence rate of 72.2% using a two-year interval. Latinas' crude rate was 9% lower than Non-Hispanic Whites, using a two-year interval, and Non-Hispanic Blacks were 7% lower than Whites.

At the same time, analysis of state-level, population-based data allows more focused examination of mammography in the context of state policies, practices and health care markets. For example, Rakowski et al. [19] found relatively low correspondence between correlates of mammography in national-level analyses of the 2002 Behavioral Risk Factor Surveillance System, compared to results from analyses within quintile-based and Census-

based groupings of states from the same dataset. This paper examines repeat and recent mammography among women ages 55–79 in California, using the 2001 and the 2005 California Health Interview Surveys (CHIS). The California Health Interview Survey is modeled after the NHIS. In 2001 and 2005 CHIS collected data for repeat mammography. California's population is more ethnically diverse than the nation as a whole and it has a larger proportion of immigrants. Because CHIS 2001 and 2005 were administered in several languages, it can provide screening-related information about persons who may be excluded from English-only, population-based surveys because they have limited or no English proficiency.

2. Materials and Methods

2.1 Sample

The CHIS is a state-level, random-digit-dial telephone survey of households from strata in California (counties and combinations of sparsely-populated counties), designed to be representative of the state's non-institutionalized population. Using CATI, the 2001 survey was conducted between November 2000 and October 2001; the 2005 survey was conducted between July 2005 and April 2006. The surveys were independent cross-sectional samples.

The 2001 CHIS was administered in six languages: English, Spanish, Chinese (Mandarin and Cantonese), Vietnamese, Korean, and Khmer [20]. The 2005 CHIS was administered in five: English, Spanish, Chinese (Mandarin and Cantonese), Vietnamese, and Korean [21].

The CHIS samples were weighted; 2000 Census data were used for CHIS 2001 and the California Department of Finance data were used for inter-censal years, including CHIS 2005, to produce accurate population parameters by gender, age, race, and ethnicity. The weighting accounted for selection probability, non-response, and telephone non-coverage. For 2001, the screener response rate (response to an interviewer contacting a household) was 59.2%, and the subsequent completed respondent-specific interview rate was 63.7%, yielding an overall response rate of 37.7% [22]. For 2005, the household response rate was 49.8% and the respondent-specific interview rate was 54.0%, yielding an overall response rate of 26.9% [23]. More detailed information on CHIS is available at www.chis.ucla.edu.

2.2 Inclusion and exclusion criteria

Adult samples for analysis were women ages 55–79 in each survey, and are shown in Tables 1 and 2, for recent and repeat mammography. Samples were just over 8,100 in 2001, and just over 7,500 in 2005. We chose women over age 50 so that there would be no question about the evidence for benefits of screening and need for regular examinations. In addition, in order for women over 50 to have adequate time to meet the repeat mammography criterion of at least every-other-year, we set the lower boundary of 55 years to accommodate the 6-year mammography history recall period. An upper age limit was set because there is no consensus on breast cancer screening for women over age 80. Women who ever had breast cancer or who reported their most recent mammogram was because of a possible breast problem were excluded. Pacific Islander samples were very small (2001, n=30; 2005, n=12) so they were excluded from multivariable regression analyses.

2.3 Dependent variables: recent and repeat mammography

Both CHIS surveys included a series of questions: whether the respondent ever had a mammogram; if so, how long ago she had her most recent mammogram; and, how many mammograms she had in the six years prior to the interview. These same questions were used in the 2000 National Health Interview Survey.

Recent mammogram was defined as within the two years prior to the CHIS interview. Women without a mammogram in the past two years were classified as not having a recent mammogram, regardless of how many they reported in the prior six years.

Repeat mammography was defined as having had a recent mammogram and having between 3–11 total mammograms in the prior 6 years. Our criteria for repeat mammography therefore made it a subset of recent mammography. This definition of repeat mammography was the same one used by Rakowski et al. in analyses with the 2000 NHIS [17].

Analyses for this paper are based on two indicators of mammography use:

Individual-level receipt of mammography, as reported in 2001 and in 2005. Individual-level status for recent and repeat mammography was used for deriving prevalence estimates, and were the dependent variables for the multivariable logistic regressions.

Ratio of repeat-to-recent mammography. A second indicator was the ratio of repeat-to-recent mammography, calculated within each CHIS sample, by dividing the repeat mammography percentage by the recent mammography percentage. This value shows the ratio, readily translated to a percentage, of women with a recent mammogram who also had repeat mammography. For example, a ratio of .50 would indicate that half of all women reporting a recent mammogram also met the criterion for repeat mammography. This indicator has not been commonly used in mammography studies to date.

2.4 Independent variables and conceptual grounding

The identification of racial/ethnic disparities in cancer screening rates can be investigated, and interventions can be informed by, the perspectives of the classic Andersen Behavioral Model of Health Service Use that proposes need, predisposing, and enabling factors [24], as well as by Social Ecological Models [25]. The Andersen Behavioral Model has not traditionally addressed in-detail the processes by which need/predisposing/enabling factors operate, but it can accommodate a large range of factors, and views them as resources that are present or absent. In so far as interventions to reduce and eliminate disparities can be seen as having objectives of resource delivery, resource support, and resource configuration, the Andersen Behavioral Model provides a useful means of classifying variables. Social Ecological Models in turn direct attention specifically to the multi-level sectors or domains from which need/predisposing/enabling factors can be drawn. The Andersen Behavioral Model also has macro-level constructs, and so is compatible with social ecological approaches. For purposes of this investigation specific to mammography, three covariates were considered predisposing (age, marital status, race/ethnicity), five were viewed as being more directly enabling (income, health insurance, education, usual source of care, English language proficiency), and four were considered to reflect need (self-rated health, Gail Model score, smoking status, Body Mass Index).

Age was coded as: 55–64 vs. 65–79. Age eligibility for the federally funded portion of a state's National Breast and Cervical Cancer Early Detection program has an upper limit of 64. Since 1991, Medicare has covered at least every-other-year mammography for women aged 65 and older. Education was coded as: Less than high school, High school graduate, Some college, and College graduate. Income was categorized according to the federal poverty level (FPL): 0–99% FPL, 100–199% FPL, 200–299% FPL, and ≥ 300% FPL. Marital status was classified as: Currently married/Living with partner, Widowed/Separated/Divorced, or Never married.

California has a large immigrant population. Self-reported English proficiency, an indicator of acculturation and ease of navigating health care, was combined with race/ethnicity for

Latinas and Asians, to create a composite variable. Very few non-Latina African-Americans, non-Latina Whites, and American Indian/Alaska Natives reported any limitation to use of English. Respondents were therefore categorized as: non-Latina White; non-Latina African-American; American Indian/Alaskan Native; Latina, proficient in English or with some limitation; Latina, with no English proficiency; Asian, proficient in English or with some limitation; and Asian, with no English proficiency.

Self-reported health was categorized as: Excellent/Very good/Good vs. Fair/Poor. Body mass index was defined as: Underweight (0–18.49), Normal (18.5–24.99), Overweight (25.0–29.99), and Obese (30.0-higher). Smoking status was defined as: Current, Former, or Never smoker.

Absolute risk of breast cancer was assessed using the Gail Model [26,27]. Questions about current age, age at first live birth, age at menarche, number of first-degree relatives with breast cancer, and number of breast biopsies are used to calculate the 5-year risk of breast cancer. Since 1.67% or greater is considered high risk over the coming 5 years, we dichotomized the Gail Model score into less than 1.67% vs. greater than 1.67%. A projected risk of 1.67% or greater was considered high risk and used as the eligibility criterion for the Breast Cancer Prevention Trial that studied the potential protective effect of tamoxifen [28].

Medical insurance coverage was categorized as: Any private coverage, Public coverage only, or Uninsured. Usual source of care was defined as: Having a usual source of care that was not an emergency room vs. Using an emergency room or having no source of care.

2.5 Statistical methods

Univariate analyses were conducted for the unadjusted prevalence rates of repeat and recent mammography, as well as the repeat-to-recent ratio, overall and for the categories of each covariate. Mutivariable logistic regression models were used to identify the correlates of repeat and recent mammography. Because the unadjusted data (Tables 1 and 2) showed a significant contrast for almost all variables in both CHIS years (i.e., non-overlap of 95% confidence intervals) analyses used the full set of independent variables. All variables (except Pacific Islander women, as noted above) were entered simultaneously because we did not have an a-priori hierarchy or ranking of the independent variables. Analyses were conducted using SAS version 9, and logistic regression analyses used the Multilog procedure with SAS-callable SUDAAN 9.0.1 to account for the 2001 and 2005 CHIS survey designs.

3. Results

3.1 Prevalence estimates

Point-estimates and repeat-to-recent ratios. Table 1 (2001 CHIS) and Table 2 (2005 CHIS) present the weighted prevalence rates of recent and repeat mammography, and the unweighted sample sizes for all independent variables. Each table also has a column for that survey's repeat-to-recent ratios, calculated for the total sample and for the categories of each independent variable.

In 2001, the estimated prevalence of recent mammography was 82.4% and was 73.8% for repeat mammography, yielding an overall repeat-to-recent ratio of 89.6%. The range was from .716 to .941 across categories of the independent variables. In 2005, the estimated prevalence of recent mammography was 87.1% and was 77.5% for repeat mammography, producing a similar overall repeat-to-recent ratio of 89.0%. The range was .616 to .936.

Two groups, however, had relatively low repeat-to-recent ratios. The lowest in both CHIS surveys was for women with no regular source of care. Their ratio was 71.6% in 2001 (an absolute 18% lower than the total sample), and was only 61.6% in 2005 (an absolute 27% lower than the total sample). These women also had the lowest absolute recent and repeat mammography rates in both 2001 and 2005. Results were similar for uninsured women. Their ratio was 73.9% in 2001 and was only 67.1% in 2005 – the second lowest in both surveys. Uninsured women also had the second lowest absolute recent and repeat mammography percentages in both surveys.

Relatively lower mammography rates and repeat-to-recent ratios occurred for other groups as well. The repeat-to-recent ratio for Asian women with no English proficiency was 79.3% in 2001 and was comparably low, 77%, in 2005. Asian women with no English proficiency had the third lowest absolute recent and repeat utilization rates. Latinas with no proficiency in English also had a relatively low ratio of 75.5% in 2001; and, although their ratio was higher in 2005, at 83.1%, it was still below most other ethnicity/English language proficiency groups.

3.2 Logistic regressions

Tables 3 (2001 CHIS) and 4 (2005 CHIS) show results of multivariable logistic regression to identify correlates of recent and repeat mammography. The first two subsections that follow report on the significant correlates between the two CHIS surveys, and the third subsection focuses on the significant correlates of recent and repeat mammography in the 2005 CHIS.

Recent mammography: Correlates in 2001 and 2005—Several correlates were associated with lower recent screening in both 2001 and 2005: being Asian with no English proficiency; being never married or being widowed/separated/divorced; being a current smoker; having a relatively lower Gail model score; being uninsured or having only public insurance; and receiving care at an ER or having no regular source of care.

Two significant associations with recent mammography in 2005 were not found in 2001. First, in 2005, women at 200–299% FPL had a significantly lower odds of recent mammography than women at 300% or more of FPL. Second, the adjusted odds ratio for Latinas with no English proficiency was markedly higher in 2005 than in 2001 and was significant compared to non-Latina Whites.

Significant associations in 2001 between recent mammography with age, non-Latina African-Americans, and moderately overweight BMI status were not found in 2005, although the association with age approached significance, and the odds ratio for African-Americans was 1.45 in 2005.

Repeat mammography: Correlates in 2001 and 2005—Consistent associations with lower repeat mammography were: being Asian with no English proficiency; being a current smoker; having a relatively lower Gail model score; being uninsured or having only public insurance; and getting care at an ER or having no source of care. Being widowed/separated/divorced, and being Asian with at least some English proficiency approached significance in 2001 and reached significance in 2005. In 2005, being Asian was therefore associated with lower repeat mammography regardless of language proficiency.

Four associations with repeat mammography in 2005 were not found in 2001. The adjusted odds ratio for women at 200–299% FPL was significantly lower compared to women at 300% or more of FPL. In addition, the adjusted odds ratios for Latinas with no English proficiency, for African-American women, and for former smokers also achieved

significance in 2005. For Latinas with no English proficiency and African-Americans, the adjusted odds ratios were higher than for non-Latina Whites; and, former smokers had a higher odds ratio than never smokers.

Several associations in 2001 were not found in 2005, those for: age, being a high school graduate, being at 100–199% FPL and at 0–99% FPL, and being never married.

Recent and repeat mammography: Correlates in 2005—Several variables were associated both with lower recent and repeat mammography in 2005 (Table 4): being at 200–299% FPL; being Asian with no English proficiency; being widowed/separated/divorced; being a current smoker; a lower Gail Model score; being uninsured or having only public insurance; and getting care at an ER or having no source of care. Latinas with no English proficiency had higher odds of both recent and repeat mammography than non-Latina Whites.

Being never married was associated with lower recent, but not repeat mammography. On the other hand, being a former smoker was associated with higher repeat, but not recent mammography. Being non-Latina African-American was also associated with higher repeat, but not recent mammography, although the adjusted odds ratio for recent mammography was 1.45 in 2001.

4. Discussion

Correlates of recent mammography and repeat mammography in our analyses of 2001 and 2005 CHIS data were consistent with findings in the literature for several variables. In both surveys current smoking, lower Gail Model score, not having health insurance, using only the ER or having no source of regular care, and being never married or being widowed/separated/divorced, were associated with lower mammography. These variables span need, predisposing, and enabling variables from the Andersen Behavioral Model, and highlight the advisability of still continuing to cast a wide net when identifying factors associated with lower utilization. The Andersen Behavioral Model and Social Ecological Model perspectives are appropriate backdrops against which to consider this range of variables. Process-oriented theories of behavior can then provide ideas for how these variables are “put into motion” to explain, and most desirably via interventions, control variance of screening practices. Datasets that include multilevel variables will undoubtedly contribute the most to optimizing screening rates, and should be utilized or even developed whenever possible. State-level and intra-state regional surveys can be very effective in this regard, because they can include questions directed to factors most relevant to that state and/or regions [29–32].

However, as discussed below, while some results were straightforward, others were unexpected and may denote the need for more complex analyses of the correlates of mammography. The strongest associations with repeat and recent mammography in both years were for insurance status and having a source of care, both enabling variables in the Andersen Behavioral Model Another key finding for California is that Asian women who reported no English proficiency had relatively lower recent and repeat mammography in both surveys compared to most other race/ethnicity/language groups, except Latinas with no English proficiency. Their repeat-to-recent ratios were also low, and they had relatively small 2001–2005 absolute differences in recent (7%) and repeat (4%) mammography. Uninsured women, women using ERs or with no source of care, Asian women regardless of language proficiency, and Latinas with no English proficiency are therefore groups that present challenges in order to eliminate mammography utilization disparities in the California population. Asian women may be an especially important at-risk group, because breast cancer mortality declines have not yet been found for Asian/Pacific Islanders [1].

Unfortunately, Pacific Islanders had extremely small numbers and so were excluded from our analyses; purposively drawn samples may be needed to adequately represent them.

The repeat-to-recent ratio is a novel indicator, and provided information not routinely reported e in studies of mammography. An analysis of the 2003 Health Information National Trends Survey found a ratio of 88.5% [18] -- within 1% of the ratios found here. The present study went beyond a population-level calculation to examine subgroups for all covariates. Repeat-to-recent ratios identified groups of special concern. Ratios for uninsured women, and those without a non-ER source of care, were low in both years (67% and 62%, respectively in 2005) and were lower in 2005 than in 2001. These two groups therefore appear to experience a type of “double jeopardy” – low absolute rates and low repeat screening among those with a recent exam. Because the maximum benefits of mammography come from regular use, the repeat-to-recent ratio may provide insights for understanding disparities in breast cancer morbidity and mortality.

At the same time, because the repeat-to-recent ratio is calculated by dividing two percentages within a survey year, and we had two CHIS surveys, there is another possible interpretation. That is, a possible reason for the lower 2005 repeat-to-recent ratio for uninsured women could be the success of publicly-funded screening programs in California. It is the pool of women with recent screening that provides eligibility for repeat screening. The Breast and Cervical Cancer Prevention and Treatment Act for women under age 65, and receiving screening through the National Breast and Cervical Cancer Early Detection Program (NBCCEDP), was passed in 2000 and implemented in 2002. If this program was progressively successful in reaching uninsured women between 2003 and 2005 (i.e., the “recent” mammogram window for the 2005 CHIS), participants in the 2005 CHIS would still have been less likely to be screened prior to 2003. As a result, the repeat-to-recent ratio would also be low, because recent mammography rates in 2005 would be higher while repeat rates would not yet have increased as much. Consistent with this possibility, comparing Tables 1 and 2 shows that uninsured women had an absolute 12% higher recent mammography in 2005 compared to 2001, but onlyabsolute 4.5% higher repeat mammography. Similarly, women using ERs or with no source of care had an absolute 10.5% higher recent mammography in 2005 compared to 2001, but only a 1.2% absolute difference in repeat mammography.

Therefore, a “rebound” of the repeat-to-recent ratio may be observed in future CHIS surveys, if access-enhancing programs continue to be successful. That is, , repeat rates would increase in future surveys, and thereby act to increase the repeat-to-recent ratio. Nonetheless, even if these groups’ currently lower ratios do in fact reflect the first steps of a possible longer-term “success story,” this hypothesis is currently offered only after-the-fact. The repeat-to-recent ratio should be closely monitored in coming years because the morbidity and mortality benefits of screening come from regular utilization.

There were also some unexpected or counter-intuitive findings. One such result was for Latinas with no English proficiency in 2005 (Table 4), who had multivariable adjusted recent and repeat odds ratios that were higher than for non-Latina Whites. In that regard, Tables 1 and 2 show that in 2005 Latinas with no English proficiency reported substantially higher absolute rates of recent and repeat mammography compared to 2001 (by 16% and 19%, respectively). Latina’s repeat-to-recent ratio also was higher in 2005 compared to 2001, even though it was lower than most other racial/ethnic groups’ ratios. Spanish-language outreach programs may therefore be beneficial; same-language outreach was used extensively for Latinas in California, but was not done as much for Asians. During the time between the two surveys, California made a concerted effort to reach Latinas for participation in the NBCCEDP.

A second unexpected finding, also in 2005, was that non-Latina African-American women had a significantly higher adjusted odds ratio for repeat mammography compared to non-Latina Whites. In addition while their association with recent mammography was not significant in 2005, the adjusted odds were still 1.45 and nearly significant. In contrast, Asian women with no English proficiency did not show such improvements, and their adjusted odds ratios remained significantly lower than non-Latina Whites in 2005. These results for Latinas and African-American women are consistent with analyses of mammography in the BRFSS and NHIS showing what appear to be “reversals” of unadjusted results when multivariable adjustment is done [33].

A third unexpected finding was for Federal Poverty Level. In 2001, the 200–299% FPL group did not differ significantly from the 300+% FPL group on either recent or repeat mammography. In 2005 however, women at 200–299% FPL did have significantly lower adjusted recent and repeat mammography odds ratios. In contrast, in 2001 the 0–99% and 100–199% FPL groups were significantly lower than the 300+FPL group for repeat mammography. However, in 2005 the 0–99% and the 100–199% FPL groups were not significantly lower than the 300% FPL group. Eligibility under the NBCCEDP, including California, ends at 250% FPL so not all women in the 200–299% FPL group are eligible. It is perplexing that even though the 200–299% FPL group had a significantly lower repeat mammography adjusted odds ratio compared to women at 300+% of FPL in 2005, Table 2 shows the absolute percentage of repeat mammography for the 200–299% FPL group was 4.5–6.5% higher than those for the 0–99% and the 100–199% groups, who did not have significantly lower adjusted odds. This difference in associations may again denote a success of the NBCCEDP and other public programs.

There were also unexpected results in the 2001 CHIS. For 2001 repeat mammography, the crude mammography percentage for Latinas with no English proficiency was virtually equal to that for Asians with no English proficiency. This is striking because the adjusted odds ratio for the Asians was significantly lower than for the non-Latina Whites, while the adjusted odds for Latinas with no English proficiency did not differ significantly from non-Latina Whites. Also the adjusted odds of repeat mammography in 2001 for high school graduates was significantly lower compared to the college degree reference group (Table 3), even though women who did not graduate high school had an 11–12% lower absolute repeat mammography percentage than the high school graduates (Table 1). Of interest, women who did not graduate high school did not have a significant difference compared to the college graduates (Table 3).

Some of our results may therefore raise questions about how to interpret and use outcomes of multivariable analyses of screening utilization. These questions may also influence how theory-based variables are interpreted, if results appear to contradict usual hypotheses about those variables producing less access to services. Specifically, we may need a better understanding of how social programs influence the associations among covariates used in analyses, and by extension the multivariable analyses intended to identify groups at-risk of lower utilization. If programs such as the NBCCEDP and other low/no-cost, access-enhancing initiatives are successful, they will increase screening rates for eligible groups. However, these programs will not change racial/ethnic or income disparities on resource and access variables. Instead, these programs circumvent the disparities for that particular screening procedure. Therefore, the algorithms that produce the multivariable, adjusted results estimate higher rates on the dependent variable for a group such as Latinas with no English proficiency, despite the presence of disparities on resource/access variables. Insofar as adjusted analyses represent predicted estimates of association with “all else held equal” by statistical control, the adjusted odds ratios can therefore produce surprising results, and even directly contradict the crude percentages and the univariate associations. The targeting

of groups for intervention routinely draws on the variables that achieve statistical significance in multivariable analyses. Several of our logistic regression results, and some of the repeat-to-recent mammography ratios, do indicate groups who should continue to be priority populations for intervention. At the same time, the presence of discrepancies between unadjusted and adjusted results suggest that attention should still be directed at the importance of crude screening rates and unadjusted odds ratios.

There are some constraints and limitations to this investigation. First, the recent and repeat mammography indicators are based on self-report, and status for repeat mammography is based on reported mammograms over 6 years. Screening tests are subject to over-reporting [34]. There is also the associated risk of misclassification due to inaccurate recall, especially for repeat mammography. For repeat mammography, it was necessary to report a most recent mammogram within the prior two years, and then to report a sufficient number of mammograms to meet at least an every-other-year schedule. Recall bias is especially possible for the 6-year recall period, which would tend to raise the repeat mammography percentage and thereby inflate the repeat-to-recent ratio. Medical claims may provide another source of data for calculating the ratio in future research. We also cannot account for possible differential over-reporting bias across the racial/ethnic/language groups. On the one hand, each CHIS survey was administered in multiple languages, so lack of English proficiency was not as much a threat to understanding question wording. On the other hand, answering in a language other than English is generally accepted as a marker for less acculturation, and could be associated with a positive response bias, if only due to unfamiliarity with survey procedures and typical question/response formats. Again, a positive response bias would tend to increase minority groups' screening rates and inflate the recent-to-repeat ratio.

Although women whose most recent mammogram was for a breast problem were excluded from the analysis, CHIS has no information about the reasons for any of the other mammograms received in the prior six years. Therefore, some of the mammograms may have been for diagnostic rather than screening purposes. There is also a potential issue with some of the independent variables. During the 6-year recall period, a respondent's status on some covariates may have changed by the time of the respective CHIS surveys. Covariates such as marital status, income, smoking behavior, health status, health insurance coverage and usual source of care could have changed (perhaps more than once) during the extended recall period. CHIS does not ask about life-changes over a preceding period of years. In addition to multilevel analyses in prospective studies, it may be advantageous to use time-varying covariates when data are collected across multiple assessments, so that such changes on a variable can contribute to estimates of association with screening utilization. Our analyses were restricted to women aged 55–79. This is a portion of the age range for which mammography is recommended. Analyses of repeat mammography for women younger than 55 could be informative, especially in regard to the repeat-to-recent ratio and the unexpected multivariable results found for certain groups in our sample.

There are also methodological considerations when using independent cross-sectional surveys to compare differences such as mammography rates, the repeat-to-recent ratio, and correlates of recent and repeat utilization across surveys. The assumption is that possible selection and recruitment biases are comparable for the two CHIS surveys. This assumption may not be fully valid. We have therefore referred to "differences" rather than to "increases" or "decreases, and have also tried to avoid commenting on small differences between the two surveys that could simply reflect recruitment or sampling issues. Future CHIS data will be extremely helpful for judging whether differences observed here are in fact trends. In addition, we have tried to highlight results that seem to be the most pertinent in the context of California.

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Table 1

Estimates of Recent and Repeat Mammography, Women Aged 55–79,[a] 2001 California Health Interview Survey

Sample Characteristics	Recent mammography[b]			Repeat mammography[c]			Repeat/ Recent
	Sample Size	Wgtd %	(95% CI)[d]	Sample Size	Wgtd %	(95% CI)	Ratio[e]
Total	8,205	82.4	(81.2–83.6)	8,133	73.8	(72.4–75.1)	0.896
Age							
55–64	3,869	83.1	(81.2–84.8)	3,843	75.1	(72.9–77.1)	0.904
65–79	4,336	81.8	(80.1–83.3)	4,290	72.5	(70.7–74.2)	0.886
Education							
< High school graduate	1,191	75.9	(72.1–79.3)	1,164	61.8	(57.9–65.6)	0.814
High school graduate	2,516	82.2	(80.0–84.2)	2,500	73.2	(70.7–75.6)	0.891
Some college /vocational/ AA or AS degree	2,448	83.6	(81.3–85.7)	2,431	76.6	(74.3–78.8)	0.916
College graduate	2,050	87.6	(85.4–89.6)	2,038	82.4	(80.2–84.5)	0.941
Federal poverty level							
0–99% FPL	1,083	73.1	(68.4–77.3)	1,054	58.2	(54.0–62.3)	0.796
100–199% FPL	2,016	78.3	(75.2–81.1)	2,001	67.7	(64.4–70.8)	0.865
200–299% FPL	1,359	82.6	(79.6–85.2)	1,351	75.5	(72.3–78.5)	0.914
300% FPL and above	3,747	87.9	(86.4–89.3)	3,727	81.8	(80.2–83.3)	0.931
Race/ethnicity and English proficiency							
Non-Latina White	6,309	85.2	(83.8–86.5)	6,274	78.0	(76.6–79.4)	0.915
Non-Latina African American	408	88.1	(83.2–91.7)	393	77.4	(71.9–82.1)	0.879
American Indian/Alaska Native	115	73.9	(60.9–83.7)	112	65.6	(49.6–78.7)	0.888
Latina, some limit or proficient in English	322	77.6	(71.3–82.8)	320	70.9	(64.7–76.4)	0.914
Latina, no English proficiency	314	70.7	(63.7–76.9)	310	53.4	(46.3–60.4)	0.755
Asian, some limit or proficient in English	277	80.7	(73.8–86.1)	274	72.0	(64.6–78.4)	0.892
Asian, no English proficiency	241	66.6	(58.0–74.2)	233	52.8	(44.6–60.9)	0.793
Other race, single or multiple	189	82.1	(72.0–89.1)	187	72.1	(60.5–81.4)	0.878
Marital status							
Married / living with partner	3,814	84.9	(83.1–86.5)	3,786	77.1	(75.0–79.0)	0.908
Widowed / separated / divorced	4,013	79.8	(77.9–81.6)	3,973	70.1	(67.8–72.3)	0.878

Sample Characteristics	Recent mammography[b]			Repeat mammography[c]			Repeat/ Recent
	Sample Size	Wgtd %	(95% CI)[d]	Sample Size	Wgtd %	(95% CI)	Ratio[e]
Never married	356	73.8	(64.8–81.1)	352	64.5	(55.9–72.2)	0.874
Health status							
Excellent/Very Good/Good	6,175	84.1	(83.0–85.1)	6,139	76.6	(75.2–78.0)	0.911
Fair or Poor	2,019	77.8	(74.5–80.7)	1,983	65.8	(62.3–69.1)	0.846
Smoking status							
Current	1,120	74.1	(69.8–78.1)	1,109	64.0	(59.4–68.3)	0.864
Former	2,913	85.9	(84.4–87.3)	2,892	79.0	(77.0–80.8)	0.920
Never	4,150	82.2	(80.3–83.9)	4,110	72.9	(70.8–74.8)	0.887
Body Mass Index							
0–18.49 (underweight)	163	71.6	(60.3–80.6)	162	59.9	(47.7–71.0)	0.837
18.5–24.99 (normal weight)	3,458	81.9	(79.9–83.8)	3,428	74.4	(72.2–76.5)	0.908
25.0–29.99 (overweight)	2,567	86.5	(84.5–88.2)	2,548	78.5	(76.1–80.7)	0.908
30.0–higher (obese)	1,751	81.3	(77.8–84.4)	1,733	70.9	(67.3–74.2)	0.872
Gail model 5-year breast cancer risk score							
1.67% or greater risk	3,054	85.9	(83.9–87.6)	3,025	79.1	(77.0–81.1)	0.921
Less than 1.67% risk	5,148	80.6	(79.0–82.2)	5,105	71.0	(69.0–73.0)	0.881
Current health insurance							
Any private insurance	6,124	87.0	(85.7–88.2)	6,085	80.0	(78.6–81.4)	0.920
Public insurance only	1,602	75.8	(72.4–79.0)	1,574	62.7	(59.4–65.9)	0.827
Uninsured	479	54.5	(48.3–60.6)	474	40.3	(34.5–46.4)	0.739
Usual source of care							
Yes	7,800	84.6	(83.3–85.7)	7,730	76.2	(74.8–77.6)	0.901
None/ ER/urgent care clinic	395	45.8	(38.1–53.7)	395	32.8	(26.1–40.3)	0.716

[a] Excludes women who have had breast cancer and those whose most recent mammogram was because of a breast problem.

[b] Most recent mammogram was in past two years.

[c] Most recent mammogram in past two years and 3–11 mammograms in the past 6 years.

[d] 95% confidence interval.

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[e] Ratio of repeat to recent mammography.

Table 2

Estimates of Recent and Repeat Mammography, Women Aged 55–79,[a] 2005 California Health Interview Survey

Sample Characteristics	Recent mammography[b]			Repeat mammography[c]			Repeat/ Recent
	Sample Size	Wgtd %	(95% CI)[d]	Sample Size	Wgtd %	(95% CI)	Ratio[e]
Total	7,567	87.1	(85.9–88.2)	7,773	77.5	(76.1–78.8)	0.890
Age							
55–64	3,969	87.8	(86.2–89.3)	4,061	77.5	(75.5–79.3)	0.883
65–79	3,598	86.3	(84.6–87.7)	3,712	77.5	(75.6–79.2)	0.898
Education							
< High school graduate	761	81.2	(76.7–85.0)	794	66.9	(61.4–71.9)	0.824
High school graduate	1,851	86.6	(84.0–88.8)	1,906	78.2	(75.6–80.6)	0.903
Some college /vocational/ AA or AS degree	2,255	88.7	(86.8–90.4)	2,317	79.2	(76.7–81.5)	0.893
College graduate	2,700	89.6	(87.8–91.2)	2,756	81.3	(79.1–83.3)	0.907
Federal poverty level							
0–99% FPL	617	84.5	(79.8–88.2)	645	67.5	(61.4–73.1)	0.799
100–199% FPL	1,261	80.6	(76.9–83.8)	1,316	69.6	(65.4–73.4)	0.864
200–299% FPL	1,111	83.0	(79.5–86.1)	1,143	74.1	(70.0–77.7)	0.893
300% FPL and above	4,578	91.0	(89.9–92.0)	4,669	83.2	(81.7–84.6)	0.914
Race/ethnicity and English proficiency							
Non-Latina White	5,896	88.7	(87.5–89.8)	6,075	80.3	(78.9–81.7)	0.905
Non-Latina African American	347	88.5	(83.6–92.2)	349	82.8	(77.1–87.2)	0.936
American Indian/Alaska Native	94	78.8	(64.4–88.5)	98	67.0	(51.1–79.8)	0.850
Latina, some limit or proficient in English	284	83.6	(77.2–88.4)	286	73.8	(66.8–79.8)	0.883
Latina, no English proficiency	210	86.9	(80.2–91.5)	216	72.2	(64.0–79.2)	0.831
Asian, some limit or proficient in English	309	85.1	(79.0–89.7)	313	71.8	(64.3–78.2)	0.844
Asian, no English proficiency	245	73.9	(65.9–80.6)	253	56.9	(47.5–65.9)	0.770
Other race, single or multiple	170	88.6	(83.0–92.5)	171	78.1	(68.3–85.6)	0.881
Marital status							
Married / living with partner	3,632	89.5	(88.0–90.9)	3,698	79.7	(77.8–81.5)	0.891
Widowed / separated / divorced	3,465	84.3	(82.3–86.2)	3,594	74.5	(72.1–76.7)	0.884

Sample Characteristics	Recent mammography[b]			Repeat mammography[c]			Repeat/ Recent
	Sample Size	Wgtd %	(95% CI)[d]	Sample Size	Wgtd %	(95% CI)	Ratio[e]
Never married	470	81.5	(76.1–86.0)	481	75.7	(69.6–80.8)	0.929
Health status							
Excellent/Very Good/Good	5,828	88.8	(87.6–89.8)	5,984	79.6	(78.3–80.9)	0.896
Fair or Poor	1,739	82.7	(79.5–85.5)	1,789	71.8	(68.0–75.2)	0.868
Smoking status							
Current	870	79.3	(75.6–82.7)	902	67.1	(62.5–71.5)	0.846
Former	2,782	89.9	(87.9–91.5)	2,867	82.7	(80.4–84.8)	0.920
Never	3,915	87.0	(85.5–88.4)	4,004	76.5	(74.6–78.2)	0.879
Body Mass Index							
0–18.49 (underweight)	167	80.2	(69.3–87.9)	174	71.0	(58.5–81.1)	0.885
18.5–24.99 (normal weight)	3,326	86.8	(85.3–88.1)	3,425	76.5	(74.3–78.5)	0.881
25.0–29.99 (overweight)	2,362	87.6	(85.3–89.6)	2,428	78.4	(75.5–81.0)	0.895
30.0-higher (obese)	1,712	87.6	(85.4–89.6)	1,746	78.6	(75.8–81.2)	0.897
Gail model 5-year breast cancer risk score							
1.67% or greater risk	2,703	89.8	(88.2–91.2)	2,770	81.4	(79.2–83.4)	0.906
Less than 1.67% risk	4,860	85.9	(84.4–87.3)	4,999	75.7	(73.8–77.5)	0.881
Current health insurance							
Any private insurance	6,049	90.3	(89.3–91.3)	6,164	82.6	(81.1–83.9)	0.915
Public insurance only	1,122	80.0	(76.1–83.4)	1,171	67.1	(62.7–71.1)	0.839
Uninsured	396	66.9	(59.2–73.8)	438	44.9	(39.1–50.9)	0.671
Usual source of care							
Yes	7,268	88.7	(87.6–89.7)	7,429	79.7	(78.4–81.0)	0.899
None/ ER/urgent care clinic	299	55.2	(45.6–64.4)	344	34.0	(27.5–41.2)	0.616

[a] Excludes women who have had breast cancer and those whose most recent mammogram was because of a breast problem.

[b] Most recent mammogram was in past two years.

[c] Most recent mammogram in past two years and 3–11 mammograms in the past 6 years.

[d] 95% confidence interval.

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[e] Ratio of repeat to recent mammography.

Table 3

Adjusted Odds Ratios (AOR) for Correlates of Recent and Repeat Mammography, Women ages 55–79[a], 2001 California Health Interview Survey

Independent Variables:	Recent Mammography[b] AOR (95% CI)[d, e]	Repeat Mammography[c] AOR (95 % CI)
Age:		
55–64	Reference	Reference
65–79	**0.67 (0.54–0.82)**	**0.73 (0.60–0.89)**
Education:		
College graduate	Reference	Reference
Some college/vocational/AA or AS degree	0.87 (0.65–1.17)	*0.82 (0.66–1.04)*
High school graduate	0.88 (0.67–1.14)	**0.75 (0.60–0.95)**
<High school graduate	1.03 (0.71–1.51)	0.82 (0.59–1.14)
Federal poverty level:		
300% FPL and above	Reference	Reference
200–299% FPL	0.86 (0.68–1.07)	0.91 (0.75–1.11)
100–199% FPL	*0.80 (0.61–1.04)*	**0.76 (0.61–0.94)**
0–99% FPL	0.78 (0.56–1.09)	**0.67 (0.52–0.88)**
Race/ethnicity and English proficiency:		
Non-Latina White	Reference	Reference
Non-Latina African American	**1.56 (1.01–2.41)**	1.26 (0.90–1.77)
American Indian/Alaska Native	0.78 (0.39–1.57)	0.91 (0.44–1.89)
Latina, some limit or proficient in English	0.74 (0.49–1.11)	0.95 (0.63–1.44)
Latina, no English proficiency	1.05 (0.64–1.71)	0.91 (0.58–1.42)
Asian, some limit or proficient in English	0.70 (0.44–1.11)	*0.68 (0.46–1.02)*
Asian, no English proficiency	**0.51 (0.30–0.88)**	**0.57 (0.38–0.87)**
Other race, single or multiple	1.12 (0.52–2.38)	1.08 (0.60–1.97)
Marital status		
Married/living with partner	Reference	Reference
Widowed/separated/divorced	**0.81 (0.66–1.00)**	*0.85 (0.71–1.03)*
Never married	**0.61 (0.38–0.97)**	**0.64 (0.42–0.97)**
Health status:		
Excellent/ Very Good/Good	Reference	Reference
Fair or poor	0.97 (0.79–1.19)	0.98 (0.80–1.19)
Smoking status:		
Never	Reference	Reference
Former	0.96 (0.79–1.18)	1.04 (0.89–1.21)
Current	**0.54 (0.41–0.71)**	**0.58 (0.45–0.74)**
Body Mass Index (BMI):		
18.5–24.99 (normal weight)	Reference	Reference
0–18.49 (underweight)	0.67 (0.39–1.15)	*0.58 (0.34–1.01)*

Independent Variables:	**Recent Mammography[b]**	**Repeat Mammography[c]**
	AOR (95% CI)[d, e]	**AOR (95 % CI)**
25.0–29.99 (overweight)	**1.31 (1.0–1.65)**	1.18 (0.96–1.44)
30.0-higher (obese)	0.92 (0.67–1.27)	0.84 (0.65–1.07)
Gail Model 5-year breast cancer risk score:		
1.67% or greater risk	Reference	Reference
Less than 1.67% risk	**0.76 (0.61–0.96)**	**0.78 (0.64–0.95)**
Current health insurance:		
Any private insurance	Reference	Reference
Public insurance only	**0.65 (0.51–0.84)**	**0.67 (0.53–0.84)**
Uninsured	**0.30 (0.21–0.42)**	**0.31 (0.22–0.42)**
Usual source of care:		
Yes	Reference	Reference
None/ER/urgent care clinic	**0.23 (0.16–0.33)**	**0.23 (0.16–0.33)**

[a] Excludes women who have had breast cancer and those whose most recent mammogram was because of a breast problem.

[b] Most recent mammogram was in past two years.

[c] Most recent mammogram in past two years and 3–11 mammograms in past 6 years.

[d] AOR (95% CI): Adjusted odds ratio and 95% confidence interval.

[e] Boldface entries indicate statistical significance at $p < .05$; italics indicate $p < .10$.

Table 4

Adjusted Odds Ratios (AOR) for Correlates of Recent and Repeat Mammography, Women ages 55–79[a], 2005 California Health Interview Survey

Independent Variables:	Recent Mammography[b] AOR (95% CI)[d,e]	Repeat Mammography[c] AOR (95 % CI)
Age:		
55–64	Reference	Reference
65–79	*0.84 (0.68–1.03)*	0.97 (0.82–1.15)
Education:		
College graduate	Reference	Reference
Some college/vocational school/AA or AS degree	0.98 (0.71–1.37)	0.92 (0.71–1.18)
High school graduate	0.95 (0.67–1.34)	1.01 (0.80–1.27)
<High school	0.76 (0.49–1.18)	*0.71 (0.48–1.06)*
Federal poverty level:		
300% FPL and above	Reference	Reference
200–299% FPL	**0.66 (0.50–0.88)**	**0.71 (0.56–0.91)**
100–199% FPL	0.82 (0.59–1.13)	0.81 (0.62–1.05)
0–99% FPL	1.29 (0.84–1.97)	0.85 (0.59–1.23)
Race/ethnicity and English proficiency:		
Non-Latina White	Reference	Reference
Non-Latina African American	1.45 (0.91–2.29)	**1.76 (1.18–2.61)**
American Indian/Alaska Native	0.68 (0.30–1.50)	0.67 (0.34–1.35)
Latina, some limit or proficient in English	0.89 (0.56–1.43)	1.00 (0.68–1.47)
Latina, no English proficiency	**2.15 (1.24–3.70)**	**1.80 (1.17–2.77)**
Asian, some limit or proficient in English	0.67 (0.40–1.11)	**0.61 (0.40–0.92)**
Asian, no English proficiency	**0.54 (0.33–0.87)**	**0.55 (0.35–0.87)**
Other race, single or multiple	1.49 (0.81–2.73)	1.30 (0.79–2.13)
Marital status:		
Married/living with partner	Reference	Reference
Widowed/separated/divorced	**0.68 (0.54–0.87)**	**0.82 (0.67–1.00)**
Never married	**0.57 (0.36–0.88)**	0.92 (0.64–1.33)
Health status:		
Excellent/Very Good/Good	Reference	Reference
Fair or poor	*0.79 (0.61–1.03)*	0.92 (0.73–1.17)
Smoking status:		
Never	Reference	Reference
Former	1.18 (0.92–1.50)	**1.27 (1.05–1.55)**
Current	**0.59 (0.46–0.76)**	**0.65 (0.50–0.84)**
Body Mass Index (BMI):		

Independent Variables:	**Recent Mammography[b]** **AOR (95% CI)[d,e]**	**Repeat Mammography[c]** **AOR (95 % CI)**
18.5–24.99 (normal weight)	Reference	Reference
0–18.49 (underweight)	0.97 (0.56–1.68)	1.11 (0.60–2.05)
25.0–29.99 (overweight)	1.00 (0.79–1.27)	1.02 (0.82–1.28)
30.0-higher (obese)	1.02 (0.81–1.29)	1.07 (0.84–1.35)
Gail Model 5-year breast cancer risk score:		
1.67% or greater risk	Reference	Reference
Less than 1.67% risk	**0.72 (0.58–0.89)**	**0.76 (0.63–0.93)**
Current health insurance:		
Any private insurance	Reference	Reference
Public insurance only	**0.59 (0.43–0.80)**	**0.58 (0.44–0.77)**
Uninsured	**0.39 (0.25–0.61)**	**0.33 (0.23–0.48)**
Usual source of care:		
Yes	Reference	Reference
None/ER/urgent care clinic	**0.22 (0.14–0.34)**	**0.19 (0.14–0.28)**

[a] Excludes women who have had breast cancer and those whose most recent mammogram was because of a breast problem.

[b] Most recent mammogram was in past two years.

[c] Most recent mammogram in past two years and 3–11 mammograms in past 6 years.

[d] AOR (95% CI): Adjusted odds ratio and 95% confidence interval.

[e] Boldface entries indicate statistical significance at p >.05; italics indicate p >.10.