Correlates of Repeat and Recent Mammography for Women Ages 45 to 75 in the 2002 to 2003 Health Information National Trends Survey (HINTS 2003)

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Abstract

Background: **Most national-level mammography data are for ever-had and most-recent screening. There are few national-level data on rates of repeat, on-schedule mammography, and on the prevalence and correlates of repeat mammography. It is also important to investigate the similarity of correlates for repeat and recent mammography.**

Methods: **Analyses were from data for women ages 45 to 75 in the 2002 to 2003 Health Information and National Trends Survey (HINTS 2003; *N* = 1,581). The two dependent variables were self-report of repeat mammography (two exams on schedule, based on an every-other-year interval) and recent mammography only (one mammogram within the past 2 years).**

Results: **The prevalence of recent mammography was 81.6% (95% confidence interval, 79.1-84.1) and for repeat mammography was 72.2% (95% confidence interval, 69.0-75.4). An access to care variable combining insurance coverage and regular source of care was the strongest sociodemographic correlate of both mammography indicators. Most other sociodemographic variables were not associated with mammography status. Five psychosocial/behavioral variables were associated with both mammography indicators (smoking status, attention to health information, knowledge of screening interval, worry about breast cancer, and recent mood status). Correlates were very similar for repeat and recent mammography.**

Conclusions: **Although access to care had the strongest association with mammography, psychosocial and behavioral variables did better as a group than the sociodemographic variables. A standard set of such variables should be considered for all national surveys.** (Cancer Epidemiol Biomarkers Prev 2006;15(11):2093–101)

Introduction

From a population-level perspective, the greatest benefits of mammography for mortality and morbidity reduction are likely to come from regular exams, paired with appropriate and timely follow-up treatments if cancer is found (1). Rates of mammography are routinely tracked in population-level surveys, such as the National Health Interview Survey and the Behavioral Risk Factor Surveillance System. High rates of *regular* screening directly depends upon high rates of *recent* mammography at any point of assessment. It is women with recent on-schedule mammograms who can then go on to adopt regular usage. One of the success stories of breast cancer screening is that a foundation for achieving high rates of repeat mammography now exists. For example, in the 2002 Behavioral Risk Factor Surveillance System, 90.7% of women ages 42 to 75 reported ever having mammograms, and of those, 77.5% reported having one in the past 2 years (calculated for this report from the public use data set: http://www.cdc.gov/brfss/technical_infodata/surveydata/2002.htm).

The increase in rates of recent mammography has been well-documented, but there are fewer data from national samples on the prevalence of repeat mammography. A review of repeat mammography (2) calculated a weighted average of 53.2% [95% confidence interval (95% CI), 44.7-61.8%], based on 11 published reports with data collected between 1995 and 2001. However, none of these studies used national- or state-level probability samples, there were differences in methodology, and the sampling frames varied across studies. Thus, estimates ranged from as low as 28% (3, 4) to as high as 92% (5). Studies since that review continue to report varying rates of repeat mammography, even when there were different subgroups examined in a single report: 45% and 49% (6); 67% and 74% (7); 73.4% (8); 29.9% and 35.8% (9); a range of 33% to 67.5% across six samples (10); 72.4% and 81.5% (11); 41% (12); 41.4% (13); 16%, 42%, and 63% (14); 79.8% (15); and 44% and 65% (16). The differences among these rates both within and between studies are due to their different samples and sampling frames, which are often local; the definitions of repeat mammography, including different intervals allowed between exams; and sometimes long elapsed times between when data were collected and when publication occurred, which does not account for secular trends during the elapsed time before publication. A national-level analysis of the Year 2000 Cancer Control Module to the 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. There is a need for additional population-level data that estimate the percentage of women who are obtaining successive, on-schedule mammograms, which we refer to here as repeat mammograms.

In addition to information about the prevalence of repeat mammography, more information is needed about the cross-sectional correlates and longitudinal predictors of repeat mammography. Previous studies have examined a wide range of correlates of repeat mammography, but often with little overlap of their respective sets of variables. For example, Barr

Received 4/17/06; revised 8/9/06; accepted 8/25/06.

Grant support: NIH grants K05-CA90485 (W. Rakowski), R01-CA76330 (S.W. Vernon), and R01-CA97263 (S.W. Vernon), R01-CA105486 (B. Rimer), and K07-CA87070 (M.A. Clark).

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doi:10.1158/1055-9965.EPI-06-0301

et al. (18) and Burns et al. (19) examined primarily health system correlates (e.g., type of insurance, primary care visits, and gynecologic visits) and had few sociodemographic and psychosocial/behavioral variables in their analyses. In contrast, Yood et al. (20), Henderson and Schenck (21), Sabogal et al. (22), Quinley et al.(7), and Blanchard et al. (14) used largely sociodemographic and health system–related variables. Other studies used a broader range of variables as covariates, including knowledge, risk perceptions, health-related attitudes and opinions, smoking status, acculturation, and family/social network variables [e.g., Halabi et al. (23), Rimer et al. (24), Otero-Sabogal et al. (25), Rakowski et al. (17), Taylor et al. (26), Lerman et al. (27), Messina et al. (28), Miller and Champion (29), Rauscher et al. (30), Somkin et al. (31), and Rosenberg et al. (15)].

This article examines the correlates of repeat mammography in a national sample of women ages 45 to 75 and includes recent mammography to compare their correlates. The source of data is the 2002 to 2003 Health Information National Trends Survey (HINTS 2003), which was sponsored by the National Cancer Institute (32). HINTS 2003 items assessed not only standard sociodemographic variables and most recent mammogram but also asked questions about the next-most-recent mammogram as well as a broad range of topics, including attention to sources of health information, trust in sources of information, cancer-related risk behaviors, future intention for screening, and other psychosocial variables. HINTS 2003, therefore, provided a larger pool of potential correlates than has been available in other population-level surveys, such as the National Health Interview Survey and the Behavioral Risk Factor Surveillance System.

The availability of information-seeking questions allowed investigation of concepts relevant to some theories of health behavior. The Elaboration Likelihood Model (33), the Precaution Adoption Process Model (34), the Cognitive-Social Health Information Processing Model (35), and the Preventive Health Model (36) each specify that the perceived personal relevance or salience of health information influences decision-making. We therefore expected that women who did not attend to sources of health information would have lower rates of recent and repeat mammography. We also expected that women who reported lack of trust in sources of health information would have lower rates of mammography. Our assumption was that women who did not attend to information sources and who did not trust information sources would be less likely to obtain information and therefore also less be likely to perceive the personal relevance of the need for early detection.

Materials and Methods

Sample. Data for this report are for women ages 45 to 75 with no personal history of breast cancer (N = 1,581) from HINTS 2003. HINTS 2003 was a nationally representative, random-digit dial telephone survey conducted between October 2002 and April 2003 by the National Cancer Institute. The development and methodology of the survey have been described elsewhere (32). Adults ages ≥18 years in the United States were interviewed in English or Spanish, with an oversampling of African Americans and Hispanics. The response rate was 55% for the initial screening interview to determine presence of an eligible individual in the household; among eligible households, the HINTS 2003 interview rate was 62.8%, as calculated according to guidelines of the American Association for Public Opinion Research (37). The multiplicative product of these percentages yielded a final response rate of 35.4%.

Age 45 was used as the lower boundary for these analyses because an every-other-year interval for mammography requires sufficient time for women over age 40 to have two consecutive exams. An upper age boundary was used because mammography guidelines are not definitive for all women over age 75 (38, 39).

Dependent Variable: Mammography Status. *Note:* Here, and below when discussing the behavioral and psychosocial variables, the article cites question numbers in the HINTS 2003 interview to facilitate identifying questions used in this report (see web site: http://cancercontrol.cancer.gov/hints/instrument.jsp).

Mammography status was based on self-report answers to three questions. The first question asked for ever-had mammography status (item BC-5). For those who ever had, the next question asked about timing of the most recent mammogram (item BC-6: ''When did you have your most recent mammogram to check for breast cancer?''). Response categories were preset in the HINTS: ≤1 year, >1 year but <2 years, >2 years but <5 years, >5 years. The third question asked for timing of the next-most-recent mammogram (item BC-8: ''You said your most recent mammogram was «*time frame inserted by interview software*». How long before that mammogram was the last one?''). The preset response categories were as follows: ≤1 year, >1 year but <2 years, >2 years but <5 years, >5 years, none before most recent.

On-schedule *recent* mammography was defined as reporting a mammogram within the 2 years before the HINTS 2003 interview. All other women, including those who said they did not know or refused to answer, were classified as not having a recent on-schedule mammogram.

On-schedule *repeat* mammography was defined as reporting a most recent exam within the previous 2 years *and* a next most recent exam within the 2 years before that. All other women, including those who did not know or refused, were classified as not having repeat on-schedule mammography. Repeat mammography is, therefore, a subset of recent mammography.

Potential Correlates of Mammography. Table 1 shows the variables that were used in the analyses to identify correlates of repeat and recent mammography. Table 1 also shows the categories for each potential correlate variable, along with their unweighted sample sizes; the category of each variable that was the reference group for the multiple logistic regression analyses; the weighted, univariate associations of each variable's categories with both repeat and recent mammography; and the results of logistic regression analyses as discussed below.

Sociodemographic Variables and Personal/Family Cancer Diagnosis. Variables assessing sociodemographic status were access to health care, age, income, race/ethnicity, marital status, and education. In addition, variables were created for two cancer history statuses: family history of any cancer and personal history of cancer other than breast cancer.

To create the indicator for access to health care, insurance status was cross-classified with usual source of care to produce a three-category variable: insured with a usual source of care, insured but reported no usual source of care, and not insured. The two groups of insured women were intended to distinguish women who had both resources for access to care versus those with insurance only. The uninsured group was not large enough to allow separating those with and without a usual source of care.

For race/ethnicity, there were not sufficient numbers of Asian Americans or Native Americans to allow retaining separate classifications; thus, a combined ''All other, non-Hispanic'' group was used.

Psychosocial and Behavioral Variables. HINTS 2003 did not ask the same set of questions about each domain of cancer screening. Thus, some of the variables in this general category of correlates were specific to breast cancer, others had reference to cancer in general, and others referred to health behaviors in general (not specific to cancer).

Smoking status was included as a behavioral covariate (items TU-1 and TU-2) and coded as Never, Former, Current. A four-category mood status indicator was created from two questions: one that asked about past month mood status and the other about the degree to which any such unfavorable mood interfered with one's daily life (items HS-2 and HS-3).

A composite variable was created pertinent to gathering health information in general, based on a series of questions that assessed whether or not participants paid attention to health information from a variety of sources: television, radio, newspapers, magazines, and the Internet (item HC-8). This composite variable was coded to reflect the number of sources to which women said they paid ''no attention at all.'' A second variable, also a composite, was created from a question that asked about the degree of trust in sources of health information about cancer in general: doctor/health care professional, family/friends, newspapers, magazines, radio, Internet, television (item HC-18). This variable was coded based on the number of sources women said they ''did not trust at all.'' These two variables were coded based on negative responses because we hypothesized that women who expressed no attention and/or no trust across several response options would be less likely to obtain mammograms, as noted above.

A question asked about the interval between mammograms that was perceived to be necessary (item BC-14). Categories were as follows: more often than yearly, every 1 to 2 years, and other intervals (i.e., ≥3 years, only when a problem exists, when a doctor says so, and that it depends on one's age). The category of ''More often than yearly'' was kept separate because although it differs from current guidelines, its frequency is in the opposite direction from responses placed in the ''Other'' category that implied a less regular interval or testing based on a particular situation.

Two variables were risk perceptions specifically about breast cancer. The question asked about the degree of the woman's worry about developing breast cancer (item BC-3). The other question asked about perceptions of risk of developing breast cancer compared with other women (item BC-2).

Another variable was based on an open-ended question asking participants if they wanted to change anything in their lifestyle to lower their personal risk of cancer in general. Wording was therefore not specific to breast cancer (item CK-10), and there were 18 pre-established options for check-off, along with ''Other'' and an option for doing nothing. Coding was dichotomized as not wanting to do anything, versus making any type of lifestyle change, including but not restricted to obtaining mammography. Our intention when using this question was to identify women not wanting to make any changes at all.

Finally, a knowledge-based variable was derived from a question that asked about the leading cause of deaths due to cancer (item CK-15). Lung cancer was set as the reference group because it is the major cause of cancer deaths among women.

Analysis Plan. Data were analyzed with SAS version 8.2 (2001; SAS Institute, Inc., Cary, NC), and SAS-callable SUDAAN version 8.0 (2001; Research Triangle Institute, Research Triangle Park, NC) was used to account for the complex survey design and to obtain variance estimates in the logistic regression analyses.

Before conducting logistic regressions, all bivariate associations were examined among the potential correlates, to guard against collinearity. The variables used in these analyses were not collinear. Two multiple logistic regressions were conducted. One analysis used repeat mammography as the dependent variable; the second used recent mammography. The results for both analyses are shown in Table 1 (see ''Repeat Mammography'' and ''Recent Mammography''). All of the potential correlate variables described above were used in the analyses. There was no evidence of collinearity that would prohibit using them simultaneously.

Results

Prevalence Estimates of Mammography. The prevalence estimates for the two dependent variables were recent mammography, 81.6% (95% CI, 79.1-84.1) and repeat mammography, 72.2% (95% CI, 69.0-75.4). These two estimates mean that 88.5% of women with a recent mammogram also reported a prior on-schedule mammogram (the ratio of 72.2%/81.6%). A χ^2 test showed that the association was statistically significant ($\chi^2 = 340.00$; degree of freedom, 1; $P < 0.0001$).

Logistic Regression Analyses

Repeat Mammography: Sociodemographics and Personal/Family Cancer Diagnosis. The strongest association among the sociodemographic variables was for the composite measure of access to care (health insurance/source of care). Uninsured women were less likely to report repeat mammography [adjusted odds ratio (OR), 0.22; 95% CI, 0.14-0.36]. However, even women with insurance but without a usual source of care were less likely to report repeat mammography than were women with both resources (adjusted OR, 0.31; 95% CI, 0.21-0.47).

For income, compared with incomes of US$50,000 or more, women with incomes of US$20,000 to US$35,000 had lower repeat mammography. There was also a trend for women with incomes less than US$20,000 to have lower repeat mammography. For age status, women ages 45 to 54 had lower repeat mammography than women ages 55 to 64.

Repeat mammography was not statistically associated with race/ethnicity, marital status, education, family history of cancer, or personal history of cancer other than breast cancer.

Recent Mammography: Sociodemographics and Personal/Family Cancer Diagnosis. Similar to repeat mammography, uninsured women had substantially lower recent mammography (adjusted OR, 0.27; 95% CI, 0.14-0.53). In addition, women with insurance but without a usual source of care were again less likely to report recent mammography than women with both resources (adjusted OR, 0.30; 95% CI, 0.18-0.48).

Compared with women with incomes of US$50,000 or more, women with incomes less than US$20,000 and women with incomes between US$20,000 and US$35,000 had lower recent mammography. For race/ethnicity, Black non-Hispanic women had a higher adjusted odds of recent mammography compared with White non-Hispanic women.

There were no significant associations between recent mammography and the same four variables that were also not associated with repeat mammography: marital status, education, family history of breast cancer, and personal history of cancer other than breast cancer. Younger age was associated with repeat but not recent mammography, whereas race/ethnicity (Black, non-Hispanic women) was associated with recent but not repeat mammography.

Repeat Mammography: Psychosocial and Behavioral Variables. Five psychosocial and behavioral variables had significant associations with repeat mammography. Current smokers reported lower repeat mammography than never smokers (adjusted OR, 0.49; 95% CI, 0.34-0.71).

Women who said their mood status interfered ''somewhat'' or ''a lot'' with daily activities tended to report lower repeat mammography rates. Women who said they paid ''no attention'' to either two to three or four to five sources of health information were also less likely to report repeat mammography.

Table 1. Univariate and multivariate results of the association between potential correlate variables and mammography

Potential Correlates (unweighted *n* and weighted percents, per coding category)	Repeat mammography		Recent mammography	
	Weighted mammography %	Adjusted OR (95% CI)	Weighted mammography %	Adjusted OR (95% CI)
A. Sociodemographic variables and family/personal cancer diagnosis				
Insurance and usual source of care				
Insured/usual source of care (*n* = 1,196, 75.0%)	79.9	Reference	87.5	Reference
Insured/no usual source of care (*n* = 236, 15.4%)	54.5	0.31 (0.21-0.47)	67.0	0.30 (0.18-0.48)
No insurance (*n* = 149, 9.6%)	41.0	0.22 (0.14-0.36)	59.4	0.27 (0.14-0.53)
Income				
US$50,000 or more (*n* = 493, 33.5%)	81.5	Reference	89.4	Reference
US$35,000 to less than US$50,000 (*n* = 223, 14.4%)	75.3	0.89 (0.46-1.73)	85.4	0.86 (0.40-1.84)
US$20,000 to less than US$35,000 (*n* = 355, 21.0%)	69.5	0.58 (0.35-0.96)	79.8	0.47 (0.24-0.92)
Less than US$20,000 (*n* = 319, 18.2%)	60.5	0.57 (0.31-1.06)	69.1	0.31 (0.16-0.60)
Do not know/refused (*n* = 191, 12.9%)	65.8	0.56 (0.32-0.98)	77.9	0.48 (0.25-0.93)
Age (y)				
55-64 (*n* = 498, 29.8%)	77.5	Reference	83.6	Reference
45-54 (*n* = 675, 45.7%)	66.8	0.53 (0.37-0.77)	79.4	0.71 (0.43-1.16)
65-75 (*n* = 408, 24.4%)	76.0	1.07 (0.64-1.79)	83.4	1.30 (0.79-2.13)
Race/ethnicity				
White, non-Hispanic (*n* = 1,150, 76.1%)	74.3	Reference	82.8	Reference
Black, non-Hispanic (*n* = 188, 10.7%)	67.7	1.58 (0.88-2.82)	82.8	2.60 (1.32-5.12)
Hispanic (*n* = 162, 8.0%)	65.5	1.37 (0.76-2.46)	74.6	1.16 (0.62-2.19)
All other, non-Hispanic (*n* = 81, 5.3%)	61.8	0.87 (0.42-1.84)	72.6	0.83 (0.35-1.95)
Marital status				
Married/with partner (*n* = 863, 66.4%)	76.7	Reference	85.1	Reference
Divorced/separated (*n* = 380, 17.7%)	59.8	0.80 (0.51-1.26)	73.0	0.90 (0.48-1.68)
Widowed (*n* = 230, 10.9%)	68.8	1.02 (0.57-1.83)	79.4	1.09 (0.55-2.16)
Never married (*n* = 108, 4.9%)	63.7	0.66 (0.27-1.65)	70.3	0.52 (0.20-1.35)
Education				
College graduate (*n* = 449, 22.4%)	78.3	Reference	85.7	Reference
Some college/technical school (*n* = 421, 24.5%)	75.5	1.04 (0.63-1.71)	82.6	0.93 (0.55-1.58)
High school graduate (*n* = 505, 35.7%)	72.3	1.01 (0.64-1.58)	82.0	1.06 (0.65-1.72)
Some high school or less (*n* = 206, 17.5%)	59.6	0.71 (0.36-1.40)	74.2	0.99 (0.47-2.09)
Family history of breast cancer				
Family history exists (*n* = 1,131, 73.4%)	71.7	Reference	81.8	Reference
No family history (*n* = 450, 26.6%)	73.6	1.05 (0.72-1.54)	81.1	0.78 (0.51-1.20)
Ever diagnosed with cancer (not breast)				
Never diagnosed (*n* = 1,367, 85.6%)	71.9	Reference	81.4	Reference
Diagnosed (*n* = 214, 14.4%)	74.1	1.04 (0.66-1.64)	82.7	0.95 (0.55-1.63)
B. Psychosocial and behavioral variables				
Smoking status				
Never (*n* = 27,024, 53.6%)	76.1	Reference	84.8	Reference
Current (*n* = 9,687, 17.2%)	57.0	0.49 (0.34-0.71)	71.2	0.52 (0.35-0.78)
Former (*n* = 15,623, 29.2%)	74.0	0.89 (0.60-1.33)	82.2	0.83 (0.50-1.38)
Interference of mood with daily activities				
Does not interfere at all (*n* = 1,039, 66.5%)	75.9	Reference	83.9	Reference
Interferes a little (*n* = 204, 14.4%)	71.5	0.83 (0.54-1.27)	83.3	0.99 (0.58-1.67)
Interferes somewhat (*n* = 168, 11.4%)	62.0	0.47 (0.29-0.75)	70.2	0.40 (0.22-0.75)
Interferes a lot (*n* = 111, 7.8%)	56.3	0.60 (0.36-1.00)	74.6	0.84 (0.48-1.45)
No attention at all to information sources				
0-1 area (*n* = 963, 60.0%)	77.9	Reference	84.4	Reference
2-3 areas (*n* = 523, 31.7%)	66.8	0.66 (0.44-0.98)	80.0	1.03 (0.63-1.70)
4-5 areas (*n* = 95, 6.3%)	47.6	0.31 (0.16-0.60)	63.9	0.49 (0.24-0.99)
Interval for having mammograms				
Every 1-2 y (*n* = 1,185, 74.4%)	77.2	Reference	85.1	Reference
More than once a year (*n* = 95, 6.3%)	65.9	0.74 (0.35-1.56)	81.8	1.16 (0.39-3.39)
Other intervals/situations (*n* = 301, 19.3%)	54.9	0.36 (0.25-0.50)	68.0	0.40 (0.27-0.60)
Worry about developing breast cancer				
Sometimes worries (*n* = 534, 34.7%)	80.9	Reference	86.8	Reference
Rarely/never worries (*n* = 914, 57.1%)	66.7	0.48 (0.35-0.67)	77.9	0.56 (0.39-0.81)
All the time/often worries (*n* = 133, 8.2%)	74.2	0.87 (0.49-1.55)	85.8	1.04 (0.52-2.07)
No. of information sources not trusted at all				
0 sources (*n* = 877, 55.2%)	74.8	Reference	85.2	Reference
1-2 sources (*n* = 530, 33.5%)	71.0	1.02 (0.72-1.46)	79.2	0.79 (0.51-1.22)
3-7 sources (*n* = 174, 11.4%)	63.1	1.28 (0.69-2.35)	71.3	0.81 (0.41-1.59)
Perceived comparative risk of breast cancer				
More likely (*n* = 212, 14.5%)	76.9	Reference	85.8	Reference
Less likely (*n* = 566, 34.6%)	68.4	0.63 (0.37-1.08)	77.2	0.61 (0.35-1.07)
About as likely (*n* = 726, 46.0%)	74.1	0.68 (0.42-1.10)	83.6	0.74 (0.40-1.38)
Do not know/refused (*n* = 77, 4.9%)	67.6	0.44 (0.18-1.08)	81.5	0.61 (0.22-1.68)
Lifestyle change to reduce personal cancer risk				
Mammography or other ways (*n* = 783, 48.4%)	72.6	Reference	82.9	Reference
Wants to change nothing/do not know (*n* = 798, 51.6%)	71.8	1.07 (0.78-1.47)	80.5	0.99 (0.68-1.46)

(*Continued on the following page*)

Table 1. Univariate and multivariate results of the association between potential correlate variables and mammography (Cont'd)

Potential Correlates (unweighted *n* and weighted percents, per coding category)	Repeat mammography		Recent mammography	
	Weighted mammography %	Adjusted OR (95% CI)	Weighted mammography %	Adjusted OR (95% CI)
Perceived cause of most cancer deaths				
Lung cancer (*n* = 350, 20.8%)	73.8	Reference	82.4	Reference
Breast cancer (*n* = 847, 54.4%)	73.7	1.03 (0.70-1.52)	82.0	1.04 (0.70-1.55)
Colon cancer (*n* = 108, 6.7%)	70.0	1.10 (0.51-2.35)	78.4	0.97 (0.47-2.00)
Cervical cancer (*n* = 185, 11.9%)	71.8	1.05 (0.61-1.80)	85.9	1.75 (0.81-3.81)
Skin cancer/do not know/refused (*n* = 91, 6.2%)	57.0	0.69 (0.33-1.43)	70.9	0.76 (0.35-1.65)

Women who gave ''other intervals'' (i.e., longer than 2 years or irregular) when asked about the appropriate interval between mammograms had a lower repeat rate compared with those who reported ''Every 1-2 years.'' Finally, women who said they ''rarely/never worry'' about breast cancer were less likely to have repeat mammography than women who said they ''sometimes worry.''

There were no statistically significant associations for four psychosocial and behavioral variables: trusting information sources about cancer, wanting to change behavior to reduce personal cancer risk, report of which cancer causes greater mortality, and perceived risk compared with other women.

Recent Mammography: Psychosocial and Behavioral Variables. Results were similar to those for repeat mammography. Current smokers had lower recent mammography than never smokers (adjusted OR, 0.52; 95% CI, 0.35-0.78). Women who said their recent mood interfered ''somewhat'' with daily activities had a lower mammography rate. Women who said they paid ''no attention'' to four to five sources of health information were also less likely to report recent mammography.

Women who gave ''other intervals'' for the interval between mammograms had lower recent mammography. Finally, women who said they ''rarely/never worry'' about breast cancer were less likely to report recent mammography than women who said they ''sometimes worry.''

The same four psychosocial/behavioral variables that were not associated with repeat mammography were also not associated with recent mammography.

Discussion

The percentages of repeat and recent on-schedule mammography were 72.2% and 81.6%, respectively. These rates used a 2-year interval and thus are higher than would be obtained if a 1-year interval were used. Because these rates are based on the same respondents, 88.5% of women who reported a recent mammogram also reported having a prior mammogram on schedule. This finding of high correspondence of recent and repeat mammography is consistent with some other reports. A review of data on repeat mammography found that in studies whose participants had an on-schedule recent mammogram, at least 70% went on to obtain subsequent on-schedule exams (2). A report by Blanchard et al. (14) also found that having a prior on-schedule mammogram was associated with a higher rate of repeat screening than for women without one on record. On the one hand, past behavior is generally a strong predictor of future behavior. On the other hand, high rates are not guaranteed. Otero-Sabogal et al. (6) found repeat screening rates of 45% and 49% for low-income women in California even with prior mammograms, suggesting that lower income may be a factor in local samples, even if it is not as clearly associated with mammography in national-level samples. Partin et al. (40) cautioned about the possible discrepancy of prevalence estimates of repeat screening calculated from administrative databases versus surveys of study participants. More data are needed on repeat mammography rates for women with baseline ''recent'' mammograms, examining differences not only by sociodemographic characteristics among persons in a single sample but also comparing rates from different sources of data for the same persons.

The variable that indicated access to health care, by combining health insurance and having a regular source of care, had strong associations with both repeat and recent mammography. The main reason why uninsured women would have the lowest mammography rates is clear; insurance is a major source of payment for most mammograms in the United States. In addition, lack of insurance limits contact with health care providers, so that a provider recommendation for mammography is less likely. An equally important result of this study, therefore, is that women who reported having health insurance but *no* regular source of care also had lower recent and repeat mammography rates compared with women who had both resources. Having insurance is not enough; having a regular source of health care is another of the strongest factors influencing obtaining a mammogram. The repeat and recent mammography percentages for insured women without a regular source of care were closer to those for uninsured women than for insured women with a source of care. These findings are consistent with other studies that have shown that having a regular source of health care increases the use of mammography and other preventive screening services (41, 42).

Except for the access to care variable, and income status of US$35,000 or less, the sociodemographic variables did not have consistent significant associations with both repeat and recent mammography. The relatively few significant associations for several sociodemographic variables may be due in part to the progressive increase in mammography rates through the 1990s to the present. That is, as mammography rates have increased, the initial disparities across categories of many sociodemographic variables have tended to converge at least to a moderate degree in national-level, self-report survey data. In turn, this convergence means that differences between the subcategories and their respective reference groups also tend to decrease, so that fewer sociodemographic variables are likely to yield significant results in typical main-effects logistic regression analyses that adjust for other covariates. In fact, adjusted analyses may even show that racial/ethnic minorities have an advantage over White women (43), which occurred in one instance in these data for non-Hispanic Black women and recent mammography. This is an empirically complicated issue that would benefit from more specific attention in cancer control research. Even with these caveats, however, women without health insurance, women with insurance but without a regular source of care, and women with lower income continue to deserve attention for intervention to improve rates of mammography.

The apparently minimal associations for several sociodemographic variables may also be partly an artifact of the methodology of national-level data sets, such as the HINTS, the National Health Interview Survey, and the Behavioral Risk Factor Surveillance System, that are based on samples who agree to respond to a survey. Larger disparities in screening rates might be found in national-level samples if potential selection biases due to nonresponse could be eliminated (44). That is, possible selection effects on screening prevalence estimates would decrease if response rates increased because the ''denominator'' of persons in the sample would better represent the intended population. In addition, national surveys are not designed to study screening rates in specific localities or in particular population groups. Data may show that disparities in mammography use are still large in specific locales that cannot be sampled in sufficient numbers in most state- and national-level surveys.

Five psychosocial and behavioral variables had consistent associations with both lower repeat and recent mammography: current smokers, women who said they paid no attention to four to five of the information sources listed, women who rarely/never worry about breast cancer, and women who said anything longer or less regular than a 1- to 2-year screening interval. For mood status, women who said their mood status interfered ''somewhat'' with their lives had lower repeat and recent mammography, and women saying that mood interfered ''a lot'' had lower repeat mammography. The results from this analysis of HINTS 2003, therefore, suggest the importance of continuing to augment traditional sociodemographic indicators in national-level surveys with information about psychosocial and behavioral variables, although national-level screening rates continue to increase. The similarity of associations for both dependent variables is not surprising, given the fact that the large majority of women with a recent mammogram also reported an on-schedule, next-most-recent mammogram. It may be helpful to develop a brief module of such questions that could be used in large surveys. Because of this, most women had a similar classification on the repeat and the recent mammography dependent variables. Thus, it seems that the same variables that would help optimize rates of recent mammography will also help achieve high rates of repeat mammography.

Results for the variable of ''paying no attention'' to sources of health information are worth noting because paying attention to information is a central factor in conceptual models of health behavior, such as the Elaboration Likelihood Model (33), the Precaution Adoption Process Model (34), the Cognitive-Social Health Information Processing Model (35), and the Preventive Health Model (36). This result has implications for strategies aimed at increasing mammography use among women who are not on schedule for screening. That is, traditional channels used to convey health information may not reach women who do not normally scan the media. It is also important to understand why women say they pay no attention because intervention could address such reasons. Women who reported never having a mammogram and those with no recent mammogram may be more influenced by interpersonal sources of communication that use a proactive or outreach strategy.

Results for the perceived interval for mammography reinforce the fact that women must believe that having a mammogram every 1 to 2 years is necessary for having on-schedule screening. Just under 20% of the sample reported intervals for mammography that were either greater than 2 years or were based on situations to which they would react (e.g., having breast symptoms and waiting for a provider recommendation), rather than being proactive for purposes of screening. Interventions should be sure to emphasize information about the recommended intervals between mammograms, when addressing the importance of staying on a regular schedule. This is an instance where screening-related knowledge (guidelines for the recommended screening interval) may overlap with a perception (what the person perceives to be the appropriate guideline).

The results for mood status are a reason to investigate the effect that factors, such as longer-term depression and negative affect, can have on deciding to, and then following through with, obtaining mammography and other screening tests. We need to know if this effect is on scheduling a mammogram, on keeping a scheduled appointment, or (most likely) on both. However, the fact that mood status was assessed for the past month could mean that recent disruptive life experiences also tend to promote underreporting of mammograms, and this possibility is important to investigate from a methodologic perspective. If other studies confirm the association between mood status and mammography status, it would provide another reason for physicians to pay attention to the mental health of their patients. For intervention planning, we would need to know whether certain strategies work better for women who are experiencing distress at the times when their mammograms should be scheduled, and also how to help them reschedule if stressors proximate to the time of their scheduled mammogram cause them to miss the exam.

The results for smoking status are consistent with other data over a period of nearly 15 years that show lower mammography for current smokers (17, 45-47). Compared with nonsmokers, smokers show several characteristics likely to interfere with obtaining mammography: higher depression, anxiety, and negative affect (48-52); higher perceived stress and more objective stressors (48, 51, 53, 54); stronger external locus of control and lower self-efficacy (48, 53, 55); lower value placed on health (55); less effective skills at mood management and fewer coping resources (56, 57); lower cancer worry and lower perceived risk, including for cervical and breast cancer (58-64); lower knowledge about harms of smoking (65); the presence of other household smokers and less social support for quitting (57, 66); a weaker future time perspective and stronger present orientation (67, 68); body dissatisfaction and unfavorable body image (69, 70); more perceived racial discrimination (71); and a tendency to have less social integration or cooperation with others, discussed as characteristics of being nonconformist, impulsive, antisocial, sensation-seeking, or having less desire for social interaction (72-76). Smoking status may, therefore, be an important factor to consider when defining women at higher-risk of not having mammograms, as a targeted group for intervention.

Similar to the results for the sociodemographic variables, not all of the psychosocial and behavioral variables were associated with mammography status. For example, worry about breast cancer was associated with mammography, but perceived risk was not. Perhaps worry about cancer is derived from a perception of perceived risk and is the concept that has more salient personal relevance. That is, perceived risk may not be a factor in the decision to take action (i.e., have a mammogram), unless perceived risk is cognitively processed into a feeling of worry, which may be a more personally relevant, affective assessment than perceived risk. It may also be necessary to find novel ways to combine variables. In the present data, neither comparative risk nor a desire to change a lifestyle practice to reduce cancer risk were associated with mammography status. Both of these variables are risk related, but a cross-classification may yield a variable that is associated with mammography status (e.g., mammography may be lower among women who perceive a higher risk, but who do not want to change any lifestyle practices to reduce cancer risk).

Distrust in sources of health information was not associated with mammography status in the logistic regressions. Table 1

shows that the crude percentages of mammography status were consistent with expectations; women who distrusted more sources had lower rates of mammography. Perhaps distrust is not as important as paying attention, insofar as it is attention that directly provides or prevents exposure to information.

A strength of HINTS 2003 is that it included a wider range of variables than available in other national-level surveys. On the other hand, however, there is no agreed upon set of psychosocial and behavioral variables that should be included in studies to identify correlates of a screening practice. In addition, as noted earlier in the article, studies to date have used differing sets of potential correlates for repeat mammography. The growing literature on repeat mammography will, therefore, benefit when publications comment on variables that were not available for analyses in a particular survey. In this regard, HINTS 2003 had no information about perceived social norms for screening, physician recommendations to have the procedure, the perceived pros and cons of breast screening, or participants' experience with screening (e.g., discomfort and ease of scheduling). It was also not possible to perform hierarchical analyses based on geocoding to examine geographic or contextual variables that may influence mammography use. Recognizing possible unmeasured variables is important not only because statistical analyses can use only the variables that are available but also because analyses rely upon the underlying matrix of associations among the correlates. Statistical adjustments in multivariable analyses are always relative to the variables used in the target sample, and those variables are the basis for the matrix of intercorrelations. The results of studies of the correlates of cancer screening practices are as susceptible to the influence of ''unmeasured variables'' as are the analyses for any other health practice.

This investigation has limitations in addition to possible covariates that were not assessed. First, mammography status was based on self-report, and the overall response rate for HINTS 2003 was relatively low. It is therefore very likely that the absolute rates of repeat and recent mammography found here are higher than the actual rates in the population, due to nonresponse bias, and to telescoping of less recent exams into the recall intervals, especially for the longer recall period needed to define repeat mammography. Second, HINTS 2003 did not ask about the reasons for a woman's mammograms (e.g., routine screening versus symptom related). Some years of the Behavioral Risk Factor Surveillance System and National Health Interview Survey, but not all, have asked about the reason for a recent mammogram. Many analyses are done for surveillance purposes, to track aggregate rates of a cancer screening procedure in the population as a whole, regardless of reason for the examination. Other analyses, though, are done to identify factors associated with utilization decisions for what is presumed to be a screening (asymptomatic) mammogram. Ideally, even with self-report, questions could separate screening from problem-based mammograms. However, the specifics of question content and tracking are more complex when dealing with *repeat* mammography because the reasons for each mammogram would need to be assessed. National-level surveys have not yet addressed this matter.

There is room to improve the data collected to investigate repeat and recent mammography, in the HINTS and other national-level surveys, although it would likely require asking some additional questions and perhaps even achieving better response rates. The effect of such changes on the correlates found for mammography would depend at least in part on a combination of whether certain population groups were more likely to be included in surveys, the degree of change in prevalence estimates due to greater participation and more precise questions, and whether the more precise classification of mammography status was differentially improved across groups in the population. In effect, the situation would be one where both the ''denominator'' and the ''numerator'' of calculations could be in flux. Thus, anticipating implications for the results of analyses, and for the literature as a whole, is extremely difficult.

HINTS 2003 had information about only the most recent and next-most-recent mammograms. However, the definition of repeat or regular mammography can specify more than two on-schedule examinations. Because most national-level surveys have asked only about the most recent mammogram, even information about the next most recent in HINTS 2003 is an important new piece of data, and hopefully future research can use criteria that specify three or more consecutive exams. As with the complexities of distinguishing screening from problem-based mammograms, however, it is important to recognize the complexities that would come from asking about mammograms that occurred even before the ''next most recent.'' Not only is recall of timing an issue, but to calculate prevalence rates, it would be important to have information about the reason for each mammogram to accurately define the ''denominator'' of women who were eligible for *screening* mammograms not only at any point of assessment but also over the entire interval of reporting. In this regard, the report by Blanchard et al. (14) illustrates the potential of a registry-type database to track women prospectively, especially if it can distinguish screening from diagnostic mammograms.

Despite these limitations, the HINTS 2003 helps substantially in the process of developing a more complete picture of repeat mammography and its correlates than has been available to date in national-level data sets. Factors that influence recent mammography also influence repeat mammography because only women with a recent mammogram can go on to have repeat examination. In that regard, health insurance and regular source of care understandably continue to be extremely important correlates of mammography. At the same time, the results of this study show the value still to be obtained by including psychosocial and behavioral variables in population-level surveys. In addition, although HINTS 2003 cannot be used to examine mammography or other screening tests in local populations, the results here should encourage newly designed local and even state-level surveys to have as broad a range of questions as possible.

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Cancer Epidemiol Biomarkers Prev 2006;15:2093-2101.