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Screening Mammography Among Women With A Family History Of Breast Cancer

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Abstract- Screening mammography among women with a family history of breast cancer
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Women with a first degree family history of breast cancer are at increased risk of developing this disease. Screening with mammography has been demonstrated to detect cancer early, when it is most treatable. We hypothesized that, due to their increased risk, women with a first degree family history of breast cancer would be more likely to obtain screening mammograms than the general population. We further sought to determine the self-reported reasons for failing to adhere to screening guidelines in this high risk population.

The National Health Interview Survey (NHIS), conducted annually by the Centers for Disease Control, is designed to be representative of the US population. The 2010 NHIS Cancer Supplement was used to evaluate the rates of mammography, predictors of screening, and the most common reasons cited for not having a mammogram, in the previous two years in women with and without a first degree family history of breast cancer.

Overall, 78.5% of women reported obtaining a screening mammogram in the previous two years. Women with a first degree family history had similar rates of screening mammography as average risk women. (79.5% vs 78.4% p=0.452). On multivariate analyses, income to poverty line ratio, and access to preventive health care services were independently associated with screening mammography in both average and high risk cohorts. The reasons women overall cited for not obtaining a screening mammogram (irrespective of risk cohort) were: “Never thought about it,” “Doctor didn’t say I needed it,” and “Too expensive, or Didn’t have insurance.”

These data demonstrate that high risk populations are not more likely to adhere to screening guidelines for breast cancer than their average risk counterparts, and that the main factors influencing adherence were income, insurance, and access to preventive health services. These findings suggest that social determinants of health affect screening, and addressing key issues such as access and cost of healthcare is critical to improving rates of screening mammography, especially in high risk groups.

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A brief history of breast cancer

Breast cancer is a disease that has been known since ancient times. The oldest documented description of breast cancer is from 1600 BC Egypt. The Edwin Smith papyrus describes 8 cases of breast tumors, from palpable lumps to ulcerating masses, and concludes for all of them, “There is no treatment.” [1]

No advances were made in treatment until the 1700s, when surgery to remove the breast and surrounding tissues, as well as the lymph nodes under the armpit, was explored. William Stewart Halsted, aided by advances in anesthesia and aseptic technique, successfully developed the radical mastectomy, and reduced local recurrence rates from 51% to 6%% [2, 3]. Though successful, it was also disfiguring and led to long term discomfort and disability.

The surgical approach remained the only treatment option until the early 1900s, when radiation therapy became available, although it was not widely used until the 1930s [4]. Further advances in cancer understanding and treatment options have improved the care of breast cancer.

While care has improved, incidence rates of breast cancer have remained fairly stable. In 1988, the incidence of breast cancer was 220 cases per 100,000 woman years. Incidence steadily rose to a peak of 232 cases per 100,000 woman years in 1999 [5]. There was a sharp 7% decrease in incidence from 2002-2003, following the cessation of long term hormone replacement therapy [6, 7]. Since 2003, incidence of breast cancer has been approximately 200 cases per 100,000 woman years, and is projected to remain stable, or slightly increase through 2016 [5, 8]. Overall, a woman’s lifetime risk of developing breast cancer is 1/8 [9].

Besides skin cancer, breast cancer is the most common malignancy in US women, with 232,340 cases diagnosed in 2013. It is the second leading cause of cancer death, with 39,620 deaths in 2013 [9].

Risk factors for breast cancer

While 12% of women in the general population will experience breast cancer in their lives, there are risk factors that increase the chance of developing the disease. The two greatest risk factors for breast cancer are female sex and increasing age. Approximately 1% of all breast cancers are diagnosed in men. While men may possess some breast tissue, in most it is not developed as it is in women, and not sensitive to hormone changes [10]. As all people age, their risk of any type of cancer increases. Specifically for breast cancer, approximately 67% of invasive breast cancers are found in women 55 and older [11].

Family history is the next strongest risk factor for breast cancer. In general, women with a first degree family history (meaning a mother, father, sister, or brother affected by the disease) have twice the risk of developing breast cancer as the general population [12-15].

The risk increases as more family members are diagnosed, and as they are diagnosed at a younger ages. For women whose mother was diagnosed at or before age 30, the relative risk is 4.3 and if a sister was diagnosed at or before 30, the relative risk is 9.4, compared to women without a family history. Having multiple family members affected further increases the risk, from a relative risk of 5.9 when a mother and sister are diagnosed by the age of 50, to a relative risk of 17.1 for a mother and 2 sisters diagnosed by the age of 50 compared to no family history of breast cancer [16]. Those women with a first degree family history of breast cancer make up 12.5% of the population, and account for 15-20% of all cases of breast cancer [17]. Other risk factors include hormone replacement therapy, obesity, early menarche, late menopause, and nulliparity, all of which have to do with increased exposure to estrogen [12].

Mammography use reduces breast cancer mortality

Great strides have been made in breast cancer beyond Halsted's radical mastectomy. Radiation therapy, adjuvant and anti-estrogen therapies, and screening mammography are all advances that have contributed to decreased mortality due to breast cancer.

The effectiveness of radiotherapy and adjuvant therapy is well documented and rarely disputed [18-20]. However, in the past decade and a half, the benefits and risks of routine screening mammography have been debated.

The goal of screening mammography is to find breast lesions earlier in their natural history than they would be found on clinical or self-breast exam. By finding lesions earlier, they are less likely to have metastasized and so can be treated with less toxic therapy and survival can be increased [21].

Since the introduction of mammography as a tool, 8 randomized control trials [22], and more observational studies, have been done on the effectiveness of mammography at reducing breast cancer mortality. Four of the randomized control trials took place in Sweden [23-26], one in Scotland [27], one in New York [28] and two in Canada [29, 30]. All but one of the Canada studies compared screening with no screening. The exception compared screening with an initial, one time clinical breast exam for both the control group [29]. They differed, however, in the years the study was conducted and followed up, recommended screening intervals and number of visits, type of screening mammography, method of group assignment, and method of analysis [22].

On the basis of these studies, most of which showed a significant reduction in breast cancer mortality from screening, as well as the observation that in areas where screening mammography was in use breast cancer mortality rates were dropping, screening mammography was believed to be lifesaving [31].

In the United States by the end of the 1990s, 71% of women 40 years and older had a screening mammogram in the previous two years, and breast cancer mortality had dropped to 27 deaths per 100,000 women, its lowest rate since 1973 [22]. A meta-analysis including eight randomized control trials and four case-control studies found a relative risk of breast cancer mortality of 0.74 (95% CI 0.66-0.83) for screened versus unscreened women ages 50 to 74 [32]. Another meta-analysis found in seven randomized control trials including women aged 40 to 49, there was a relative risk of breast cancer mortality of 0.85 (95% CI 0.73- 0.99) for screened versus unscreened women in the 40 to 49 year age cohort [33]. With this evidence, many major cancer fighting groups recommended routine screening mammography for women 50 to 69 years of age, and some for screening mammography for women 40 to 49 years of age [22].

Then, in 2000, a widely cited meta-analysis by Gotzsche and Olson claimed that, of the 8 randomized control trials, six were so flawed that they could not be reliably included in any analysis [34]. Their meta-analysis of the 2 adequately randomized trials found no reduction in breast cancer mortality (Relative Risk 1.04 CI 0.84-1.27). They further argued that breast cancer mortality was not a reliable outcome measure, as they believe cause of death for women in the screening arm was biased towards a cause other than breast cancer [35]. They calculated relative risk of all-cause mortality for screening versus unscreened groups and found 0.99 (95% CI 0.94-1.05)

In addition to the harms that may increase mortality, they noted screening was associated with an increase in the number of mastectomies by 20% and lumpectomies by 30% in the screened versus unscreened groups .

After discussing these findings, and the merits and failures of the analysis, the 2002 National Health Council of the Netherlands reported “The committee sees no scientific basis in light of the Cochrane Review to conclude that population screening for breast cancer for women over the age of 50 has no survival benefit.” The cited disagreements with trial exclusion, and the replacement of breast cancer mortality with all-cause mortality. Their meta-analysis produced a relative risk of breast cancer mortality for the invited to screening versus unscreened of 0.72 (95% CI 0.61-0.85)[36].

The independent UK Panel on Breast Screening utilized 11 randomized control trials for their analysis and found a breast cancer mortality relative risk of 0.80 (95% CI 0.73-0.89) for those invited to screening versus those not screened. They also estimated that for every 235 women invited to screening, 1 life would be saved. Though they acknowledged uncertainties in the trials included, they still concluded that “Breast Cancer screening extends lives.” [37]

The United States Preventive Services Task Force released their own set of recommendations using the same trials as Gotzsche and Olsen, but agreed that while the trials were only “fair” quality, this was not grounds for exclusion from the meta-analysis. The group reported a relative risk of breast cancer mortality of 0.84 (0.77-0.91) for the invited to screening women versus the unscreened women. They recommended screening mammography every 1 to

2 years for all women aged 40 and older [38]. In 2009, they updated their recommendations, still only taking into account randomized control trials. Their recommendation was for women 50 to 69 to have regular screening mammograms, based on evidence that indicated a 15% mortality reduction [39].

The arguments came down to how to judge randomized control trials. Steven Goodman of Johns Hopkins Cancer Center said of the debate:

“One of the main tenants of evidence based medicine is that scientific demonstrations of efficacy, from randomized, controlled trials or carefully designed population studies, should supersede expert opinions about efficacy. However, this controversy shows that the justification for why studies are included or excluded from the evidence base can rest on competing claims of methodological authority that look little different from the traditional claims of medical authority that proponent of evidence based medicine have criticized.” [40]

All of the recommendations insisted on discussing the benefits and risks of screening mammography with their patients, which in light of the debate about which trials are scientifically accurate seems even more prudent [36-38].

If we consider all studies of screening mammography’s effect on breast cancer mortality, we can include observational and case control studies. An observational study with data from 20 years before and after the introduction of screening mammography, after adjustment for age, self-selection bias, and changes in breast cancer incidence, found the relative risk of breast cancer mortality was 0.56 (95% CI 0.49-0.64) for women exposed to screening versus women before screening was introduced in the 40 to 69 year old age group. Comparing women not exposed to screening despite its introduction to women before the introduction of screening gave a relative risk of 0.84, indicating some, but not all, of the mortality reduction is due to factors other than screening mammography [41].

A study using the British Columbia screening mammography program calculated a relative risk of breast cancer mortality of 0.76 for screened versus unscreened women older than age 40 after correcting for self-selection bias as well as income [42].

Because of the argument about randomized control trials, and the value of observational and case control studies, the Wolfson Institue of Preventive medicine summarized the non-randomized evidence from 1990 onward. They found a relative risk of breast cancer mortality of 0.74 (95% CI 0.67-0.82) associated with invitation to screening. When they considered only those women who were actually screened and adjusted for self-selection bias, the relative risk of breast cancer mortality found was 0.68 (0.61-0.76) [43].

Evidence for the women 39-49 is less clear than the evidence for women 50-69, however, some researchers attempted to pool data to find a stronger conclusion. A meta-analysis in 2009 used the 8 randomized control trials and found a relative risk of breast cancer mortality of 0.85 (95% CI 0.75-0.96) for invitation to screening versus control, of the 39 to 49 year age group [44].

Another analysis utilizing data only from the Netherlands trials found a relative risk of breast cancer mortality of 0.50 (95% CI 0.30-0.82) for screened versus unscreened women 40 to 49 years of age, however, they did not take into self-selection bias [45].

So it would seem that breast cancer mortality is indeed decreased by screening mammography. Some have argued that reduction in mortality is in fact due to better treatment options. In 2005 a consortium of investigator developed 7 independent models of breast cancer incidence and mortality. Their data set came from the following databases for the years 1975 to 2000:

The National Health Interview Survey

The Surveillance Epidemiology and End Results Patterns of Care

The Breast Cancer Surveillance Consortium

The Surveillance Epidemiology and End Results 9

The Connecticut Tumor Registry

The Human Mortality Database

The National Center for Health Statistics

They determined that the total reduction in deaths due to breast cancer that can be credited to screening ranged from 28 to 65% with a median of 46%. They determined adjuvant treatment contributed the rest [46]. Thus, while some reduction in breast cancer mortality is due to advances in treatment, screening mammography plays an important role as well.

Mammography use allows for less toxic therapy

In addition to reducing mortality, screening mammography allows patients to be treated with less toxic therapy. One study using data from the Dartmouth Medical Center found that for breast cancers found on screening mammography compared to those found on physical exam, they were significantly smaller on average (1.5 cm versus 2.9 cm, $p<0.0001$) and significantly less likely to be node positive (16% versus 42%, $p<0.0001$) [47].

Being smaller and less advanced, the screening detected breast cancers were more likely than physical exam detected breast cancers to be treated with breast conservation (56% versus 32%, $p<0.0001$) and less likely to receive systemic chemotherapy (28% versus 56%, $p<0.0001$). On a multivariate analysis controlling for age, women whose tumor was found on physical exam were 2.9 times (95% CI 2.1-3.9) as likely to have chemotherapy and 2.5 times (95% CI 1.9-3.3) as likely to have a mastectomy than women whose cancer was found on screening mammography [47].

A 2007 study from the Swedish Organized Service Screening Evaluation Group found that with the introduction of screening mammography, there was a significant 45% reduction in tumors larger than 2 cm in the 40-49 year age group, and a significant 33% reduction in the 50-69 year age group. Both groups also had lower rates of node positive cancers after screening was introduced (40 to 49 age group- 29% reduction; 50 to 69 age group- 16% reduction) [48].

Risks associated with mammography use

While it seems that on the whole, mammography reduces breast cancer mortality, it is not without its risks. Investigators have raised concerns about overdiagnosis, false positive mammograms, and undue anxiety brought on women.

A recent study compared the rates of early and advanced disease from pre- screening mammography introduction to recent years when screening mammography was used by 70% of women. They found that while there was an absolute increase of 122 cases of ductal carcinoma in situ and localized disease per 100,000 women years, there was only a reduction of 8 cases of advanced disease for 100,000 women years [49].

A different study from Europe found the rate of overdiagnosis to be only 7%. The purpose of their study was to evaluate the trials from Europe for appropriate methodology, and determine if the mortality reductions were really due to screening mammography. Through meta-analysis, they determined their much lower overdiagnosis rate [50].

The large difference in these overdiagnosis rates has most to do with the method of modeling the trend of incidence. No particular method of modeling is scientifically favored over another, so there is no reason to trust one of these studies over the other [21].

Another way to determine the overdiagnosis rate is to compare incidence rates of screening women versus control groups not offered screening after the trial. Using this method, the Independent UK Panel on Breast Cancer Screening found a rate of overdiagnosis of 19% (19% of cancers diagnosed during screening would not have been clinically apparent in the woman's lifetime); that is, for every 10,000 women invited to screening mammography, a total of 681 cancers (both invasive and ductal carcinoma in situ) would be diagnosed, of which, 129 would be overdiagnoses. 43 deaths from breast cancer would be prevented [37].

In addition to overdiagnosed cases, there are false positive mammograms. Nationally, 11% of screening mammograms require further evaluation. 3% of those 11% are found to be cancer (0.3% of all mammograms) [22]. After 10 mammograms, each, up to 49% of women will experience a false positive result, and 19% will have a biopsy [51].

The women receiving call backs have higher levels of anxiety, although generally it is not to a clinically diagnosable level, and the anxiety is not sustained [52]. Schwartz in 2000 surveyed women regarding their knowledge and tolerance of false positives. She found that 99% of women knew that false positives were a risk of screening mammography. Further, she found that 63% of women thought that 500 or more false positives was a reasonable trade-off for 1 life saved [53]. The meta-analysis from 1993 with the eight randomized control trials and four case control trials estimated that for each life saved, there were between 3 and 200 false positive mammograms [32], thus the majority of women surveyed would tolerate well above the actual number of false positives.

Regarding overtreatment of ductal carcinoma in situ cases, Schwartz also asked women "at what threshold for the chance of ductal carcinoma in situ becoming invasive, would [they] want treatment?" 42% of women wanted to be treated with even a 1% chance of progression. Another , 38% of women said they would want to be treated if there was a 33% risk of progression [53]. Estimates for progression of ductal carcinoma in situ to invasive cancer put it up to 33% [54].

Recommendations from major health organizations

Taking into account all the evidence, major health organizations have released their recommendations for mammography screening guidelines. Most recommended routine screening mammography for women 50-69 either annually or every two years. For women 40-49, most still recommended screening, but made it clear that the risks and benefits should be thoroughly discussed as the mortality benefit may not be as great in this age range as in the older cohort. [39, 55-62] (Table 1)

Table 1- Screening guidelines from major health organizations		Age		
Group	Frequency	40-49	50-69	>69

American Academy of Family Physicians 2012 [55]	2	No	Yes	No
American Cancer Society 2013 [56]	1	Yes	Yes	Yes
American College of Obstetrics and Gynecologists 2011 [57]	1-2 if 40-49, 1 if >49	Yes	Yes	Yes
American College of Radiology 2012 [58]	1	Yes	Yes	Yes
American Medical Association 2012 [59]	1	Yes	Yes	Yes
Canadian Task Force on Preventive Health Care 2011 [60]	2-3	No	Yes	Yes
National Cancer Institute 2012 [61]	1-2	Yes	Yes	Yes
National Comprehensive Cancer Network [62]	1	Yes	Yes	Yes
US Preventive Services Task Force 2009 [39]	2	No	Yes	Yes

Mammography in the family history population

The efficacy of screening mammography on reducing breast cancer mortality mostly focused on the women at average risk of developing breast cancer. Few studies however have looked at screening in the higher risk first degree family history cohort. To our knowledge, there are no randomized trials comparing screening mammography to no screening and reduction of breast cancer mortality solely within the first degree family history population. Some investigators have studied, however, the rates of breast cancer detection in women with a first degree family history compared to those without it.

Kollias in 1997 studied the cancer detection rates in women younger than 50, who had increased risk of developing breast cancer based on family history. The group was followed for 8 years, and 29 cases were detected in 1371 women by a combination of screening mammography and clinical breast exam. Compared to age matched females, the first degree family history group had a relative risk of invasive breast cancer of 5.0. Compared to women 50 years and older, not at higher risk, cancer screening detection rates were similar, i.e. women at increased risk had rates of breast cancer similar to women a decade older [63].

Kerlikowske also studied cancer detection rates in women with a first degree family history of breast cancer and compared them to the general population. He too saw that higher risk women have a greater number of cancer cases per 1000 exams than the average risk group. For the women aged 40 to 49, the numbers were 4.7 versus 2.7 for higher risk versus general population. He also found that women with a first degree family history had similar rates of cancer as the average risk women a decade older (Higher risk 40-49 years olds- 4.7, Average risk 50-59 year olds- 4.6) [64].

So women with a first degree family history not only are at increased risk of developing breast cancer over their life time, but screening programs are effective ways of catching these cases of breast cancer before they progress to advanced disease.

We can extrapolate that if screening mammography confers a breast cancer mortality reduction to average risk women, and screening mammography is effective at discovering breast cancers in women with a first degree family history, then screening mammography would also reduce breast cancer mortality in this higher risk population, possibly to a greater magnitude than the average risk group given the greater risk of early disease.

Aims and Hypotheses

Our aims were to:

A) Determine whether women with a first degree family history of breast cancer are more likely to obtain a screening mammogram than women without a first degree family history, independent of other factors

B) Determine what reasons the women who did not obtain screening mammograms cite for their non-adherence

We hypothesized that, because of their increased risk, and the emotional and psychological burden of being at increased risk, women with a first degree family history of breast cancer would be more likely to undergo screening mammography than women without the first degree family history.

For the women with a family history who did not obtain a screening mammogram, we hypothesized they would have varied reasons, however, “Never thought about it,” would not be one of the most cited reasons. Surely, the anxiety from seeing a family member suffer with breast cancer would be motivation to think about getting a mammogram, and so there must be another reason for failing to be screened.

Trends in mammography

From 1987 to 2000, screening mammography rates rose from 39.1% to 70.1% [65]. However, despite success in reducing breast cancer mortality, rates of screening mammography began to drop. Prompted by lay literature that Medicare claims for screening mammography were declining, a non-profit group model Health Maintenance Organization in the Pacific Northwest investigated the screening mammography rates for the women in their group. They found from 1999 to 2002, the percentage of eligible screening time appropriately covered by a screening mammogram fell from 67% to 62.5% [66].

On a national level, using data from the 2000 and 2005 National Health Interview Survey database, it was determined that rates of women who obtain screening mammograms within the past two years significantly decreased from 70% in 2000 to 66% in 2005 [67]

Chagpar in 2007 using the National Health Interview Survey database found that of the women not having had a mammogram in the past two years, most cited “Never thought about it” as their reason for not obtaining a mammogram. Analyzing sociodemographic factors, Chagpar found that income, education, and markers of access predicted mammography usages, but race did not [68].

Slomiany then investigated whether women with a first degree family history also had a decline in screening mammography rates. Compared to the general population who had a decline of 67.0% to 63.9% ($p=0.0006$), these higher risk women had a smaller decline, from 82.7% in 2000 to 79.8% in 2005, that did not reach statistical significance ($p=0.1328$). The higher risk women remained more likely to have a screening mammogram in the previous two years than the average risk women (79.8% versus 63.9% $p<0.0001$) [69].

Methods

Data from the 2010 National Health Interview Survey (NHIS) database and cancer supplement were gathered. This is a face-to-face population-based health survey designed to be representative of the American civilian non-institutionalized population. The survey has been conducted annually since 1957 by the National Center for Health Statistics, Centers for Disease Control and Prevention, and consists of two components: a “Basic Module” containing basic health and demographic information, and “Supplements” which relate to specific areas of interest. Every five years, including 2010, the “Supplement” concerns cancer screening and incidence. The Basic Module, which remains largely unchanged from year to year, consists of 3 components: the Family Core, the Sample Child Core, and the Sample Adult Core. Information collected for all family members includes household composition and socio-demographic characteristics among other factors. From each family in the NHIS, one sample child (if any children under age 18 are present) and one sample adult are randomly selected, and information on each is collected with the Sample Child Core and the Sample Adult Core questionnaires. In 2010, sample adults also completed the cancer supplement, which collected information regarding use of mammography and other cancer screening modalities.

Nationally, the NHIS uses about 400 interviewers, trained and directed by health survey supervisors in the 12 U.S. Census Bureau Regional Offices. The interviewers receive training on an annual basis in basic interviewing procedures and in the concepts and procedures unique to the NHIS. The NHIS is conducted using computer-assisted personal interviewing (CAPI). This method presents the questionnaire on computer screens to each interviewer and guides the interviewer through it, automatically routing the interviewer to appropriate questions based on answers to previous questions. Interviewers enter survey responses directly into the computer, and the CAPI program determines if the selected response is within an allowable range, checks it for consistency against other data collected during the interview, and saves the responses into a survey data file. This technology reduces the time required for transferring, processing, and releasing data, and ensures the accurate flow of the questionnaire. The survey sample is re-evaluated every 10 years in order to better reflect the changing U.S. population. The sample is chosen in such a way that each person in the U.S. population has a known non-zero probability of selection. The probability of selection, along with 9 adjustments for nonresponse and post-stratification, are reflected in the sample weights that are provided in the data files provided by the NHIS. These weights, which account for the multistage sample design to reflect the civilian non-institutionalized population of the United States, are used for data analysis. In addition to the design and ratio adjustments, weights are further modified by adjusting them to the 2010 Census-based population estimates for sex, age, and race/ethnicity populations (post-stratification). Because of this complex sample design involving stratification, clustering, and multistage sampling, and the resulting adjusted sampling weights, statistical software that provides the capability of variance estimation and hypothesis testing for complex sample designs (e.g. Survey Data Analysis (SUDAAN)) is needed.

In 2010, the NHIS survey included 27157 adults with an average response rate of 60.8%.

After determining the rate of a first degree family history and mammography, for the whole population of women aged ≥ 40, we divided the women into two groups: those with a first degree family history of breast cancer and those without. We analyzed rates of mammography in the past year for both groups. We also analyzed other possible confounding factors and performed a multivariate analysis controlling for age, race, personal history of breast cancer, income, insurance, education, region, and access to a health care professional. A second multivariate analysis was performed on the first degree family history cohort and testing for these possibly significant predictors.

To determine reasons women cite for non-adherence, we analyzed the group of women who did not have a mammogram within the past two years for their answer to the supplement question, “What is the most important reason why you have a) NEVER had a mammogram or b) NOT had a mammogram in the PAST 2 YEARS?” Possible responses were: “Never thought about it,” “Didn’t need it,” “Doctor didn’t say I needed it,” “Haven’t had any problems,” “Put it off,” “Too expensive, or no insurance,” “Too painful, unpleasant, or embarrassing,” “Too young,” “Don’t have a doctor,” and “Other.”

We performed the analysis on the population of all women over 40 who had not had a mammogram in the past two years. For each possible response we assessed whether women with a first degree family history were more likely to cite that reason than women without a family history.

All statistics were performed using SAS Version 9.0.1 (SAS, Cary, NC, USA) and Survey Data Analysis (SUDAAN) software (Research Triangle Institute, Research Triangle Park, NC, USA.

Statement of Work

In consultation with my thesis advisor, I discussed my interest in preventing advanced disease as a focus for this thesis. I was directed to the Nation Health Interview Survey as a possible data source. After determining my specific question and conducting a literature search, I developed my hypothesis and determined the fields needed to test it. I coded these fields as would be need for analysis in SUDAAN. While my advisor has the expertise in programming SUDAAN, I participated in the process and learned the general framework of this program. I familiarized myself with the statistical analyses employed, and was responsible for analyzing the resulting output. Subsequent to the initial analysis, I proposed post-hoc analyses when necessary. I wrote two abstracts resulting from this work, presented at 2 national meetings, and intend to submit 2 papers to peer reviewed journals. In addition, this thesis is entirely my own work.

Results

In 2010, the National Health Interview Survey included 9631 women over the age of 39 representing the 73,448,042 women over the age of 39 in the United States population. Overall 78.5% of women reported having had a screening mammogram in the previous two years.

Of the women surveyed, 12.5% had a first degree family history of breast cancer. Presence of family history varied with age, personal history of breast cancer, race, education, insurance, and poverty ratio, but not region. (Table 2)

Table 2-

Univariate comparison of sociodemographic factors by first degree family history status (FDFHx)

Percentage (%) of women over 39 years of age					
		Overall	(+) FDFHx	(-) FDFHx	p-value
Age	40-49	29.59	19.49	31.04	<0.01
	50-59	28.21	27.97	28.24	
	60-69	21.06	26.65	20.26	
	70-79	12.3	17.18	11.61	
	80+	8.83	8.70	8.85	
Personal History	Yes	4.21	7.91	3.68	<0.01
	No	95.79	92.09	96.32	
Race	Hispanic	10.06	6.02	10.64	<0.01
	White	73.17	81.50	71.97	
	Black	11.37	8.89	11.73	
	Asian	4.47	2.36	4.78	

	Other	0.93	1.23	0.89	
Education	Some High School	14.46	11.81	14.84	<0.01
	High School	29.1	29.63	29.03	
	Some College	29.41	28.58	28.58	
	Bachelors	16.91	19.26	19.26	
	Masters	8.00	7.77	7.77	
	Prof/ Doc	2.12	2.12	2.00	
Insurance	Not Covered	11.12	6.27	11.83	<0.01
	Medicare	33.23	40.23	32.20	
	Medicaid	3.93	2.80	4.09	
	Military	1.66	2.04	1.61	
	Private	50.06	48.57	50.28	
Income to poverty line ratio	<1	12.31	8.61	12.85	<0.01
	1-1.99	17.71	15.47	18.04	
	>2	69.97	75.92	69.12	
Region	Northeast	19.01	19.48	18.94	0.6381
	Midwest	22.97	23.24	22.94	
	South	35.36	36.47	35.20	
	West	22.66	20.81	22.92	

On univariate analysis, women with a first degree family history had similar rates of screening mammography as those women without the family history. (79.5% versus 78.4% p=0.4521). (Table 3)

Table 3-

Univariate comparison of sociodemographic factors by screening mammography (MMG) status

Percentage (%) of women over 39 years of age				
		(+) MMG	(-) MMG	p-value
Overall		78.54	21.46	
First Degree Family History	Yes	79.50	20.50	0.452
	No	78.40	21.60	
Age	40-49	81.84	18.16	<0.01
	50-59	80.17	19.83	
	60-69	80.40	19.60	
	70-79	75.95	24.05	
	80+	61.98	38.52	
Personal history of breast cancer	Yes	82.47	17.53	0.0793
	No	78.37	21.63	
Race	Hispanic	80.79	19.21	0.0687
	White	77.83	22.17	
	Black	79.89	20.11	
	Asian	81.98	18.02	
	Other	77.61	22.39	
Education	Some High School	73.00	27.00	<0.01

	High School	76.67	23.33	
	Some College	78.05	21.93	
	Bachelors	82.93	17.07	
	Masters	84.94	15.06	
	Prof/ Doc	89.11	10.89	
Insurance	Not Covered	67.98	32.02	<0.01
	Medicare	72.31	27.69	
	Medicaid	82.09	17.91	
	Military	90.28	9.72	
	Private	84.36	15.64	
Income to poverty line ratio	<1	72.96	27.04	<0.01
	1-1.99	70.14	29.86	
	>2	81.83	18.17	
Region	Northeast	82.75	17.25	0.0004
	Midwest	78.61	21.39	
	South	77.28	22.72	
	West	76.91	23.09	

On a multivariate analysis of all US women over 39 years of age, controlling for first degree family history, insurance status, age, education, race/ ethnicity, region, income to poverty line ration, personal history of breast cancer, and access to preventative care, women with a first degree family history were still no more likely to obtain a screening mammogram in the previous two years than their average risk counter parts (OR- 1.04 95% CI 0.86-1.26). (Table 4)

Table 4-

Odds Ratios, Factors affecting screening mammography (MMG) in US women aged 40 and older

		Odds Ratio (95% CI)	p-value
First degree family history	Yes	1.02 (0.85-1.24)	0.7047
	No	1.00	.
Age	40-49	1.08 (0.81-1.45)	0.5186
	50-59	0.98 (0.74-1.30)	0.9427
	60-69	1.12 (0.87-1.44)	0.3771
	70-79	1.00	.
	80+	0.63 90.5-0.8)	0.0001
Personal history of breast cancer	Yes	1.27 (0.89-1.81)	0.1931
	No	1.00	.
Race	Hispanic	1.67 (1.32-2.10)	<0.0001
	White	1.00	.
	Black	1.33 (1.11-1.60)	0.0044
	Asian	1.4 (1.02-1.92)	0.0345
	Other	0.93 (0.47-1.82)	0.8633
Education	Some High School	1.00	.
	High School	1.07 (0.88-1.29)	0.5275
	Some College	1.06 (0.86-1.31)	0.5404
	Bachelors	1.34 (1.04-1.73)	0.0258

	Masters	1.35 (0.94-1.95)	0.1046
	Prof/ Doc	1.94 (1.08-3.49)	0.0275
Insurance	Not Covered	1.00	.
	Medicare	1.50 (1.15-1.95)	0.0715
	Medicaid	2.30 (1.59-3.33)	0.0005
	Military	3.69 (1.66-2.62)	0.0002
	Private	2.09 (1.66-2.62)	0
Income to poverty line ratio	<1	1.00	.
	1-1.99	0.93 (0.75-1.14)	0.5868
	>2	1.40 (1.14-1.71)	0.0016
Region	Northeast	1.47 (1.21-1.79)	0.0003
	Midwest	1.16 (0.96-1.39)	0.1531
	South	1.00	.
	West	0.94 (0.77-1.14)	0.5476
Access to preventive care	Yes	1.66 (1.23-2.23)	0.0009
	No	1.00	.

Having insurance, higher income, and access to preventive care were significantly associated with rates of screening mammography.

On a stratified multivariate analysis of just the US women over 39 with a first degree family history of breast cancer having insurance, higher income, and access to preventive care were significantly associated with rates of screening mammography. (Table 5)

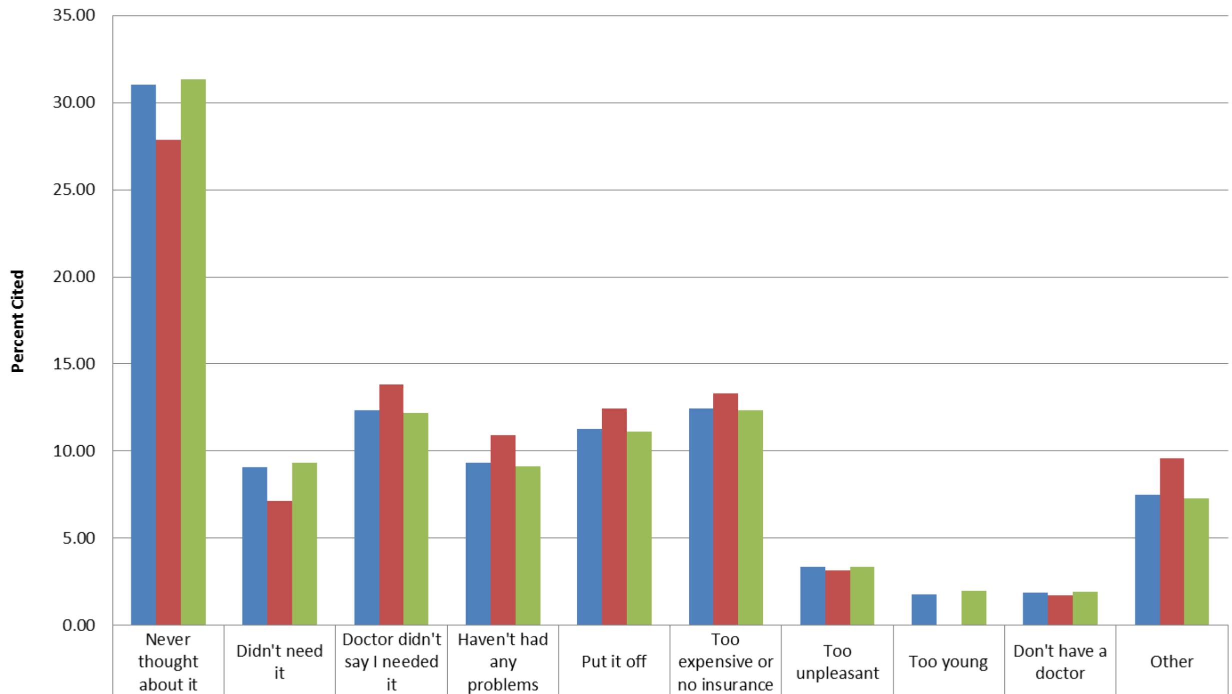
Table 5-

Odds Ratios, Factors affecting screening mammography (MMG) in women with a first degree family history of breast cancer aged 40 and over			
Variable		Odds Ratio (95% CI)	p-value
Age	40-49	0.95 (.38-2.36)	0.9105
	50-59	1.11 (0.50-2.45)	0.8007
	60-69	1.47 (0.73-2.95)	0.2819
	70-79	1.00	.
	80+	0.78 (0.39-1.56)	0.4837
Personal history of breast cancer	Yes	0.88 (0.44-1.77)	0.7168
	No	1.00	.
Race	Hispanic	3.01 (1.41-6.41)	0.0044
	White	1.00	.
	Black	2.18 (1.14-4.17)	0.0183
	Asian	0.67 (0.17-2.62)	0.5666
	Other	0.62 (0.17-2.26)	0.4714
Education	Some High School	1.00	.
	High School	0.56 (0.28-1.12)	0.1023
	Some College	0.62 (0.30-1.27)	0.1879
	Bachelors	0.70 (0.33-1.48)	0.3514
	Masters	0.66 (0.24-1.81)	0.4182
	Prof/ Doc	1.09 (0.34-3.47)	0.8898
Insurance	Not Covered	1.00	.
	Medicare	2.21 (0.95-5.11)	0.0639

	Medicaid	3.07 (1.00-9.41)	0.0498
	Military	.	.
	Private	3.61 (1.71-7.64)	0.0008
Income to poverty line ratio	<1	1.00	.
	1-1.99	1.46 (0.58-2.33)	0.679
	>2	2.39 (1.26-4.56)	0.008
Region	Northeast	1.16 (0.66-2.03)	0.6055
	Midwest	1.28 (0.76-2.14)	0.3504
	South	1.00	.
	West	0.96 (0.54-1.68)	0.8724
Access to preventive care	Yes	2.89 (1.03-8.09)	0.0431
	No	1.00	.

On the analysis for reasons cited for not obtaining a mammogram, the most common reason cited, with 31.01%, was “Never thought about it.” Other reasons cited at least 10% of the times, in decreasing order, were “Doctor didn’t say I needed it,” “Too expensive, or no insurance,” “Haven’t had any problems,” and “Put it off.” (Chart and Table 6)

Chart and Table 6- Reasons cited for not obtaining a screening mammogram for US women aged 40 and over, and those with and without a first degree family history (FDFHx)



	Never thought about it	Didn't need it	Doctor didn't say I needed it	Haven't had any problems	Put it off	Too expensive or no insurance	Too unpleasant	Too young	Don't have a doctor	Other
Overall	31.01	9.10	12.34	9.32	11.27	12.46	3.34	1.76	1.90	7.51
(+) FDFHx	27.89	7.15	13.82	10.89	12.47	13.34	3.17	0.00	1.70	9.57
(-) FDFHx	31.36	9.32	12.17	9.14	11.14	12.36	3.36	1.96	1.92	7.28

A significantly lower percentage of women with a first degree family history cited "Never thought about it" than women without the history (6.71% versus 9.60% P=0.0012), and a lower percentage with a family history cited "Didn't need it" than those without the history (1.72% versus 2.85% p=0.0215). Of those with a family history, 0% cited "Too young" as their reason for not obtain a mammogram, which was significantly lower than those without a family history (0% versus 0.60% p<0.0001) (Table 7)

Table 7- Percent make up of all reasons for no screening mammogram cited			
	(+) First Degree Family History	(-) First Degree Family History	p value

Never thought about it	6.71	9.6	0.0012
Didn't need it	1.72	2.85	0.0215
Doctor didn't say I needed it	3.32	3.73	0.5355
Haven't had any problems	2.62	2.8	0.761
Put it off	3	3.41	0.5222
Too expensive or no insurance	3.21	3.79	0.3675
Too unpleasant	0.76	1.03	0.4087
Too young	0	0.6	<0.0001
Don't have a doctor	0.41	0.59	0.4604
Other	2.3	2.23	0.8738

Discussion

In the United States, breast cancer remains the leading malignancy, and despite widespread public knowledge on screening, the second leading cause of malignancy related death among women [11]. The incidence of breast cancer since 2006 has been 200 cases per 100,000 women years, and is projected to remain at this level through 2016 [5, 8].

A first degree family history of breast cancer is an important risk factor for future personal history of breast cancer. Women with a single first degree family member with breast cancer are 2 to 3 times more likely to suffer breast cancer themselves. The risk increases as the number of family members with breast cancer increases, and with younger ages at diagnosis [12-15].

Mammography has been instrumental in reducing mortality from breast cancer. Estimates from meta-analyses range from 20% to 35% for reduction of breast cancer mortality [22]. In addition, mammography allows for earlier detection, which then allows for fewer mastectomies, and lower rates of chemotherapy [47].

While there is the risk of over diagnosis and false positive mammograms [37, 49-51], the American Cancer Society recommends yearly screening mammograms for all women starting at age 40 [56], while the United States Preventive Services task Force recommends screening mammography every two years beginning at age 50 [39].

In women with a first degree family history of breast cancer, those being screened between ages 39 and 49 had a higher incidence of invasive tumors than the women aged 50 to 60 without a significant family history [63, 64]. Thus, if we hold that mammography is important for average risk women aged 50 and older, it is even more important for those women with a first degree family history, and thus at higher risk, to undergo screening mammography.

The rates of screening mammography have been reported to be declining. From 2000 to 2005, the National Health Interview Survey revealed a decrease of approximately 4% of women who were screened within the past two years [67]. While some studies indicate the decrease is limited to lower risk women, there was a decrease in the higher risk cohort that failed to reach significance [69].

Our study sought to determine if women with a first degree family history of breast cancer were more likely than women without a first degree family history of breast cancer to obtain a screening mammogram at least every two years. Further, we sought to determine the reasons women who did not obtain screening mammography cite for their non-adherence to recommendations.

Overall, in our study, 78.5% of women over 40 reported obtaining a mammogram in the previous two years. Of the women 40 years of age and older with a first degree family history, 79.5% reported obtaining a screening mammogram in the previous two years, compared to 78.4% of women without a first degree family history ($p=0.452$).

Previous studies had also looked at rates of screening mammography in the first degree family history population compared to the average risk population. For example, an analysis of the 2005 California Health Interview Survey showed that 83.5% (95% CI 81.0%-85.9%) of women with a first degree family history of breast cancer obtained a screening mammogram in the previous 2 years, compared to only 76% (95% CI 74.7%-77.3%) of women at average risk [70]. 2005 National Health Interview Survey data had indicated that 79.8% of women with a first degree family history had a screening mammogram, while among women without a first degree family history, only 63.9% had a screening mammogram ($p<0.0001$) [69]. It would seem from our data that women with a first degree family history of breast cancer are no longer more likely to obtain screening mammography than the average risk population.

We looked at sociodemographic factors that were predictive of screening mammography. For the general population, having insurance, being higher above the poverty line, having higher education, and reporting a place to go to access preventive care were associated with higher rates of mammography. Depending on the type of insurance, women were 1.5-3.7 times as likely as those not covered to obtain a screening mammogram in the past two years. Being two times above the poverty line was associated with an odds ratio of 1.4 times as likely to have a screening mammogram than those below the poverty line. Increasing education led to increasing odds ratios compared to non- high school graduates, which reached significance at the level of a doctorate degree (OR 1.94 95% CI 1.08-3.49). Finally access to preventive health care was associated with an increased odds of obtaining screening mammography of 1.66 compared to women without access to preventive care.

Swan et al using 2000 National Health Interview Survey data found that at a rate of 34.6% (95% CI 30.7-38.6%), the women with no usual source of health care had the lowest rates of screening mammography, while 73.0% (95% CI 71.9-74.1%) of women with a usual source of care obtained screening mammograms [65]. By comparison with results from the 1987 survey, those with no usual source of care increased screening mammography rates by only 19.9% (95% CI 15.0-2.8%) compared with those with a usual source of care who increased their rate by 42.2% (95% CI 40.2-44.2%) [65]. Schueler, from 2005 National Health Interview Survey, similarly noted that women without a primary care provider were 0.41 times as likely (95% CI 0.32-0.53) to have a screening mammogram in the past two years than women with a primary care provider [71].

We naively believed that women with a first degree family history, with at least twice the risk of breast cancer, would not allow socioeconomic status to dictate screening behavior. Perhaps the only predictor would be access to a physician for preventive care, as breast cancer screening falls under the umbrella of preventive care. Without access to preventive care, they could not be expected to obtain a preventive care test. However, results of our multivariate of just the women with a first degree family history yielded much of the same results as the analysis of the general population. Having insurance was associated with a 2.2 to 3.6 OR in favor of having a screening mammogram compared to no coverage. Education was not associated with screening adherence, however, poverty ratio was. Having an income greater than or equal to two times the poverty line was associated with an odds ratio of 2.39 (95% CI 1.26- 4.56) compared to those below the poverty line. Access to preventive health care was indeed associated with improved mammography rates, with an odds ratio of 2.89 (95% CI 1.03-8.09) compared to no access.

From the California Health Interview Survey in 2005, which had found significantly more women with a first degree family history undergo screening than those without a family history, it was noted that lacking insurance and having no physician visit in the previous year were significantly predictive of lacking a screening mammogram. Just from the first degree family history population, women without insurance during the previous year were 0.25 times as likely to obtain a screening mammogram as women who were insured ($p<0.01$). Not having a physician predicted a woman was 0.19 times as likely to have a screening mammogram in the past two years, compared to women who had seen a physician ($p<0.01$) [71].

Another study using the 2000 National Health Interview Survey had looked at similar variables, and also had found that women without a visit to a doctor in the past year were 0.59 times as likely (95% CI 0.42-0.83) as women with a doctor's visit to obtain a screening mammogram in the previous year [72].

Predictors of screening mammography usage, both for the higher risk and the average risk populations have not changed much in the past ten years. Efforts at improving the societal infrastructure to help women at risk for lacking care are necessary to remedy this situation. It is not just screening mammography that is failing to reach the lower socioeconomic status individuals, however. National Health Interview Survey data from 2000 also indicated that people without health insurance or access to preventive care were also significantly less likely to have had a pap smear, or a colonoscopy in the recommended previous screening interval [65].

Our study also looked at reasons women who didn't have a screening mammogram in the previous two years cited for their non- adherence. The most commonly reason cited was, "Never thought about it." While it was cited significantly less often for the positive first degree family history cohort than those without a family history (made up 6.71% of responses versus 9.6% of responses, p=0.0012), still 27.89% of women with a first degree family history cited this as their primary reason. Given that there is an abundance of evidence regarding the increased risk of breast cancer due to a first degree family history, the finding that over a quarter of higher risk women "didn't think about" getting a mammogram should incite public health advocates to raise awareness in this population.

A meta-analysis of 19 studies on using telephone reminders to increase screening mammography rates found that the median increase in screening mammography rates resulting from a telephone reminder was 18.5%, compared to the group that did not receive a reminder

[73]. These results indicate that reminders may be a tool to increase screening mammography rates. However, it is unknown what percentage of women in the United States already receives reminders, so the size of the population the intervention could be used on may be very small.

Another most commonly reason cited is “Doctor didn’t say I needed it.” Whether because they forgot to order preventive tests, or believed another member of their staff was handling the order, or there was inaccurate record keeping, or they simply neglected the topic due to time pressure, it may be true that physicians failed to inform their patients about the need for a screening mammogram.

Alternatively, the women citing this as a reason may actually reflect poor doctor-patient communication skills. Doctor patient communication strongly influences a patient’s compliance with a doctor’s recommendations [74]. A study out of Germany analyzed how interactions differed between doctors and their high and low socioeconomic patients. They determined that when communicating with lower socioeconomic status individuals, doctors gave less positive socio-emotional comments, and interacted in a less conversational, and more directive style than when communicating with higher socioeconomic status individuals. The style was characterized by a greater time spent in biomedical speak and less diagnostic and treatment information given or discussed [75]. So it is entirely possible that the doctors did not effectively communicate the need for a screening mammogram to their less educated, lower income patients, leading to lower screening mammography rates.

Finally, that women commonly cited the reason, “Too expensive, or no insurance” is not surprising given our sociodemographic context. In our study, women below the poverty line were two thirds as likely as women at two times the poverty line to obtain a screening mammogram. Indigent women, regardless of family history are at risk for missing screening mammograms.

This study is limited by its data source. The National Health Interview Survey is based on self-report data, and as such, is at risk for overestimating true mammography screening rates. We already believe the estimated screening rates are too low, so true screening rates would be even more cause for alarm.

In addition, the method of data collection for why women cite not having a screening mammogram did not allow for more than one answer. There are likely multiple reasons for a woman's difficulty in obtaining screening mammography, and even those with the same responses likely have nuanced differences based on their own situation.

Still 20.5% of women with a first degree family history of breast cancer did not obtain a screening mammogram in the recommended interval. Predictors of their screening behavior correlated with lower socioeconomic status. Public health policy and infrastructure change are necessary to increase access to care for this group, and promote breast cancer screening practices.

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