Preventive Medicine Reports 5 (2017) 27–32

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: http://ees.elsevier.com/pmedr

Using mammograms to predict preventive health services behavior and mortality in women

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ARTICLE INFO

Article history:
Received 28 March 2016
Received in revised form 17 September 2016
Accepted 24 October 2016
Available online 26 October 2016

Keywords:
Mammograms
Mortality
Health behavior
Screening behavior

ABSTRACT

This study examined whether mammography receipt was associated with mortality due to causes other than breast cancer, hypothesizing that mammography screening was a proxy for the predisposition to seek preventive health behaviors. Using data on 89,574 women from the 2000 National Health Interview Survey and National Death Index, a discrete-time hazard model estimated the mortality from any cause except breast cancer as a function of screening status. Receiving a mammogram was associated with a 24% reduction in the likelihood of death all causes except breast cancer. These odds were reduced to 21.1% when demographic and socioeconomic variables are added and reduced further to 20.9% when health resource variables were added. The final adjusted model shows that women who received a mammogram had reduced their probability of death by 20%. These results suggest women who undergo mammograms may be more likely to seek other preventive health services or engage in healthy behaviors that affect mortality. While the use of mammograms to predict breast cancer mortality merits further consideration, if a proxy for a woman's predisposition for additional preventive screenings, encouraging mammography may be a pivotal pathway for preventing mortality due to other causes for women.

1. Introduction

Preventive health services significantly reduce premature morbidity and mortality (Sox, 1994; Hayward et al., 1991). Preventive health behavior has been defined as "any activity under taken by a person who believes himself to be healthy for the purpose of preventing disease or detecting disease in an asymptomatic stage." (Kasl and Cobb, 1966). Health researchers often measure the use of preventive health services by asking questions about receipt of influenza vaccination (Diab and Johnston, 2004), participation in routine checkups (Musa et al., 2009), a prostate-specific antigen (PSA) test for men (Trivedi and Ayanian, 2006), and mammograms for women (Diamant et al., 2000), all of which being performed within the recommended time frames. These health services and preventive health behaviors can be viewed as social constructs, changing over time according to social norms at given times (Nathanson, 1977).

Receiving a mammogram is not part of a standard physical as pap smear is; rather, routine checkups have to be followed up with a specialist appointment. Hence, women who receive a mammogram may be thought of as *active preventive health service seekers*. In other words, these women may be more likely to seek routine preventive care and also participate in other healthy behaviors that could reduce mortality compared to women who did not receive a mammogram. For instance people who smoke tend to exhibit other unhealthy behaviors related to exercise, diet, alcohol, and preventive screening (Fredman et al., 1999; Rakowski et al., 1999).

In the U.S., nearly 40,000 women die each year due to breast cancer (DeSantis et al., 2013). Breast cancer screening by mammography has been shown to detect breast cancer before any signs or symptoms occur (Egan, 1962). The United States Prevention Services Task Force (USPSTF) recommends that women who are 50–74 years old and have average risk for breast cancer should receive a mammogram every two years (US Preventive Services Task Force, 2009). Other cancer organizations, such as the American Cancer Society (ACS), have changed previous screening recommendations to annual mammogram for women who are 45–55 years old and of average risk and every other year for women 55 and older (Oeffinger et al., 2015; Keating and Pace, 2015). Screening recommendations for high-risk women include annual mammograms beginning at age 30 (National Comprehensive Cancer Network, 2013). Furthermore, women at moderate risk are advised to discuss with their physician the timing for beginning routine mammograms and the frequency of receiving mammograms (National Comprehensive Cancer Network, 2013; National Cancer Institute, 2012).

Given the current mortality risk for breast cancer among women and the awareness and attention on breast cancer screening, we hypothesize that mammography screening to be a proxy for a woman's

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http://dx.doi.org/10.1016/j.pmedr.2016.10.012

predisposition to preventive health behaviors. The use of mammogram is an ideal proxy for health behavior since most screening is done when a woman does not exhibit any breast cancer symptoms. The routine use of mammography for women, particularly those who may be at increased risk of breast cancer, is important to reduce the number of lives lost to breast cancer (Berry et al., 2005; Kalager et al., 2010), but the act of obtaining a mammogram itself could be related to other causes of mortality. The effect of mammography on all-cause mortality and causes of death other than breast cancer have not been investigated.

Demographic characteristics, such as socioeconomic status, age and marital status, as well as access to a usual source of care, have been identified as factors associated with receiving preventive services (Weissman et al., 1991). For an accurate estimate of the effect of mammography on mortality rates, the influence of these factors, as well as measures of health status, must be controlled. This study examines whether mammography is associated with mortality due to causes other than breast cancer. In addition, this study examines how the probability of death changes with additional resources known to be associated with screening. The overall goal is to examine if ever having obtained a mammogram affects the mortality rate in U.S. females.

2. Methods

2.1. Data

This study uses data from the 2000 National Health Interview Survey (NHIS) Cancer Control Supplement (CSS) and linked mortality file. The NHIS is a cross-sectional, nationally representative survey of the civilian, non-institutionalized U.S. population (CDC/National Center for Health Statistics, 2012). The cancer screening section of the 2000 Cancer Control supplement collected information about several cancer screening tests received by sample adults, including mammograms. The linked mortality file used probabilistic matching to connect NHIS participants to death records from the National Death Index (NDI). This 2000 sample was followed through December 31, 2006, resulting in six-year follow-up from the initial survey. Data for this study was downloaded from the Integrated Health Interview Series (Minnesota Population Center and State Health Access Data Assistance Center, 2012).

2.2. Sample

The sampling technique and the sampling frame used by NHIS are described elsewhere (CDC/National Center for Health Statistics, 2012). The final sample was restricted to women who answered the cancer control supplement, had known vital status in the NDI and who were 30 and older at the time of the survey since NHIS only asked women in this age group about mammography use ($n = 89{,}574$). The incidence of breast cancer before 30 is small (American Cancer Society, 2013) and sensitivity analysis (not shown) used a sample of women 40 and older and did not yield significant differences in results. For this analysis, the person-level data file was reshaped into person-year records, which included one record for each year of survival following the survey until death or censorship.

2.3. Measures

The outcome of interest is the probability of death of each respondent. For each year of follow-up, this variable is categorized as death from any cause except breast cancer (from here referred to as ‘deaths’), and no death (reference). The specific cause of death is not available in the public access data file for survey participants in later NHIS samples or for participants who died after December 2006 (Minnesota Population Center and State Health Access Data Assistance Center, 2012). The NHIS asked women the main reason they had their most recent mammogram. The independent variable, “received mammogram” in this study included women who had never had a mammogram, those who had had a mammogram as part of a routine physical exam or screening test and those who had their first mammogram. It excluded women who had gotten a mammogram due to prior breast cancer diagnosis, a family history of breast cancer or a previously identified breast issue. The reliability of self-reported mammogram rates has been shown in different populations (Caplan et al., 2003). Current age was categorized into five-year intervals, starting with 30–34 (reference) to 80+ to calculate five-year mortality specific rates. Demographic variables included race, categorized as non-Hispanic White (reference), non-Hispanic Black, non-Hispanic Asian, Hispanic and other consisting of women who identified as American Indian/Alaska native, multiple or other race. Other variables included in the analyses were: education was categorized as <12 years (reference), 12 years, and >12 years; married was categorized as single (reference) and married; and poverty categorized as below the poverty line (reference) and at/above the poverty line. Finally a wealth variable was added that captures home ownership (yes or no). Health resource variables were also added. Access to care was measured with two variables: health insurance status and usual source of care. Insurance status was coded to insured and uninsured (reference). Usual source of care was coded as yes if women had one or more usual sources of care and no if women did not have a usual source of care (reference).

To capture a women's predisposition toward a healthy lifestyle or use of other preventive services, we included several measures of health behaviors. Alcohol use was categorized as never (reference), former drinker, and current drinker. Smoking status was categorized as never smoked (reference), current smoker, and former smoker. BMI was categorized as underweight (reference), normal, overweight, and obese. Self-rated health was categorized as not good (reference) if women said their health was poor or fair and good if their response was good, very good, or excellent. Finally, ever received a pap smear was coded as yes or no (reference).

2.4. Analysis

Data from NDI was used to determine who died among the NHIS participants and if death occurred within the five years following the survey. Descriptive statistics were used to summarize characteristics of the sample by survival and death. For a better understanding of the relationship between mammography and death, discrete time survival analysis was used to estimate the probability that each woman died as a function of whether she was screened or not in four models. This method is more appropriate than standard regression models because it accounts both for whether the respondent died during the follow-up period and her age of death (Allison, 2014). Model 1 was unadjusted; model 2 controlled for race, education, marital status, wealth and poverty; model 3 added additional health resources to model 2; and model 4 added health behaviors to model 3. Estimates from these models take the form of hazard ratios (Singer and Willett, 2003). Variance and standard error of the estimates were adjusted with individual, strata, and probability sampling unit (PSU) weights provided by NHIS. All analyses were carried out in Stata 13 (College Station, TX).

3. Results

Table 1 shows the descriptive statistics and survival status of the sample by mammogram receipt. Of the total sample of women analyzed, 61,114 had received a mammogram while 28,460 had never had a mammogram. Of the women who had never had a mammogram 1.1% of them had died during the interval period analyzed compared to 2.2% of women who had received a mammogram died during the same time period. In total, 1.8% of the sample or 1872 women died in the 5 year period following the survey. Table 2 shows hazard-odds ratios (HR) associated with the risk of mortality after receiving a mammogram across various models. Model 1 shows that receiving a mammogram, compared to not receiving a mammogram, was associated with a 24%

Table 1
Descriptive statistics and survival status (excluding breast cancer deaths) of U.S. females, 30 years and older by mammogram receipt.

Percentages	Never had a mammogram (n = 28,460)	Received a mammogram (n = 61,114)	Total (n = 89,574)
Survival status			
Alive	98.9	97.8	98.2
Dead	1.1	2.2	1.8
Age			
30–34	14.3	0.8	5.0
35–39	31.1	3.5	12.1
40–44	22.7	9.5	13.6
45–49	10.7	14.3	13.2
50–54	4.9	14.9	11.8
55–59	3.1	12.6	9.7
60–64	2.2	10.1	7.6
65–69	2.1	8.5	6.5
70–74	2.2	7.9	6.1
75–79	2.1	7.1	5.5
80+	4.6	10.8	8.9
+Race			
White	68.8	79.2	76
Black	12.9	10.6	11.3
Asian	4	1.9	2.5
Hispanic	9.1	5.7	6.8
Other	5.2	2.6	3.4
Years of education			
<12 years	16.6	14.9	15.4
12 years	33.9	35.7	35.1
>12 years	49.5	49.5	49.5
Poverty			
Below poverty line	13.2	9	10.4
At/above poverty line	86.8	91	89.6
Usual source of care			
No	14.9	5.1	8.1
Yes	85.1	94.9	91.9
Insurance status			
Uninsured	19.4	7.3	11.1
Insured	80.6	92.7	88.9
Smoking status			
Never	60.1	57	57.9
Former	26.4	17.9	20.6
Current	13.5	25.1	21.5
BMI			
Underweight	3.3	2.1	2.4
Normal	46.3	39.8	41.8
Overweight	24.6	29.9	28.3
Obese	25.8	28.2	27.5
Self-rated health			
Not good	9.8	15.7	13.9
Good	90.2	84.3	86.1
Alcohol use			
Never	29.2	28.3	28.6
Former	13.6	16.4	15.5
Current	57.2	55.3	55.9
Ever had a pap smear			
No	8.8	1.3	3.6
Yes	91.2	98.7	96.4

Source: Derived from National Health Interview Survey, 2000+ Racial groups are all non-Hispanic except the Hispanic group.

($p < 0.001$) reduction in the likelihood of death. These odds are reduced to 21.1% ($p < 0.001$) when demographic and socioeconomic variables are added in model 2 and reduced further in model 3 when health resource variables were added (20.9%, $p < 0.01$). The final adjusted model shows that women who received a mammogram had reduced their probability of death by 20% $p < 0.01$). The final model is also shown in Fig. 1.

Asian women had a significant reduction in odds of dying from breast cancer compared to non-Hispanic Whites in models 2 and 3 (53% and 52.6% respectively, $p < 0.05$). However, the significance disappeared in the final model when other health behaviors were accounted for. Models 2 and 3 show that those with >12 years of education were less likely (HR 0.82 and 0.83, $p < 0.05$) than those with <12 years of education to die. This significance also disappeared in the final model. Women who owned a home were significantly less likely to have died compared to women in did not own a home in all models. Finally, women who were at or above the poverty line were significantly more like to still be alive but the significance disappeared once health behavior variables were accounted in the final model.

Compared to abstainers, current drinkers were less likely to have died (17%, $p < 0.05$). As expected, current and former smokers, compared to never smokers, had increased probability of being dead while those with good health were less likely to have died (44%, $p < 0.001$). Across all BMI categories, a reduction in the likelihood of death was observed compared to being underweight.

4. Discussion

The risk of developing breast cancer varies based on race, age and family history (U.S. Cancer Statistics Working Group, 2015), and most women will not develop breast cancer during their lifetime (Oeffinger et al., 2015; U.S. Cancer Statistics Working Group, 2015). Obtaining a mammogram requires a measure of judgment of the risk of potentially developing breast cancer with the burden associated with testing, a decision based on personal preference and ideally with clinical guidance. A 2011 study investigating the effects of the change in USTFP guidelines found that a majority of women surveyed would not delay routine screening exams to age 50, even if their doctor made such a recommendation (Davidson et al., 2011). These women value the potential early detection benefit and would be willing to accept the risk of additional testing. Are these women more likely to engage in other preventive interventions and or engage in healthy behaviors that could affect mortality rates? Breast cancer awareness is so widespread in the U.S., even being advertised in beauty salons and by the U.S. postal service (Linnan et al., 2001; Woloshin et al., 1999) that it is plausible to use mammograms as a proxy for use of preventive services in women.

Using a nationally representative sample of U.S. females, this current study examined the mortality rates for women who had and those who never had a mammogram, controlling for socio-demographic, health resource, and behavior variables. The results show that that mammography is associated with mortality from causes other than breast cancer in the sample population after controlling for demographic, health resource, and health behavior variables. Women who undergo mammograms may seek other preventive health services or engage in healthy behaviors that affect mortality and supports previous research examining health behaviors. Schwartz et al. (2004) found that most women who had undergone a pap smear or mammogram and most men who had been screened with a PSA planned to undergo annual testing (Schwartz et al., 2004). People with unhealthy habits such as smoking tend to have fewer medical visits, and cigarette smokers who are heavy drinkers have lower rates of prevention activities (Fredman et al., 1999).

Our hypothesis assumes that health behaviors are correlated, meaning that performing one behavior will predict another. Liang et al. (1999) examined correlations among preventive health behaviors using a population-based sample. Twenty-five percent of these correlations among females were significant and included fruit and vegetable consumption being correlated to exercise behavior and pap smears and clinical breast examinations and mammograms being significantly

Table 2
Risk of death in hazard odds ratio associated with screening status and risk of death from all causes except breast cancer controlling for demographic, health resources and health behavior variables, among U.S. females, 2000.

	Model 1	Model 2	Model 3	Model 4
Had a mammogram	0.759*** [0.679,0.849]	0.789** [0.682,0.912]	0.791** [0.686,0.912]	0.800** [0.681,0.940]
Age (ref = 30–34)				
35–39	1.31 [0.334,5.152]	1.25 [0.313,4.943]	1.25 [0.313,4.943]	1.03 [0.255,4.185]
40–44	3.902* [1.068,14.25]	3.40 [0.915,12.66]	3.40 [0.915,12.63]	3.07 [0.824,11.41]
45–49	9.498*** [2.785,32.40]	7.280** [2.117,25.04]	7.251** [2.111,24.90]	6.114** [1.773,21.09]
50–54	10.18*** [2.893,35.84]	9.639*** [2.721,34.14]	9.596*** [2.712,33.96]	8.155** [2.297,28.95]
55–59	17.89*** [5.171,61.92]	14.95*** [4.222,52.98]	14.89*** [4.205,52.75]	12.42*** [3.490,44.19]
60–64	24.01*** [6.953,82.95]	20.45*** [5.866,71.29]	20.46*** [5.865,71.34]	16.70*** [4.767,58.51]
65–69	34.22*** [9.933,117.9]	25.59*** [7.378,88.75]	24.87*** [7.171,86.22]	20.24*** [5.790,70.72]
70–74	45.47*** [13.37,154.7]	36.24*** [10.62,123.6]	35.72*** [10.44,122.2]	29.40*** [8.470,102.0]
75–79	87.57*** [25.88,296.4]	65.30*** [19.18,222.3]	63.66*** [18.63,217.5]	54.23*** [15.62,188.3]
80+	227.5*** [67.49,766.7]	162.5*** [48.02,549.8]	159.2*** [46.89,540.5]	157.3*** [45.48,544.2]
+Race (ref = White)				
Black		0.99 [0.839,1.157]	1.00 [0.847,1.168]	0.98 [0.818,1.172]
Asian		0.470* [0.242,0.912]	0.474* [0.245,0.920]	0.58 [0.307,1.106]
Hispanic		0.83 [0.664,1.040]	0.84 [0.672,1.057]	0.92 [0.732,1.165]
Other		0.82 [0.566,1.187]	0.84 [0.576,1.215]	0.77 [0.546,1.097]
Education (ref <12 years)				
12 years		0.96 [0.836,1.103]	0.96 [0.839,1.107]	1.06 [0.910,1.222]
>12 years		0.824* [0.706,0.962]	0.827* [0.708,0.966]	1.00 [0.850,1.181]
Poverty (ref below poverty line)				
At/above poverty line		0.795** [0.686,0.922]	0.796** [0.686,0.923]	0.92 [0.789,1.079]
Marital status (ref = single)				
Married		0.88 [0.768,1.010]	0.88 [0.763,1.008]	0.90 [0.782,1.032]
Wealth (ref = does not own home)				
Owns home		0.740*** [0.650,0.843]	0.741*** [0.649,0.847]	0.828** [0.725,0.946]
Usual source of care (ref No)				
Yes			0.94 [0.711,1.245]	0.88 [0.658,1.178]
Insurance status (ref uninsured)				
Insured			1.12 [0.808,1.563]	1.27 [0.918,1.763]
Smoking status (ref never smoked)				
Former smoker				2.624*** [2.215,3.107]
Current smoker				1.549*** [1.343,1.786]
BMI (ref underweight)				
Normal				0.640** [0.478,0.858]
Overweight				0.607*** [0.452,0.815]
Obese				0.743* [0.553,0.997]
Self-rated health (ref not good)				
Good				0.556*** [0.481,0.643]

Table 2 (*continued*)

	Model 1	Model 2	Model 3	Model 4
Alcohol use (ref abstainer)				
Former drinker				1.11 [0.952,1.300]
Current drinker				0.830* [0.719,0.957]
Ever received a pap smear (ref no)				
Yes				0.98 [0.775,1.244]

Source: Derived from National Health Interview Survey, 2000 and National death Index, 2000–2005; Hazard odds ratio coefficients; Standard errors below; *$p<0.05$, **$p<0.01$, ***$p<0.001$. +Racial groups are all non-Hispanic except the Hispanic group.

correlated to medical and cholesterol checkup behaviors among middle age women (Liang et al., 1999).

Although factors such as age, health care access issues, and socioeconomic status have been shown to limit preventive care use (Barkley, 2008), another possibility is that people who live less healthy lives hold beliefs that are barriers to receiving preventive services. The health belief model suggests health behaviors are determined, in part, by individual perception of susceptibility to an outcome and benefit of the behavior over perceived barriers (Glanz et al., 2008). Hence, changes in perceptions and attitudes will be necessary to change or influence health behaviors and increase use of preventive services. Identifying characteristics of women who are more likely to engage in preventive behavior may help health and education interventions identify and target vulnerable populations. Studies have shown a variety of factors influence health behavior, including attitudes, health-related knowledge, provider-patient interaction, and access to health services; (Liang et al., 1999) however, future work is needed to examine differences within attitudes toward preventive care.

Our findings should be interpreted in light of several potential limitations. Previous research has shown that self-reported estimates tend to underestimate screening rates (Boxwala et al., 2010). There is also no way to determine if the stated screening reflects actual behavior. Furthermore, participants may have over reported their participation in screening due to positive implications of being screened. However, Caplan et al. (2003) and Zapka et al. (1996) examined the accuracy of self-reported mammography rates among diverse sample of women and found that self-report data are generally valid, more so when participants were asked to recall most recent mammogram (Caplan et al., 2003; Zapka et al., 1996). Finally, the cross-sectional design of the dataset prevents us from determining if women received a mammogram after the survey was conducted.

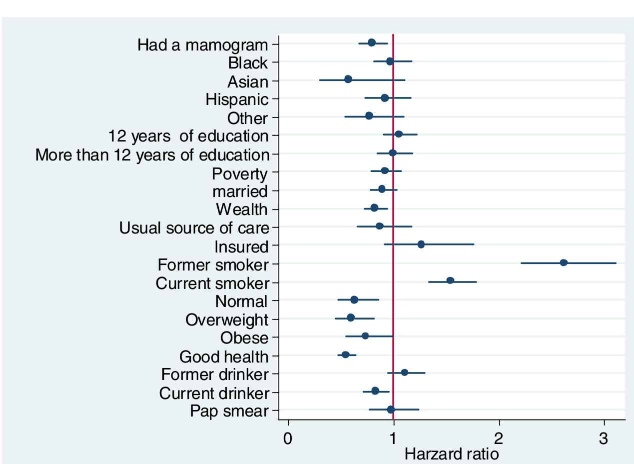

Fig. 1. Adjusted hazard ratio of death from all causes except breast cancer.

Since 2009, the focal point of studies examining mammography has found evidence for age-based screening recommendations (Allen et al., 2013; Weeks et al., 2012). In developing its new breast cancer screening recommendations, the American Cancer Society "judged women's values and preferences as having a more important role in decisions where the balance of absolute benefits and harms is less certain." (Oeffinger et al., 2015). Our findings suggest an even greater utility in promoting mammograms for women beyond that of preventing breast cancer – increased odds of utilizing other preventive services which demonstrated reduced mortality among women. Therefore, equal physician recommendations play an important role in addressing health disparities, particularly among the most vulnerable women in the U.S. While the use of mammograms to predict breast cancer mortality merits further consideration, if a proxy for a woman's predisposition for additional preventive screenings, encouraging mammography may be a pivotal pathway for preventing mortality due to other causes for women. Furthermore, if women who receive mammograms are indeed more likely to engage in healthy behaviors compared to those who do not receive a mammogram, disparities in breast cancer screening will have greater detrimental consequences above and beyond predicting breast cancer mortality.

Funding source

No funding was secured for this study.

Financial disclosure

Authors have no financial relationships relevant to this article to disclose.

Acknowledgment

The authors would like to thank Jennifer Van Hooke for helping with data analysis and Rhonda BeLue for reviewing earlier drafts of this paper. The authors also acknowledge the support of this research by grant UL1 TR000127 and KL2 TR000126 from the National Center for Advancing Translational Sciences (NCATS), as well as the Penn State Hershey Cancer Institute, Social Science Research Institute, and Clinical and Translational Science Institute.

References

Allen, J.D., et al., 2013. Women's responses to changes in U.S. preventive task force's mammography screening guidelines: results of focus groups with ethnically diverse women. BMC Public Health 13 (1169).

Allison, P.D., 2014. Event History and Survival Analysis. Sage .

American Cancer Society, 2013. American Cancer Society recommendations for early breast cancer detection in women without breast symptoms.Available at:. http://www.cancer.org/cancer/breastcancer/moreinformation/breastcancerearlydetection/breast-cancer-early-detection-acs-recs (Accessed: 17th December 2013).

Barkley, G.S., 2008. Factors influencing health behaviors in the National Health and Nutritional Examination Survey, III (NHANES III). Soc. Work Health Care 46, 57–79.

Berry, D.A., et al., 2005. Effect of screening and adjuvant therapy on mortality from breast cancer. N. Engl. J. Med. 353, 1784–1792.

Boxwala, F.I., Bridgemohan, A., Griffith, D.M., Soliman, A.S., 2010. Factors associated with breast cancer screening in Asian Indian women in metro-Detroit. J. Immigr. Minor. Health 12, 534–543.

Caplan, L.S., et al., 2003. Validity of women's self-reports of cancer screening test utilization in a managed care population. Cancer Epidemiol. Biomark. Prev. 12, 1182–1187.

CDC/National Center for Health Statistics, 2012. NHIS - about the National Health Interview Survey.Available at:. http://www.cdc.gov/nchs/nhis/about_nhis.htm (Accessed: 16th December 2013).

Davidson, A.S., Liao, X., Magee, B.D., 2011. Attitudes of women in their forties toward the 2009 USPSTF mammogram guidelines: a randomized trial on the effects of media exposure. Am. J. Obstet. Gynecol. 205, 30.e1–30.e7.

DeSantis, C., Ma, J., Bryan, L., Jemal, A., 2013. Breast cancer statistics, 2013. CA Cancer J. Clin. http://dx.doi.org/10.3322/caac.21203 .

Diab, M.E., Johnston, M.V., 2004. Relationships between level of disability and receipt of preventive health services. Arch. Phys. Med. Rehabil. 85, 749–757.

Diamant, A.L., Schuster, M.A., Lever, J., 2000. Receipt of preventive health care services by lesbians. Am. J. Prev. Med. 19, 141–148.

Egan, R.L., 1962. Mammography, an aid to diagnosis of breast carcinoma. JAMA 182, 839–843.

Fredman, L., et al., 1999. Cigarette smoking, alcohol consumption, and screening mammography among women ages 50 and older. Prev. Med. 28, 407–417.

Glanz, K., Rimer, B.K., Viswanath, K., 2008. Health Behavior and Health Education: Theory, Research, and Practice. John Wiley & Sons .

Hayward, R.S.A., Steinberg, E.P., Ford, D.E., Roizen, M.F., Roach, K.W., 1991. Preventive care guidelines: 1991. Ann. Intern. Med. 114, 758–783.

Kalager, M., Zelen, M., Langmark, F., Adami, H.-O., 2010. Effect of screening mammography on breast-cancer mortality in Norway. N. Engl. J. Med. 363, 1203–1210.

Kasl, S.V., Cobb, S., 1966. Health behavior, illness behavior and sick role behavior. Arch. Environ. Health Int. J. 12, 246–266.

Keating, N.L., Pace, L.E., 2015. New guidelines for breast cancer screening in us women. JAMA 314, 1569–1571.

Liang, W., Shediac-Rizkallah, M.C., Celentano, D.D., Rohde, C., 1999. A population-based study of age and gender differences in patterns of health-related behaviors. Am. J. Prev. Med. 17, 8–17.

Linnan, L.A., et al., 2001. Working with licensed cosmetologists to promote health: results from the North Carolina BEAUTY and health pilot study. Prev. Med. 33, 606–612.

Minnesota Population Center and State Health Access Data Assistance Center, 2012s. Integrated health interview series: version 5.0.Available at:. http://www.ihis.us (Accessed: 17th December 2013).

Musa, D., Schulz, R., Harris, R., Silverman, M., Thomas, S.B., 2009. Trust in the health care system and the use of preventive health services by older black and white adults. Am. J. Public Health 99, 1293–1299.

Nathanson, C.A., 1977. Sex roles as variables in preventive health behavior. J. Community Health 3, 142–155.

National Cancer Institute, 2012. Mammograms fact sheet - National Cancer Institute.Available at:. http://www.cancer.gov/cancertopics/factsheet/detection/mammograms (Accessed: 17th December 2013).

National Comprehensive Cancer Network, 2013. NCCN clinical practice guidelines in oncology (NCCN guidelines).Available at:. http://www.nccn.org/professionals/default.aspx (Accessed: 17th December 2013).

Oeffinger, K.C., Fontham, E.H., Etzioni, R., et al., 2015. Breast cancer screening for women at average risk: 2015 guideline update from the American cancer society. JAMA 314, 1599–1614.

Rakowski, W., Clark, M.A., Ehrich, B., 1999. Smoking and cancer screening for women ages 42–75: associations in the 1990–1994 National Health Interview Surveys. Prev. Med. 29, 487–495.

Schwartz, L.M., Woloshin, S., Fowler Jr., F.J., Welch, H., 2004. Enthusiasm for cancer screening in the United States. JAMA 291, 71–78.

Singer, J.D., Willett, J.B., 2003. Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence. Oxford University Press .

Sox, H.J., 1994. Preventive health services in adults. N. Engl. J. Med. 330, 1589–1595.

Trivedi, A.N., Ayanian, J.Z., 2006. Perceived discrimination and use of preventive health services. J. Gen. Intern. Med. 21, 553–558.

U.S. Cancer Statistics Working Group, 2015. United States Cancer Statistics: 1999–2012 Incidence and Mortality Web-Based Report. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute, Atlanta (Available at: www.cdc.gov/uscs Accessed: 1st December 2015).

US Preventive Services Task Force, 2009. Screening for breast cancer: U.S. preventive services task force recommendation statement. Ann. Intern. Med. 151, 716–726 (NaN-236).

Weeks, B.E., Friedenberg, L.M., Southwell, B.G., Slater, J.S., 2012. Behavioral consequences of conflict-oriented health news coverage: the 2009 mammography guideline controversy and online information seeking. Health Commun. 27, 158–166.

Weissman, J.S., Stern, R., Fielding, S.L., Epstein, A.M., 1991. Delayed access to health care: risk factors, reasons, and consequences. Ann. Intern. Med. 114, 325–331.

Woloshin, S., Schwartz, L.M., The, U.S., 1999. Postal service and cancer screening–stamps of approval? N. Engl. J. Med. 340, 884–887.

Zapka, J.G., et al., 1996. Mammography use among sociodemographically diverse women: the accuracy of self-report. Am. J. Public Health 86, 1016–1021.