Change in Mammography Use Following the Revised Guidelines from the U.S. Preventive Services Task Force

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Abstract: The U.S. Preventive Services Task Force (USPSTF) recommended screening mammography every 1–2 years for women 40 years and older in 2002, and changed its recommendations in 2009 to no routine screening for women between 40 and 49 years of age; and biennial screening for women between 50 and 74 years of age. This study evaluates the change in mammographic use after the issuance of the revised recommendations. Women who participated in a cross-sectional study of breast cancer risk factors from 2007 to 2013 were asked if they had received a mammogram in the preceding 2 years. All 3442 study participants who enrolled in the study after January 1, 2011 were matched by race, age, and educational level with women enrolled between 2007 and 2010. The proportions of women who stated they had received a mammogram in the past 2 years were compared between the two groups. One fourth of the participants were African American and 39% were 40–49 years of age. Among white women, significant decreases in recent mammogram use from 2007–2010 to 2011–2013 were detected for women 40–49 years of age (−10.3%, p < 0.001) and 50–74 years of age (−8.8%, p < 0.001). Among African-American women, the change in recent mammogram use was not statistically significant for women 40–49 years of age (−2.7%, p = 0.440) or 50–74 years of age (−2.2%, p = 0.398). Following the change in the USPSTF guidelines, mammography use among white women declined; however, no change was observed among African-American women.

Key Words: breast cancer, mammography, screening

Breast cancer is the most frequently diagnosed non-skin cancer among women in the USA (1). Non-palpable breast cancers identified solely by screening mammography are smaller and more likely to be either in situ or node negative than those identified by other methods (2). Screening mammography reduces the breast cancer mortality rate (3), and the absolute number of prevented deaths increases with follow-up time (4). Early detection of breast cancer by mammography increases the likelihood that patients will be candidates for breast conservation surgery (5,6) and not require chemotherapy (6). Potential harms related to mammography include radiation exposure, pain due to breast compression, psychological distress and anxiety, and additional imaging and biopsies (7).

The U.S. Preventive Services Task Force (USPSTF) recommended screening mammography every 1–2 years for women 40 years and older in 2002 (8), and revised those recommendation in 2009 (9). Routine screening was not recommended for women between 40 and 49 years of age, but the recommendations stated that the decision to initiate regular, biennial screening mammography before age 50 should be an individual one (9). Biennial screening was recommended for women between 50 and 74 years of age; and no recommendation for or against screening mammography was issued for women 75 years or older due to insufficient evidence (9). These recommendations differed from those of the American Cancer Society (ACS) (10) and the American College of Radiology (ACR) (11), which recommended annual screening mammograms for women 40 years of age and older. After the release of the revised USPSTF...
guidelines, the American College of Obstetricians and Gynecologists (ACOG) endorsed annual mammographic screening for women 40 years and older (12).

The revised recommendations received intense media coverage: 51.9% of newspaper articles, blogs, and twitter feeds were negative and 17.6% were supportive (13). The publicity brought awareness to the issue of screening mammography, but not a clear understanding of the new guidelines on the part of health care providers (14) or the lay public (15,16). In a survey of obstetricians–gynecologists at a tertiary care center, 48.7% correctly reported that the guidelines recommended that screening mammography was to start at 50 years of age and 46.2% knew that biennial screening was recommended for women between 50 and 74 years of age (14).

In a survey of female patients, 87% were aware of the revised USPSTF guidelines, but two thirds were unclear about the starting age and recommended frequency of screening mammograms (15). In a national phone survey of women evenly divided between those 40–49 years of age and 50–74 years of age, 50.8% of younger women and 33.0% of older women knew about the revised guidelines (16).

The purpose of this study was to evaluate the change in mammography use associated with the release of the 2009 USPSTF guidelines in a cross-sectional study of women which collected individual-level data. By matching demographic characteristics, the objective was to assess differential changes in mammography use.

**METHODS**

Recruitment procedures for this cross-sectional study have been described previously (17). Women were recruited during community events designed to increase breast cancer awareness. After participants signed a consent form, they completed a questionnaire, provided a saliva sample, and were asked if they were willing to be contacted to participate in further research studies. The questionnaire captured demographic characteristics, risk factors for breast cancer, and prior personal and family history of breast cancer. Educational levels were categorized into women who had graduated from high school or had completed their education prior to completing high school; women who had gone to college or technical training, but had not graduated from college; and women who had graduated from college.

This analysis is based on study participants who resided in Arkansas, were at least 40 years of age and less than 75 years of age at the time of enrollment, were white or African American (AA), did not have a history of breast cancer, provided information on educational level, and enrolled in the study between September 2007 and April 2013. The USPSTF revised recommendations were released in November 2009 (9). Our questionnaire asked participants whether or not they had received a mammogram in the preceding 2 years. For the calendar year 2010, 69% of the months in the preceding 2 years occurred on or before November 2009. Thus, two time periods were studied based on year of participant enrollment: 2007–2010 and 2011–2013. Each participant who enrolled after January 1, 2011 was randomly matched with a participant enrolled prior to that time by race (white or AA), age in 5-year increments (40–44, 45–49, 50–54, 55–59, 60–64, 65–69, and 70–74), and educational level as described above.

Differences in recent mammography use between time periods were estimated using their point estimates and 95% asymptotic confidence intervals, and compared using the z-test. All statistical significance levels were two sided, and the criterion for statistical significance was the 0.05 level. All analyses were performed using SAS 9.4 (SAS Institute, Cary, NC).

**RESULTS**

A total of 3,442 women enrolled after January 1, 2011, and 3,442 race–age–educational-level-matched women enrolled prior to that time were included in this analysis: 26% were AA and 74% were white (Table 1). The majority of women were at least 50 years of age (61%); and 35% had a college degree.

Among white women, 64.8% and 76.8% of those 40–49 years of age and 50–74 years of age, respectively, reported having had a recent mammogram between 2007 and 2010; 54.5% and 68.0% of

| Age in years | White, N (%) | African-American, N (%) |
|--------------|--------------|--------------------------|
| 40–49        | 962 (37.9)   | 371 (41.0)               |
| 50–74        | 1,575 (62.1) | 534 (59.0)               |

| Educational level | White, N (%) | African-American, N (%) |
|-------------------|--------------|--------------------------|
| High school graduate | 837 (33.0)  | 305 (33.7)               |
| Some college       | 807 (31.8)  | 278 (30.7)               |
| College graduate   | 893 (35.2)  | 322 (35.6)               |
younger and older white women, respectively, reported recent mammogram use between 2011 and 2013 (Table 2). Among AA women between 40–49 years and 50–74 years of age, 66.8% and 75.8% reported a recent mammogram between 2007 and 2010; 64.2% and 73.6%, respectively, reported having had a biennial mammogram between 2011 and 2013. For white women, significant decreases were observed for women who had not completed college. Among AA women, only older women who had completed their education by high school showed a significant decrease in mammogram use.

Women who had completed their education by high school experienced a greater decline in mammography use from 2007–2010 to 2011–2013 than their counterparts who had graduated from college for both white (p = 0.005) and AA women (p = 0.004). The decline in mammography use did not differ by age group for white (p = 0.575) or AA women (p = 0.918).

**DISCUSSION**

In comparison to the USA population as a whole, the study population has a greater proportion of minority participants and lower proportion of women who did not pursue post-secondary education. Demographic characteristics reflect the geographic location of the study and the high educational level may be related to the recruitment of study participants at events aimed at raising awareness of breast cancer.

Reports on the change in mammography use after the release of the USPSTF recommendations in 2009 are mixed (18–25). Our findings for white women are consistent with the decline in annual and biennial mammography use in Vermont from 2009 to 2011 (18) and the abrupt drop in 2010 in screening mammography utilization following an increase from 2005 to 2009 among older women based on data from the Medicare Part B physician/supplier files (21). No significant change in mammography rates were observed in the Medical Expenditure Panel Surveys (19), National Health Interview study (20), and the Behavioral Risk Factor Surveillance System (25). A small decrease in mammography use was detected among women in their forties and no change was detected in older women (24). After adjustment for socioeconomic and access to care factors, no difference in breast mammography screening rates after the

**Table 2. Recent Mammogram Use**

| Age group   | Education | White women | African-American women |
|-------------|-----------|-------------|------------------------|
|             |           | Recent mammogram use 2007-2010 (%) | Difference (95% CI) | p-value* | Recent mammogram use 2007-2010 (%) | Difference (95% CI) | p-value* |
| 40–49 years | ≤H.S. grad | 60.8 | 44.0 | -16.8 (-25.1, -8.6) | < 0.001 | 57.9 | 46.1 | -11.8 (-27.6, 3.9) | 0.141 |
|             | Some college | 55.9 | 49.2 | -10.7 (-18.4, -3.0) | < 0.006 | 66.6 | 63.5 | -3.1 (-6.3, 1.1) | 0.571 |
|             | College grad | 71.8 | 66.7 | -5.1 (-11.7, 1.5) | < 0.131 | 69.6 | 73.4 | -3.8 (-6.2, 13.7) | 0.454 |
|             | All levels | 64.8 | 54.5 | -10.3 (-14.6, -5.9) | < 0.001 | 66.8 | 64.2 | -2.7 (-9.5, 4.1) | 0.440 |
| 50–74 years | ≤H.S. grad | 71.8 | 60.1 | -11.7 (-17.2, -6.2) | < 0.001 | 77.7 | 66.4 | -11.3 (-19.5, -3.2) | 0.006 |
|             | Some college | 78.0 | 67.8 | -10.2 (-15.7, -4.7) | < 0.001 | 66.7 | 76.8 | 7.1 (-3.6, 17.7) | 0.192 |
|             | College grad | 81.0 | 76.8 | -4.2 (-9.2, 0.7) | < 0.094 | 81.1 | 83.5 | 2.4 (-5.8, 10.7) | 0.562 |
|             | All levels | 76.8 | 68.0 | -8.8 (-11.9, -5.6) | < 0.094 | 75.8 | 73.6 | -2.2 (-7.5, 3.0) | 0.398 |
| 40–74 years | ≤H.S. grad | 68.2 | 54.8 | -13.4 (-18.0, -8.8) | < 0.001 | 72.8 | 61.3 | -11.5 (-18.9, -4.1) | 0.002 |
|             | Some college | 70.9 | 60.5 | -10.4 (-15.0, -5.8) | < 0.001 | 67.6 | 68.7 | 1.1 (-0.7, 8.8) | 0.785 |
|             | College grad | 77.2 | 72.6 | -4.6 (-8.6, -0.6) | < 0.025 | 75.5 | 78.6 | 3.1 (-3.4, 9.6) | 0.349 |
|             | All levels | 72.2 | 62.9 | -9.3 (-11.9, -6.8) | < 0.001 | 72.2 | 69.7 | -2.4 (-6.6, 1.8) | 0.255 |

*p-value* based on the z-test for risk difference.
USPSTF guideline changes were detected in Medicare beneficiaries (23). These studies reported mammography rates aggregated across racial groups. Our results are similar to those reported in a commercially insured population that showed significant decreases in biennial mammography rates among white, Hispanic, and Asian women, but no change among AA women (22). Race and ethnicity information were based on neighborhood information for each woman.

The degree to which the decline in biennial mammography use is related to the change in the USPSTF guidelines remains unclear. The guideline changes would have been expected to have the greatest impact among women in their forties, but our results did not show a differential change between women in their forties and older women across racial groups. As the release of the USPSTF recommendations occurred during a recession of 2007-2009 in the USA, some of the decrease in mammographic use might be attributed to the effects of the recession: increased unemployment rate (26), increased proportion of persons without health insurance (26), rising cost of premiums for employer-provided insurance, and an increase in out-of-pocket expenses (27). A modest decline in mammography use associated with the recession has been reported in white women, with no change among AA women (28). The large decline in biennial mammography levels among those whose education was completed at high school in this study may reflect the disproportionate impact of the recession on this group.

The reason for the racial disparity with respect to the impact of the USPSTF-revised recommendations on recent mammographic use remains unclear. In a web-based survey of women conducted shortly after the release of the revised USPSTF guidelines, there was no difference between AA and white women with respect to their knowledge of the guidelines, or the perceived effect of the new guidelines (13,16). Minority representation in studies that assessed awareness and potential action related to the revised guidelines, however, was limited (13,16,29). It has been reported that AA women more accurately perceive the benefits of mammographic screening (30). Although predicted breast cancer risk does not differ by race (31), AA women are diagnosed with breast cancer at a more advanced stage, and have a poorer prognosis than white women (32).

The USPSTF guidelines were not universally implemented and many physicians adhered to the guidelines of the ACS, ACR, or ACOG. Some women may have obtained a screening mammography due to concerns that third-party payers might cease to cover mammograms that were not administered in accordance with the USPSTF guidelines (33). Alternatively, the media attention that accompanied the issuance of the revised USPSTF guidelines may have reminded women to schedule their mammograms.

The foremost strength of this study is the large sample size, the matching by age, race, and educational level, and the overrepresentation of AAs who are typically underrepresented in research studies (34–37). There are, however, limitations to this study. The women recruited to the study attended events that increased breast cancer awareness, and may have been highly motivated to participate due to risk factors such as family history. Study participants were more highly educated than the general population of women at risk for breast cancer. The study population was primarily from the south-central area of the USA and may vary from women who live in other regions of the country. Health insurance and employment information was not available for study participants. Information on mammographic use came from self-report.

This report shows that the release of the revised guidelines for screening mammography by the USPSTF in 2009 was associated with a decline in mammographic use among white women, but not among AA women. Future studies should address the reasons for this racial disparity.

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REFERENCES

1. Desantis C, Ma J, Bryan L, et al. Breast cancer statistics, 2013. CA Cancer J Clin 2014;64:32–62.
2. Smith RA, Cokkinides V, Eyre HJ. Cancer screening in the United States, 2007: a review of current guidelines, practices, and prospects. CA Cancer J Clin 2007;57:90–104.
3. Berry DA, Cronin KA, Plevritis SK, et al. Effect of screening and adjuvant therapy on mortality from breast cancer. N Engl J Med 2005;353:1784–92.
4. Tabar L, Vitak B, Chen TH, et al. Swedish two-county trial: impact of mammographic screening on breast cancer mortality during 3 decades. Radiology 2011;260:658–63.
5. Freedman GM, Anderson PR, Goldstein LJ, et al. Routine mammography is associated with earlier stage disease and greater...
eligibility for breast conservation in breast carcinoma patients age 40 years and older. Cancer 2003;98:918–25.
6. Barth RJ Jr, Gibson GR, Carney PA, et al. Detection of breast cancer on screening mammography allows patients to be treated with less-toxic therapy. AJR Am J Roentgenol 2005;184:324–9.
7. Nelson HD, Tyne K, Naik A, et al. Screening for breast cancer: an update for the U.S. Preventive Services Task Force. Ann Intern Med 2009;151:727–37, W237-42.
8. U.S. Preventive Services Task Force. Screening for breast cancer: recommendations and rationale. Ann Intern Med 2002;137 (5 Part 1):344–6.
9. U.S. Preventive Services Task Force. Screening for breast cancer: U.S. Preventive Services Task Force recommendation statement. Ann Intern Med 2009;151:716–26, W-236.
10. Smith RA, Cokkinides V, Brooks D, et al. Cancer screening in the United States, 2011: a review of current American Cancer Society guidelines and issues in cancer screening. CA Cancer J Clin 2011;61:8–30.
11. Lee CH, Dershaw DD, Kopans D, et al. Breast cancer screening with imaging: recommendations from the Society of Breast Imaging and the ACR on the use of mammography, breast MRI, breast ultrasound, and other technologies for the detection of clinically occult breast cancer. J Am Coll Radiol 2010;7:18–27.
12. American College of Obstetricians-Gynecologists. Practice bulletin no. 122: breast cancer screening. Obstet Gynecol 2011;118 (2 Pt 1):372–82.
13. Squiers LB, Holden DJ, Dolina SE, et al. The public’s response to the U.S. Preventive Services Task Force’s 2009 recommendations on mammography screening. Am J Prev Med 2011;40:497–504.
14. Hinz EK, Kudesia R, Rolston R, et al. Physician knowledge of and adherence to the revised breast cancer screening guidelines by the United States Preventive Services Task Force. Am J Obstet Gynecol 2011;205:201 e1-5.
15. Allen SV, Solberg Nes L, Marnach ML, et al. Patient understanding of the revised USPSTF screening mammogram guidelines: need for development of patient decision aids. BMC Womens Health 2012;12:36.
16. Kiviniemi MT, Hay JL. Awareness of the 2009 US Preventive Services Task Force recommended changes in mammography screening guidelines, accuracy of awareness, sources of knowledge about recommendations, and attitudes about updated screening guidelines in women ages 40–49 and 50+.. BMC Public Health 2012;12:899.
17. Bondurant KL, Harvey S, Klimberg S, et al. Establishment of a southern breast cancer cohort. Breast J 2011;17:281–8.
18. Sprague BL, Bolton KC, Mace JL, et al. Registry-based study of trends in breast cancer screening mammography before and after the 2009 U.S. Preventive Services Task Force recommendations. Radiology 2014;270:354–61.
19. Howard DH, Adams EK. Mammography rates after the 2009 US Preventive Services Task Force breast cancer screening recommendation. Prev Med 2012;55:485–7.
20. Pace LE, He Y, Keating NL. Trends in mammography screening rates after publication of the 2009 US Preventive Services Task Force recommendations. Cancer 2013;119:2518–23.
21. Sharpe RE Jr, Levin DC, Parker L, et al. The effect of the controversial US Preventive Services Task Force recommendations on the use of screening mammography. J Am Coll Radiol 2013;10:21–4.
22. Wharam JF, Landon B, Zhang F, et al. Mammography rates 3 years after the 2009 US Preventive Services Task Force guidelines changes. J Clin Oncol 2015;33:1067–74.
23. Salloum RG, Kohler RE, Jensen GA, et al. U.S. Preventive Services Task Force recommendations and cancer screening among female Medicare beneficiaries. J Womens Health (Larchmt) 2014;23:211–7.
24. Wang AT, Fan J, Van Houten HK, et al. Impact of the 2009 US Preventive Services Task Force guidelines on screening mammography rates on women in their 40s. PLoS ONE 2014;9:e91399.
25. Block LD, Jarlenski MP, Wu AW, et al. Mammography use among women ages 40–49 after the 2009 U.S. Preventive Services Task Force recommendation. J Gen Intern Med 2013;28:1447–53.
26. Holahan J. The 2007-09 recession and health insurance coverage. Health Aff (Millwood) 2011;30:145–52.
27. Claxton G, DiJulio B, Whitmore H, et al. Health benefits in 2010: premiums rise modestly, workers pay more toward coverage. Health Aff (Millwood) 2010;29:1942–50.
28. King CJ, Chen J, Garza MA, et al. Breast and cervical screening by race/ethnicity: comparative analyses before and during the Great Recession. Am J Prev Med 2014;46:359–67.
29. Davidson AS, Liao X, Magee BD. 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 2011;205:30 e1-7.
30. Haggstrom DA, Schapira MM. Black-white differences in risk perceptions of breast cancer survival and screening mammography benefit. J Gen Intern Med 2006;21:371–7.
31. Lee JY, Klimberg S, Bondurant KL, et al. Cross-sectional study to assess the association of population density with predicted breast cancer risk. Breast J 2014;20:615–21.
32. Clarke CA, West DW, Edwards BK, et al. Existing data on breast cancer in African-American women: what we know and what we need to know. Cancer 2003;97(1 Suppl):211–21.
33. Allen JD, Bluethmann SM, Sheets M, et al. 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 2013;13:1169.
34. Baquet CR, Commiskey P, Daniel Mullins C, et al. Recruitment and participation in clinical trials: socio-demographic, rural/urban, and health care access predictors. Cancer Detect Prev 2006;30:24–33.
35. Rochon PA, Mashari A, Cohen A, et al. The inclusion of minority groups in clinical trials: problems of under representation and under reporting of data. Account Res 2004;11:215–23.
36. Murthy VH, Krumholz HM, Gross CP. Participation in cancer clinical trials: race-, sex-, and age-based disparities. JAMA 2004;291:2720–6.
37. UyBico SJ, Pavel S, Gross CP. Recruiting vulnerable populations into research: a systematic review of recruitment interventions. J Gen Intern Med 2007;22:852–63.