Original Investigation

Screening Mammography in Older Women

Effect of Wealth and Prognosis

Brie A. Williams, MD; Karla Lindquist, MS; Rebecca L. Sudore, MD; Kenneth E. Covinsky, MD; Louise C. Walter, MD

Background: Wealthy women have higher rates of screening mammography than poor women do. Screening mammography is beneficial for women with substantial life expectancies, but women with limited life expectancies are unlikely to benefit. It is unknown whether higher screening rates in wealthy women are due to increased screening in women with substantial life expectancies, limited life expectancies, or both. This study examines the relationship between wealth and screening mammography use in older women according to life expectancy.

Methods: A cohort study was performed of 4222 women 65 years or older with Medicare participating in the 2002 and 2004 Health and Retirement Survey. Women were categorized according to wealth and life expectancy (based on 5-year prognosis from a validated prognostic index). The outcome was self-reported receipt of screening mammography within 2 years.

Results: Overall, within 2 years, 68% of women (2871 of 4222) received a screening mammogram. Screening was associated with wealth (net worth, >$100,000) and good prognosis (≤10% probability of dying in 5 years). Screening mammography was more common among wealthy women than among poor women (net worth, <$10,000) both for women with good prognosis (82% vs 68%; P<.001) and for women with limited prognoses (≥50% probability of dying in 5 years) (48% vs 32%; P=.02). These associations remained after multivariate analysis accounting for age, race, education, proxy report, and rural residence.

Conclusions: Poorer older women with favorable prognoses are at risk of not receiving screening mammography when they are likely to benefit. Wealthier older women with limited prognoses are often screened when they are unlikely to benefit.

Arch Intern Med. 2008;168(5):514-520

Low socioeconomic status (SES) is associated with decreased utilization of screening mammography even among women with Medicare.

Evidence suggests that in older adults SES may be best measured by means of a comprehensive evaluation of assets and debts known as “wealth” or “net worth.” This is because accumulated wealth may serve as a buffer during times of low income (retirement or illness) or for people with limited education. To our knowledge, no studies have assessed screening mammography use among older women according to net worth.

Assessing SES disparities in screening mammography use requires a consideration of prognosis. Most cancer screening guidelines advocate the use of prognosis to guide appropriate screening decisions because randomized controlled trials suggest that benefit from screening mammography occurs at least 5 years after screening.

Therefore, women with favorable prognoses of 5 years or more are likely to benefit from screening mammography, whereas women with limited life expectancies are not likely to derive survival benefit. Instead, studies suggest that women with limited life expectancies are more likely to experience the potential harms of screening that occur immediately (complications from procedures due to false-positive results and identification and treatment of clinically unimportant disease) instead of the benefits that occur only years in the future.

Therefore, because guidelines recommend screening mammography only for older women with favorable prognoses, a potential mechanism for SES disparities in the receipt of screening mammography may be that low SES is associated with worse health and prognosis. Yet, studies of prognosis and screening mammography have not assessed net worth, and studies of economic disparities in screening mammography among older women are needed.

Author Affiliations: Division of Geriatrics, University of California, San Francisco (Drs Williams, Sudore, Covinsky, and Walter and Ms Lindquist), and Division of Geriatrics, San Francisco Veterans Affairs Medical Center (Drs Williams, Sudore, Covinsky, and Walter).
We compared characteristics across net worth by using Kruskal-Wallis tests for continuous variables and χ² tests for categorical variables. To describe the health of women in each net worth category, we calculated percentages of comorbid conditions, activities of daily living, and mobility impairment. To establish whether screening rates were associated with net worth and prognosis, we used χ² tests when comparing 2 categories and χ² tests for trend when comparing across all categories. We also performed a sensitivity analysis to assess trend in screening rates across prognoses, assuming that women excluded for lacking 2004 data had all received screening mammograms.

Our primary interest was to examine whether net worth was associated with screening mammography at each end of the prognostic spectrum: those with good prognoses and those with limited prognoses. We assessed whether net worth was independently associated with screening mammography among women with good prognoses and among women with limited prognoses after adjusting for age (<75 years vs ≥75 years), race/ethnicity (white vs nonwhite), educational attainment (less than high school vs high school/GED), and rural residence.3,19,28

STATISTICAL ANALYSES

We considered other variables measured in 2002 that, based on previous literature, might affect the association between net worth, prognosis, and receipt of screening mammography; these included age, race/ethnicity, education, proxy respondent, and rural residence. In multivariate analyses, we categorized age according to the mean age of the sample: less than 75 years or 75 years or older. Race/ethnicity was based on self-identification from 2 questions: (1) “Do you consider yourself primarily white or Caucasian, black or African American, American Indian, or Asian, or something else?” and (2) “Do you consider yourself Hispanic?” All participants who answered yes to being Hispanic were categorized as Hispanic, regardless of race. We categorized education as less than high school, high school graduate/GED, or more than high school. Rural residence was based on the Beale Rural-Urban Continuum Code of the US Department of Agriculture, dichotomized as rural vs suburban/urban residence.22

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We determined 5-year prognosis by using data from the 2002 interview to complete a prognostic index previously developed and validated in the HRS (area under the receiver operating characteristic curve, 0.83).27 The prognostic index uses self-reported information including age, body mass index, smoking status, diseases (cancer, chronic lung disease, congestive heart failure, or diabetes mellitus), and functional ability (difficulty doing tasks such as walking several blocks, pulling or pushing large objects, bathing, or managing money). We extrapolated this index to categorize women into 4 prognostic groups: good prognosis (≤10% probability of dying in 5 years), intermediate prognosis (11%-25% and 26%-49% probability of dying in 5 years), and limited prognosis (≥50% probability of dying in 5 years). These categories were chosen to assess how extremes in life expectancy influence the use of screening mammography.
RESULTS

SUBJECT CHARACTERISTICS

Baseline characteristics of the 4222 women are presented in Table 1 according to net worth. In this nationally representative sample, the distribution of wealth was wide ranging, from a debt of $87,021 to a net worth of $10.3 million. The median net worth was $133,850 (25th percentile, $36,500; 75th percentile, $350,000).

The mean age was 75 years (range, 65-105 years), 77% were white, and 72% had received a high school diploma. There were significant differences in 5-year prognosis, demographics, comorbidities, and functional ability by net worth. For example, among women with high net worth, 58% (1400 of 2431) had good prognoses and 4% (91 of 2431) had limited prognoses. Among women with low net worth, 33% (224 of 675) had good prognoses and 14% (94 of 675) had limited prognoses.

Overall, 68% of women (2871 of 4222) had received a screening mammogram in the 2 years studied. Higher net worth was associated with higher rates of screening (Figure 1). Among women with a net worth of more than $100,000, 75% (1823 of 2431) had received a screening mammogram, compared with 60% of women (667 of 1116) with a net worth of $10,000 to $100,000 and 56% of women (381 of 675) with a net worth of less than $10,000 (P for trend, <.001).

Within each net worth category, younger age was associated with screening. For example, among women with high net worth, 84% of women aged 65 to 69 years (644 of 770) had received screening compared with 54% of women aged 80 years or older (294 of 540) (P < .001). Among women with low net worth, 68% of women aged 65 to 69 years (151 of 222) received screening compared with 41% of women aged 80 years or older (99 of 243) (P < .001).

Table 1. Characteristics of Women by Net Worth

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Low (&lt; 10,000)</th>
<th>Middle (10,000-100,000)</th>
<th>High (&gt; 100,000)</th>
<th>P Valueb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>76 (8)</td>
<td>75 (7)</td>
<td>74 (7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Prognosis, % probability of dying in 5 y</td>
<td>224 (33)</td>
<td>480 (43)</td>
<td>1400 (58)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>≤ 10 (good)</td>
<td>199 (29)</td>
<td>333 (30)</td>
<td>690 (28)</td>
<td></td>
</tr>
<tr>
<td>11-25</td>
<td>158 (23)</td>
<td>196 (18)</td>
<td>250 (10)</td>
<td></td>
</tr>
<tr>
<td>≥ 50 (limited)</td>
<td>94 (14)</td>
<td>107 (10)</td>
<td>91 (4)</td>
<td></td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>328 (49)</td>
<td>752 (67)</td>
<td>2182 (90)</td>
<td></td>
</tr>
<tr>
<td>Black/African American</td>
<td>216 (32)</td>
<td>233 (21)</td>
<td>130 (5)</td>
<td></td>
</tr>
<tr>
<td>Latina</td>
<td>109 (16)</td>
<td>111 (10)</td>
<td>81 (3)</td>
<td></td>
</tr>
<tr>
<td>Otherc</td>
<td>22 (3)</td>
<td>20 (2)</td>
<td>38 (2)</td>
<td></td>
</tr>
<tr>
<td>Medicare HMO</td>
<td>132 (20)</td>
<td>226 (20)</td>
<td>506 (21)</td>
<td>.99</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; High schoold</td>
<td>386 (57)</td>
<td>458 (41)</td>
<td>338 (14)</td>
<td></td>
</tr>
<tr>
<td>High school degree or GED</td>
<td>208 (31)</td>
<td>448 (40)</td>
<td>1064 (44)</td>
<td></td>
</tr>
<tr>
<td>&gt; High school</td>
<td>81 (12)</td>
<td>210 (19)</td>
<td>1029 (42)</td>
<td></td>
</tr>
<tr>
<td>Rural residence</td>
<td>171 (25)</td>
<td>377 (34)</td>
<td>637 (26)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Married</td>
<td>127 (19)</td>
<td>387 (35)</td>
<td>1427 (59)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Comorbid conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>89 (13)</td>
<td>133 (12)</td>
<td>181 (7)</td>
<td></td>
</tr>
<tr>
<td>Heart disease</td>
<td>230 (34)</td>
<td>310 (28)</td>
<td>462 (19)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>188 (28)</td>
<td>229 (21)</td>
<td>278 (11)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Stroke</td>
<td>98 (15)</td>
<td>123 (11)</td>
<td>166 (7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Difficulty with activities of daily living</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bathing</td>
<td>121 (18)</td>
<td>117 (10)</td>
<td>108 (4)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Toileting</td>
<td>81 (12)</td>
<td>92 (8)</td>
<td>121 (5)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Dressing</td>
<td>128 (19)</td>
<td>124 (11)</td>
<td>148 (6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Transferring</td>
<td>91 (13)</td>
<td>71 (6)</td>
<td>74 (3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Eating</td>
<td>46 (7)</td>
<td>45 (4)</td>
<td>29 (1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Mobility impairmentd</td>
<td>397 (59)</td>
<td>512 (46)</td>
<td>741 (30)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviations: GED, General Educational Development certificate; HMO, health maintenance organization.

a Values are expressed as number (percentage) unless otherwise stated.

b P value calculated by χ² test for categorical variables and Kruskal-Wallis test or analysis of variance for continuous variables.

c Other race/ethnicity includes Native American, Asian, and those who identified themselves as “other.”

d Did not receive a high school diploma.

e Mobility impairment was defined as difficulty walking several blocks.
women with limited prognoses, 58% of women aged 65 to 69 years (7 of 12) had received screening compared with 33% of women 80 years or older (75 of 229) (P < .001).

RELATIONSHIP BETWEEN SCREENING MAMMOGRAPHY, PROGNOSIS, AND NET WORTH

Net worth differed by prognostic category. Among the 2104 women with good prognoses, median net worth was $189,000 compared with $125,000 and $65,000 among the 1826 women in the 2 intermediate prognostic groups and $45,000 among the 292 women with limited prognoses (P < .001). High net worth (≥ $100,000) was associated with higher screening rates across the prognostic categories (Figure 3). For example, among women with good prognoses, who are likely to benefit from screening, 82% with high net worth (1149 of 1400) had received a screening mammogram compared with 68% with low net worth (153 of 224) (P < .001). Among women with limited prognoses, who are unlikely to benefit from screening, 48% with high net worth (44 of 91) had received a screening mammogram compared with 32% with low net worth (30 of 94) (P = .02).

The association between high net worth and receipt of screening mammography for women with good prognoses and for women with limited prognoses remained significant even after adjustment for age, race, education, proxy respondent, and rural residence (Table 2). Among women with limited prognoses, high net worth was even more strongly associated with receipt of screening mammography after adjustment (adjusted relative risk for high vs low net worth, 1.92; 95% confidence interval, 1.20-3.09). Sensitivity analyses confirmed the trend for women with good prognoses to have higher rates of screening mammography than women with limited prognoses (P < .001) even after assuming that all women who died before 2004 received mammograms.

RELATIONSHIP BETWEEN SCREENING MAMMOGRAPHY AND PROGNOSIS

Fifty percent of women (2104 of 4222) had a good 5-year prognosis, whereas only 7% (292 of 4222) had a limited prognosis. Worsening 5-year prognosis was associated with lower screening rates (Figure 2). Mammography was reported by 78% of women (1644 of 2104) with good 5-year prognoses (≤ 10% probability of dying in 5 years), 65% of women (793 of 1222) with 11% to 25% probability of dying in 5 years, 53% of women (319 of 604) with 26% to 49% probability of dying in 5 years, and 39% of women (115 of 292) with limited 5-year prognoses (≥ 50% probability of dying in 5 years) (P for trend, < .001).

Within each prognostic category, younger age was associated with screening. For example, among women with good prognoses, 80% of women aged 65 to 69 years (833 of 1035) had received screening compared with 52% of women 80 years or older (31 of 60) (P < .001). Among
have co-payments for screening, and differential access disparities indicate that women with a low likelihood of surviving generally produces benefit by detecting slow-growing tumors.40 However, women with limited prognoses who are poor may actually be receiving more guideline-appropriate screening than are wealthy women with limited prognoses. Conversely, among poorer women who have favorable 5-year prognoses, the screening mammography rate was only 68%, compared with 81% among wealthier women. Thus, many poorer healthy older women are not receiving screening mammography from which they are likely to benefit.

Women 80 years or older had low screening rates regardless of prognosis. This is consistent with previous studies showing that cancer screening decreases with increasing age regardless of prognosis.30 Good prognosis was defined as a 10% or less probability of dying within 5 years; limited prognosis, 50% or greater probability of dying within 5 years.

In this large population-based study of older women with Medicare, wealth was associated with screening mammography use regardless of prognosis both at baseline and after adjustment for age, race, education, proxy use, and rural residence. Thus, greater wealth (net worth > $100 000) was associated with higher screening rates not only among women with good prognoses but also among women with limited prognoses, who are unlikely to benefit from screening.

There are many causes of economic disparities in screening mammography.30,31 For example, women may have co-payments for screening, and differential access to supplemental insurance may contribute to disparities.30 Although we found no difference in Medicare HMO enrollment across categories of wealth, differential access to supplemental insurance among the women without Medicare HMO may have contributed to screening disparities. Other reasons for screening disparities are numerous and may include the specialty of one's physician, having regular health care access, and transportation costs.30,31

Still, a fundamental question left unanswered by previous studies is whether the association between high SES and screening mammography use is explained by low screening rates in poor women with good prognoses, high screening rates in wealthy women with limited prognoses, or both. Our results suggest that both explanations are correct. Prognosis is a fundamental determinant of the appropriateness of screening, according to cancer screening guidelines,9,11 because mammography generally produces benefit by detecting slow-growing tumors that would cause future symptoms.17 Thus, studies indicate that women with a low likelihood of surviving 5 years are unlikely to benefit from screening and may be more likely to suffer the harms associated with screening (complications from false-positive results and treatment of clinically insignificant cancer).15,17,19 We found that among women with limited prognoses, for whom the likelihood of benefit from screening is low, 48% of wealthier women reported screening compared with 32% of poorer women. Therefore, women with limited prognoses who are poor may actually be receiving more guideline-appropriate screening than are wealthy women with limited prognoses.

COMMENT

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In contrast, guidelines concur that women with a life expectancy of 5 years or less are unlikely to derive survival benefit from screening mammography. Therefore, we defined limited prognosis as a life expectancy of 5 years or less. A strength of this study is that we used a validated prognostic index that can be used at the bedside to estimate prognosis in older adults. This index includes comorbidity and functional status in addition to age. Although some women with limited prognoses will live more than 5 years, they will have a combination of comorbidity and impairment in mobility and activities of daily living, putting them at risk for the burdens of screening mammography and follow-up tests and treatment.

This study has several limitations. First, screening was self-reported, and self-reported rates are consistently higher than rates from Medicare claims. This is likely due to underreporting of mammography by claims data and overreporting by survey data. Studies based on self-report have the advantage of being able to include women with Medicare HMO who are excluded in studies using claims data, and measures of SES are often limited in claims data. In addition, studies show that self-report is a valid method for assessing screening rates, and self-report of screening mammography is as accurate in older women as it is in younger women. However, women with lower educational attainment and of racial/ethnic minority may be more likely to overreport mammography. Because women from vulnerable populations are overrepresented in the lower net worth category, screening mammography rates might be even lower among women with low net worth than we report.

Second, 5% of our sample required proxy respondents. We did not exclude these women because the goal

Table 2. Association Between Net Worth and Screening Mammography by Prognosis Group

<table>
<thead>
<tr>
<th>Prognosis Group</th>
<th>Net Worth Category</th>
<th>Unadjusted RR (95% CI)</th>
<th>Adjusted RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Low</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>0.94 (0.91-1.00)</td>
<td>0.95 (0.91-1.00)</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>1.08 (0.96-1.21)</td>
<td>1.09 (0.97-1.24)</td>
</tr>
<tr>
<td>Limited</td>
<td>Low</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>1.18 (1.10-1.32)</td>
<td>1.18 (1.10-1.32)</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>1.18 (1.05-1.32)</td>
<td>1.18 (1.05-1.32)</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>1.52 (1.05-2.18)</td>
<td>1.62 (1.10-2.39)</td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>1.80 (1.32-2.45)</td>
<td>1.92 (1.35-2.72)</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>1.92 (1.20-3.09)</td>
<td>2.03 (1.27-3.25)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; RR, relative risk.

The association between high net worth (> $100 000) and receipt of screening mammography for women with good prognosis and for women with limited prognosis remained significant even after adjustment for age, race, education, proxy use, and rural residence. Among women with limited prognosis, high net worth was even more strongly associated with receipt of screening mammography after adjustment.

Good prognosis was defined as a 10% or less probability of dying within 5 years; limited prognosis, 50% or greater probability of dying within 5 years.

Low net worth was defined as a net worth of less than $10 000; middle net worth, $10 000 to $100 000; and high net worth, > $100 000.

Adjusted for age, race, education, urban/rural residence, and use of a proxy respondent.
was to study the use of screening by older women, including those with limited prognoses who were more likely to need proxy respondents. Many surveys about older adults use proxy respondents to decrease health-related nonresponse, which is critical for understanding the health and health care utilization patterns of frail, older adults. In addition, adjustment for proxy respondent status did not change the relationships between wealth, prognosis, and screening mammography.

Third, the use of a prognostic index to define appropriateness of screening might be seen as a limitation because, depending on the individual woman, clinicians might extend screening to women with limited prognoses if a woman understands the risks and believes the benefits of screening outweigh the risks. However, physicians also have a responsibility to prevent patients from undergoing unwarranted procedures. A prognostic index can serve as a guide to help physicians inform their patients about the likelihood of benefit from screening because they can improve the accuracy of prognostication when combined with clinical judgment. Studies show that when patients are educated about the realistic risks and benefits of interventions, they frequently choose to forgo the intervention. Understanding prognosis can help physicians clarify which patients are most likely to derive benefit from screening mammography.

In summary, this study demonstrates economic disparities in screening mammography use by older women regardless of prognosis. Greater wealth was associated with higher screening rates among women with good prognoses, and wealth also was associated with higher screening rates among women with limited prognoses. These economic disparities were significant even though we used net worth, a stringent assessment of wealth, and studied only women with Medicare. A goal of Healthy People 2010 is to increase mammography screening to 70% of all women 40 years or older. Instead, we should focus on increasing screening rates in healthy older women who may reasonably benefit while decreasing screening rates in women who are unlikely to benefit. Special attention should be focused on 2 groups of women: poor women with good prognoses who are at risk of low screening rates when they are likely to benefit from screening, and wealthy women with limited prognoses who have high rates of screening even though guidelines indicate that they are unlikely to benefit.

Accepted for Publication: September 19, 2007.
Correspondence: Brie A. Williams, MD, Division of Geriatrics, San Francisco Veterans Affairs Medical Center, 4150 Clement St, Campus Box 181-G, San Francisco, CA 94121 (brie.williams@ucsf.edu).
Author Contributions: Dr Williams had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Williams, Lindquist, Sudore, Covinsky, and Walter. Acquisition of data: Williams, Lindquist, Sudore, and Walter. Analysis and interpretation of data: Williams, Lindquist, Sudore, Covinsky, and Walter. Drafting of the manuscript: Williams. Critical revision of the manuscript for important intellectual content: Williams, Lindquist, Sudore, Covinsky, and Walter. Statistical analysis: Williams, Lindquist, Sudore, and Walter.

Obtained funding: Williams and Walter. Administrative, technical, and material support: Williams, Lindquist, and Walter. Study supervision: Williams, Covinsky, and Walter.

Financial Disclosure: None reported.

Funding/Support: This study was supported by Department of Defense Breast Cancer Research Program Concept Award BC043560 and by National Institute on Aging grant R01-AG023626. Dr Williams is supported by training grant T32-AG00212 from the National Institute on Aging and is a Hartford Foundation Geriatrics Health Outcomes Research Scholar. Dr Sudore is supported by a Pfizer Fellowship in Clear Health Communication and a National Institutes of Health Diversity Investigator Supplement. Dr Walter is a recipient of the Veterans Affairs Advanced Research Career Development Award in Health Services Research and Development and is a Robert Wood Johnson Physician Faculty Scholar.

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