Background: Older women whose life expectancy is less than 5 years are unlikely to benefit from screening mammography or Papanicolaou (Pap) smears. Since life expectancy is better predicted by health status than by age alone, guidelines recommend considering an older woman’s general health when making screening decisions.

Objective: To determine whether screening mammography and Pap smears are targeted to healthy older women and are avoided in women with limited life expectancies.

Design: Cross-sectional population-based study.

Setting: California.

Patients: 4792 women 70 years of age or older who participated in the California Health Interview Survey between November 2000 and October 2001.

Measurements: Predictor variables included age and health status. Health status was measured by using the Medical Outcomes Study 12-item Short Form Physical Summary Scale. The main outcome was self-reported receipt of screening mammography within the previous 2 years and a screening Pap smear within 3 years.

Results: Seventy-eight percent of women reported recent screening mammography, and 77% reported a recent Pap smear. Screening rates decreased with advancing age. However, within each age group, the percentage of women reporting screening did not significantly decrease with worsening health status ($P > 0.1$ for all comparisons). More than half of women 80 years of age or older in the worst health quartile reported recent screening, representing approximately 81,000 mammograms and 35,000 Pap smears.

Limitations: This study relied on self-report, and the interview response rate was 63.7%.

Conclusions: Rates of recent screening mammography and Pap smears are high among older women in California. Although screening rates drop with advancing age, women in poor health do not avoid screening. Screening should be better targeted to healthy older women and should be avoided in women with limited life expectancies for whom risks of screening outweigh potential benefits.

One of the most striking features of the elderly population is its heterogeneity (1). While many individuals remain quite healthy with advancing age, others develop worsening health and functional impairments that can significantly decrease life expectancy and the benefit-to-harm ratio of cancer screening tests (2–4). Many cancer screening guidelines now recognize this heterogeneity, recommending that screening decisions should be based not on age alone but should also take into account an older person’s health status (5–7). Life expectancy is better predicted by health status than by age alone, and older women with life expectancies less than 5 years are unlikely to benefit from cancer screening tests (8, 9). However, it is unclear to what extent cancer screening tests are actually targeted to healthy older women who might reasonably benefit and are avoided in older women with limited life expectancies.

Previous studies evaluating associations among age, health status, and recent receipt of cancer screening have found that rates of screening mammography and Papanicolaou (Pap) smears decrease with advancing age (10–14). However, results have been mixed regarding associations between screening use and health status. Several studies using the 1992 National Health Interview Survey found that self-rated health and physical function were not associated with recent screening mammography (10, 11). More comorbid conditions have been associated with both higher and lower rates of screening mammography and Pap smears (12, 15, 16). A study using the 1991 Medicare Current Beneficiary Survey and Medicare claims data found that functional and cognitive impairments were associated with decreased mammography use (13), while a cohort study in Connecticut found that screening mammography was underused among healthier older women (14). All of these studies were done during the early 1990s, when screening rates were low among older women; Medicare coverage of mammography and Pap smears began only in 1991. Since that time, mammography and Pap smear rates have steadily increased (17–19), but we do not know of any recent studies that evaluate how age and health status currently affect receipt of screening mammography or Pap smears in the elderly population.

To determine whether screening mammography and Pap smears are currently targeted to healthy older women and avoided in older women who are unlikely to benefit, we examined data from the 2001 California Health Interview Survey (CHIS). We evaluated recent screening mammography and Pap smear use by older California women stratified into distinct health quartiles on the basis of a validated measure of health status.
METHODS

Data Source and Participants

Data used in this population-based cross-sectional study came from the public-use files of the 2001 CHIS, which is the largest state health survey in the United States (20). The CHIS is a 2-stage, geographically stratified random-digit-dial telephone survey that collected health and demographic information from adults residing in California households between November 2000 and October 2001. At the first stage, California telephone numbers were randomly generated by a computer, and a random sample of these numbers was then dialed for each of 41 pre defined geographic areas. At the second stage, 1 adult was randomly selected to be interviewed from among all adults living in the contacted household. Trained staff administered the interviews in 6 languages using a computer-assisted telephone interviewing system. These interviews had a response rate of 63.7%, resulting in a total sample size of 55,428 adults.

The potential analytic cohort for this study included the 5103 women who were 70 years of age or older. We excluded 311 women (6%) who were missing data on the Medical Outcomes Study 12-item Short Form (SF-12), leaving 4792 women. In addition, women were excluded if data on their most recent mammography or Pap smear were missing, if they reported a history of breast or cervical cancer, or if they reported that the test was obtained for symptoms or work-up of abnormal examination results. Participants were excluded separately for mammography and Pap smears, resulting in slightly different sample sizes for each test (Figure 1). Proxy respondents were accepted for frail or ill adults who could not answer for themselves (n = 85).

Context

Some worry that clinicians will screen for breast and cervical cancer even when the probability of benefit is very low because of the patient’s age and comorbid disease.

Contribution

Over 75% of women age 70 years or older reported recent mammography and Papanicolaou smear in a 2000–2001 health survey. Rates decreased with age but not with worsening self-reported health status.

Implications

Decisions to screen for breast and cervical cancer may not appropriately consider an individual woman’s health.

Cautions

The researchers used self-reported health, which correlates with life expectancy in populations but may not be accurate enough to use in individual patients.

--The Editors

Data Collection and Measurement

Outcome Variables

Participants were asked a series of questions about the receipt of screening mammography and Pap smears. Questions inquired about whether participants had ever had the test and, if so, when the most recent test had been performed. On the basis of established screening guidelines, participants were counted as screened for breast cancer if they reported routine screening mammography within the 2 years preceding the date of the survey (5). They were counted as screened for cervical cancer if they reported a routine screening Pap smear within the past 3 years (21, 22).

Predictor Variables

Age was categorized into 4 groups: 70 to 74 years, 75 to 79 years, 80 to 84 years, and 85 years or older. Health status was assessed by using the SF-12 Physical Summary Scale (PCS-12), which is a 12-item questionnaire constructed from the Medical Outcomes Study 36-item Short Form to describe functional health status (23). The PCS-12 includes questions about self-rated health and whether a person’s health limits his or her physical functioning in a series of activities a lot, a little, or not at all (24). Answers to the PCS-12 questions were scored by using established norm-based methods, with higher scores indicating better health. The median score for the general population on the PCS-12 is 50.0.

Figure 1. Flow diagram of women included in analyses for each screening test.

- Women included in final analyses
  Mammography (n = 3988)
  Pap smear (n = 2143)

- Excluded because test was not routine screening
  Mammography (n = 727 [15%])
  Pap smear (n = 493 [10%])

- Excluded for having had a hysterectomy for a nonmalignant condition
  Pap smear (n = 1944 [41%])

- Excluded because data were missing on when test was performed
  Mammography (n = 77 [2%])
  Pap smear (n = 212 [4%])

- Women with a history of breast cancer and those in whom mammography was most recently performed because of a specific breast problem or as follow-up for a previously identified breast problem or abnormal mammogram were excluded.

- Women with a history of cervical cancer and those whose most recent Papanicolaou (Pap) smear was performed for work-up of a specific medical problem or follow-up of a previous medical examination were excluded.
U.S. population 70 years of age or older is approximately 40 (24).

The number of physician visits was recorded to evaluate whether the number of screening opportunities might explain the relationships among screening rates, health status, and age. Other factors known to influence the use of cancer screening tests were also ascertained, including ethnicity, education, income, use of hormone replacement therapy, and presence of comorbid illnesses.

The Committee on Human Research at the University of California, San Francisco, and the Committee for Research and Development at the San Francisco Veterans Affairs Medical Center approved the study.

Statistical Analysis

We used SUDAAN, version 8.0.1 (Research Triangle Institute, Research Triangle Park, North Carolina), to take the CHIS sample weights and complex survey design into account in all statistical analyses. We compared baseline characteristics across health status quartiles using chi-square tests. We also categorized women into 16 subgroups on the basis of age (4 categories) and PCS-12 quartile to evaluate the combined effect of age and health status on the use of screening mammography and Pap smears. Subgroups ranged from women 70 to 74 years of age in the best health status quartile (who are most likely to derive survival benefit from cancer screening since their estimated life expectancy is >20 years) to women 85 years of age or older in the worst health status quartile (who are least likely to benefit from cancer screening since their estimated life expectancy is <3 years) (8). Differences between percentages of women screened in each age–health subgroup were determined according to advancing age and worsening health status by using the Cochran–Armitage chi-square test for trend. Population estimates were generated by SUDAAN using sample weights and the jackknife replication method (25).

Multivariate logistic regression modeling was used to assess the independent associations between age or health status and cancer screening after adjustment for ethnicity, education, income, and marital status. Interaction terms between health status and ethnicity and between age and ethnicity were not statistically significant for mammography or Pap smear use.

Role of the Funding Sources

This study was funded through grant support from the Veterans Administration Health Services Research and Development program and the Agency for Healthcare Research and Quality. The funding agencies had no role in the design, conduct, or reporting of this study.

RESULTS

Participant Characteristics

Baseline characteristics of the 4792 women in this analytic cohort are presented in Table 1, according to health status. Thirty-six percent of women were at least 80 years of age. Thirty-six percent of women were at least 80 years of age. Thirty-six percent of women were at least 80 years of age.
Use of Screening Mammography and Pap Smears by Elderly Women

Figure 2. Women in California who reported receiving screening mammography within 2 years, according to health status and age (n = 3988).

Error bars represent 95% CIs. *Health status quartiles are defined by the Medical Outcomes Study 12-item Short Form Physical Summary Scale (PCS-12). Quartile 1 = PCS-12 score > 51.7; quartile 2 = PCS-12 score ≤ 51.7 but > 43.4; quartile 3 = PCS-12 score ≤ 43.4 but > 31.6; quartile 4 = PCS-12 score ≤ 31.6.

of age. Seventy-nine percent of women were white, and 51% had more than 12 years of education. Very few women (<1%) had no health insurance, and 31% were taking hormone replacement therapy at the time of the survey.

The median PCS-12 score was 43.4. Scores were normally distributed, ranging from 10.6 to 66.8. The top 25th percentile of women had PCS-12 scores greater than 51.7, whereas the bottom 25th percentile had PCS-12 scores less than or equal to 31.6. Women in the worst PCS-12 quartile were less educated; had lower incomes; and had higher rates of diabetes, heart disease, and hypertension. Thirty-seven percent of women in the worst PCS-12 quartile had seen a physician more than 6 times in the previous year compared with only 8% of women in the best quartile. Only 1% of women in the best PCS-12 quartile rated their health as poor or fair compared with 71% in the worst quartile. Ninety-six percent of women in the worst health quartile reported that their health limited them in climbing several flights of stairs, and 95% reported that their physical health had limited their regular activities during the past 4 weeks.

Screening Mammography according to Age and Health Status

Seventy-eight percent of women (3115 of 3988) reported receiving routine screening mammography within 2 years of the survey; 79% of these tests were performed within the past year. Seven percent of women had never had mammography. The percentage of persons reporting screening mammography within the past 2 years decreased with advancing age: 88% for those 70 to 74 years of age, 81% for those 75 to 79 years of age, 72% for those 80 to 84 years of age, and 61% for those 85 years of age or older (P < 0.001). However, within each age group, the percentage of women reporting a screening examination within 2 years did not significantly decrease with worsening health status, as measured by PCS-12 quartile (P > 0.1 for all comparisons) (Figure 2). Except for women at least 85 years of age, women in the worst PCS-12 quartile reported rates of recent screening mammography that were similar to or higher than those of women in the best PCS-12 quartile. In addition, women 75 to 79 years of age in the worst PCS-12 quartile were more likely to report screening mammography than women 80 to 84 years of age in the healthiest PCS-12 quartile (82% vs. 66%; P = 0.002), even though healthy women 80 to 84 years of age probably have greater life expectancies than unhealthy women in their 70s.

Extrapolating these data to the California population, we estimated that 97 000 (95% CI, 85 000 to 109 000) women 70 to 84 years of age in the best 2 health status quartiles had not recently received screening mammography. In contrast, an estimated 81 000 (CI, 74 000 to 88 000) women at least 80 years of age in the worst health quartile reported recent screening mammography. Advancing age remained predictive of recent screening mammography after adjustment for potential confounders (Table 2). Health status was not an independent predictor of mammography use.

Screening Pap Smears according to Age and Health Status

Seventy-seven percent of women with an intact uterus (1659 of 2143) reported a routine screening Pap smear within 3 years of the survey, and 71% of those Pap smears were performed within the past year. Seventy-three percent of recently screened women reported having 3 or more normal Pap smears in the past 6 years. Six percent of women reported that they had never had a Pap smear to check for cervical cancer.

The percentage of women reporting a screening Pap smear within the past 3 years decreased with advancing age: 86% for those 70 to 74 years of age, 79% for those 75 to 79 years of age, 72% for those 80 to 84 years of age, and 60% for those at least 85 years of age (P < 0.001). However, within each age group, the percentage of women reporting a recent screening examination did not significantly decrease with worsening health status (P > 0.2 for all comparisons) (Figure 3). Except for women 85 years of age or older, women in the worst PCS-12 quartile reported rates of recent screening Pap smears that were similar to or higher than those of women in the best PCS-12 quartile.
In addition, of the 1944 women excluded from the main analyses because they had had a hysterectomy for a nonmalignant condition, 39% reported a screening Pap smear within a year of the survey, which represents approximately 214,000 (CI, 198,000 to 230,000) California women.

An estimated 35,000 (CI, 30,000 to 40,000) women 80 years of age or older in the worst PCS-12 quartile reported a recent screening Pap smear, whereas 58,000 (CI, 51,000 to 66,000) women 70 to 84 years of age in the best 2 health quartiles, without a history of 3 normal Pap smears, reported that they had not received a recent Pap smear. Multivariate logistic regression confirmed that age remained independently predictive of having a screening Pap smear (Table 2). Health status was not significantly associated with having a recent Pap smear.

**Impact of the Number of Physician Visits on Screening Rates**

Only 5% of the women in our cohort had not seen a physician within the past year, but these women had the lowest screening rates for both mammography (42%) and Pap smears (45%). However, once a woman reported at least 1 physician visit within the past year, rates of mammography and Pap smears did not significantly increase with increasing numbers of visits. For example, rates of screening mammography were the same in women who saw a physician once and those who saw a physician more than 6 times (79% vs. 80%). The percentage of Pap smears was also similar for women reporting 1 physician visit in the past year and in those reporting more than 6 visits (79% vs. 76%; P > 0.2). In addition, analyses restricted to women who had 2 or more physician visits in the past year showed the same trends as those found for the whole cohort.

**Table 2. Multivariate Analysis: Relation of Age and Health Status to Use of Screening Mammography and Papanicolaou Smears among California Women 70 Years of Age or Older**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Adjusted Odds Ratio for Mammography within the Previous 2 Years (n = 3988) [95% CI]*</th>
<th>Adjusted Odds Ratio for Papanicolaou Smear within the Previous 3 Years (n = 2143) [95% CI]*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70–74 y</td>
<td>4.7 [3.4–6.6]</td>
<td>4.1 [2.7–6.3]</td>
</tr>
<tr>
<td>75–79 y</td>
<td>2.7 [2.0–3.5]</td>
<td>2.4 [1.6–3.7]</td>
</tr>
<tr>
<td>80–84 y</td>
<td>1.7 [1.2–2.3]</td>
<td>1.8 [1.1–2.8]</td>
</tr>
<tr>
<td>≥85 y</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Health status quartile†</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (best)</td>
<td>0.8 [0.6–1.0]</td>
<td>0.8 [0.6–1.2]</td>
</tr>
<tr>
<td>2</td>
<td>1.2 [0.9–1.6]</td>
<td>1.1 [0.8–1.7]</td>
</tr>
<tr>
<td>3</td>
<td>1.1 [0.9–1.5]</td>
<td>1.0 [0.7–1.5]</td>
</tr>
<tr>
<td>4 (worst)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

* Adjusted for age, health status quartile, ethnicity, education, income, and marital status.
† Health status quartiles are defined by the Medical Outcomes Study 12-item Short Form Physical Summary Scale (PCS-12). Quartile 1 = PCS-12 score > 51.7; quartile 2 = PCS-12 score ≤ 51.7 but > 43.4; quartile 3 = PCS-12 score ≤ 43.4 but > 31.6; quartile 4 = PCS-12 score ≤ 31.6.

**DISCUSSION**

Rates of recent screening mammography and Pap smears are high among older women in California. However, even though health status among older women is a stronger determinant of life expectancy than chronologic age (8), age is a stronger predictor of recent screening than is health status. Among older women of similar ages, current health was not significantly associated with recent receipt of screening mammography or a Pap smear.

Many screening guidelines and cost-effectiveness analyses recommend that health status be considered before screening mammography or Pap smears are performed in older women (5–9). Women whose life expectancy is less than 5 years are unlikely to benefit from cancer screening and will probably experience only the potential harms, which include unnecessary tests and procedures due to false-positive results, identification and treatment of clinically insignificant disease, and accompanying psychological distress (4, 26).

Regardless of these recommendations, we found that many older California women in poor health have recently had screening mammography and a Pap smear. Although we do not have mortality follow-up information on our sample, there is strong evidence that life expectancy is limited in women with the worst health status as measured by the PCS-12 (27). First, physical functioning measures and
Use of Screening Mammography and Pap Smears by Elderly Women

self-reported health in the PCS-12 are strongly associated with mortality in older adults (28, 29). Second, the PCS-12 correlates very strongly with the Medical Outcomes Study 36-item Short Form Physical Summary Scale, which has been associated with a 12-fold increase in 5-year mortality rates for adults with scores less than 25 versus those with scores greater than 54 (30). Third, life-table analyses of the U.S. population showed that women 80 years of age or older in the lowest quartile of life expectancy live less than 5 years (8). Therefore, it is likely that women in our study who were 80 years of age or older and were in the lowest PCS-12 quartile did not have life expectancies long enough to benefit from screening mammography or Pap smears. However, more than half of this group reported having such screening tests recently, representing an estimated 81,000 mammograms and 35,000 Pap smears.

On the other hand, many healthy older women have substantial life expectancies and may benefit from screening mammography and Pap smears (31). The median life expectancy for older women in the United States exceeds 5 years until age 90 years (32). Therefore, mammography rates should not decrease with advancing age among women in the upper health quartiles who are in their 70s or 80s (8). The decline in Pap smear use with advancing age is more understandable because most guidelines recommend that even healthy women can stop Pap smears at age 65 or 70 years if they have had normal results 3 or more times (21, 22, 33). This is because in these women the risk for cervical cancer is remote (26, 34). However, we found high rates of recent Pap smear screening among women older than age 70 years. This suggests that most California women do not stop receiving Pap smears at age 65 years, even though most older women in our study reported previously normal results.

Other studies have suggested that more frequent contact with clinicians may increase the likelihood of receiving cancer screening tests, which could explain why healthy older women, who see clinicians less frequently, are often underscreened and unhealthy older women may be overscreened (15, 35). However, in our study, even among frequent users of health care (≥2 physician visits per year), worsening health status was not associated with lower screening rates among women of similar ages, suggesting that visit frequency does not explain our findings. In addition, adjustment for ethnicity, education, income, and marital status did not change our findings.

Our findings are consistent with studies of U.S. women in the early 1990s, which found that mammography decreased with advancing age regardless of comorbid illnesses, functional status, or self-rated health (10–14). When Medicare began covering mammography and Pap smears in 1991, it was hoped that removing the financial barrier would reduce the age-associated decrease in screening. However, while screening rates for older women have dramatically increased since that time (18), it appears that Medicare payment may have increased screening indiscriminately both among older women likely to benefit and among women whose limited life expectancy makes them more likely to experience harm.

A probable explanation for our findings is that physicians err on the side of overscreening because there is no available method for predicting the life expectancy of an individual older woman. While the PCS-12 is a reasonable predictor of mortality in populations, its accuracy in predicting an individual’s mortality is not known (36). However, clinicians can use several characteristics to identify older women with limited life expectancies. End-stage renal disease, severe dementia, or severe functional dependencies in activities of daily living are examples of characteristics associated with high 5-year mortality rates (8). Clinicians should consider such characteristics in concert with clinical judgment to estimate an individual’s potential risks and benefits from screening, rather than basing screening decisions on age alone. Since cancer screening decisions in older adults will often be “close calls,” clinicians should use shared decision making to weigh estimated benefits and harms according to patient preferences and arrive at an informed decision (8, 37, 38).

Women who do not have a cervix because of hysterectomy for benign disease should be informed that they are not at risk for cervical cancer and do not need to be screened (21, 39, 40). An estimated 214,000 California women in our study who had had hysterectomies had also had a Pap smear within a year of the survey. While some hysterectomies (<2%) in the United States are supracervical (that is, the cervix is retained), the vast majority are total hysterectomies performed for non-neoplastic conditions (41). Time and resources spent performing Pap smears in women who have undergone a total hysterectomy could be redirected to performing interventions that could have some benefit.

Our study has several limitations. First, we relied on self-report of the receipt and timing of screening. However, although the desire to report behaviors in a favorable light and telescoping (recalling events as occurring more recently than they actually did) probably result in overestimates of screening mammography and Pap smears (13, 18), several studies have shown that self-report data validly measure screening use (42–44). Second, we lacked data on specific comorbid conditions other than diabetes, hypertension, and heart disease. However, the PCS-12 includes self-reported health and function, which predict mortality regardless of specific comorbid conditions (45). Third, our most significant limitation was the 63.7% response rate, and we lacked data to directly compare respondents with nonrespondents. However, comparisons of CHIS with 2000 U.S. Census data confirm that ethnic and income profiles of study participants closely mirror those of the California population (46). This suggests that despite nonresponse bias, our sample is generalizable to women in California. Nonetheless, it is possible that nonresponse bias
resulted in an overestimate of the overall rate of screening. It is very unlikely, however, that nonresponse bias would change our robust central finding that age has a much greater effect on receipt of cancer screening than health status. For nonresponse bias to affect this central finding, it would have to be acting in dramatically opposite directions for older people compared with people in poor health, which seems implausible.

Our study was performed in California, so questions may arise about the generalizability of our findings to older women in other states. However, PCS-12 scores in our study were very similar to the norms for the general U.S. elderly population (24), and mammography and Pap smear rates for older women in our study were not significantly different from average rates in the United States. For example, the 2001 Behavioral Risk Factor Surveillance System estimated that the median mammography rate for U.S. women 65 to 74 years of age was 79%, ranging from 54% in the Virgin Islands to 90% in Rhode Island. The median Pap smear rate was 79%, ranging from 64% in Mississippi to 87% in Arizona (47).

In conclusion, screening mammography and Pap smears should be better targeted to healthy older women who might reasonably benefit and should be avoided in older women with limited life expectancies for whom the harms outweigh the potential benefits. Future research is needed to develop tools to more accurately identify older women who are most likely to benefit from cancer screening tests and to determine the best way to present such information to patients so that they can make informed screening decisions.

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Statistical expertise: K. Lindquist, K.E. Covinsky.