Mammography Screening: How Important Is Cost as a Barrier to Use?

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ABSTRACT

Objectives. Recent legislation will improve insurance coverage for screening mammography and effectively lower its cost to many women. Although cost has been cited as a barrier to use, evidence of the magnitude of its effect on use is limited.

Methods. Mammography use in the past 2 years among women aged 50 to 75 residing in four suburban or rural counties in Washington State was estimated from 1989 survey data. Logistic regression analysis was used to estimate the odds ratio of mammography use as a function of economic and other variables. Within a residential area, averages were used to measure the market price of mammography and the time cost to obtain a mammogram.

Results. Use was lower among women who faced a higher net price or who preferred to obtain a mammogram during weekend or evening hours and higher among women with higher incomes. Visiting no doctor regularly and smoking were predictors of failure to use mammography.

Conclusion. The effects of economic variables on mammography use are important and stable across subsets of the population, but they are modest in size. (*Am J Public Health.* 1994;84:50–55)

Introduction

The burden of breast cancer in the United States is great and is not likely to decrease in the near future.[1] Although one out of nine US women can expect to be diagnosed with breast cancer during her lifetime, and regular screening by mammography among women aged 50 or older has been shown to reduce breast cancer mortality by 30% or more,[2,3] surveys done between 1988 and 1989 suggest that fewer than 42% of US women aged 50–75 have had mammography in the past year and that over 25% of women aged 50–75 have never had a mammogram.[4]

The reasons most frequently cited by women for never having had mammography are that they do not have any problems with their breasts, and that their doctors never recommended it.[4–10] A recent study of use of mammography by primary-care physicians found cost and lack of insurance coverage to be major deterrents to use.[10] In studies of women's use of mammography in which cost has been measured, cost has been identified as a factor influencing use,[5,8] and the role of insurance has been found to be important.[5,9]

If cost is a significant barrier, mammography use can be expected to increase in the next decade because recent legislation in many states mandates that screening mammography be included among covered services in private health insurance policies,[11] and many of the remaining states have passed or are considering legislation mandating coverage of screening mammography by insurers. Moreover, effective January 1, 1991, biennial screening mammography has been reimbursable by Medicare. Until then, Medicare reimbursed 80% of reasonable and customary charges for diagnostic mammography once the deductible was met, but benefits for screening mammography were not provided.

This paper examines the role of economic variables, including insurance coverage, in the use of mammography among women aged 50–75 in four counties in Washington State before implementation of legislation that improved insurance coverage. Data are presented describing the perceptions of women in 1989 regarding their insurance coverage for screening mammograms and the influence of cost and insurance coverage on use. The bivariate relationships among recent mammography use and insurance coverage, mammography price, and income are reported for women aged 50 to 64 and for women aged 65 to 75.

An economic behavioral model, the theory of demand, suggests that the price of mammography is a key variable. Total price to the consumer is the net money price plus the time cost. The net money price is equal to the price charged for the mammogram less the amount paid by insurance, or the price charged multiplied by the coinsurance rate. The time cost is the total time required to obtain a mammogram. Other things being equal, as the net price of a screening mammogram falls, regular screening mammography will be used by more women. The theory of demand suggests as well that (1) use will rise with income; (2) use will rise with a fall in the time cost; (3) as the net money price falls, sensitivity to time cost will rise; and (4) price sensitivity will be greater among

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low-income women for whom price represents a larger proportion of disposable income. The results of multivariate analyses to test these hypotheses are reported.

Methods

Data and Variable Definitions

Data on mammography use were obtained from a telephone survey conducted in spring 1989 of women aged 50–75 residing in four communities. The communities were selected on the basis of their comparability with respect to size, sociodemographics, and proximity to an urban area from among all the suburban and rural counties in Washington State with at least 10 000 women aged 50 and above. To be eligible for the survey, women had to be between the ages of 50 and 75, had to have lived in their county of residence for 2 or more years, and had to have no history of breast cancer. Approximately 97% of the target population had telephones; of those without telephones, many would have been ineligible for the survey due to lack of 2-year residence in the community. A total of 1538 women were interviewed through a random-digit dial survey technique that samples numbers proportional to size (for residential lines) within a dialing prefix, producing a self-weighted stratified sample for the geographical areas.[12] The response rate to the survey was 72%, calculated as the number of completed surveys divided by the estimated number of eligible women sampled, which was quite good relative to the response rates reported in similar surveys.[4] The denominator included an estimate of the number of eligible women in households at telephone numbers that were sampled but were not reached (n = 192), as well as all eligible women reached (n = 1937). To avoid selection bias, the introduction to the survey described it as relating to the health of women rather than to mammography specifically. The questions used to elicit relevant information from women respondents are available from the authors on request.

The use of mammography was defined as one or more mammographic studies in the past 2 years, based on the woman's self-report. Validation was not undertaken because validity of self-reported mammography use has been found to be very good in other studies.[13] Although interest was primarily in screening mammography, no attempt was made to distinguish between screening and diagnostic mammograms because the distinction between them is insufficiently clear among physicians to be recognized reliably by women.[14] Of women who had ever had a mammogram, 82.4% reported that their last mammogram was for a routine check-up rather than for a current or previous breast problem. We are therefore confident that the majority of mammograms were for screening purposes.

Specification and Estimation of the Multivariate Models

Variables were selected for inclusion in the analytic model on the basis of microeconomic theory and the health economics literature. A single-equation model was specified that related use of mammography in the past 2 years to (1) economic variables and (2) other determinants of demand that reflect the value that women place on mammography as a contributor to their health.[15] Economic variables included in the model were the out-of-pocket cost to the woman of a screening mammogram (the net money price), the cost in time that is incurred to obtain the mammogram, whether or not weekdays are inconvenient for obtaining the mammogram, and household income.

The net money price was defined as the total charge for the mammography multiplied by the proportion of that charge paid by the woman rather than by her insurance company. For women with insurance that pays all of the cost of mammography, the net price is zero. The time cost was defined as the total time a woman would need to obtain the mammogram, including travel time to the facility, waiting time, and the time required to receive services. Measurements of the net money price and the time cost are described below. Inconvenience was measured as a woman's preference for evenings or weekends over weekdays to obtain the mammogram. Income was measured as reported total household income.

Theory suggests that demand is a function of the value of the good or service to the consumer, as well as a function of prices and income. The value of breast cancer screening to a woman was assumed to depend on her risk of breast cancer, measured by her age and family history of breast cancer; her valuation of her breast health, measured by her monthly practice of breast self-examination; and her valuation of her health more generally, which for lack of a better indicator was measured by her current smoking habits. Screening mammography can be viewed as an investment in health. Because microeconomic theory suggests that consumers with more education can be expected to invest more in their health,[15] years of education completed were also included in the model.

Because a woman may depend on her physician to assess the value of screening mammography for her,[16] a set of dummy variables indicating the type(s) of physician(s) she visits regularly were constructed. Based on bivariate analyses, these variables were reduced to two: an indicator that the woman regularly visits a gynecologist and an indicator that she does not visit any provider regularly. Because the probability of referral for mammography by a physician may increase with exposure to physicians, the average number of annual visits to providers whom the woman sees regularly was included as well.

Logistic regression analysis was used to estimate the model from the survey data obtained from the women. Of the 1538 women surveyed, there were 1528 usable interviews, of which 1377 had sufficiently complete data to be included in the demand analyses. The dependent variable was set equal to 1 if the woman reported having a mammogram within the last 2 years and set equal to 0 otherwise. The statistical software package EGRET[17] was used to estimate the model. Dummy variables were included for three of the four counties to account for county effects and any intraclass correlation among women in the same county.

An equation was also estimated in which the economic variables were omitted, in order to test their importance as a group; and two additional equations were estimated to test the interaction effects of economic variables with the economic conditions of the women. First, interaction effects were estimated for women with insurance covering more than half of the cost of screening mammography, which permitted a test of the hypothesis that sensitivity to the time cost is greater among well-insured women. Second, interaction effects were estimated for women with household incomes above $15 000, which yielded a test of the specific hypothesis that sensitivity to the money price is greater among low-income women.

Estimation Issues in the Multivariate Analyses

Missing values for economic variables were an important source of potential selection bias in these analyses. Among the 1528 usable interviews, the prevalence of missing values for reported

TABLE 1—Percentage of Women Aged 50–75 y Who Reported That Their Health Insurance Paid for Screening Mammography, by Age

Does Your Health Insurance Pay for Routine Screening Mammograms?	Age, %		
	50–64 y (n = 911)	65–75 y (n = 609)	All Ages (n = 1520)
Yes, all	31.7	31.2	31.5
Yes, partially	23.5	19.1	21.7
No, or no health insurance	28.1	21.4	26.0
Don't know	15.7	28.4	20.8

TABLE 2—Percentage of Women Aged 50–75 y Who Had a Mammogram within 1 or 2 Years of Interview, by Insurance Coverage and Age

Time Since Last Mammogram	Insurance Coverage for Screening Mammography							
	Covers All		Covers Part		Covers None[a]		Insurance Unknown	
	Age 50–64 y (n = 84)	Age 65–75 y (n = 186)	Age 50–64 y (n = 213)	Age 65–75 y (n = 114)	Age 50–64 y (n = 264)	Age 65–75 y (n = 130)	Age 50–64 y (n = 143)	Age 65–75 y (n = 173)
Within 1 year	52.1	52.2	48.8	46.5	39.0	45.4	18.2	11.0
Between 1 and 2 years	21.8	16.1	24.4	18.4	19.3	21.5	7.7	15.0
Over 2 years	11.3	13.4	14.1	15.8	16.3	10.0	20.3	19.7
Never	14.8	18.3	12.7	19.3	25.4	23.1	53.9	54.3

[a]Includes women with no insurance coverage and women with health insurance that does not cover screening mammography.

price, reported insurance coverage, reported time cost, and income were 19.4%, 26.5%, 9.7%, and 16.1%, respectively. Moreover, missingness for three of these economic variables was related to mammography use. Simple chi-square tests of independence between the variable indicating whether a woman had a mammogram in the last 2 years and the variables indicating whether or not she reported money price, insurance coverage, and time cost were highly significant ($P < .001$). Missingness for income was not related to mammography use.

Another potential source of bias was a possible correlation of reported price (in money, time, or both) and insurance coverage with the error term of the demand equation. Such a correlation would be introduced if women's recent use of mammography made them better informed regarding price and if poorly informed women systematically believed the price to be higher or lower than it actually was.

Predicted, rather than actual, prices and insurance coverage were therefore used to compute net price. Sixty-eight telephone number prefixes were used as indicators of approximate market areas. For each prefix area, the mammography price was estimated as the average price reported by women with that prefix who knew, or were willing to guess, the cost of screening mammography in their community. When there were fewer than three such women in a prefix area (a situation that occurred for 16 women), the overall average for the community was used. A dummy variable was included in the prediction equation indicating whether or not the woman had guessed, to allow for the possibility that these women systematically guessed higher or lower than women who claimed to know the price.

The procedure for predicting time cost was identical to that used for predicting money price, and an analogous approach was used to predict values for insurance coverage. All women were asked what kinds of health insurance they had. Fifty-six types of health insurance coverage were identified, and regression analysis (with dummy variables for each type of insurance) was used to estimate the proportion of the price paid by each insurer based on the survey responses of those women who answered the questions. These estimates were then used in place of reported insurance coverage in computing the net price as the product of the charge for mammography and the proportion paid by the woman. This procedure for imputing prices is an instrumental-variables approach that yields consistent estimates of the coefficients of interest.[18] It simultaneously computes missing values, precludes correlation of the regressor with the error term, and specifies demand as a function of the *market* price faced by the woman.

To avoid the exclusion from the sample of the women whose household income was not reported, a regression model based on geographic area as indicated by telephone prefix and sociodemographic characteristics of the woman (age, education, working status, and marital status) was estimated. Predicted incomes based on this equation were used to impute missing values.

Results

Of the 1528 usable interviews, 8 were excluded from all analyses because the age was missing. Approximately 40% of the remaining 1520 women were over the age of 65. The percentages of women, by age, who reported having health insurance that covered screening mammography are shown in Table 1. Over half of the women reported that they had insurance that paid all (31.5%) or part (21.7%) of the cost of a screening mammogram. The older women were slightly less likely than the younger women to report insurance coverage that paid all or part of the cost (50.3% vs 55.2%). The younger women were more likely than the older women to report no health insurance for screening mammograms (28.1% vs 21.4%), and the older women were more likely than the younger women not to know whether their insurance would pay for screening mammograms (28.4% vs 15.7%). Differences were statistically significant (χ^2 with 3 degrees of freedom [df] = 40.1, $P < .001$).

Bivariate relationships between mammography use and economic variables, based on the perceptions of the women themselves, are reported in Tables 2 and 3. Of the 1515 women reporting their mammography use, 40.5% had had a mammogram within the past year. Another 18.7% had had one between 1 and 2 years ago, and only 26.1% had never had a mammogram. The percentages of women who had a mammogram within 1 year, 2 years, more than 2 years ago, and never, by age and insurance coverage, are reported in Table 2. Over half of the women reporting that they did not know whether their insurance covered screen-

ing mammography had never had a mammogram: 53.9% of those under the age of 65 and 54.3% of those aged 65 or older, respectively. Of the women with full coverage, just over half had had mammography in the past year. About a quarter of the women who reported that their insurance did not cover any portion of the cost of screening mammography (or who reported no insurance at all) had never had a mammogram.

The percentages of women who had a mammogram within 1 year, 2 years, more than 2 years ago, and never, by age and income, are given in Table 3. Low-income women were much more likely never to have had a mammogram. Recent mammography (within 2 years) was reported most often among the younger women with incomes above $15 000 annually (68.7%) and least often among the younger women with incomes below $15 000 (42.5%). Age differences were not statistically significant in these analyses, but income and insurance were both significantly related to use when age was controlled (χ^2 with 1 df = 12.8 and 160.7, respectively; both $P < .001$).

Definitions for all variables used in the multivariate analyses are given in Table 4. A total of 1377 women had sufficiently complete data to be included. Means and standard deviations (or percentages for dichotomous variables) are shown for women who did (59.4%) and did not (40.6%) report having had a mammogram in the past 2 years. The statistical significance of the differences between the two groups is also shown for all variables. The average net price was predicted as $31 among users of mammography and $35 among nonusers of mammography. (The average price of mammography in the market areas where the women resided was reported to be $77, among the 1148 women who knew or were willing to guess the price. On average, among the 1032 women who knew whether their insurance covered screening mammography, 61% of the price was believed to be paid by insurance.) Users differed significantly from nonusers with respect to all variables except performance of breast self-examination and time cost. They differed from nonusers most notably with respect to whether they visited a gynecologist regularly (19.9% vs 6.1%), whether they reported that they visited no doctor regularly (3.4% vs 19.1%), and whether they were current smokers (15.0% vs 26.7%). Nonusers also reported lower incomes than users ($19 300 vs $26 300 annually), and a higher proportion of them reported

TABLE 3—Percentage of Women Aged 50–75 y Who Had a Mammogram within 1 or 2 Years of Interview, by Income and Age

	Income <$15 000		Income ≥$15 000		Income Unknown	
Time Since Last Mammogram	Age 50–64 y (n = 174)	Age ≥65 y (n = 229)	Age 50–64 y (n = 613)	Age ≥65 y (n = 252)	Age 50–64 y (n = 117)	Age ≥65 y (n = 122)
Within 1 year	27.0	34.5	47.5	42.1	36.8	35.3
Between 1 and 2 years	15.5	14.9	21.2	17.5	16.2	22.1
Over 2 years	16.7	13.1	13.7	15.5	18.0	17.2
Never	40.8	37.6	17.6	25.0	29.1	25.4

TABLE 4—Variable Definitions and Descriptive Statistics for Women Aged 50–75 y

	Users of Mammography (n = 818)		Nonusers of Mammography (n = 559)		
	Mean or %	SD	Mean or %	SD	*P*
Age ≥65: 1 if age was >65	36.8%		42.4%		.037
Married: 1 if married or living as married	74.1%		63.5%		<.001
Working: 1 if working full-time or part-time	33.3%		32.0%		.248
Education: mean years of education	13.2	2.2	12.7	2.3	<.001
Smoker: 1 if current smoker	15.0%		26.7%		<.001
Breast self-examination: 1 if performed monthly	50.9%		51.5%		.809
History: mean number of first-degree relatives with breast cancer	.174	.410	.095	.293	<.001
Physician visits: average number of annual visits made to physicians seen regularly	1.90	1.30	1.42	1.30	<.001
No doctor: 1 if no physician was visited regularly	3.4%		19.1%		<.001
Gynecologist: 1 if regularly visited gynecologist	19.9%		6.1%	.239	<.001
Net price: mean out-of-pocket cost of mammography, in $10 increments	$3.07	$1.70	$3.50	$1.71	<.001
Time cost: total hours set aside to obtain a mammogram	1.32	0.39	1.35	0.47	.181
Inconvenience: 1 if weekdays are less convenient than evenings and weekends to obtain mammography	9.0%		15.2%		<.001
Income: mean household income in $10 000 increments	$2.63	$2.08	$1.93	$1.79	<.001
No insurance: 1 if no health insurance	3.5%		10.4%		<.001
Medicare only: 1 if Medicare only	1.6%		7.3%		<.001
Health maintenance organization: 1 if insured through HMO	13.7%		9.3%		.011

that obtaining mammography on weekdays was inconvenient (15.2% vs 9.0%) and that Medicare was their only form of health insurance (7.3% vs 1.6%).

Results of the multivariate analysis are given in Table 5. As predicted by the theory of demand, use was lower among women who faced a higher net money price (odds ratio [OR] = 0.91 per $10 increase in net price, $P = .006$) or who preferred to obtain a mammogram during weekend or evening hours (OR = 0.53, $P = .001$), and higher among women with higher incomes (OR = 1.14, with a 14% increase associated with each $10 000 increment in total household income; $P < .001$). The effect of time cost was negative, as expected, but not statistically significant (OR = 0.86, with a decrease of 14% for each additional hour required; $P = .29$). As a group, the economic variables were highly statistically significant (likelihood ratio with 4 df = 34.0, $P < .001$).

The value of mammography to the woman was also important in determining demand. Use was higher among women with a family history of breast cancer (OR = 2.22, with more than a twofold increase for each first-degree relative with breast cancer; $P < .001$) and among women who visited a gynecologist regularly (OR = 2.59, $P < .001$). Women who visited no doctor regularly and women who were current smokers were less likely to have had mammography (OR = 0.24, $P < .001$ for no doctor; OR = 0.59, $P < .001$ for smokers). More visits to physicians increased the likelihood of mammography (OR = 1.11 per additional visit,

TABLE 5—Odds Ratios for Mammography Use in the Last 2 Years for Women Aged 50–75 y (n = 1377)[a]

Independent Variable	Odds Ratio[b]	95% Confidence Interval
Age ≥65	0.81	0.61, 1.06
Married	1.24	0.95, 1.62
Working	1.01	0.75, 1.37
Education	1.05	0.99, 1.11
Smoker	0.59	0.43, 0.79
Breast self-examination	0.92	0.72, 1.16
History	2.22	1.56, 3.16
Physician visits	1.11	1.00, 1.23
No doctor	0.24	0.15, 0.39
Gynecologist visits	2.59	1.71, 3.92
Net price	0.91	0.90, 0.91
Time cost	0.86	0.64, 1.14
Inconvenience	0.53	0.36, 0.78
Income	1.14	1.06, 1.22

[a]Controlling for county of residence.
[b]Odds ratios are calculated for a one-unit change in continuous variables.

P = .047), but education and marital status were not statistically significant when economic variables were included in the model. When economic variables were excluded from the model, married women were more likely to be users (OR = 1.47, P = .003), as were more educated women (OR = 1.08 for each additional year of education, P = .004).

A variable indicating whether a woman's health insurance covered 50% or more of the price of a mammogram was created. This variable and the interactions between it and those variables measuring time cost, inconvenience, and income were added to the model to test the hypothesis that the importance of economic variables may be greater among women with poor insurance coverage. These interactions were not statistically significant, either individually or as a group (likelihood ratio statistic on 3 df = 5.30, P = .151), suggesting that the effects of time cost, inconvenience, and income on mammography use do not vary with insurance coverage. Similarly, to test the hypothesis that price sensitivity is greater among women with low income, interaction effects between net price, time cost, and inconvenience and a dummy variable for women with household incomes above $15 000 were estimated. The interaction effects were not statistically significant, either individually or as a group (likelihood ratio statistic on 3 df = 0.671, P = .880), suggesting that the effects of net price, time cost, and inconvenience are stable across the income groups.

Discussion

As suggested by the theory of demand, the effects of net price and income on the use of mammography among women aged 50–75, residing in four suburban or rural counties in Washington State, were found to be significantly negative and positive, respectively. The analyses provided no evidence that economic variables are more important for low-income or uninsured women. Instead, effects were stable across the subsets of the population investigated.

The effects of economic variables on use of mammography were found to be important, but they do not suggest that improvements in insurance coverage will dramatically increase the use of screening mammography. The data suggest that insurance coverage for mammography was already quite good among women aged 50 to 75 in Washington State in 1989; over half of the women reported that their insurance paid some (usually 80%) or all of the cost of screening mammography. The new legislation can be expected to increase the average proportion paid by insurance from about 60% to about 80%, which can be expected to decrease the average net price from about $32 to about $16. If the coefficients estimated from these cross-sectional data were to be given a causal interpretation, they would suggest that the percentage of women having a mammogram in the last 2 years might increase in response to improved insurance coverage from about 59% to about 61%, a change of less than 4%. Such an increase would be negligible relative to the secular trend in mammography use. This study provides no evidence that the effect of improved insurance coverage would be greater among low-income women.

However, if physicians are influenced in their referral patterns by the improvement in insurance coverage, the legislation could have a greater impact. A woman might depend on her physician to advise her regarding the value of mammography because the physician has better information than she does about the expected medical benefit of alternative medical services. The physician presumably acts in the best interest of the patient, taking into account her ability to pay for mammography as well as his or her assessment of its value to the patient. This phenomenon has long been recognized as the "agency role" of the physician.[16] However, the physician may be ignorant of the individual woman's ability to pay and reluctant to discuss the issue with her. Instead, the physician may assume that insurance will (or will not) pay for screening mammography and treat all or most women accordingly.

To the extent that the legislative mandates change the physician's assumptions regarding insurance coverage for screening mammography, they could influence physicians' recommendations. State legislation mandating coverage of screening mammography by private insurers and federal legislation mandating such coverage by Medicare may have an important impact on use by creating a "standard of care" recognized by all physicians. The strength of the influence of physicians is evident from the statistical significance of the physician variables in the demand equation. If all physicians were to refer women for mammography at the rates reported for the gynecologists, the estimates obtained here suggest that use of mammography might rise from 59% to about 75%.

Mandating insurance coverage for screening mammography will not compensate for lack of coverage for preventive office visits. As has been shown in previous studies, exposure to physicians, especially to gynecologists, is an important determinant of whether breast cancer screening is done, including clinical breast examination as well as mammography use.[19] In this sample of primarily upper-middle-class White women, 19.1% of the women who had not had mammography in the last 2 years reported seeing no physician regularly, compared with 3.4% of those who had had mammography. Of the nonusers, 10.4% reported having no health insurance at all, compared with 3.5% among the users.

Because variables other than economic variables are important in determining the use of mammography, interventions will still be needed to reach women who do not obtain screening even when it is available at low cost. Among the women in this sample, family history of breast cancer was an important predictor of use, but age was negatively related to use. A family history of breast cancer may contribute to awareness and fear of the disease in a way that aging does not. In addition, women may be more aware of family history than aging as a risk factor. Also notable in this study is the high rate of smoking among the nonusers, 26.7%

compared with 15.0% among the users. In the multivariate analyses, smokers were found to be about half as likely to have had mammography as nonsmokers. This result suggests that compliance with physicians' recommendations for mammography may be an important problem among smokers, perhaps because the procedure is generally performed at a different facility at a later time, providing ample opportunity for noncompliance.

Despite suggestions in the literature that time costs are substantial,[20] time cost was not statistically significant in the demand analysis. However, women who preferred to obtain mammography during evenings or weekends rather than weekdays were significantly less likely to have had mammography during the previous 2 years, suggesting that logistics are indeed important, as has been suggested previously.[21] The relative unimportance of time cost in these analyses may be attributable in part to limitations in its measurement: although total time to obtain a mammogram was measured, the value of time to the woman was not measured.

Other limitations of this study include the cross-sectional, self-report nature of the data and the lack of measures of price and insurance coverage for physicians' services. Most mammography screening is the result of a referral after a visit to a primary-care physician for routine care. The cost of preventive services may remain a barrier to use of breast cancer screening when the cost of mammography services is reduced by insurance. A minor limitation is that, because a direct measure of general health status was not available, the effect of the number of visits to physicians, intended to measure exposure to physicians, may be biased. Similarly, household income was not adjusted for family size because the latter was not measured.

A potential limitation of the study is that women may not be well informed regarding price and insurance coverage for screening mammography. Of interest in this regard is that women who guessed the price differed from women who knew the price by only $2 on average in their estimate of mammography price. Similarly, all but 27 of the 161 members of Group Health Cooperative of Puget Sound who were included in the analyses (10.5% of the sample) knew that their insurance covered 100% of the cost of screening mammography. The Group Health Cooperative is a large health maintenance organization that has had a risk-based breast cancer screening program since 1984.[22] There is no out-of-pocket charge for screening mammography for enrollees in the Group Health Cooperative. Of the 27 patients in this group, 18 did not know whether the Group Health Cooperative covered screening mammography, 5 thought that it did not, and the remaining 4 thought that it covered something less than 100% of the cost. External validation by means of a survey of mammography facilities in the four study communities also confirmed that women were quite knowledgeable. On average, the women reported a price of $77, and the mammographers reported a charge of $63 for screening mammography and $94 for diagnostic mammography. A related concern is that the dummy variables indicating health insurer that were used to predict the proportion of the price of screening mammography paid by insurance are crude measures. As a group in the prediction equation, they explained 24% of the variance, suggesting that they served adequately as instrumental variables.

This study is an attempt to carefully measure mammography price and insurance coverage and to analyze the use of mammography within the conceptual framework of the theory of demand. It provides evidence that cost is indeed important as a barrier to use of mammography. However, it should not be assumed that mandatory coverage of screening mammography will solve the problem of underutilization of breast cancer screening among all women aged 50 to 75. Uninsured women, smokers, and women who do not visit a physician regularly may still have relatively low rates of use. The analyses corroborate the abundant evidence in the literature that the key to use of mammography among women aged 50 to 75 is referral by a physician. □

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