The Relation of Household Income to Mammography Utilization in a Prepaid Health Care System

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Managed care organizations should be expected to provide equivalent access to preventive and screening services to all members. We studied mammography in 1,667 women members of one HMO who had an overall utilization rate of 84.9%. Significant correlates of mammography utilization included age, estimated household income, and division of the managed care organization in which the member was enrolled. Each \$10,000 increment of income increased mammography rates by 2.5 percentage points (95% confidence interval [CI], 1.4% to 3.6%), independent of age and division. Our findings suggest that coverage for mammography services is not sufficient to ensure equivalent use of screening across income groups.

KEY WORDS: mammography; socioeconomic status; managed care.

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A disproportional burden of breast cancer mortality¹ falls on persons of lower income and racial minorities. Mammography utilization has been shown to vary according to insurance coverage and ability to pay for the service.²⁻⁴

Work from other countries with universal health insurance coverage⁵ or free mammography programs⁶ has shown that socioeconomic factors are associated with differential mammography rates, despite equivalent "access." A study from a U.S. managed care organization found repeat adherence to mammography was correlated with members' income levels.⁷ We wanted to determine if income level was related to mammography use among women enrolled in a managed care organization that provided mammography to its members at no cost, and whether the effect of income was different in the various models (Staff, Group and Network) represented in the managed care organization.

METHODS

Setting

Harvard Pilgrim Health Care is a large, non-profit multi-model managed care organization (MCO) with components including a staff model HMO, a group model

HMO and a network-based MCO. The Staff Model HMO employed salaried clinicians who cared for members in health centers, while the Group Model HMO contracted with midsize to large primary care groups to provide capitated care to members. The Network Model HMO provided capitated care through a large and geographically dispersed network of smaller offices and individual physicians.

Mammography was a covered benefit in all divisions of the managed care organization, with no associated co-pay. Guidelines disseminated throughout the organization recommended biennial mammography screening for women between the ages of 40 and 49 and annual screening for women ages 50 years and older. These guidelines were unrelated to coverage; clinicians were free to order screening mammography for women of any age at any interval they deemed appropriate.

Sample

Eligible subjects were women 40 to 64 years of age as of January 1, 1995, who were continuously enrolled by the managed care organization for the period January 1, 1995, to December 31, 1997. Members of the three divisions were selected in a random stratified fashion to include equal numbers in each division, and in the following age groups: 40-44 years, 45-49 years, 50-54 years, 55-59 years, and 60-64 years.

Measurements

Documentation of receipt of a mammogram during the time period January 1, 1995, to December 31, 1997, was obtained from computerized medical records⁸ (maintained in the Staff Model) and from claims files (in the case of the Group and Network Models).

Demographic data, including birthdate and address as of August 1, 1998, were obtained from enrollment records. Household income was estimated by mapping the home address to census tract information using census mapping software⁹; for each woman, we included the median household income of her census tract.¹⁰

Analysis

Mammography utilization was examined with regard to age, estimated household income, and model of managed care. The population was grouped into quintiles based on estimated household income. Bivariate frequency analyses of mammogram utilization versus age group,

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Table 1. Selected Characteristics of Study Population

Division	Staff	Group	Network	Total
Age group, y				
40–44, n	122	108	109	339
45–49, n	82	97	90	269
50–54, n	129	116	125	370
55–59, n	93	102	99	294
60–64, n	124	137	134	395
Estimated household income*				
Median, \$	42,944	50,595	43,023	45,738
Range, \$	10,391–117,840	15,754–117,840	12,543–98,069	10,391–117,840
Quintiles of estimated household income				Median income in quintile, \$, range
One (lowest)				30,068 (10,391–35,655)
Two				39,116 (35,859–41,934)
Three				45,738 (41,934–48,595)
Four				53,356 (48,595–58,495)
Five (highest)				68,696 (58,495–117,840)

* All pairwise comparisons of means between divisions are significant at the 0.05 level. U.S. national median household income from the 1990 census was \$30,056.

income quintile, and managed care division used χ^2 tests and Mantel-Haenszel tests for trend. The relationship between mammography and the explanatory variables was examined using logistic regression in which age and income were treated as continuous variables. We checked the assumption of linearity for continuous variables and also examined potential interaction terms. Only the quadratic term for age was significant. Analyses were performed using SAS.¹¹ Odds ratios (ORs) from logistic regression and their confidence interval bounds were transformed using an approximating formula^{12,13} to provide adjusted risk ratios (RRs).

RESULTS

The study population included 1,667 women from the three divisions of the managed care organization (Table 1). The median estimated household income varied by division: the Staff Model population had the lowest estimated income, and the Group Model population the highest. The population was divided into quintiles according to estimated income, and the median income levels for each quintile are shown in Table 1.

The overall rate of mammography utilization in the three-year time period was 84.9%. Variation was noted by age group ($P = .001$ for trend), with the lowest rate seen in the group of women between the ages of 40 and 44 years (75.8%), and highest rate of use seen in women between the ages of 50 and 54 years (91.6%). Mammography utilization was highest in the Staff Model Division (88.4%), with rates of 84.4% and 82.1% in the Network and Group Models respectively ($P = .014$).

The lowest rate of mammography was found in the second to the lowest income quintile (81.7%) and the highest rate (90.4%) was seen in the highest income quintile (Table 2) ($P = .014$ for trend). The association of income and mammography utilization was statistically

significant within the Group and Network Model divisions, but not in the Staff Model (Table 2).

Multivariate logistic modeling demonstrated that mammography utilization was independently associated with median household income after adjusting for age, the quadratic age term, and division of the managed care organization. The magnitude of the odds ratio associated with each \$10,000 increment in annual median household income was 1.23 (95% CI, 1.12 to 1.36).

Because the incidence of mammography in this population is high, the odds ratio may not provide a proper approximation of the risk ratio. We therefore used a transformation¹² of the odds ratio to determine the risk ratio for each \$10,000 increment in annual household income, which is 1.025 (95% CI, 1.014 to 1.036). This may be expressed as a 2.5 percentage point lower rate of mammography screening per \$10,000 decrement in annual household income, and thus a 10 percentage point lower mammography rate per difference in income of \$40,000, e.g., in a group of women with median household income of \$25,000 compared to women with median household income of \$65,000.

DISCUSSION

We found that household income had a modest effect on mammography utilization in a cohort of women enrolled in a mixed model managed care system. Members with higher estimated household income were more likely to undergo mammography in the three-year period. The RR of 1.025 specifies the expected increase in mammography per \$10,000 increment in household income. In our sample, this corresponds to a mammography rate almost 10 percentage points lower in the lowest income group compared to the highest income group.

In a sample of insured citizens, Katz et al. found that women with incomes over \$45,000 had an odds ratio of 2.4

Table 2. Mammography Rates by Managed Care Model and Quintiles of Median Household Income

Division	Staff	Group	Network	Total (95% CI)
Income quintile				
One (lowest)	85.3	80.0	78.2	82.9 (78.7 to 87.1)
Two	83.2	77.4	79.4	81.7 (77.5 to 86.0)
Three	94.5	76.9	86.7	87.7 (84.0 to 91.4)
Four	87.1	85.0	88.2	82.0 (76.4 to 87.7)
Five (highest)	91.3	91.0	87.5	90.4 (87.1 to 93.7)
Test for trend				
Mantel-Haenszel χ^2	2.52, 1 df	7.36, 1 df	6.01, 1 df	6.10, 1 df
P value	.112	.007	.014	.014

for mammography utilization compared to women in the lowest income level (<\$15,200).⁵ The comparable odds ratio in our study population is 1.9 for women with incomes greater than \$45,000 compared to the poorest income group (for our population, less than \$27,700). Yood et al. found that women with estimated household income greater than \$38,100 had a higher rate of repeat mammography than women with estimated incomes below \$25,399 (69% vs 59%).⁷ Comparison of our data with Katz et al. shows that household income is a less powerful factor in our homogeneously insured, and wealthier, population and yet the effect of income continues to be significant. Our data extends the findings of Yood et al. in repeat mammography to all screening mammography, and suggests that income continues to be related to mammography use at higher income levels.

The mammography rates we found in the different divisions of the managed care organization are likely to reflect the presence of organizational systems in the Staff Model, such as automated clinician reminders, and mammography units located at clinical sites. It is also possible that high rates of mammography utilization reflect self-selection of patients into a Staff Model HMO because of its promotion of preventive services.

Our study confirms findings indicating that 100% coverage for mammography is not sufficient alone to ensure equivalent use of screening mammography across an entire population. Our study is one of the first to demonstrate the magnitude of the effect of income in a population homogeneous for health insurance. Furthermore, ours is the first to report the relationship of household income to mammography use within different insurance models of managed care. Because of known inaccuracies in claims data we did not attempt to distinguish diagnostic mammograms.³ Therefore our estimate of mammography as used for screening may be slightly inflated by the inclusion of diagnostic mammography. Women undergoing investigation to rule out cancer are considered "screened" and inclusion of these women should not introduce bias by income level. Our method for estimating household income by using census tract information has been used elsewhere.⁷ Inaccuracies in this data would be expected to bias our findings toward the null.

The nature of factors active in the differential use of screening mammography by lower income women is still

not well established. In addition to financial and logistical barriers^{2,3,14} investigators have found various motivators^{15,16} and perceptions^{17,18} about mammography to have different impacts on women according to socioeconomic status.

The high rate of mammography utilization at all income levels in the division that uses automated reminder systems suggests that organizational or system-level efforts may minimize any income-related gap. Further research on the continuing presence of an income effect is worthy of study. Such research might boost our effectiveness at improving screening compliance at all levels of the population.

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