Mammogram Utilization Among Farm Women

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ABSTRACT: *Utilization of preventive health care services is lower in rural populations than in urban populations, possibly as a result of barriers to preventive health care that are characteristic of rural settings. This study was conducted to identify factors associated with mammogram utilization among farm women. Mammogram utilization among farm women from six southern Minnesota counties was examined as part of a larger community-based cancer intervention study. Farm women aged 40 and older were randomly selected from a list of farm households and interviewed by telephone to determine mammogram utilization and factors related to utilization. Of the 606 respondents, 78 percent reported ever having a mammogram and 49 percent reported a mammogram within the past year. Physician recommendation for a screening mammogram and family history of breast cancer were found to be associated with ever having a mammogram. Correct knowledge of mammogram screening guidelines was associated with a mammogram within the past 12 months. Overall, physician recommendation was the most influential determinant of utilization. As more emphasis is placed on prevention, patient education by physicians could have the greatest impact on mammogram utilization.*

One out of eight women will develop breast cancer in their lifetime (American Cancer Society, 1995). The etiology of breast cancer is unknown although many risk factors have been identified (Kelsey & Horn-Ross, 1993). In the absence of primary prevention strategies only secondary prevention strategies (i.e., early detection and treatment) are available. There is a general consensus that screening mammography for women older than age 50 does reduce breast cancer mortality (Fletcher, Black, Harris, Rimer, & Shapiro, 1993; Kerlikowske, Grady, Rubin, Sandrock, & Ernster, 1995; Miller, Baines, To, & Wall, 1992; Morrison, 1993; Shapiro, Venet, & Strax, 1992; Sickles & Kopans, 1993). While mammogram utilization has been increasing, annual screening by mammography is used by only 14 to 60 percent of eligible women (American Cancer Society, 1985; Breen & Kessler, 1994; Centers for Disease Control [CDC], 1993; Coleman, Fever, National Breast Cancer Screening Consortium, 1992; Fox, Murata, & Stein, 1991; Gardiner, Mullan, & Rosenman, 1995; Kaplan, Weinberg, Small, Herndon, 1991; Kottke, et al., 1995; Lerman, Rimer, Trock, Balshem, & Engstrom, 1990; Rakowski, Rimer, & Bryant, 1993; Rettig, Nelson, & Faulk, 1994; Zapka, Stoddard, Maul, & Constanza, 1991).

Potential barriers to mammography utilization include lack of physician recommendation, lack of perceived need, risk, cost, inconvenience, lack of knowledge about breast cancer and the effectiveness of mammography screening, and misunderstanding about the need for mammography without symptoms (Breen & Kessler, 1994; Burack & Liang, 1987; CDC, 1990; Fox, et al., 1991; Glockner, Holden, Hilton, &

Norcross, 1992; Lantz, Remington, & Soref, 1990; National Cancer Institute Breast Cancer Screening Consortium, 1990; Rimer, Keintz, Kessler, Engstrom, & Rosan, 1989; Rutledge, Hartman, Kinman, & Winfield 1988; Schechter, Vanchieri, & Crofton, 1990; Urban, Anderson, & Peacock, 1994; Zapka, Stoddard, Costanza, & Greene, 1989). The two reasons most frequently reported by women for not undergoing breast cancer screening are lack of a physician recommendation and the belief that a mammogram was not needed or not indicated without symptoms (Breen & Kessler, 1994; Lerman, et al., 1990; Love, Brown, Davis, Baumann, Fontana, & Sanner, 1993; Rimer, Trock, Engstrom, Lerman, & King, 1991; Zapka, et al., 1991; Zapka, et al., 1989). Studies have shown that most women would follow a physician's recommendation for a mammogram (Bryant & Mah, 1992; Burack & Liang, 1987; Fox, et al., 1991; Rimer, et al., 1989; Slenker & Grant, 1989; Zapka, et al., 1989). Rural women report an even greater likelihood of compliance with mammography than urban women (Bryant & Mah, 1992). Unfortunately only 38 to 60 percent of eligible women have had a physician recommend a screening mammogram (Bryant & Mah, 1992; Lerman, et al., 1990).

Relatively little attention has been paid to the characteristics of farm life that may pose unique barriers to breast cancer screening. Utilization of health care services, particularly preventive health care services, is lower in rural populations than in urban populations (Bryant & Mah, 1992; Calle, Flanders, Thun, & Martin, 1993). Distance to medical facilities and inadequate health insurance coverage may be barriers to preventive health services for farm families. Minnesota farm families tend to purchase their own health insurance, which generally provides less coverage and has higher deductibles and copayments compared to employer-provided insurance plans in urban areas (Kralewski, Yuanli, & Shapiro, 1992).

This study was conducted to identify barriers to preventive health services among farm families and was part of a community intervention project to evaluate and enhance preventive health strategies in rural areas. This article presents the results of a pre-intervention survey that identified current practices and barriers to mammography screening.

Methods

Data were collected by a cross-sectional telephone survey conducted in 1992. Participants were sampled from farm operations in six rural southern Minnesota counties that have similar demographic and agricultural production characteristics.

Participants were chosen randomly in a two-stage process. In the first stage, a random sample of farm operations was selected from the list of farms maintained by the U.S. Department of Agriculture (USDA) and the Minnesota Agricultural Statistics Service (MASS). The USDA defines a farm as any place from which $1,000 or more of agricultural products were produced and sold in a given year. A farm operation was eligible for participation if there was at least one member of the household aged 40 or older who also lived on a farm for the last five years. The second stage involved selecting at random one eligible person (aged 40 or older who lived on a farm for five years) from the household to serve as the study respondent. To ensure a balanced number of subjects by age and gender, an approximately equal number of subjects was sampled from each of six age-gender strata using a weighted random sampling scheme. The response rate for the first stage of interviewing (eligibility screen) was 81 percent. Of those who completed the eligibility screen and were eligible for participation, 1,327 (82%) completed full interviews.

Telephone interviews proceeded in two stages following the sampling procedures. The first stage determined household eligibility and solicited study participation. Eligible households that agreed to participate were then interviewed to collect project data.

Conceptual Model. Three modified models were employed, the Health Belief Model (Kegeles, 1963; Kegeles, 1968); the model of Andersen (Andersen, 1968) and Andersen, Kravits, and Anderson (1976) on consumption of health care services; and the microeconomic model of consumer behavior (Henderson & Quandt, 1971) to produce a conceptual model for mammogram utilization among farm women. The model served as the theoretical basis for the analysis of study data, using the method proposed by Maldonado (1995a) for eliciting and summarizing information about causal relations. Briefly, Maldonado's method is based on the sufficient-component cause model of Rothman (Rothman, 1976). Under this model, a sufficient cause for an outcome or

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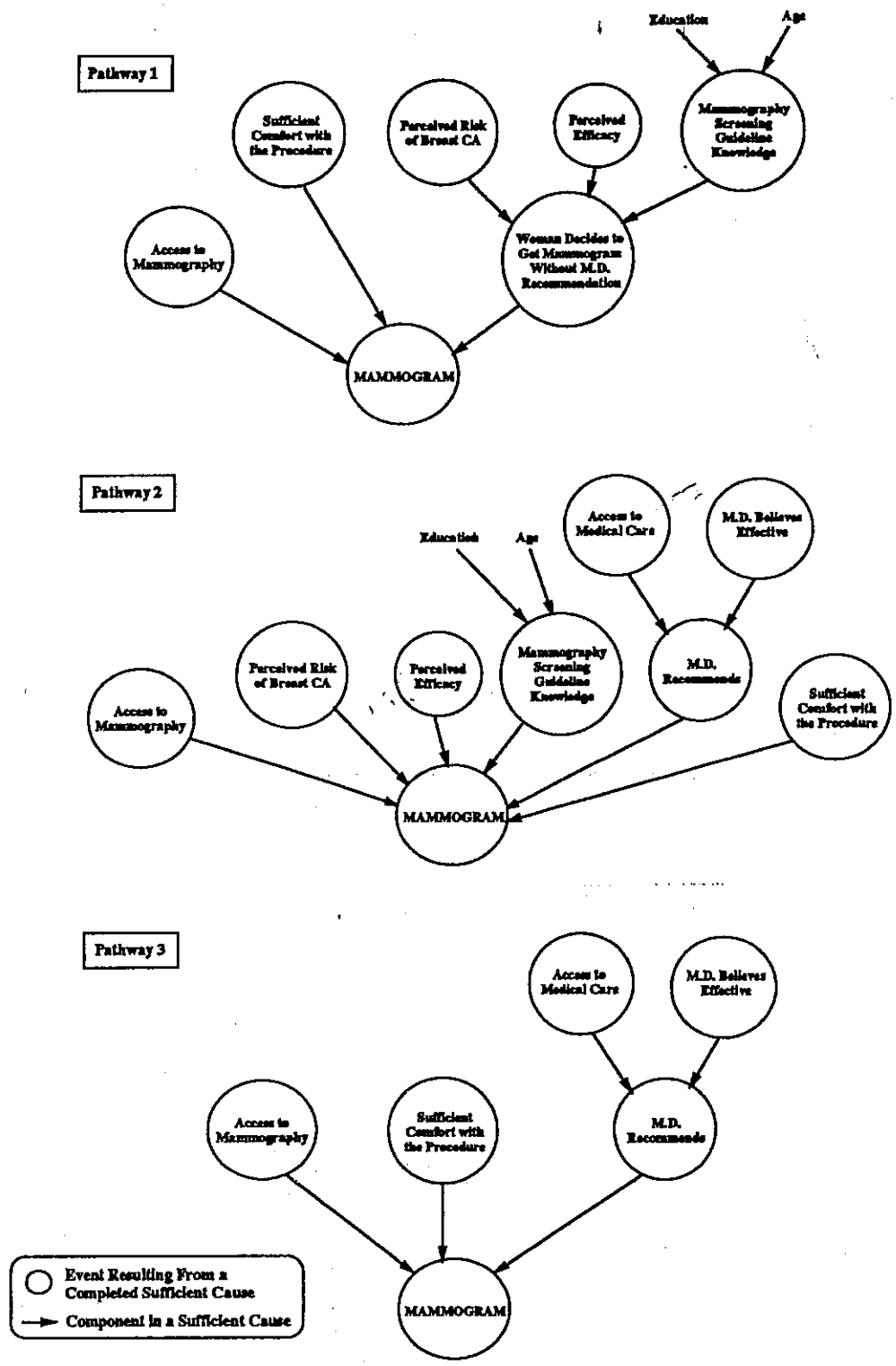
Figure 1. Conceptual Model for Mammogram Utilization.



causal event consists of several components. The outcome occurs in an individual when all required components occur together; if some required components are missing, the sufficient cause is not completed and the sufficient cause does not cause the outcome. A specific outcome may result from one or more sufficient causes (causal pathways). Maldonado (Maldonado, 1995a) modified the "causal pie" schematic illustration of Rothman (Rothman, 1976) to allow for the illustration of complex causal relations. In the modified graphic presentation, each sufficient-component cause (causal pathway) is drawn separately, causal events are circled, and an arrow is drawn from each component cause to the causal event.

As Figure 1 shows, this study found three causal pathways that result in a midwestern farm woman getting a mammogram. In Pathway 1, a woman will get a mammogram if she has access to mammography, if she is sufficiently comfortable with the procedure, and if she decides on her own (without a physician recommendation) that she should get one. This type of woman will decide on her own to get a mammogram if she perceives she is at risk of breast cancer, if she perceives that mammograms are effective in increasing survival if breast cancer should occur, and if she knows the mammogram screening guidelines. Knowledge of the screening guidelines is affected by education, age, and probably, other factors not fully specified in this study.

In Pathway 2, a woman will get a mammogram if she has access to mammography, if she perceives that she is at risk for breast cancer, if she perceives that mammograms are effective, if she is knowledgeable about the mammogram screening guidelines, if a physician recommends she get one, and if she is sufficiently comfortable with the procedure. Note that in Pathway 2, the woman requires a physician recommendation before a mammogram is obtained.

In Pathway 3, a woman will get a mammogram if she has access to mammography, if she is sufficiently comfortable with the procedure, and if her physician recommends one. For this type of woman, the decision to get a mammogram is primarily a clinical decision.

Figure 2 illustrates, in more detail, causal pathways for two causal event components of the mammogram utilization conceptual model: access to mammography and perceived risk of breast cancer. As Figure 2 shows, this study assumes that there are two pathways that result in access to mammography. In one pathway, access to mammography results if the woman has access to medical care, if she can afford to pay for the mammogram, and if a mammography unit is an acceptable distance away. In the second pathway, access to mammography results if the woman has access to medical care, if the mammogram is covered by health insurance, and if a mammography unit is an acceptable distance away.

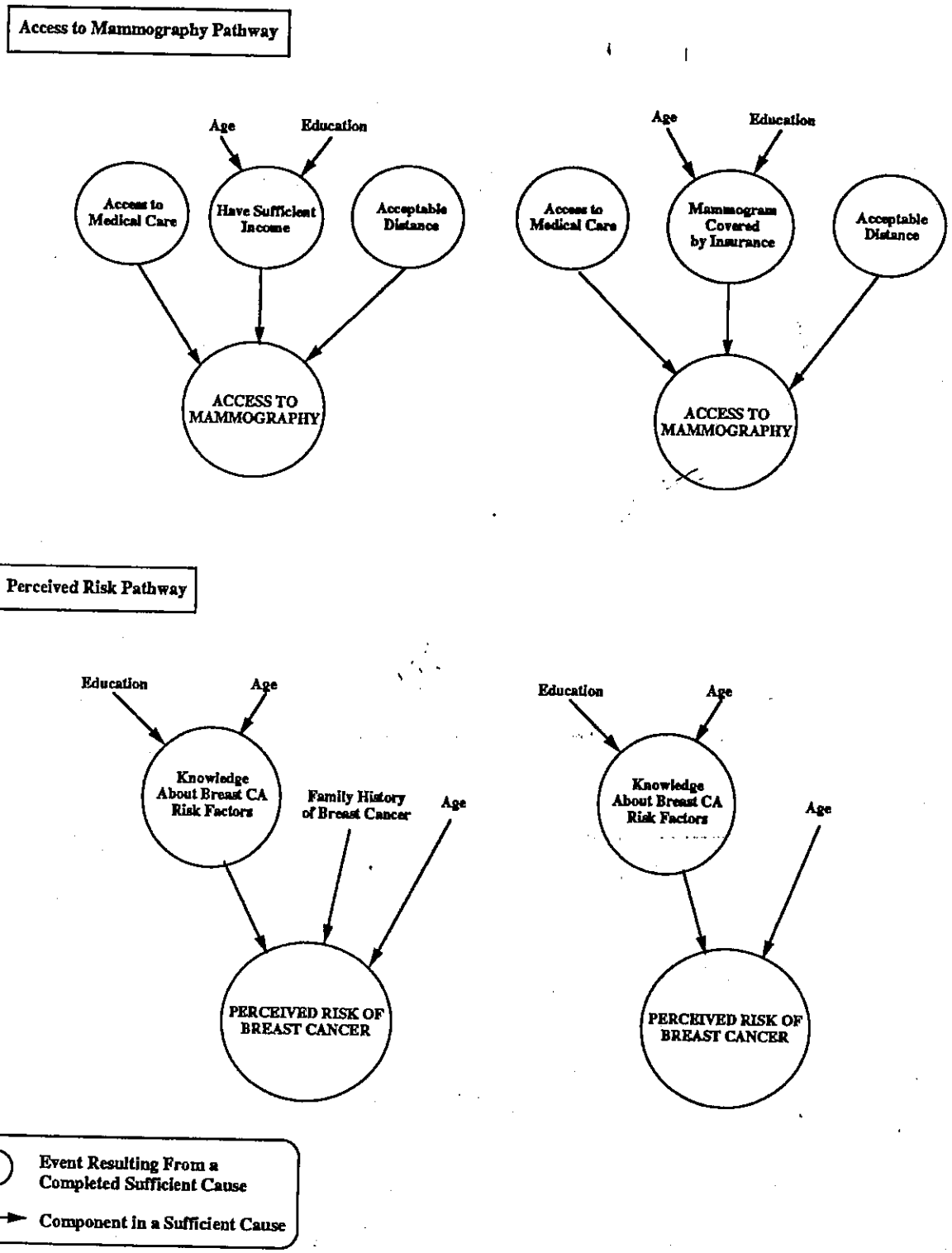
As Figure 2 also shows, there are two pathways that result in a woman's perception that she is at risk for breast cancer. In one pathway, a woman perceives she is at risk of breast cancer if she is knowledgeable about breast cancer risk factors, if she has a family history of breast cancer, and if she is older. In the other pathway, a woman perceives she is at risk of breast cancer if she is knowledgeable about breast cancer risk factors, and if she is older.

Study Variables. The interview instrument contained items on demographic characteristics, health insurance coverage, access to and use of screening for breast and skin cancer, and knowledge and use of cancer prevention measures. Additional information was obtained on knowledge and perceived efficacy of breast cancer screening, objective risk measures, knowledge of cancer risk factors, and perceived risk of cancer.

Three variables in the model were composite variables, created by combining responses from multiple variables. A single computed variable for physician mammogram recommendation was created for all respondents, regardless of mammogram utilization status, by combining responses to two mutually exclusive variables: physician recommendation for the most recent mammogram (for women that had ever had a mammogram) and ever receiving a physician's recommendation (for women that reported never having had a mammogram). A positive response to either question resulted in the computed variable being coded "yes." A single variable for assessing chances of surviving breast cancer with early detection was created by combining responses to questions on perceived effectiveness of mammography and chances of surviving breast cancer with early detection. A response of "very effective" to the mammogram effectiveness variable in combination with a response of "good" to the chances of surviving breast cancer with early treatment variable resulted in the computed variable being coded "good." A response of "not sure" to either variable resulted in a not sure response for the computed variable. All other combinations of responses resulted in a "fair/poor" code for the computed variable.

Knowledge of breast cancer risk factors was measured by a computed variable that combined

Figure 2. Conceptual Models for Access to Mammography and Perceived Risk of Breast Cancer.



responses from two risk factors questions—age and age at first childbirth—using a comparable process. Family history as a risk factor was not included in this computed variable because 95 percent of the respondents had correctly identified family history as a risk factor. Assessment of correct mammogram screening guideline knowledge was made on the basis of guidelines in effect in 1992 and took the respondent's age into account.

Data Analysis. Logistic regression was used to describe the dependence of mammogram utilization on the variables from the hypothesized pathways. The conceptual model was used to guide statistical modeling decisions and to identify risk factors, potential confounders, and potential effect modifiers (Maldonado, 1995a). Results were weighted by age and household composition to compensate for unequal selection probabilities.

Results

Of 625 primary female respondents, 606 (97%) reported no history of breast cancer, i.e., they were eligible for breast cancer screening. Women who reported a history of breast cancer (n=19; 3%) are excluded from these analyses. As shown in Table 1, a majority of the respondents had at least a high school education (88%), and reported total incomes (farm and nonfarm) of more than $20,000 (53%). Ninety-five percent had some type of health insurance coverage and for 53 percent, mammograms were fully or partially covered by health insurance once deductibles had been met. Twenty-five percent of the respondents were not sure what proportion of a mammogram was covered by their health insurance. Overall, 78 percent reported ever having a mammogram and 49 percent had a mammogram within the previous 12 months.

The results of logistic regression analyses for ever having had a mammogram and having had a mammogram in the previous 12 months are presented in Table 2. To distinguish between factors associated with ever having had a mammogram and factors asocciated with having a had one within the prior 12 months, women who reported never having had a mammogram (n=135) were excluded from the analysis for mammogram in the prior 12 months. Each variable in the statistical model is adjusted for all other variables.

Table 1. Population Characteristics and Mammogram Utilization.*†

	Number	Percent
Demographic Characteristics		
Age		
40 to 49 years	227	34
50 to 64 years	301	50
65 years or older	78	16
Education		
Less than high school	67	12
High school	261	43
More than high school	278	45
Annual Income from all Sources		
Less than $10,000	52	9
$10,000 to $19,999	104	17
$20,000 to $34,999	170	28
$35,000 to $49,999	83	14
$50,000 or more	68	11
Unknown/refused	129	22
Health System Factors		
Physician Ever Recommended Mammogram		
Yes	433	71
No	173	29
Health Insurance Coverage		
Yes	573	95
No	33	5
Mammogram Insurance Coverage		
All	84	14
Most	179	30
Some	54	9
None/no health insurance	133	22
Unknown	152	25
Distance to Mammogram Unit		
0 to 9 miles	211	35
10 to 15 miles	197	32
More than 15 miles	174	29
Unknown	24	4
Mammogram Utilization		
Heard of a Mammogram	601	99
Ever Had a Mammogram	471	78
Had a Mammogram in Previous 12 Months*	293	49

* Nine women excluded with unknown most recent mammogram date.
† Percentages weighted to adjust for unequal sampling probabilities.

Table 2. Logistic Regression Analysis of Factors Associated with Ever Having Had a Mammogram and Having Had a Mammogram in the Previous 12 Months.#*†

	Ever Had a Mammogram		Had a Mammogram in the Previous 12 Months	
	Odds Ratio	95% CI	Odds Ratio	95% CI
Income (reference group: less than $10,000)				
$10,000 to $19,999	1.5	(0.5, 4.6)	0.8	(0.3, 2.1)
$20,000 to $34,999	2.4	(0.8, 7.2)	0.9	(0.4, 2.2)
$35,000 to $49,999	1.8	(0.5, 6.1)	0.9	(0.3, 2.4)
$50,000 or more	2.6	(0.7, 9.6)	0.9	(0.3, 2.4)
Unknown/refused	3.4	(1.1, 10.9)	1.1	(0.5, 2.7)
Physician Mammogram Recommendation	32.5	(17.9, 59.1)	1.7	(0.9, 3.1)
Mammogram Insurance Coverage After Deductible (reference group: no coverage)				
All	1.4	(0.4, 4.2)	1.3	(0.6, 2.6)
Most	1.7	(0.7, 3.8)	1.2	(0.7, 2.0)
Some	2.6	(0.8, 8.5)	1.1	(0.5, 1.7)
Unknown	0.4	(0.2, 0.9)	0.9	(0.5, 1.7)
Distance to Mammogram Unit (reference group: more than 15 miles)				
0 to 9 miles	1.7	(0.9, 3.5)	1.1	(0.7, 1.8)
10 to 15 miles	2.0	(1.0, 4.0)	1.6	(0.9, 2.6)
Unknown	0.4	(0.1, 2.0)	2.2	(0.4, 12.4)
Knowledge of Breast Cancer Risk Factors (reference group: age incorrect/first child after age 30 incorrect)				
Age correct/first child after age 30 correct	1.3	(0.6, 2.9)	1.1	(0.6, 1.9)
Age correct/first child after age 30 incorrect	1.4	(0.7, 3.0)	0.4	(0.4, 1.2)
Age incorrect/first child after age 30 correct	0.6	(0.2, 1.4)	0.8	(0.4, 1.6)
Mother or Sister with Breast Cancer	3.8	(1.2, 12.2)	1.5	(0.7, 3.1)
Perceived Chance of Surviving Breast Cancer with Mammogram Screening and Early Treatment (reference group: poor)				
Good	2.0	(1.1, 3.7)	1.2	(0.8, 1.8)
Unknown	0.7	(0.2, 2.1)	0.3	(0.1, 1.0)
Correct Mammogram Screening Knowledge	1.3	(0.7, 2.3)	2.4	(1.6, 3.7)

\# Each variable in the statistical model is adjusted for all other variables.
* Nine women excluded with unknown most recent mammogram date.
† Percentages weighted to adjust for unequal sampling probabilities.

Among factors for which intervention strategies are possible, physician recommendation demonstrated the strongest association with ever having a mammogram (odds ratio [OR]=32.5, 95% confidence interval [CI]=17.9, 59.1). There was also an association between having ever had a mammogram and the perception that the chance was good of surviving breast cancer with mammography screening and early treatment (OR=2.0, 95% CI=1.1, 3.7). Weaker associations were present for knowledge of breast cancer risk factors, having some insurance coverage for mammograms, and a mammogram center less than 15 miles away. A family history of breast cancer (mother or sister) was also associated with ever

Table 3. Univariate Description of Mammography Utilization by Selected Characteristics.*†

	Ever Had a Mammogram				Never Had a Mammogram	
	Mammogram in the Previous 12 Months		Mammogram More Than 12 Months Ago			
	Number	Percent	Number	Percent	Number	Percent
Demographics						
Age						
40 to 49 years	100	45	72	32	53	24
50 to 64 years	153	52	79	27	64	22
65 years or older	40	52	18	23	18	24
Education						
Less than high school	29	43	14	21	23	36
High school	115	46	72	28	70	27
More than high school	149	55	83	30	42	15
Annual Income from all Sources						
Less than $10,000	22	45	11	22	18	33
$10,000 to $19,999	44	44	31	30	27	26
$20,000 to $34,999	85	51	49	29	35	20
$35,000 to $49,999	41	50	26	31	16	19
$50,000 or more	36	54	20	29	11	17
Unknown/refused	65	51	32	25	28	24
Family History						
Mother or Sister with Breast Cancer	34	65	12	23	5	11
No Family History of Breast Cancer	259	48	157	28	130	24
Health System Factors						
Physician Ever Recommend Mammogram						
Yes	263	62	142	33	22	5
No	30	18	27	15	113	67
Health Insurance Coverage						
Yes	288	51	162	28	116	21
No	5	16	7	22	19	62
Insurance Coverage for Mammogram (after deductible)						
All	53	64	21	24	10	12
Most	99	57	57	31	21	12
Some	29	54	19	36	6	10
None	58	45	38	30	32	25
Unknown/refused	54	36	34	22	62	43
Distance to Mammogram Unit						
0 to 9 miles	102	50	65	31	39	19
10 to 15 miles	109	57	50	25	35	18
More than 15 miles	76	44	52	29	46	27
Unknown	6	28	2	10	15	63
Mammogram Knowledge/Beliefs						
Perceived Chance of Surviving Breast Cancer with Mammogram Screening and Early Treatment						
Good	153	58	74	27	42	16
Fair/Poor	136	45	86	28	80	27
Unknown	4	15	9	34	13	51
Correct Mammogram Screening Knowledge						
Yes	220	58	90	23	74	19
No	73	35	79	36	61	29

* Nine women excluded with unknown most recent mammogram date.
† Percentages weighted to adjust for unequal sampling probabilities.

Table 4. Mammography Utilization by Family History of Breast Cancer and Physician Recommendation.†

		Ever Had a Mammogram		
	Number of Cases in the Category*	Percent Having a Mammogram in the Previous 12 Months	Percent Having a Mammogram Longer than 12 Months Ago	Percent Never Having a Mammogram
Positive Family History of Breast Cancer	51	65	23	11
Physician mammogram recommendation	41	76	22	2
No physician mammogram recommendation	10	26	28	46
Negative Family History of Breast Cancer	546	48	28	24
Physician mammogram recommendation	386	61	34	5
No physician mammogram recommendation	160	17	15	68

† Percentages weighted to adjust for unequal sampling probabilities.
* Nine women excluded with unknown most recent mammogram date.

having had a mammogram (OR=3.8, 95% CI=1.2, 12.2). Income also showed some association with ever having a mammogram, but there was no consistent pattern with increasing income.

Among women who have ever had a mammogram, correct knowledge of mammogram screening guidelines was most strongly associated with having a mammogram within the past 12 months (OR=2.4, 95% CI=1.6, 3.7). Associations were also present with physician recommendation, distance to mammogram unit, and mother or sister with breast cancer.

A univariate description of mammogram utilization by demographic and health system factors, family history of breast cancer, and mammogram knowledge and beliefs is presented in Table 3. Percentages in each row sum to 100; for example, of women 40 to 49 years old, 45 percent have had a mammogram within the previous 12 months, 32 percent have had a mammogram more than 12 months ago, 77 percent have ever had a mammogram, and 24 percent have never had a mammogram. Table 4 describes mammography utilization by family history of breast cancer and physician recommendation, two factors that were strongly associated with ever having a mammogram. The importance of physician recommendation is highlighted by its impact among both women with and without a family history of breast cancer. Of the 41 women with a family history of breast cancer whose physician ever recommended a mammogram, 98 percent had ever had a mammogram and 76 percent had one in the previous 12 months compared to 54 percent and 26 percent, respectively, of those with no physician recommendation. A similar pattern is present for women with no family history of breast cancer. Among those who did receive a physician recommendation, 95 percent were ever screened and 61 percent were screened within the previous 12 months compared to 32 percent and 17 percent for women with no physician recommendation, respectively.

Table 5 describes mammography screening by factors amenable to intervention: mammogram screening guideline knowledge, perception of the odds of surviving breast cancer with mammography screening, and physician recommendation. Only 19 percent of women with the correct knowledge regarding mammography screening guidelines reported never having a mammogram, compared to 29 percent of those with the incorrect knowledge. Physician recommendation is strongly associated with ever having a mammogram as well as having one in the past 12 months across all categories of knowledge and survival perception. Knowledge of correct age-specific mammogram screening guidelines is more strongly related to having a mammogram in the past 12 months than to ever having a

Table 5. Mammography Utilization by Mammogram Screening Knowledge, Breast Cancer Survival Perception, and Physician Recommendation.†

		Ever Had a Mammogram		
	Number of Cases in the Category*	Percent Having a Mammogram in the Previous 12 Months	Percent Having a Mammogram Longer Than 12 Months Ago	Percent Never Having a Mammogram
Correct Mammogram Screening Knowledge	372	58	23	19
Perceived Chance of Surviving Breast Cancer with Mammogram Screening and Early Treatment: Good	190	63	21	16
Physician mammogram recommendation	147	75	22	3
No physician mammogram recommendation	43	25	19	57
Perceived Chance of Surviving Breast Cancer with Mammogram Screening and Early Treatment: Fair/Poor	182	55	24	22
Physician mammogram recommendation	130	68	27	5
No physician mammogram recommendation	52	21	15	64
Incorrect Mammogram Screening Knowledge	199	35	36	29
Perceived Chance of Surving Breast Cancer with Mammogram Screening and Early Treatment: Good	79	44	40	16
Physician mammogram recommendation	60	53	47	0
No physician mammogram recommendation	19	15	20	65
Perceived Chance of Surviving Breast Cancer with Mammogram Screening and Early Treatment: Fair/Poor	120	32	34	34
Physician mammogram recommendation	79	42	45	13
No physician mammogram recommendation	41	12	14	74

† Percentages weighted to adjust for unequal sampling probabilities.
* Nine women excluded with unknown most recent mammogram date, and 26 women excluded with unknown perception of chance of surving breast cancer if screened.

mammogram. Perception of breast cancer survival was associated with a small increase in mammogram utilization. It appears that intervention could substantially increase mammogram utilization: 75 percent of women with correct mammogram screening guideline knowledge, perception that mammography is effective, and physician recommendation reported having a mammogram in the past 12 months. In contrast, only 12 percent of women had a mammogram within the previous 12 months who had incorrect mammogram screening knowledge, perception that mammography is not effective, and no physician recommendation.

Discussion

Screening mammography is effective in reducing breast cancer mortality; it is also underutilized. In an attempt to better understand how mammogram utilization can be increased, this cross-sectional study examined factors associated with mammogram utilization among farm women.

A positive association was found between mammogram utilization and several factors for which intervention strategies are possible. Foremost among the possible interventions is a physician's

recommendation for a screening mammogram. Women whose physician had ever recommended a mammogram (71%) were far more likely to have ever received one and were also more likely to have had a mammogram within the past 12 months.

Two factors for which educational programs are possible were also associated with mammogram utilization. A woman's perception that the chances of surviving breast cancer through mammogram screening were good was associated with ever having a mammogram, although it was not strongly associated with having had one in the preceding 12 months. Correct knowledge of mammogram screening guidelines was associated with screening mammography within the past 12 months.

Two other factors for which intervention is possible were also associated with mammogram utilization. Closer distance to a mammogram unit and insurance coverage after deductible were found to be associated with ever having had a mammogram. Cost did not appear to be a major barrier to mammography in the past 12 months, however, although 25 percent of women did not know what proportion of mammogram costs were covered by insurance and 22 percent did not know or were unwilling to provide information on household income.

Mammogram utilization was higher than expected, with 78 percent reporting ever having a mammogram and 49 percent having one within the preceding 12 months, rates which equal or even exceed reports from urban populations. This is in contrast to the hypothesis that preventive care is underutilized in rural areas. Rural women have been found to be less likely to have had a mammogram than urban women (68% versus 37% for those older than 50 years [Bryant & Mah, 1992]), despite similar access to physician care and correction for demographic variables. Physician recommendation, which is known to have a positive influence on mammogram utilization, also has been reported to vary significantly between urban and rural women. Sixty-five percent of urban women and only 38 percent of rural women reported ever having had a physician recommend mammography (Bryant & Mah, 1992). However, this study's utilization rates are consistent with reports of a trend of increasing mammogram utilization over time (Zapka, Costanza, Harris, Hosmer, Stoddard, & Barth, 1993) and consistent with reported rates for rural women in southeastern Minnesota and Michigan in which 46 percent and 52 percent reported a mammogram within the past year, repsectively (Gardiner, et al., 1995; Kottke, et al., 1995). Several factors may be contributing to the unexpectedly high rates, including the absence of hypothesized barriers to mammography, ready access to preventive care, and high levels of physician mammogram recommendation (71%) in this study's population. The high levels of mammography utilization in this study of Minnesota farm women may not be characteristic of all other midwestern communities. Minnesota has a strong commitment to public health and a well developed community public health system that may be contributing to the observed levels of mammography use.

It is well known that a data analysis strategy for an explanatory study should incorporate as much prior subject matter knowledge as possible (Maldonado, 1995a; Maldonado & Greeland, 1995b; Robins & Greenland, 1986). One strength of this study is that it developed a conceptual model for mammogram utilization, and that it used this conceptual model to guide the statistical analysis (Maldonado, 1995a).

Even with this strength, however, the odds ratios reported should be interpreted as associations, but should not be interpreted as unbiased estimates of relative risks or be given a causal interpretation, for the following reasons. Because of the cross-sectional design, variables were measured at one point in time; this may have resulted in measurement error for variables that can change over time. For example, the following variables could have been influenced by having had a mammogram: knowledge of breast cancer risk factors, perception that mammography increases survival if breast cancer should occur, knowledge of screening guidelines, and perhaps even the memory of a physician recommendation. Also, it was difficult to collect information regarding cost as a potential barrier to mammogram utilization. Two items were used to assess cost as a barrier, presence or absence of health insurance coverage and degree to which mammograms were covered. Respondents had difficulty reporting information on mammogram insurance coverage as evidenced by the high percentage of unknowns for this variable. These potential sources of measurement error could have directly resulted in biased odds ratios, and also could have impaired the ability to control confounding (Greenland, 1995).

In developing the conceptual model, this study recognized that there was no way to fully describe all components of each causal pathway. As an example, in constructing the model this study recognized that perceived risk of developing breast cancer is influenced by factors not included in the model that are

beyond the scope of this study to identify or measure. These factors include friends or acquaintances with breast cancer and their detection and survival experience as well as media influences.

Another potential limitation of this study is the reliance on self-reported mammography, which may influence the reported utilization rates. Self-reports have been shown to be very accurate for determining if a woman has ever had a mammogram and less accurate for reporting the time since the most recent mammogram (Degnan, Harris, Ranney, Quade, Earp, & Gonzalez, 1992; King, Rimer, Trock, Balshem, & Engstrom, 1990). Finally, because this study was not able to directly estimate the incidence proportion (risk, cumulative incidence) ratio or the person-time incidence (rate, incidence density, hazard) ratio, the odds ratio was estimated, which probably overestimates the relative risk because mammogram utilization was not a rare event in this study.

Most of the factors that influenced mammogram utilization in this study lend themselves to intervention. The most influential factor was physician recommendation. As more emphasis is placed on prevention, patient education by rural physicians could have the greatest impact on mammogram utilization, ultimately reducing mortality from breast cancer.

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