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Risk Factors for Late Screening Mammography

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A B S T R A C T

Background: Breast cancer has the highest incidence of cancers in women in the United States. Previous research has shown that screening mammography contributes to reduced breast cancer mortality. This study aimed to clarify why late screening might occur in an at-risk population.
Materials and Methods: This study was a prospective cross-sectional study including 758 patients presenting to our radiology department for routine screening mammography who completed a 30-question survey regarding personal characteristics and mammography history. Univariate and multivariate logistic regression were performed to determine whether survey responses correlated with late screening.
Results: Of the 758 patients, 184 (24%) were noncompliant with screening mammography guidelines. Risk factors for late screening included younger age (P = 0.001), white race/ethnicity (P = 0.03), self-reported lack of financial means or health insurance (P = 0.005), lack of satisfaction with a previous mammogram experience (P = 0.001), inadequate mammography education by a physician (P = 0.001), and lack of awareness/comprehension of screening mammography guidelines (P = 0.002).
Conclusion: Many factors contribute to late screening mammography. Although some are outside physician control, others can be influenced: patient education regarding screening mammography guidelines, and patient satisfaction with the mammography experience. This study highlights the importance of communication with and education of patients.

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Introduction

Breast cancer has the highest annual incidence of cancers in women in the United States, and was responsible for 40,450 deaths (6.8% of all cancer deaths) in 2016.[1] Previous research has shown that screening mammography contributes significantly to reduction of breast cancer mortality.[2,3] A concerted push for adherence to screening guidelines has led to increased mammography screening over the past few decades, with decreased breast cancer mortality as a result.[4,5]

Despite widespread use and increased willingness to discuss breast cancer screening, mammography usage differs among population groups for reasons that are unclear.[6] Some studies have found that differences in screening frequencies among Non-Hispanic White and Latino/Hispanic women are now insignificant, whereas other studies indicate that disparities continue to exist.[7,8] Other investigations have concluded that low income, lack of health insurance, recent immigrant status, and lack of a usual source of health care are factors that decrease the likelihood of obtaining screening mammography.[9-11] Others attribute the heterogeneity in screening mammography to differences in English proficiency or health literacy among groups.[12,13] Some research has hinted at possible sociocultural factors affecting screening mammography behavior.[14] Many of these studies have concluded that further investigation is needed to explain the differences in mammography screening that continue to exist among various socioeconomic groups and racial/ethnic groups.[15,16]

Our institution provides health care to a patient population that has historically been predominately low-income, uninsured, and Latino/Hispanic. Given that previous studies have yielded conflicting findings and recommended further inquiry, our study seeks to explain why some women do not undergo on-time screening, and clarify why differences in screening mammography rates might exist within an at-risk patient population.

Materials and Methods

The study was approved by the institutional review board. The study design was a prospective cross-sectional study of patients presenting to the radiology department for routine screening mammography from December 2016 to February 2017. These patients were asked to complete a 30-question anonymous survey, available in English or Spanish language formats, while waiting for their appointment. Survey questions pertained to biographic and demographic information, education level, employment status, income, insurance status, personal mammography history, mammogram appointment logistics, mammography satisfaction, and awareness of screening mammography importance and guidelines. In addition, patient billing

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information was reviewed for public insurance, private insurance, or uninsured status.

Of 980 patients presenting during the study, a total of 758 submitted survey responses and were included in the statistical analyses. These survey responses were stratified by on-time and late screening mammography status, as defined by American College of Radiology (ACR) guidelines.[17,18] For the purposes of the study, a patient was considered late if presenting for a first-ever screening exam and aged greater than 40 years, or for a repeat examination occurring greater than 2 years after the patient's most recent previous examination. A total of 184 patients met one of these criteria for late screening. Not all survey questions were answered by all survey respondents. Surveys with missing information for a given question were excluded from the corresponding portion of the statistical analysis.

Patient and survey characteristics were assessed using means, standard deviations for continuous variables and frequencies, and proportions for categorical variables. Univariate logistic regression was implemented to ascertain independent associations between the covariates and late mammogram status. Subsequently, covariates with $P < 0.20$ were added into a second model where backwards stepwise variable selection was conducted to ascertain which covariates, as a group, best predict late mammogram status. Multivariate logistic regression calculated adjusted odds ratios and 95% CI after controlling for age, ethnicity, parents' language, patient's education, mothers' education, employment status, and insurance status. Finally, a subgroup analysis was conducted with the women who had undergone multiple mammograms (ie, nonfirst time screening patients) to ascertain

TABLE 1
Survey variables by category, stratified by late status

Variable	Overall Number, %	On-time examination Number, %	Late examination Number, %	Odds ratio (95% CI)	*P* trend*
Age†	52.3 (8.6)	53.0 (8.5)	50.1 (8.8)	0.95 (0.93-0.98)	<0.001
Marital status					
Never married	138 (18.2)	110 (19.2)	28 (15.2)	1.00 (Reference)	0.44
Married	344 (45.4)	258 (44.9)	86 (46.7)	1.30 (0.80, 2.11)	
Widowed	53 (6.9)	42 (7.3)	11 (5.9)	1.03 (0.47-2.25)	
Divorced or separated	194 (25.6)	141 (24.6)	53 (28.8)	1.47 (0.87-2.48)	
Missing Data	29 (3.8)	23 (4.0)	6 (3.3)		
Ethnicity					
Non-Hispanic White	164 (21.6)	113 (19.7)	51 (27.7)	1.00 (Reference)	0.03
African-American	88 (11.6)	71 (12.4)	17 (9.2)	0.53 (0.28-0.99)	
Latino/Hispanic	450 (59.4)	349 (60.8)	101 (54.9)	0.64 (0.43-0.95)	
Other	32 (4.2)	20 (3.5)	12 (6.5)	1.32 (0.60, 2.92)	
Missing data	24 (3.2)	21 (3.7)	3 (1.6)		
Employment					
Employed for wages	203 (26.8)	164 (28.6)	39 (21.2)	1.00 (Reference)	0.07
Self-employed	72 (9.5)	48 (8.4)	24 (13.0)	2.10 (1.15-3.83)	
Out of work	95 (12.5)	67 (11.7)	28 (15.2)	1.75 (1.00-3.08)	
Homemaker or student	235 (31.0)	171 (29.8)	64 (34.8)	1.57 (1.00-2.47)	
Unable to work	112 (14.8)	87 (15.2)	25 (13.6)	1.20 (0.68-2.12)	
Missing data	41 (5.4)	37 (6.5)	4 (2.2)		
Income					
Less than $30,000	507 (66.9)	375 (65.3)	132 (71.7)	1.00 (Reference)	0.17
$30,000-$$49,999	68 (8.9)	57 (9.9)	11 (5.9)	0.54 (0.27-1.07)	
$50,000 or greater	56 (7.4)	41 (7.2)	15 (8.2)	1.03 (0.56-1.93)	
Missing data	127 (16.8)	101 (17.6)	26 (14.1)		
Health insurance					
None	321 (42.5)	250 (43.6)	71 (38.6)	1.00 (Reference)	0.09
Public	316 (41.7)	227 (39.6)	89 (48.4)	0.54 (0.27-1.07)	
Private	121 (15.9)	97 (16.9)	24 (13.0)	1.03 (0.55-1.93)	
Is this your first mammogram?‡	84 (11.0)	6 (1.1)	78 (42.4)	69.6 (29.5-163.9)	<0.001
Difficulty getting today's appointment?‡					
It took a long time to get this appointment	40 (5.3)	32 (5.6)	8 (4.4)	0.73 (0.33-1.62)	0.44
I didn't have money or insurance	35 (4.6)	19 (3.3)	16 (8.7)	2.68 (1.34-5.35)	0.005
I had no form of transportation	20 (2.6)	16 (2.8)	4 (2.2)	0.74 (0.24-2.24)	0.59
I couldn't get time off of work	13 (1.7)	8 (1.4)	5 (2.7)	1.89 (0.61-5.87)	0.26
I didn't know where to get my mammogram	10 (1.3)	3 (3.8)	7 (3.8)	7.24 (1.85-28.4)	0.004
I was too busy	11 (1.4)	7 (1.2)	4 (2.2)	1.74 (0.50-6.04)	0.38
Has anyone explained to you the medical significance of getting a mammogram?‡	562 (74.2)	438 (76.3)	124 (67.4)	0.44 (0.28-0.68)	<0.001
Do you believe that you understand the medical significance of getting a mammogram?‡	629 (82.9)	484 (84.3)	145 (78.8)	0.34 (0.19-0.62)	<0.001
Has anyone explained to you when you should receive your first mammogram?‡	523 (69.0)	403 (70.2)	120 (65.2)	0.50 (0.33-0.76)	0.001
Has anyone explained to you how often you should get mammograms?‡	515 (67.9)	423 (73.7)	92 (50.0)	0.21 (0.13-0.31)	<0.001
Do you believe that you received adequate information from your doctor regarding mammograms?‡	557 (73.5)	443 (77.2)	114 (61.9)	0.30 (0.19-0.46)	<0.001

*P trend calculated via univariate analysis using Logistic regression.
†Mean (standard deviation).
‡Given statistic refers to "yes" answers.

associations between specific covariates and late mammogram status. All P values were 2-sided and $P < 0.05$ was considered as statistically significant. All data analysis were conducted using STATA version 14 (College Station, TX).

Results

Of the 758 patients included in the study, 574 (75.7%) met criteria for on-time screening, while 184 (24.3%) did not. After analysis, several factors correlated with late screening, including both demographic and personal factors. These data are summarized in Table 1. The average age for patients obtaining on-time screening was older than that for patients obtaining late screening. Patients identifying as African-American and Latino/Hispanic were less likely to be late for screening than those identifying as Non-Hispanic White. Patients reporting that this was their first screening mammogram, who self-reported a lack of financial means or insurance, or who reported that they did not know where to obtain a mammogram were more likely to be late.

Several factors relating to previous patient interactions with physicians also correlated with late screening. Patients who reported that someone had explained the medical significance of screening mammography, that they understood this medical significance, that someone had explained the age at which the first screening mammogram should be obtained, and that someone had explained how often to get screening mammograms, were less likely to be late. Patients who believed that they received adequate information from their doctors regarding mammograms were more likely to be on-time for screening.

Factors that were examined, but did not significantly correlate with on-time screening include marital status, primary language spoken, level of education attained, parents' primary language spoken, mother's level of education attained, father's level of education attained, employment status, income, or insurance status.

When multivariate analysis was performed, controlling for age and ethnicity, along with a number of variables that did not correlate significantly with on-time screening (ie, level of education attained, parents' primary language spoken, mother's level of education attained, employment status, and insurance status) and for the other variables within the model, further correlations were found. These data are summarized in Table 2. Patients who stated that screening mammograms should be obtained "every 2 years or less" were more likely to be late. In keeping with the single-variate analysis, patients who self-reported a lack of financial means or insurance, or who didn't know where to obtain a mammogram were more likely to be late. Also in keeping with the single-variate analysis, patients who reported that someone had explained the medical significance of screening mammography were less likely to be late, and patients presenting for their first mammogram were more likely to be late altogether, the area under the curve (AUC) for this multivariate analysis was 0.81.

When considering only patients who were obtaining repeat screening mammography, other correlations were found. These data are summarized in Table 3. The average age at which patients reported obtaining their first mammogram was greater for those who were presenting for on-time screening than for those who were late. Patients who reported obtaining screening mammography exams "approximately every 2 years" or "less frequent than every 2 years" were more likely to be late. As with study patients in general, those reporting lack of financial means or insurance were more likely to be late for their repeat screening exam. When asked about satisfaction the previous mammography experience, those who replied "good" or "poor/satisfactory," were more likely to be late than those who replied "excellent." When asked about specific parts of the previous mammography experience, patients who reported satisfaction with the wait time to get their appointment were more likely to be on-time for screening.

TABLE 2
Odds ratios from multivariate analysis of survey variables

Variable	OR (95% CI)	*P* value*
How often do you believe you should get mammograms?		
At least once per year	1.00 (Reference)	0.76
Approximately every year	1.10 (0.58-2.06)	<0.001
2 years or less	3.79 (1.96-7.35)	
Difficulties with today's appointment?†		
I didn't have money or insurance	4.94 (1.93-12.6)	0.001
I didn't know where to get my mammogram	6.55 (1.22-35.1)	0.028
Has anyone explained to you how often you should get mammograms?†	0.36 (0.19-0.69)	0.002
Is this your first mammogram?†	28.2 (10.2-78.4)	<0.001
Area under the curve	0.81	

*P values calculated using multivariate logistic regression adjusting for all other variables within the model along with age, ethnicity, parents' language, patient's education, mothers' education, employment status, and insurance status.
†Given statistic refers to "yes" answers.

Discussion

Overall, there was a high rate of late screening using study definitions, with roughly a quarter of patients presenting late. In keeping with recent studies which have not found a decrement in screening compliance among Latino/Hispanic populations as compared to non-Hispanic White populations, our study found that non-Hispanic White patients were actually more likely to be presenting late for screening than the African-American or Latino/Hispanic patients. The average age for patients who were presenting late was roughly 3 years younger than those presenting on time, and approximated 50 years of age. This difference could possibly reflect greater ease of obtaining repeat screening mammography after the initial screening exam. Eighty-four patients indicated that this was their first mammogram, and nearly all of these patients were late for screening (accounting for roughly 40% of all late patients), As patients also tended to be late if they did not know where to obtain a mammogram, these findings underscore the importance of barriers to obtaining a first screening mammogram in influencing patients to obtain late screening.

Interestingly, while patients who self-reported a lack of financial means or insurance were more likely to be late for screening, when asked to quantify their annual income, or when their insurance status was objectively verified, neither of those values correlated with late screening. It is difficult to say which component of subjective lack of financial means might have contributed most strongly to late screening, particularly as specific questions regarding lack of transportation or lack of time off of work did not correlate with lateness. However, these targeted questions had low response rates within the survey, and a larger set of responses might have led to finding a stronger correlation. It is also worth pointing out that the majority of patients who reported any of the specific barriers to obtaining today's screening exam were nevertheless on time for screening.

Although such factors are outside of the sphere of physician influence, other risk factors were identified which are highly modifiable. Patients who reported that physicians had explained the importance of screening mammography and that they understood that discussion, as well as when to begin screening and how often to screen, were more likely to have obtained on-time screening exams. This was corroborated when patients were asked to state at what age screening should begin, and how often screening should be obtained,

TABLE 3
Survey variables by category, stratified by late status, for repeat mammography patients only

Variable	Overall Number, %, *N* = 674	On-time examination Number, %, *N* = 568	Late examination Number, %, *N* = 106	Odds ratio (95% CI)	*P* trend*
Age at first mammogram†	44.5 (10.8)	44.9 (10.9)	42.3 (10.4)	0.97 (0.95-0.99)	0.02
How often do you get mammograms?					
At least once per year	229 (40.2)	222 (46.4)	7 (7.7)	REF	<0.001
Approximately every year	150 (26.3)	146 (30.5)	4 (4.4)	0.86 (0.24-3.02)	
Approximately every 2 years	95 (16.7)	80 (16.7)	15 (16.5)	5.9 (2.3-15.1)	
Less frequent than every 2 years	96 (16.8)	31 (6.5)	65 (71.4)	66.5 (27.9-158.0)	
Difficulty getting your previous mammogram?‡					
It took a long time to get this appointment	35 (6.5)	31 (7.0)	4 (4.0)	0.55 (0.19-1.59)	0.27
I didn't have money or insurance	74 (13.7)	50 (11.3)	24 (24.0)	2.46 (1.43-4.25)	0.001
I had no form of transportation	13 (2.4)	8 (1.8)	5 (5.0)	2.84 (0.91, 8.90)	0.07
I couldn't get time off of work	6 (1.1)	6 (1.4)	0 (0)	N/A	N/A
I didn't know where to get my mammogram	14 (2.6)	10 (2.3)	4 (4.0)	1.79 (0.55-5.84)	0.33
I was too busy	34 (6.3)	24 (5.4)	10 (10.0)	1.93 (0.89-4.17)	0.09
How long did it take to get your previous mammogram appointment?					
Within 3 days	139 (30.4)	119 (31.3)	20 (25.9)	REF	0.02
Within 1 week	124 (27.1)	106 (27.9)	18 (23.4)	1.01 (0.50-2.01)	
Within 2 weeks	101 (22.1)	88 (23.2)	13 (16.9)	0.87 (0.41-1.86)	
Within 1 month	93 (20.4)	67 (17.6)	26 (33.8)	2.30 (1.19-4.44)	
Overall satisfaction with your previous mammogram?					
Excellent	303 (55.7)	266 (59.2)	37 (38.9)	REF	<0.001
Good	198 (36.4)	158 (35.2)	40 (42.1)	1.82 (1.11-2.96)	
Poor/satisfactory	43 (7.9)	25 (5.6)	18 (18.9)	5.17 (2.57-10.4)	
Satisfaction with previous mammogram?‡					
I was satisfied with the wait time to get my appointment	377 (68.3)	320 (70.6)	57 (57.6)	0.54 (0.36-0.88)	0.01
I was satisfied with the wait time at my appointment	233 (42.2)	195 (43.5)	38 (38.4)	0.82 (0.52-1.28)	0.39
I was satisfied with the time I spent with the mammography technologist	200 (36.2)	168 (37.1)	32 (32.3)	0.81 (0.51-1.28)	0.37
I received adequate information from the mammography technologist	181 (32.8)	147 (32.5)	34 (34.3)	1.08 (0.68-1.72)	0.71

**P* trend calculated via univariate analysis using Logistic regression.
†Mean (standard deviation).
‡Given statistic refers to "yes" answers.

with patients with on-time screening specifying a younger age for initial screening, and a shorter ideal interval between exams. It is unsurprising that patients who endorse appropriateness of earlier and more frequent screening are more likely to obtain on-time screening. Taken altogether, though, this suggests that physicians who have engaged in clear communication regarding mammography, have influenced patients to obtain screening that better reflects screening guidelines.

Even so, the average ages specified for screening initiation by patients both on-time and late for screening are in the late 30 second, below not just the 50 year age suggested by the US Preventive Services Task Force (18), but also below the 40 year age recommended by the ACR. Although misunderstanding of guidelines leading to more appropriate screening behavior may be preferred to the alternative, this finding still suggests that there is significant misunderstanding. Further, patients presenting for repeat mammography reported initiating screening in their early 40 second, on average. This behavior not only does not match the stated ideal screening age, but also is late for screening initiation, further underscoring the incomplete match between patient understanding and behavior, and screening guidelines.

In considering the multivariate analysis, when controlling for a number of variables, only a few factors were able to account for roughly 80% of the variance between on-time and late screening in our patient sample. Two of the factors are nonmodifiable: presenting for the first screening mammogram, and a self-reported lack of financial means or insurance. On the other hand, several can be effected by physician communication: patient understanding of the appropriate frequency of screening, and knowledge of where to obtain a mammogram. Given these factors, it is possible that by instituting programs intended to provide extra support and education to patients nearing age 40 regarding the importance of screening, how frequently screening should be performed, and where they can go for their first mammogram, significant improvement in on-time screening would result.

Patients obtaining repeat screening mammography were found to have similar factors effecting on-time or late screening, including the self-reported lack of financial means or insurance, and reported frequency of screening. For these patients, however, several other physician-modifiable factors emerged. Specifically, patients who waited the longest for previous mammogram appointments tended to be late for a subsequent screening exam. It is possible that such patients had limited windows in their schedules in which they could present for a screening exam, and as such are likely to experience delays in obtaining appointments, a fact that might persist over time and eventually lead to late screening. However, it is possible that distaste with the scheduling process and wait time for the appointment influenced the patient to delay subsequent screening. This is corroborated by our finding of an increased likelihood to be on-time for screening if satisfactory wait time for their previous appointment was reported.

Patient satisfaction with the previous mammogram experience in total was also strongly associated with on-time screening. When contributing factors to this experience were explored, no other factor beyond wait time for the appointment correlated significantly with on-time screening, though some patients did report dissatisfaction with wait time while at their previous appointment, their time with the mammography technologist, and the information given them by the mammography technologist. Factors that have been previously identified as contributing to patient's mammography experience include pain, anxiety, and embarrassment relating to examination technique, interactions with the mammography technologist, and interactions with radiologists, in addition to factors relating to

obtaining an appointment or the mammography facility itself.[6,19-21] In addition, patient satisfaction and compliance has also been tied to the rapidity at which mammography results are communicated to the patient.[22] Taken together, efforts to reduce waiting time for mammography appointments, and to maximize comfort during the mammography experience, such as through clear and personable communication from mammography technologists and radiologists, may lead to greater on-time screening behavior in the future.

Limitations to the study include self-selection on the part of survey respondents, as survey completion was optional. Further, objective data was not utilized to verify patients' survey responses. As such, inaccurate recall may have affected some survey answers. Although surveys were anonymous, patients may also have underreported dissatisfaction with previous experiences, or with obtaining appointments, if this stemmed from experiences at our institution. Given that our study involved only one institution, other institutions with demographically dissimilar populations may differ.

In conclusion, a number of factors influence on-time versus late screening mammography behavior. These include factors outside of physician control, such as patient ethnicity, or undergoing the first screening mammogram. However, other factors can be influenced, including patient education regarding screening guidelines, and patient satisfaction with the mammography experience. By implementing interventions designed to address modifiable risk factors, it is possible that on-time mammography rates in at-risk populations may be improved.

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