ORIGINAL ARTICLES

Chronic Disease as a Barrier to Breast and Cervical Cancer Screening

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OBJECTIVE: **To assess whether chronic disease is a barrier to screening for breast and cervical cancer.**

DESIGN: **Structured medical record review of a retrospectively defined cohort.**

SETTING: **Two primary care clinics of one academic medical center.**

PATIENTS: **All eligible women at least 43 years of age seen during a 6-month period in each of the two study clinics (n = 1,764).**

MEASUREMENTS AND MAIN RESULTS: **Study outcomes were whether women had been screened: for mammogram, every 2 years for ages 50–74; for clinical breast examinations (CBEs), every year for all ages; and for Pap smears, every 3 years for ages under 65. An index of comorbidity, adapted from Charlson (0 for no disease, maximum index of 8 among our patients), and specific chronic diseases were the main independent variables. Demographics, clinic use, insurance, and clinical data were covariates. In the appropriate age groups for each test, 58% of women had a mammogram, 43% had a CBE, and 66% had a Pap smear. As comorbidity increased, screening rates decreased ($p < .05$ for linear trend). After adjustment, each unit increase in the comorbidity index corresponded to a 17% decrease in the likelihood of mammography ($p = .005$), 13% decrease in CBE ($p = .006$), and 20% decrease in Pap smears ($p = .002$). The rate of mammography in women with stable angina was only two fifths of that in women without.**

CONCLUSIONS: **Among women who sought outpatient care, screening rates decreased as comorbidity increased. Whether clinicians and patients are making appropriate decisions about screening is not known.**

KEY WORDS: **mass screening; breast cancer; cervical cancer; comorbidity.**
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Convincing scientific evidence shows that screening for either breast cancer or cervical cancer in appropriate age groups reduces mortality by 20% to 60%, depending on the condition and baseline risk level of the group being screened.[1–3] Nevertheless, screening for both these malignant conditions is underused.[4–5] Although an extensive body of literature exists on the determinants of screening,[1,2,6–20] little is known about how the presence of chronic disease affects screening behavior by patients or physicians.[9,21] As approximately 100 million Americans living in the community have one or more chronic conditions,[22] much more research is needed on the relation between chronic disease and cancer screening.

Some evidence suggests that women with chronic conditions such as hypertension or diabetes undergo more cancer screening than women without these diseases,[23,24] but other reports suggest that, especially among minority women,[25] the opposite is true.[26] The literature is inconclusive on whether or not the presence of chronic disease constitutes a barrier to screening. As physicians, we need to understand the barriers preventing us and our patients from adhering to clearly beneficial screening recommendations. If there is, indeed, a hidden bias against screening women with chronic diseases, we need to bring it to light so we can address its appropriateness and intervene accordingly. An understanding of current practices is a first step in the direction of improving our ability to deliver appropriate and cost-effective preventive care.

We reviewed the medical records of patients followed in two primary care clinics at one academic institution. We sought to assess whether chronic disease is associated with screening for breast cancer and cervical cancer, before and after adjustment for other known determinants of screening, and whether specific conditions, such as angina, are associated with the use of screening.

METHODS

Study Design, Setting, and Population

We reviewed the medical records of all women aged 43 years or over who visited the general internal medicine or family practice clinics at the University of Alabama at Birmingham (UAB) between January 1 and June 30, 1995. In these clinics, each patient is assigned a primary care physician (an internal medicine resident in the gen-

eral medicine clinic, a family practice resident or faculty physician in the family practice clinic). Residents are supervised by a faculty physician who assumes ultimate responsibility for the patient's care. Both study clinics have the necessary nursing personnel and equipment to perform pelvic examinations and Pap smears. Mammograms are performed at UAB's radiology department. We designated each subject's first visit within the study period as the index visit. We excluded women without at least one clinic visit before the index visit.

Data Collection

The records for all study patients were reviewed by trained research assistants. Before reviewing study records, the research assistants abstracted pilot charts under the supervision of two investigators (CIK, MNF) until they reached excellent agreement on the study's main outcome measures and on comorbidity. As a second quality control measure, approximately 10% of the records in the first month and 5% thereafter were abstracted independently by two research assistants. We calculated κ coefficients to estimate agreement between the two abstractions beyond that expected by chance alone; a value of $\kappa > 0.40$ is considered good, and $\kappa > 0.75$ is considered excellent.[27] Our κ values ranged from 0.76 to 0.89 for screening status and from 0.63 to 0.90 for ascertaining comorbidity.

Chart abstraction covered a period of 3 years prior to the index visit if the patient had been followed for at least 3 years, or the entire period the patient had been followed if less than 3 years. Abstractors entered data directly into laptop computers equipped with software customized to facilitate the computation of a comorbidity index, as well as with range and consistency checks.

Data elements included personal information (age, race, and insurance status), number of clinic visits, screening history, and clinical characteristics. Dates of each woman's three most recent mammograms, clinical breast examinations (CBEs), and Pap smears were obtained when possible. Any woman with documentation of screening elsewhere was considered to have been screened and a likely date was assigned. Clinical data included all chronic diseases documented in the chart at any time during the 3 years covered by chart abstraction, including but not limited to diagnoses that physicians listed in patient problem lists or on clinic visit reports for all visits, as well as histories of breast biopsy, breast cancer, colposcopy, hysterectomy, and cervical cancer. A checklist with 12 categories of chronic conditions, divided into 34 subcategories, and a free-text field for "other chronic conditions" were part of the customized software used for data abstraction. Hard copies of the data abstraction forms are available from the authors on request.

Analysis

We hypothesized that there would be associations of cancer screening with overall comorbidity and with specific medical conditions. We computed a comorbidity score based on the weights assigned by Charlson, who assigned weights of 0 to 6 for common chronic medical conditions (Table 1).[28] The sum of assigned weights for a given patient's conditions is the Charlson index. A Charlson index of 0 denotes the absence of any of the diseases listed in Table 1. An index of 2 may represent, for example, a history of both diabetes without end-organ damage and ulcer disease, or alternatively, only diabetes with end-organ damage. The Charlson index correlates with life expectancy (i.e., prognosis) but does not address quality of life or functional status.[29] In one prospective study of patients with diabetes or hypertension, the estimated 5-year relative risk of death from an increase of one unit in the Charlson comorbidity index was approximately equal to that from another decade of age.[29] Precise definitions for each of the conditions are available.[28] For example, the category chronic pulmonary disease subsumes asthma, and connective tissue disease subsumes rheumatoid arthritis.

Our primary interest was whether a woman had been screened according to the recommendations of the U.S. Preventive Services Task Force (USPSTF)[3,30]: mammography within the past 2 years for women aged 50 to 74 years; a CBE within the past year for women of all ages; and a Pap smear within the past 3 years for women aged less than 65 years (43 to 64 years in this study population). We studied women aged 43 years and above at index visit because our chart abstraction covered 3 years prior to index visit and we were interested in women aged 40 years and above during the entire period covered by our data collection. Although the most recent USPSTF recommen-

Table 1. Conditions Included in Comorbidity Index, with Assigned Weights*

Condition	Weight
Myocardial infarction	1
Congestive heart failure	
Peripheral vascular disease	
Cerebrovascular disease	
Dementia	
Chronic pulmonary disease	
Connective tissue disease	
Ulcer disease	
Mild liver disease	
Diabetes without end-organ damage	
Hemiplegia	2
Moderate or severe renal disease	
Diabetes with end-organ damage	
Any tumor (without metastases)	
Leukemia	
Lymphoma	
Moderate or severe liver disease	3
Metastatic solid tumor	
AIDS	6

*Adapted from Charlson et al.[28]

dations limit mammography to the age group 50 to 69,[3] the USPSTF recommendation in effect during the study period advised mammography up to age approximately 75.[30] When we repeated our mammography analyses restricted to the group aged 50 to 69 years, results did not change qualitatively. We examined several different age groups, but because of USPSTF recommendations, our primary interest was in the groups aged 50 to 74 years for mammography and those aged less than 65 years for Pap smears. However, there is some controversy in terms of the upper age limits, so we also performed separate analyses for all three screening tests restricted to the older age groups (75+).

The USPSTF recommendations that were current during the study period did not specifically exclude women without a cervix.[30] Furthermore, even though the USPSTF recommendations released in 1995 exclude most women without a cervix,[3] up to 20% of women who have undergone a hysterectomy may still have an intact cervix.[31] Therefore, all analyses were first performed including women who had a hysterectomy, then separately for women with and without a history of hysterectomy.

Age, clinic, race, number of clinic visits in the previous 12 months, time enrolled in the clinic, insurance status, ability to walk, and a history of hysterectomy, breast biopsy, or breast cancer were assessed as potential confounders, i.e., a characteristic associated with both screening status and comorbidity as measured by the Charlson index. We used Student's *t* test, one-way analysis of variance, and χ^2 tests to study bivariate associations of these potential confounders with screening status and with Charlson index.[27] We used tests for linear trend to assess whether screening decreased with increasing Charlson index.[27]

We used multiple logistic regression to determine the association of the Charlson index with screening while adjusting for the potential confounders.[27] First, we built two predictive models: the dependent variable in one model was whether a woman aged 50 to 74 years had had a mammogram in the past 2 years; in the other it was whether a woman aged less than 65 years had had a Pap smear in the past 3 years. The association between each potential confounder and the screening test of interest was first assessed individually and then entered into the model in a stepwise manner. Continuous variables were categorized to assess whether a monotonic dose-response relation was indicated, and if found, an ordinal variable with equally spaced intervals was defined and entered into the model. An ordinal variable was used for the number of clinic visits in the prior year, and a dichotomous variable indicating whether a woman had attended the clinic for over a year was used for length of time enrolled in clinic. Age was only associated (inversely) with screening status when analysis was restricted to women over 65 years of age. After the predictive models were built, the Charlson index was entered as an ordinal variable (namely, an integer variable to 5).

Logistic regression was also used to assess whether specific medical conditions were associated with cancer screening. First, we estimated crude associations of each Charlson condition diagnosed for at least 2% of the women, as well as hypertension and osteoarthritis, with whether a woman had been screened. We felt the model's power was too limited to assess conditions that had been diagnosed in fewer than 2% of the women. These conditions were then entered individually into the predictive models previously built. Next, the associations of these conditions with screening status were assessed jointly; i.e., all of the conditions were entered into the model.

RESULTS

Charts were abstracted for 1,764 women; mean age ± SD was 62.4 ± 13.7 (range, 43–100) and mean Charlson index was 1.24 ± 1.23 (range, 0–8). Selected characteristics of the study population and the mean Charlson index for women with those characteristics are presented in Table 2. The Charlson index was positively associated with greater age and more clinic visits; the family practice clinic had the lower Charlson index of the two clinics.

The percentages of women screened according to the USPSTF recommendations are shown in Table 3; the family practice clinic had higher screening rates for all three screening tests. For both mammography and Pap smear, but not CBE, there was a consistent positive association between screening and a greater number of clinic visits.

The percentage of women screened with mammography, CBE, and Pap smears decreased significantly with increasing Charlson index (Fig. 1). Multiple logistic regression analyses, adjusting for potential confounders, showed that for each unit increase in the Charlson index a woman was 17% less likely to have had a mammogram ($p = .005$), 13% less likely to have had a CBE ($p = .006$), and 19% less likely to have had a Pap smear ($p = .002$; Table 4). This inverse relation between the Charlson index and having had a Pap smear was present when the data were stratified according to whether a woman had a hysterectomy; for each unit increase in the Charlson index, a woman with no history of hysterectomy was 22% less likely to have had a Pap smear ($p = .018$) and a woman with a history of hysterectomy was 19% less likely to have had a Pap smear ($p = .037$).

For chronic conditions individually, we found that the adjusted odds ratio for screening for women with a particular disorder (vs those without it) were frequently below 1.00, but those findings were usually not significant at the level of $p < .05$ (Tables 5 and 6, column A). Conditions significantly related to screening were chronic stable angina, rheumatoid arthritis, congestive heart failure, and myocardial infarction. Hypertension was the only disorder in this analysis to be positively associated with screening; hypertensive women were 32% more likely to have had a Pap smear ($p = .041$).

In our joint assessment of each chronic condition with the other nine (Tables 5 and 6, column B), the five associations we had discovered in the individual analyses

Table 2. Distribution of Selected Characteristics, with Mean Charlson Index of Comorbidity, by Characteristic

Characteristic	*n**	%	Charlson Index
Total	1,764	100.0	1.24
Age in years			
<50	452	25.6	0.68
50–64	587	33.3	1.16
65–74	350	19.9	1.37
≥75	374	21.2	1.89†
Clinic			
General internal medicine	904	51.2	1.50
Family practice	860	48.8	0.96†
Race			
African American	1,392	79.0	1.30
White	361	20.5	0.99‡
Other	9	0.5	0.22†
No. of clinic visits in previous 12 mo			
1	398	22.6	0.87
2–3	573	32.5	1.08
4–5	434	24.6	1.38
≥6	359	20.4	1.71†
Attended clinic for at least 1 yr			
Yes	1,378	78.2	1.29
No	385	21.8	1.05†
Any insurance			
Yes	1,676	95.0	1.24
No	88	5.0	1.04
Ambulatory			
Yes	1,621	92.0	1.15
No	140	8.0	2.19†
History of hysterectomy			
Yes	713	40.4	1.29
No	1,051	59.6	1.20
History of breast biopsy			
Yes	185	10.5	1.58
No	1,579	89.5	1.20†

**Category counts may not add up to 1,764 because of missing values.*
†$p < .001$; *all* p *values indicate whether differences in Charlson index across categories of a characteristic are statistically significant;* p *values for age and number of clinic visits also show linear trend.*
‡*Difference between African Americans and whites,* $p < .001$.

all persisted. For example, women with angina were still 60% less likely ($p = .003$) to have had a mammogram; those with rheumatoid arthritis were 48% less likely ($p = .030$) to have had a mammogram.

DISCUSSION

This clinic-based study suggests that women followed in a primary care setting are screened less frequently for breast cancer or cervical cancer as their burden of chronic disease increases. In light of the underutilization of these life-prolonging tests, and considering how many women have chronic disorders, such a conclusion is cause for concern. As a nation, we are making progress in the use of breast cancer and cervical cancer screening,[4,5] but we continue to fall short of goals, such as the one set forth in *Healthy People 2000*, that at least 60% of women aged 50 years and older receive a CBE and a screening mammogram every 1 to 2 years.[32,33] Why are we falling short, and should the screening needs of women with chronic disease receive special attention?

A great deal is known about screening behaviors of both patients and providers,[6–20,34–36] and interventions to increase screening rates have been tested.[11–14] It is well established that screening decreases with increasing patient age,[5,37,38] and that physicians' recommendations for screening strongly influence patient behavior.[6–11] However, the role of chronic disease as a predictor of screening behavior has received limited attention.[21] Although the presence of chronic disease may increase early detection of malignancy because of intensified contact between patient and provider,[39] it is also plausible that physicians are less likely to screen for cancer patients who are elderly or whose life expectancy they believe has been shortened by disease.[40] In addition, chronic disease management may constitute a "competing demand" diverting resources and attention from the delivery of clinical preventive services.[41]

Our results are consistent with the two other clinic-based studies we found on similar subjects. In a chart-review study conducted at an internal medicine clinic in a large teaching hospital, patients whose overall medical condition was moderate or severe were less likely to receive a physician request for mammography than patients whose condition was mild.[26] In another study of older African-American women attending an internal medicine teaching clinic, those with two or more serious illnesses were more likely to refuse a mammogram than those with one or no serious illnesses.[25]

Population-based studies, however, have suggested positive associations between chronic disease and screening. In a community-based study in the upper Midwest, 38% of women with a chronic monitorable condition, and 32% of women without such a condition, had ever had a mammogram ($p = .02$).[23] In an earlier study of a retirement community in southern California, women diagnosed with a chronic disease had higher rates of screening for breast cancer and cervical cancer.[36] A third population-based study, conducted in Massachusetts, found that women being treated for chronic conditions were 20% more likely to have ever had a mammogram; however, this association disappeared after multivariate adjustment.[24]

Thus, at least two population-based studies support Feinstein's postulation that there is a positive association between chronic disease and screening.[39] Conversely, three clinic-based studies, including our own, show an inverse association for women having regular contact with a health care provider. The consistent differences between these two types of studies might be explained by differences in methodology (e.g., interview data vs chart-review data). Nonetheless, from the available evidence (our own

Table 3. Percentage of Women Who Had Been Screened for Breast and Cervical Cancer According to U.S. Preventive Services Task Force Guidelines, by Selected Characteristics

Characteristic	Mammogram Within 2 Years Ages 50–74 (*n* = 937)	Clinical Breast Exam Within 1 Year Ages 43–100 (*n* = 1,764)	Pap Smear Within 3 Years Ages 43–65 (*n* = 1,039)
Overall	58.0	43.1	66.5
Age in years			
<50	—	49.8	67.9
50–64	58.4	46.5	65.4
65–74	57.1	43.1	—
≥75	—	29.4*	—
Clinic			
General internal medicine	53.4	31.5	54.9
Family practice	63.0†	55.2*	75.1*
Race			
African American	58.6	43.1	67.8
White	56.4	43.2	62.3
Other	25.0	33.3	100.0
No. of clinic visits in previous 12 mo			
1	41.0	36.9	51.2
2–3	56.8	45.9	69.5
4–5	66.2	43.1	73.9
≥6	67.7*	45.4‡	74.8*
Attended clinic for at least 1 yr			
Yes	62.6	43.5	71.7
No	41.4*	41.6	51.0
Any insurance			
Yes	58.9	43.6	67.2
No	43.1‡	34.1	58.0
Ambulatory			
Yes	59.2	44.3	67.1
No	34.0*	29.3*	45.2‡
History of hysterectomy			
Yes	61.3	46.6	64.2
No	55.3	40.7‡	68.3
History of breast biopsy			
Yes	73.5	59.5	69.1
No	56.1*	47.2*	66.2

*$p < .001$; *all* p *values indicate whether differences in proportions of women screened across categories of a characteristic are statistically significant.*
†$p < .01$.
‡$p < .05$.

and that of others), we conjecture that screening rates increase with comorbidity in the population as a whole, in which most individuals have no or very few chronic conditions. However, in the subset population undergoing regular medical care, which is much more heavily weighted toward persons with chronic conditions, screening rates decline with increasing numbers of such conditions. Further prospective research is needed to increase our understanding of chronic diseases' effects on cancer screening.

In a survey of community-based primary care physicians, comorbidity was commonly cited by physicians as a reason for not advising mammography.[9] Is a failure to screen because a woman has chronic disease inappropriate, or are physicians and patients frequently making rational decisions to forgo screening that are based on life expectancy or perceptions of reduced quality of life? We cannot answer this question definitively, in part because we lack direct data on how chronic disease may reduce gains in life expectancy resulting from screening. Some evidence suggests that comorbidity may justify less screening,[42] while other studies indicate that the benefits of screening persist, even in the presence of, for example, severe congestive heart failure.[43] Our study and others suggest that having a chronic disease makes cancer screening relatively less likely, but we did not attempt to determine whether failure to screen was ever appropriate. Randomized control trials or, at least, subgroup analyses addressing the efficacy of screening for breast cancer and cervical cancer among women with defined levels of comorbidity are clearly called for.

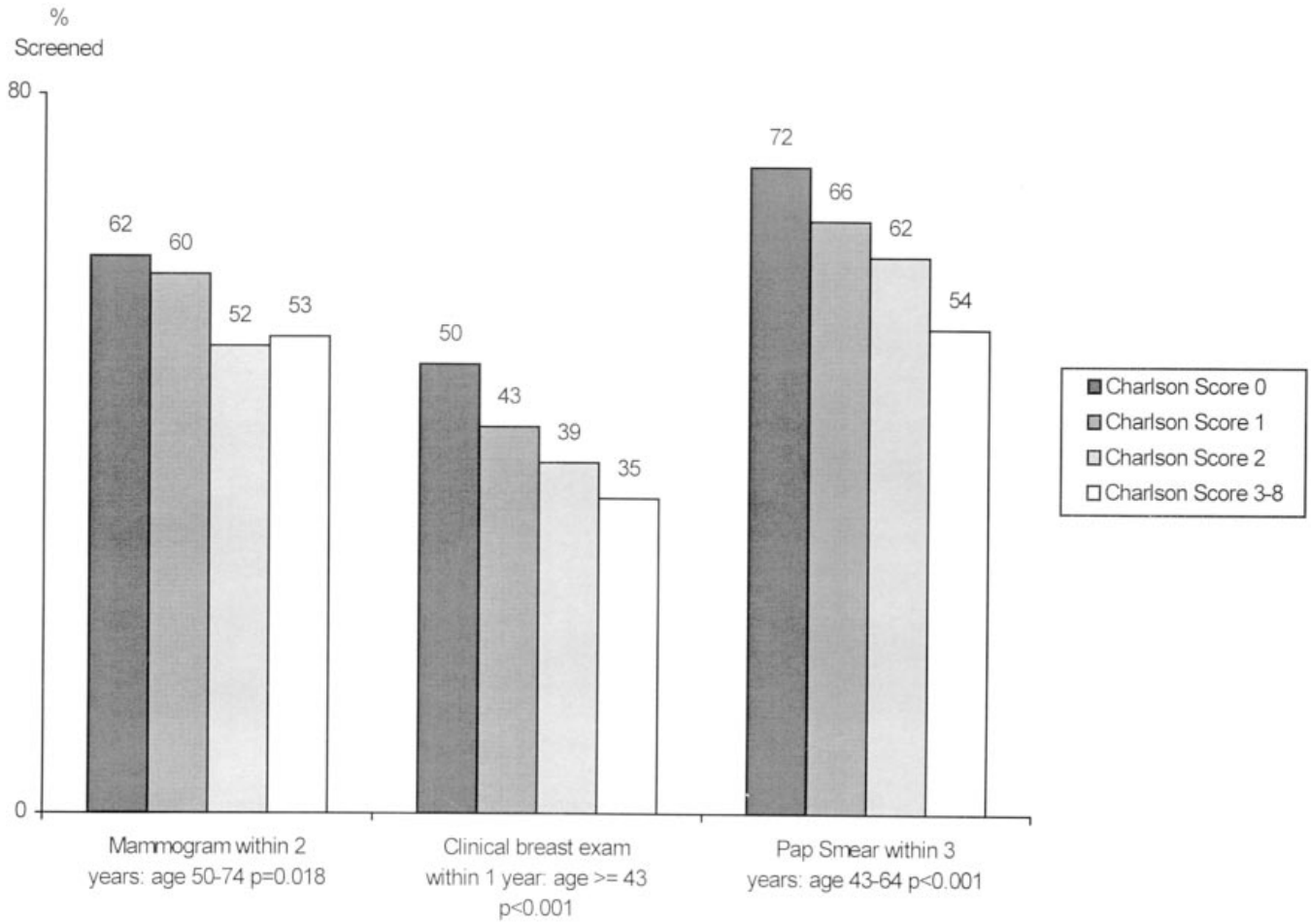

FIGURE 1. Proportion of women in appropriate age group who were screened by Charlson comorbidity category. See Methods section for definitions.

The upper age limits in the USPSTF recommendations are conservative owing to the absence of primary data for the older age groups.[30] However, the 75+ age group is the fastest growing segment of the U.S. population, and our data confirm that this subgroup of women is the least screened and has the highest comorbidity.[44] We observed an inverse association between comorbidity and screening in this subgroup as well, although we have not

Table 4. Adjusted Odds Ratios (95% Confidence Intervals) for Mammography, Clinical Breast Examination, and Pap Smear Screening*

Characteristic	Mammography	Clinical Breast Exam	Pap Smear
Comorbidity index (1-unit increase)	0.83 (0.72, 0.94)	0.87 (0.79, 0.96)	0.81 (0.70, 0.93)
Ambulatory	2.54 (1.31, 4.89)	NS	2.20 (1.00, 4.84)
History of breast biopsy	2.53 (1.54, 4.15)	2.32 (1.67, 3.23)	NS
Family practice clinic	1.48 (1.12, 1.97)	2.64 (2.14, 3.26)	2.46 (1.85, 3.28)
No. of visits in prior 12 mos (2-visit increase)	1.43 (1.24, 1.66)	1.20 (1.09, 1.32)	1.44 (1.24, 1.66)
Attended clinic >1 yr	1.96 (1.39, 2.78)	NS	1.75 (1.26, 2.42)
Hysterectomy	NS	NS	0.77 (0.58, 1.01)
Age (10-yr increase)	NS	0.88 (0.82, 0.95)	NS
African American	NS	1.47 (1.14, 1.89)	1.38 (1.01, 1.90)

**Each column represents one multiple logistic regression model: mammography pertains to screening within 2 years for women age 50–74; clinical breast exam pertains to screening within 1 year for all women; Pap smear pertains to screening within 3 years for women age 43–64. NS indicates not significant;* $p > .10$*, not retained in model.*

Table 5. Associations (Odds Ratios) of Having Had a Mammogram Within 2 Years with Selected Medical Conditions, by Age

	50–74			< 50		50–64		65–74		75+	
Condition	Crude	A*	B† (95% CI)	Crude	C‡	Crude	C‡	Crude	D§	Crude	D§
Angina	0.43‖	0.40‖	0.41 (0.22, 0.76)	0.73	0.99	0.47	0.44	0.40‖	0.34‖	0.66	0.58
Congestive heart failure	0.84	0.78	0.90 (0.48, 1.68)	0.50	0.44	0.82	0.91	0.88	0.64	0.41‖	0.39‖
Myocardial infarction	0.99	1.10	1.08 (0.46, 2.57)	0.00‖	—	0.70	0.73	1.52	1.88	1.08	1.05
Hypertension	1.16	1.10	1.17 (0.85, 1.61)	1.17	1.34	1.18	1.13	1.14	1.00	1.43	1.18
Diabetes											
No end-organ damage	0.88	0.71‖	0.71 (0.50, 1.02)	0.59	0.61	0.74	0.62‖	1.16	0.92	1.64	1.46
With end-organ damage	0.66	0.50	0.47 (0.17, 1.25)	0.27	0.36	0.62	0.48	0.74	0.51	0.89	0.84
Mild renal disease	1.03	0.96	1.35 (0.54, 3.40)	0.22	0.25	0.70	0.78	1.53	1.15	0.64	0.68
Asthma	0.67	0.64	0.63 (0.30, 1.32)	2.44‖	1.56	0.70	0.66	0.50	0.69	1.45	1.59
Chronic obstructive pulmonary disease	0.77	0.77	0.77 (0.42, 1.42)	1.45	1.43	0.70	0.77	0.87	0.70	0.99	0.61
Osteroarthritis	0.99	0.86	0.84 (0.62, 1.14)	1.50	1.27	1.03	0.85	0.97	0.91	2.01‖	1.90‖
Rheumatoid arthritis	0.42	0.51	0.51 (0.19, 1.38)	0.36	0.36	0.23‖	0.24‖	1.00	1.20	0.25	0.36
Peptic ulcer	0.61	0.57	0.64 (0.36, 1.14)	1.54	2.19	0.45‖	0.42‖	0.97	0.79	0.58	0.56
GI bleeding	0.61	0.58	0.55 (0.23, 1.33)	1.10	1.70	0.91	1.06	0.24	0.17‖	1.08	0.72

**Adjusted for clinic, whether attended the clinic for at least a year, number of visits prior year, history of breast biopsy, and whether ambulatory.*

†Adjusted for items in A plus all other listed conditions.

‡Adjusted for clinic, whether attended the clinic for at least a year, number of visits prior year, and history of breast biopsy.

§Adjusted for age, clinic, whether attended the clinic for at least a year, number of visits prior year, history of breast biopsy, and whether ambulatory.

‖$p < .05$.

presented these data. More studies are clearly needed in older age groups.[43,45]

Beyond pointing out the need for further research on cancer screening and comorbidity, our study suggests a very specific area in which intervention appears warranted. The USPSTF does not recommend Pap smears for most women without a cervix; this is borne out by recent evidence.[46,47] A high proportion (64%) of women without a

Table 6. Associations (Odds Ratios) of Having Had a Pap Smear Within 3 Years with Selected Medical Conditions, by Age

	<65			<50		50–64		65–74		75+	
Condition	Crude	A*	B† (95% CI)	Crude	C‡	Crude	C‡	Crude	D§	Crude	D§
Angina	0.58	0.67	0.72 (0.34, 1.49)	0.70	1.15	0.55	0.53	0.57	0.59	0.75	0.74
Congestive heart failure	0.49‖	0.47‖	0.52 (0.27, 0.98)	0.55	0.44	0.44‖	0.46	0.52	0.46	0.61	0.65
Myocardial infarction	0.40	0.47	0.46 (0.16, 1.29)	0.16	0.32	0.52	0.56	0.63	0.85	1.08	1.21
Hypertension	1.26	1.28	1.43 (1.05, 1.93)	1.23	1.27	1.36	1.39	0.99	0.94	1.13	1.09
Diabetes											
No end-organ damage	0.78	0.71	0.74 (0.50, 1.10)	0.45‖	0.40‖	1.07	1.01	0.72	0.66	0.93	0.95
With end-organ damage	0.50	0.42	0.54 (0.18, 1.68)	0.12	0.14	0.79	0.64	1.52	0.97	1.01	0.91
Mild renal disease	0.61	0.61	0.74 (0.24, 2.22)	0.47	0.51	0.70	0.72	1.30	1.39	1.20	1.42
Asthma	0.70	0.52‖	0.56 (0.30, 1.04)	0.58	0.32‖	0.81	0.71	0.16	0.18	2.58	2.09
Chronic obstructive pulmonary disease	0.68	0.75	0.77 (0.36, 1.65)	1.18	0.75	0.60	0.66	1.03	1.12	1.71	1.20
Osteoarthritis	0.97	0.81	0.78 (0.54, 1.13)	1.42	1.20	0.90	0.72	1.06	1.09	1.58‖	1.64‖
Rheumatoid arthritis	0.33‖	0.43	0.37 (0.14, 0.99)	0.46	0.65	0.26‖	0.31	0.48	0.47	0.67	0.96
Peptic ulcer	0.61	0.79	0.94 (0.51, 1.75)	1.02	1.25	0.48‖	0.56	0.32‖	0.31‖	0.70	0.64
GI bleeding	0.61	0.69	0.61 (0.24, 1.56)	0.16	0.20	0.88	0.96	4.62	6.49	0.80	0.69

**Adjusted for clinic, race, whether attended the clinic for at least a year, number of visits to clinic in prior year, history of hysterectomy and ability to walk.*

†Adjusted for items in A plus all other listed conditions.

‡Adjusted for clinic, race, and number of visits to clinic in prior year.

§Adjusted for clinic, number of visits to clinic in prior year, whether attended clinic for at least a year, and whether had the ability to walk.

‖$p < .05$

uterus underwent Pap smears in our study, and this resource consumption should probably be redirected.

Our study has the limitations of a retrospective chart review, which may have caused screening rates to be underestimated. However, others have demonstrated a high level of validity and reliability for estimates of cancer screening rates based on medical record review.[48,49] The measure of comorbidity we used, the Charlson index, was designed and validated to correlate with long-term mortality, i.e., prognosis, and thus was an appropriate choice for our study.[28,29,50] We also focused analyses on specific conditions, including two (hypertension and osteoarthritis) that are not included in the Charlson index. Still, we did not measure quality of life or functional status, which are sometimes included in other measures of comorbidity but require more complex methods of data collection.[51–53] Recent studies comparing these different methodologies suggest that they are highly correlated and have similar effects when used to adjust risk for outcomes such as mortality.[54,55] Although most of the instruments measuring comorbidity, including the Charlson index, were developed in the inpatient setting, Greenfield and colleagues published an office-practice based measure after data collection for the present study was completed.[56]

Our study was conducted in the ambulatory care setting within one teaching institution and thus is not generalizable to the entire population. Even so, many women receive their care in such settings, and their experience may well have considerable generalizability. Another limitation of our study is a possible lack of power to detect associations between screening and certain conditions. For example, peptic ulcer disease was present in only 6% of the study group, and therefore the lack of statistical significance for the 39% reduction in both mammography and Pap smear rates we found in women with peptic ulcer disease (Tables 4 and 5) may be due to limited power of the model rather than the absence of a true effect.

In conclusion, we believe that clinicians need more information about the benefits of cancer screening for their patients who have chronic disease. As breast cancer and cervical cancer account for approximately 20% of cancer deaths among American women,[57] and as we have identified a possible bias against screening for the approximately 50 million American women with chronic disorders,[22] the case for conducting further research on cancer screening for women with chronic disease is compelling. In the meantime, in our primary care practices, we should pay particular attention to the screening status of women with chronic diseases. For every woman with, say, a history of angina or congestive heart failure who has not been screened, we should ask ourselves why this is so, and address the issue with the patient.

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