Are Depressive Symptoms Associated with Cancer Screening and Cancer Stage at Diagnosis among Postmenopausal Women? The Women's Health Initiative Observational Cohort

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Abstract

Background: Women with depressive symptoms may use preventive services less frequently and experience poorer health outcomes. We investigated the association of depressive symptoms with breast and colorectal cancer screening rates and stage of cancer among a cohort of postmenopausal women.

Methods: In The Women's Health Initiative Observational Study, 93,676 women were followed on average for 7.6 years. Depressive symptoms were measured at baseline and at 3 years using the 6-item scale from the Center for Epidemiological Studies Depression scale (CES-D). We calculated a cancer screening rate expressed as a proportion of the years that women were current with recommended cancer screening over the number of follow-up visits in the study. Breast and colorectal cancers were staged based on Surveillance, Epidemiology and End Results (SEER) classification.

Results: At baseline, 15.8% (12,621) women were positive for depressive symptoms, and 6.9% (4,777) were positive at both baseline screening and at 3 years. The overall average screening rate was 71% for breast cancer and 53% for colorectal cancer. The breast cancer screening rate was 1.5% (CI 0.9%–2.0%) lower among women who reported depressive symptoms at baseline than among those who did not. Depressive symptoms were not a predictor for colorectal cancer screening. Stage of breast and colorectal cancer was not found to be associated with depressive symptoms after adjusting for covariates.

Conclusions: Among a healthy and self-motivated cohort of women, self-reported depressive symptoms were associated with lower rates of screening mammography but not with colorectal cancer screening.

Introduction

BREAST AND COLORECTAL CANCER are the second and third leading causes of cancer death among women in the United States.¹ Early detection of these cancers can save lives, reduce length of treatment, and increase quality of life

(QOL). Race, economic status, family history of cancer, medical comorbidity, healthcare access, health behavior, and education have been recognized as major factors associated with screening behavior.^{2,3} Only a few studies have investigated the role of psychiatric comorbidities in cancer screening behavior and mortality.

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In the United States, about 1 in 8 women can expect to develop clinical depression during her lifetime,^{4,5} a condition that may cause considerable impairment, suffering, and disruption of personal, family, and work in one's life. Although depressed women are more likely to experience functional impairment,^{5,6} less than half seek medical care.⁷ Several studies have addressed the association of chronic mental illnesses, such as depression, with use of general medical care.^{8–12} These studies indicate poor adherence to medical treatment and follow-up as well as worse outcome in the population with psychiatric illness or substance use disorder or dual diagnoses. Few of these studies looked specifically at preventive care and cancer screening among patients with chronic mental illnesses.^{8,13} Although each of these studies shows lower cancer screening rates among patients with chronic mental illnesses, they did not study depression as a factor independent of substance abuse. The inclusion of individuals with dual diagnoses does not allow us to understand the independent effect of the mental illness.

Moreover, these studies included a broad spectrum of psychiatric illnesses, such as depression and schizophrenia, that are significantly different in their prevalence, latency, course of disease, and, most importantly, their effect on patient functioning. It may not be reasonable to study them as a single group of diseases. Furthermore, most studies were performed on veterans,^{8–10} who exhibit higher rates of multiple mental illnesses and may experience a more serious course of disease compared with nonveterans.^{14–16} There are no data available on the association of depression with cancer stage at initial presentation. We hypothesize that depressive symptoms may be associated with lower cancer screening rates as a result of reduced motivation for use of preventive services, less receipt of recommendations for screening by providers who are focusing on depression treatment, or reduced compliance with screening recommendations. These lower rates of early cancer screening may result in a more advanced stage of cancer at the initial presentation. On the other hand, depression itself might affect on the growth of cancer cells, leading to higher incidence of advanced stage cancers. Advanced stage of breast and colorectal cancers is associated with increased cancer morbidity, mortality, and healthcare costs. To better understand the association of depressive symptoms with cancer screening rates and stage of cancer at clinical presentation, we analyzed data from the Women's Health Initiative Observational Study (WHI-OS).

Materials and Methods

Study population

The WHI-OS is a cohort of 93,676 women with an average follow-up time of 7 years. Postmenopausal women aged 50–79 years who gave written informed consent were recruited into the WHI study at 40 clinical centers in the United States, mostly through mass mailings to age-eligible women. The WHI cohort is multiethnic, with 83.3% white, 8.2% African American, 3.9% Hispanic, 2.9% Asian/Pacific Islander, 0.5% American Indian/Alaskan Native, and 1.4% unknown ethnicity. Details of the WHI study design are reported elsewhere.¹⁷ Exclusions for WHI-OS were participation in other randomized trials, survival prediction of <3 years, alcohol abuse, dementia, drug dependency, documented diagnosis of a serious mental illness (which includes schizophrenia,

schizoaffective disorder, bipolar-affective disorder, and other nonorganic psychotic disorders), or other conditions making women unable to participate in the study. Because individuals with a prior history of cancer often have increased surveillance and sometimes have different screening guidelines, this analysis excluded all subjects with a history of cancer at baseline, except nonmelanoma skin cancer. Previous research has shown an increased incidence of depression among patients diagnosed with cancer.¹⁸ Women with cancer diagnosed within the first year of the study were also excluded to reduce the bias of a causal association of cancer and depression.

Variables

Participants were assessed for their current and past history of depressive symptoms using the Burnam screen¹⁹ for depression. This screen consists of 6 items from the 20-item Center for Epidemiological Studies Depression scale (CES-D) and 2 items from the National Institute of Mental Health's Diagnostic Interview Schedule (DIS).²⁰

The 6-item CES-D and DIS scale was administered at baseline and again at the 3-year follow-up visit. Current depressive symptoms were assessed using 6 items from the CES-D in the Burnam scale, which is highly correlated with the 20-item CES-D scale (correlation coefficient $r = 0.88$, $p < 0.001$).^{20,21} Burnam et al.¹⁹ showed that this screen has adequate psychometric properties for detecting current depressive disorder (major depression and dysthymia), with 86% sensitivity and 95% specificity for detecting depression in a primary care population. Participants are asked how often they felt the depressive symptoms during the past week. Each item is scored as 0 (rarely or none of the time <1 day), 1 (some or a little of the time 1–2 days), 2 (occasionally or a moderate amount of the time 3–4 days), or 3 (most or all of the time 5–7 days). The items included: (1) you felt depressed, (2) your sleep was restless, (3) you enjoyed life (reversed scoring), (4) you had crying spells, (5) you felt sad, and (6) you felt that people disliked you.

The DIS scale consists of two questions used to assess depressive symptoms^{20,21} over the previous 2 years. These dichotomous response questions are (1) In the past year, have you had 2 weeks or more during which you felt sad, blue, or depressed or lost pleasure in things that you usually cared about or enjoyed? (2) Have you had 2 years or more in your life when you felt depressed or sad most days, even if you felt okay sometimes? If yes, have you felt depressed or sad much of the time in the past year?"

A score of ≥ 5 on the short form of the CES-D at baseline was used as the primary definition for depressive symptoms. This definition represents depressive symptoms over the previous week at study baseline. During this longitudinal study, depressive symptoms were also assessed using another measure (DIS scale) and at a different time point (3 years). We used additional definitions for depressive symptoms to assess the correlation of depressive symptoms with cancer screening and stage at initial presentation. The three additional definitions in this sensitivity analysis used to strengthen our results are (1) depressive symptoms defined as both a score of ≥ 5 on the CES-D and a positive DIS score (score of 2) at baseline, (2) a score of ≥ 2 on the DIS, and (3) depressive symptoms defined as a score of ≥ 5 at both the baseline visit and 3 years later on the CES-D.

Current breast cancer screening was defined as a mammogram within the last 12 months.^{22,23} Current colorectal screening was defined as an annual fecal occult blood test (FOBT) or lower endoscopy or double-contrast barium enema within the last 5 years.^{22,23} This information was collected during the baseline and annual follow-up questionnaires. We calculated a screening rate expressed as a proportion of the years that women were current with recommended screening over the number of follow-up visits in the study.

Breast and colorectal cancers were staged based on the Surveillance Epidemiology and End Results (SEER) classification.²⁴ All *in situ* and localized cancers were classified as early stage cancers, and regional and distant cancers were classified as late stage cancers. Unstaged cancers and women diagnosed with cancer during the first year of the study were not included in this analysis, but there was little difference in the incidence rates for this subset of cancers between depressed and nondepressed cohorts (data not shown).

Sociodemographic characteristics, past medical history, and information about known breast and colorectal cancer risk factors were self-reported on the baseline questionnaire. Descriptive characteristics included age, ethnicity, education, income, insurance type, physical activity, age at menarche, age at first pregnancy, number of children breastfed, family history of breast or colorectal cancer, history of breast biopsy, history of ulcerative colitis or Crohn's disease, use of hormone therapy (HT) (estrogen only or estrogen and progesterone combination therapy), aspirin use, smoking and alcohol use status, and use of a primary care provider. Body mass index (BMI) was calculated based on weight and height measurements taken by study nurses at baseline. New medical problems and changes in treatment were reported during follow-up questionnaires. Comorbidity burden was calculated using a modified version of the Charlson Index (unpublished WHI data by R. Gold et al.), a commonly used and validated^{25,26} comorbidity index composed of 19 diseases weighted based on how well they predict mortality, with a maximum possible score of 37. Charlson Index scores were calculated using WHI baseline data from each study subject's self-reported medical history. Use of antidepressant medication was not included in the model because of the variety of other indications for these classes of medication.

Statistical analysis

Baseline sociodemographic characteristics and cancer risk factors of the study cohort were compared among women who screened positive for depression vs. those who did not. Simple linear regression was used to determine the association between depressive symptoms and subsequent breast

or colorectal cancer screening rates. To control for potential confounding factors, the estimates and corresponding 95% confidence intervals (95% CI) for depression status in the breast cancer screening model were adjusted for sociodemographic characteristics, family history of breast cancer, history of previous breast biopsy, HT, alcohol intake, BMI, comorbidity index, insurance, and having a primary care provider. Adjustment factors for the colorectal cancer screening analysis included sociodemographic characteristics; family history of colorectal cancer, ulcerative colitis, or Crohn's disease; alcohol intake; comorbidity index; and having a primary care provider.

Logistic regression was used to assess the correlation of depressive symptoms with late vs. early stage at presentation of subsequent breast and colorectal cancers. To control for potential confounding, odds ratios (ORs) and 95% CIs for depression status in the breast cancer model were adjusted for sociodemographic characteristics, insurance type, breast biopsy, number of relatives with breast cancer, moderate or strenuous physical activity, BMI, age at first birth, number of children breastfed, parity, and aspirin use. Depression status in the colorectal cancer model was adjusted for sociodemographic characteristics, insurance type, BMI, moderate or strenuous physical activity, and smoking status. We ran additional multivariate models with different measurements of depressive symptoms at baseline and 3-year follow-up. All analyses were conducted using SAS (version 9.1.3) (SAS Institute, Cary, NC) software. Analyses were statistically significant at alpha of 0.05.

Results

There were 12,621 (15.8%) women (Table 1) with current depressive symptoms and a mean CES-D score of ≥ 5 at baseline. The mean CES-D score for those above the cutoff of 5 was 7.0 (standard deviation [SD] 2.4), compared with 1.45 (SD 1.33) for women scoring below the cutoff. Using our alternative definitions, 5,152 (7.4%) women had both positive CES-D and DIS scores at baseline, 9,760 (12.1%) had positive DIS scores, and 4,777 (6.9%) women had positive CES-D at baseline and at the 3-year follow-up.

Table 2 compares the sociodemographic and health characteristics of women with and without depressive symptoms at baseline in the WHI-OS cohort. Women with depressive symptoms were younger (aged 50–59 years); had lower educational attainment; and were less likely to be white, have a $> \$20,000$ annual income, and be insured. Women with depressive symptoms were more likely to have BMI ≥ 30 , were less physically active, used more alcohol in the past, and were more likely to be current smokers.

The overall average screening rate was 71% for breast can-

TABLE 1. PREVALENCE OF DEPRESSIVE SYMPTOMS REPORTED BY WOMEN: WOMEN'S HEALTH INITIATIVE OBSERVATIONAL COHORT

Depressive symptoms	n	%	Mean depressive score	SD ^a
CES-D > 5 at baseline	12,621	15.8	7.0	2.4
DIS > 2 at baseline	9,760	12.1	8.0	2.5
CES-D > 5 and DIS > 2 at baseline	5,152	7.4	8.0	2.7
CES-D > 5 at baseline and 3-year follow-up	4,777	6.9	7.5	2.6

^aCES-D, Center for Epidemiological Studies Depression scale; DIS: Diagnostic Interview Schedule; SD, standard deviation.

TABLE 2. BASELINE CHARACTERISTICS OF WOMEN WITH AND WITHOUT DEPRESSIVE SYMPTOMS: WOMEN'S HEALTH INITIATIVE OBSERVATIONAL COHORT^a

Variable	Depressive symptoms ^b n = 12,623		No depressive symptoms n = 67,368	
	n	%	n	%
Age group, at screening, years				
50–59	4,755	38	21,459	32
60–69	5,201	41	30,058	45
70–79	21	15,851	23	
Education				
High school diploma or less	3,402	27	13,413	20
Posthigh school/some college	4,836	39	24,109	36
College degree or more	4,262	34	29,324	43
Annual household income (dollars/year)				
<\$20,000	2,794	24	8,660	14
\$20,000–\$50,000	5,088	44	27,061	43
\$50,000+	3,736	32	26,830	43
Ethnicity				
White	9,998	79	56,730	84
Black	1,223	10	5,181	8
Hispanic	854	7	2,134	3
American Indian	80	<1	263	<1
Asian/Pacific Islander	262	2	2,147	3
Unknown	206	2	913	1
Body mass index (kg/m ²)				
<25	4,356	35	28,218	42
25–<30	4,219	34	22,738	34
≥30	3,900	31	15,631	24
Insurance				
None	747	6	1,951	3
Private only	6,488	52	36,145	54
Medicare/Medicaid only	1,189	10	4,822	7
Other	4,021	32	23,815	36
Physical activity				
No activity	2,425	19	8,273	12
Some activity	5,217	42	25,009	38
2–<4 episodes per week	2,049	16	12,632	19
4+ episodes per week	2,839	23	20,837	31
Alcohol intake				
Never drinker	1,383	12	7,516	11
Past drinker	2,923	24	11,825	18
<7 drinks/week	6,948	55	38,922	58
7+ drinks/week	1,277	10	8,750	13
Smoking				
Never smoked	6,080	49	34,342	52
Past smoker	5,313	43	28,348	43
Current smoker	1,056	8	3,852	5
Primary care provider				
Yes	2,439	93	63,999	95
Comorbidity index		0.56		0.38
Mean (SD)	12,623	(0.87)	67,368	(0.70)
Aspirin use				
Yes	2,676	21	14,817	22
Age at menarche, years				
<12	2,974	24	14,526	22
12–13	6,677	53	37,299	56
14+	2,904	23	15,320	22
Age at first birth, years				
Never pregnant/no term pregnancy	1,557	14	8,441	14
<20	1,827	16	7,146	12
20–29	6,895	62	40,369	66
30+	883	8	5,184	8

TABLE 2. BASELINE CHARACTERISTICS OF WOMEN WITH AND WITHOUT DEPRESSIVE SYMPTOMS: WOMEN'S HEALTH INITIATIVE OBSERVATIONAL COHORT^a (CONT'D)

Variable	Depressive symptoms ^b n = 12,623		No depressive symptoms n = 67,368	
	n	%	n	%
Number of children breastfed				
No term pregnancy	1,557	12	8,442	13
0	4,803	38	24,192	36
1–2	3,952	32	21,224	32
3+	2,147	18	12,778	19
Hormone therapy use				
Never used	5,038	40	26,349	39
Past user	1,818	14	9,139	14
Current user	5,767	46	31,880	47
First degree relatives with breast cancer				
None	9,549	84	52,010	84
1	1,573	14	8,643	14
2+	188	2	943	2
Breast reduction/removal				
Yes	634	5	2,877	4
History of benign breast disease				
No breast biopsy	9,659	78	51,417	77
One biopsy	1,913	15	10,374	16
2+ biopsies	849	7	4,547	7
Mammogram last year				
No mammogram ever	439	4	1,959	3
No mammogram last year	4,263	35	20,932	32
Mammogram last year	7,482	61	42,618	65
Ulcerative colitis or Crohn's disease				
Yes	215	2	724	1
First-degree relatives with colorectal cancer				
None	9,254	83	51,978	84
1	1,619	15	8,558	14
2+	239	2	1,021	2
Prior endoscopy				
None	5,787	46	31,184	47
<5 years ago	4,099	33	22,686	34
5+ years ago	2,553	21	12,493	19
Antidepressant use (at baseline)				
Yes	1,766	14	4,086	6
Antidepressant use (at 3-year follow-up)				
Yes	1,885	18	4,664	8
History of depression—DIS ^c (at baseline)				
Yes	5,152	42	4,427	7

^aAll analyses were statistically significant ($p < 0.0001$).^bDepressive symptoms: CES-D > 5 at baseline.^cDIS, Diagnostic Interview Schedule.

cer and 53% for colorectal cancer. Of women with current depressive symptoms at baseline, 61% reported screening for breast cancer compared with 65% of women without depressive symptoms. Differences in these rates persisted even when the rates were adjusted for factors associated with breast cancer screening (Table 3). Breast cancer screening rates during the average 7.6 years of follow-up among women with current depressive symptoms at baseline were 1.5 percentage points lower (–1.5 % difference, 95% CI –0.9, –2.0) compared with women without depressive symptoms, after adjustment for risk factors and differences between the two groups.

Screening rates were even lower among women with a positive DIS at baseline (–3.6% difference, CI –2.9, –4.2) and among those with positive CES-D at both baseline and 3-year follow up (–2.2% difference, CI –1.3, –3.0) during the study.

Depressive symptoms at baseline or any other time during the follow-up were not associated with colorectal screening (Table 3). Neither breast cancer nor colorectal cancer stage at diagnosis (Table 4) was associated with current depressive symptoms, past depressive symptoms at baseline, or depressive symptoms at baseline and at the 3-year follow-up in unadjusted or adjusted analysis.

TABLE 3. CHANGE IN CANCER SCREENING WITH DEPRESSIVE SYMPTOMS: WOMEN'S HEALTH INITIATIVE OBSERVATIONAL COHORT

<i>Depressive symptoms</i>	<i>Breast cancer screening^a</i>		<i>Colorectal cancer screening^b</i>	
	<i>Difference in percentage, %^c</i>	<i>95% CI</i>	<i>Difference in percentage, %^c</i>	<i>95% CI</i>
CES-D ^d > 5 at baseline	−1.5	−0.9, −2.0	0.2	1.1, −0.07
DIS > 2 at baseline	−3.6	−2.9, −4.2	0.0	1.0, 1.0
CES-D > 5 and DIS > 2 at baseline	−2.9	−2.0, −3.7	−0.1	1.3, −1.4
CES-D > 5 at baseline and 3-year follow-up	−2.2	−1.3, −3.0	0.6	2.0, −0.8

^aAdjusted for sociodemographic characteristics, family history of breast cancer, history of previous breast biopsy, HT, alcohol intake, BMI, comorbidity index, insurance, and having a primary care provider.

^bAdjusted for sociodemographic characteristics, family history of colorectal cancer, ulcerative colitis, or Crohn's disease; alcohol intake; comorbidity index; and having a primary care provider.

^cDifference in percentage, %, comparing women with variable listed as reference group.

^dCES-D, Center for Epidemiological Studies Depression scale; DIS: Diagnostic Interview Schedule.

Discussion

This study examined whether depressive symptoms are associated with breast and colorectal cancer screening rates and stage of diagnosis among postmenopausal women. To examine this hypothesis, we used WHI-OS data from 1991 to 1998, the largest (93,676) longitudinal study of healthy postmenopausal women. Among this large cohort, we found a high prevalence (15.8%) of women who screened positive for depressive symptoms at baseline, and almost half of them continued to have depressive symptoms at 3-year follow-up. Women with depressive symptoms at baseline had 1.5% lower breast cancer screening rates during the study period, controlling for other known predictors for screening. Breast cancer screening rates were even lower (−2.2% difference) among women reporting a past history of depression at baseline. This difference in breast cancer screening among women with depressive symptoms was not associated with presentation at a later stage of breast cancer. Depressive symptoms in the past, at baseline, or at 3-year follow-up had no association with adequate colorectal cancer screening rate or stage of colorectal cancer.

The incidence of cancer-related deaths in the year 2005 was the same as that in 1950.²² Significant effort and resources have gone toward promoting early detection of cancer to reduce mortality and improve QOL. One possible barrier to

early detection is co-morbid mental illness, such as depression. Numerous studies describe greater physical illness, functional impairment, and morbidity among patients with depression.^{11,27–29} Patients with depression use more health-care resources, including clinician visits and hospital admissions.^{30,31} However, despite higher utilization rates, routine care such as screening may be overlooked. Patients and providers may be overly focused on managing the depression, or they may assume it is a natural consequence of events associated with aging, such as the loss of loved ones or medical illness, and appropriate proper treatment may not be considered. Additional barriers to seeking care include the social stigma associated with depression and social stressors, such as lack of social or financial support.⁴

Our results confirm that depressed women have modestly lower breast cancer screening rates, but we found no association with colorectal cancer screening rates. Pirraglia et al.³² found similar results in a small cohort of younger women, aged 42–52 years, for whom high depressive symptom burden was a modest barrier for breast cancer screening but not for cervical cancer screening. Druss et al.^{8,9} found that veterans with any mental illness or a dual diagnosis of mental illness and substance abuse were less likely to receive optimal cancer screening, including colorectal and prostate screening. Our study results differ from their studies for colorectal cancer screening. One possible reason for this differ-

TABLE 4. ODDS RATIO OF LATER STAGE OF CANCER AT DIAGNOSIS: WOMEN'S HEALTH INITIATIVE OBSERVATIONAL COHORT

<i>Depressive symptoms</i>	<i>Breast cancer^a OR, (95% CI)^c</i>	<i>Colorectal cancer^b OR, (95% CI)^c</i>
CES-D ^d > 5 at baseline	0.93 (0.71, 1.21)	1.01 (0.61, 1.69)
DIS > 2 at baseline	1.03 (0.77, 1.37)	1.1 (0.63, 1.92)
CES-D > 5 and DIS > 2 at baseline	0.97 (0.66, 1.44)	1.22 (0.59, 2.52)
CES-D > 5 at baseline and 3-year follow-up	1.17 (0.78, 1.74)	0.84 (0.34, 2.04)

^aAdjusted for sociodemographic characteristics, insurance type, breast biopsy, number of relatives with breast cancer, moderate or strenuous physical activity, BMI, age at first birth, number of children breastfed, parity, and aspirin use.

^bAdjusted for sociodemographic characteristics, insurance type, BMI, moderate or strenuous physical activity, and smoking status.

^cOR, odds ratio; CI, confidence interval; CES-D, Center for Epidemiological Studies Depression scale; DIS: Diagnostic Interview Schedule.

ence may be that we examined the effect of depression independently from other mental illness, such as psychotic or anxiety disorders, which were combined in previous studies. As these mental illnesses differ significantly from depression in their severity impact on the patient, they may also differ in their relationship to obtaining cancer screening. WHI participants tended to be relatively healthy and self-motivated, as women with the most severe forms of mental illness were excluded from the study.

Although we found a moderate association of depressive symptoms and breast cancer screening, we found no association with colorectal cancer screening. Several possible reasons may account for this difference. Colorectal cancer screening can be adequate with less frequent screening modalities, such as endoscopy, which is repeated every 3–5 years. Because the severity of depressive symptoms can vary widely over time, it is possible that individuals may obtain screening during their symptom-free periods and thus achieve adequate colorectal cancer screening. On the other hand, breast cancer screening requires yearly mammography. A depressed woman may have difficulty adhering to annual appointments because of lack of interest in cancer screening, or she may have difficulty remembering appointments. Colorectal cancer screening is not as widely accepted as breast cancer screening. In our study, only 53% of all women received adequate colorectal cancer screening vs. 71% for breast cancer. Given the relatively lower rate of colorectal screening, the influence of depression may not be evident.

We did not find any association of depressive symptoms with breast or colorectal cancer in early stage or late stage at initial presentation. The results were consistent when all cancer stages were analyzed independently. One explanation for the lack of a finding may be that our cohort included fewer women with chronic, severe, or untreated depression. Second, this cohort may have had different baseline screening practices related to other factors, including their personal risk of cancer. The incidence rates of both breast and colorectal cancer were 3-fold and 1.5 fold higher, respectively, in the WHI-OS cohort than nationally reported by SEER data.²⁴ In the WHI-OS cohort, approximately 80% of the incident breast cancer cases diagnosed were in early stages compared with 60% nationally. Among colorectal cancer incident cases, 44% were diagnosed at the early stages, which is similar to national rates.

There are limitations to our study. The depression screening instrument (Burnam screen) may also reflect anxiety or psychological distress, and when it is used clinically, any patient with positive screening would generally be referred for further psychiatric evaluation. Although the positive screening result has high sensitivity and specificity for diagnosing clinical depression, it is only an indicator of depressive symptoms. The association between depressive symptoms and breast cancer screening might be stronger among subjects with severe or untreated depressive illness than is reported in this cohort of women. We were unable to verify the self-reported mammogram and colorectal cancer screening among these women. The literature supports high accuracy in self-reported screening data, 75% for breast³³ and 85% for colorectal screening,³⁴ if asked within 2 years. In the WHI study, women were queried about their health habits annually. Because of the limited data regarding the purpose of

medication use, we could not control for antidepressant use and adherence to medications. The WHI was not designed to study the association of depressive symptoms with cancer stage.

One of the strengths of this study is the large number of participants, allowing us to adjust for most covariables without overfitting the multivariate models. Depression was measured at two different times during the study period using an instrument with reasonably high sensitivity and specificity for clinical depression. Sensitivity analysis by using a variety of definitions for depression, ranging from current depression to depression at multiple time points, was an added strength to the methodology. Additionally, stronger association of depressive symptoms with lower breast cancer screening rates among women with long-standing depressive symptoms also strengthened our results; we had enough power to study the effect of depressive symptoms on stage of cancer at presentation, which previous studies had been unable to do. Although our study is the first to study and show no effect of depressive symptoms on stage of breast and colorectal cancer, this association may be different among patients with severe refractory depression or other chronic mental illnesses. It is hoped that our study will help researchers to design additional studies looking at cancer screening and chronic mental illnesses.

In conclusion, we found that among a healthy and self-motivated cohort of women, self-reported depressive symptoms were associated with moderately lower rates of screening for breast cancer. No association was noted between depressive symptoms and adequacy of colorectal cancer screening. We were unable to find any association of depressive symptoms with stage of cancer at presentation. Cancer control programs might consider assessing psychiatric comorbidities, such as depression, when planning strategies to improve breast cancer screening rates.

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