Published in final edited form as:

Am J Prev Med. 2010 March ; 38(3): 303–310. doi:10.1016/j.amepre.2009.10.039.

Breast and Cervical Cancer Screening:

Specific Effects of Depression and Obesity

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Abstract

Background—Obesity and depression may each be associated with less cervical and breast cancer screening. Studies have examined obesity or depression alone, but not together, despite the established link between them.

Purpose—To disentangle the effects of depression and obesity on receipt of breast and cervical cancer screening.

Methods—A stratified sampling design was used to recruit women aged 40–65 years with information on BMI from an integrated health plan in Washington in 2003–2005. A telephone survey included the PHQ-9 for depression, weight, and height. Automated data assessed Paps for 3097 women over a 3-year period and screening mammograms over a 2-year period for 2163 women aged ≥51 years. Logistic regression models (conducted in 2008) examined the association between obesity and depression and receipt of screening tests.

Results—In univariate logistic regression models, women were less likely to receive a Pap if they were obese (OR = 0.53, 95% CI 0.41–0.69) or depressed (OR = 0.60, 95% CI= 0.42–0.87). Women were less likely to receive a screening mammogram if they were depressed (OR = 0.45, 95% CI= 0.30–0.67). In multivariable models, only obesity remained significantly associated with lower likelihood of Pap screening (OR =0.67, 95% CI= 0.0.49–0.93) and only depression remained significantly associated with less screening mammography (OR =0.49, 95% CI 0.31–0.76). Obesity and depression did not interact significantly in either model.

Conclusions—Obesity and depression appear to have specific effects on receipt of different cancer screening tests.

Introduction

Cancer is one of the leading causes of death among women worldwide.¹ For cancers of the breast, cervix, and colon (three of the five leading causes of cancer death worldwide), regular

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screening can reduce mortality.^{2–4} Unfortunately, screening participation is variable^{5,6}, even in health systems with adequate resources.⁷ Emerging evidence links both obesity and depression with lower likelihood of cancer screening. A recent systematic review of research on obesity and screening for cancer of the breast (10 studies) and cervix (14 studies) found the most consistent associations between cervical cancer screening and increasing BMI.⁸

Findings have varied in the smaller number of studies that examined the relationship between cancer screening and depressive symptoms. One study found less screening for breast but not cervical cancer⁹ and two others found less breast cancer screening among women with depressive symptoms.^{10,11} One of these studies linked mood disorders with high severity, including depression—but not those that were less severe—to less screening for breast cancer.¹¹ Conversely, another study did not link psychological distress to breast cancer screening.¹² Finally, a study reported that younger depressed women were more likely—and older depressed women (defined as 40 and older) were less likely—to report recent screening for cervical cancer, compared with nondepressed women.¹³

Lower screening participation associated with obesity and depressions are remarkable, since both conditions are associated with increased use of medical services in general, for example, outpatient primary care and specialty care visits.^{14–16} This suggests that obesity and depression may affect patients' attitudes (e.g., body dissatisfaction) or providers' attitudes toward screening rather than reducing opportunities for screening to occur.

Few previous studies considered screening for both cancers of the breast and cervix. None has examined the joint contributions of depression and obesity. Given the strong association between depression and obesity,^{17,18} it is essential to examine their joint and separate effects on screening participation. This study was designed to examine associations of obesity and depression with receipt of breast and cervical cancer screening among women aged 40 to 65 years enrolled in a prepaid health plan with mailed screening reminders. It was hypothesized that depression and obesity would have specific associations with each type of cancer screening.

METHODS

Setting

Women aged 40 to 65 years were recruited from Group Health Cooperative (GHC), an integrated prepaid health plan serving more than 500,000 members in the Pacific Northwest. During the study period, all women aged ≥ 40 years received mailed reminders for cervical cancer screening and all women aged ≥ 50 years received mailed reminders for breast cancer screening. Reminder intervals depended on personal risk and screening history with a maximum interval of 2 years for breast cancer screening and 3 years for cervical cancer screening.

Recruitment

Details of recruitment and survey procedures have been published¹⁷ and are briefly described here. Study participants were recruited from eight GHC clinics in the Seattle/Tacoma area between November 2003 and February 2005. To increase efficiency of the survey, medical records data were used to sample 100% of women with a previously reported BMI of 30 or more, 25% of women with no previously reported BMI, and 12% of women with a previously reported BMI less than 30. All analyses incorporated sampling weights (see below) so that results accurately reflect the entire population of women aged 40 to 65 years. An invitation letter that included all elements of informed consent and a \$5 gift card pre-incentive was sent to 8000 women and 4659 (62% of those eligible) completed the survey by telephone. The

response rates varied significantly across sampling strata and were incorporated into the sampling weights (63% among those who reported BMI of 30 or more on the breast cancer screening questionnaire vs 59% among those reporting BMI less than 30 vs 34% among those declining to participate in breast cancer screening, $X^2=344$, $df=2$, $p<.001$).

Measures

The survey collected self-report of height, weight, depressive symptoms, health behaviors, and demographics.

BMI was calculated from self-reported height and weight and dichotomized as obese ($BMI \geq 30$) or not obese ($BMI < 30$). Demographic information included age, race, ethnicity, marital status, educational attainment, and annual household income; current smoking status was also assessed. A potential mediator, body dissatisfaction, was assessed through a single item ("I feel satisfied with the shape of my body")¹⁹ with six response options (Always, Usually, Often, Sometimes, Rarely, and Never). Responses were dichotomized as Never or Rarely (body dissatisfaction) vs Sometimes or more (body satisfaction).

Depressive symptoms were measured using the Patient Health Questionnaire (PHQ-9)²⁰ which provides a continuous severity score ranging from 0 to 27, with each of the nine items scored from 0 (not at all) to 3 (nearly every day). For this study, the PHQ-9 was dichotomized as depressed ($PHQ \geq 10$) or not depressed ($PHQ < 10$), the usual threshold for identification of probable clinical depression. This threshold has a sensitivity for major depression of 88%, a specificity of 88%, and a positive likelihood ratio of 7.1.²¹

Pap data were obtained from Group Health's cytology, pathology, outpatient and claims data files for a 3-year period (18 months before and 18 months after the survey).

Screening mammogram data were obtained from Group Health's radiology, outpatient and claims data for a 2-year period (12 months before and 12 months after the survey). Mammograms for this study were restricted to screening mammograms.

Medical comorbidity was measured by RxRisk²², which uses automated pharmacy records of prescription drug use in the past 12 months to compute a measure of medical comorbidity and predicted healthcare utilization. The RxRisk has been found to be comparable to using Ambulatory Care Groups²³ in predicting total future health costs.²²

Primary care visits during the potential cancer screening interval were identified through electronic medical records. .

Exclusions

Of 4569 women completing the survey, the following groups of women were excluded from these analyses:

- BMI was less than 18.5 were excluded (few in number and a more chronically ill and frail population)
- missing survey data regarding BMI or depression score
- not enrolled for 3 years prior to the survey (data on screening not available)
- declined use of medical records for research
- excluded from the cancer screening reminder program
- history of breast or cervical cancer

In addition, women aged 40 to 49 years were excluded from analyses regarding breast cancer screening as screening was not recommended for all women in this group. After exclusions described above, 3097 women remained in the analysis for Pap (66% of original survey women) and 2163 for mammogram (46% of original survey women). The proportion of women excluded did not differ by BMI category. However, women with higher depression scores were more likely to be excluded; primarily because these women often had less than 3 years of enrollment.

Analysis

The outcomes of interest were the proportion of women: (1) aged 40–65 years receiving a Pap; and (2) aged 51–65 years receiving a screening mammogram. Descriptive analyses include the proportion of women receiving these preventive services by BMI, PHQ-9 score, demographics, health behavior, and body dissatisfaction. The proportion of women receiving preventive services and primary care visits by BMI category after stratifying on depression status was also calculated.

Logistic regression models were used to test the association between obesity and depression and preventive services. First, univariate models examined obesity and depression separately in association with each outcome. Then, both obesity and depression were included as main effects in the models. Next, age (40–49, 50–59, 60–65 years), race/ethnicity (non-Hispanic white, African-American or Hispanic, Other), marital status (currently married vs not), education (4-year college graduate vs not), smoking status (current smoker vs not), comorbidity index (<800, 800–<1600, 1600+), and body dissatisfaction (yes vs no) were included as categorical covariates in the model. Lastly, an interaction term between obesity and depression in the model tested for effect modification. Because obesity and depression are commonly linked, the test for interaction helps to explore whether or not the effect of depression differs by obesity status and vice versa. All analyses were carried out using SAS software, Version 9.0. CIs (95%) were used to estimate significance. All analyses incorporated sampling weights to account for the stratified sampling procedure and differential response rates across sampling strata.

RESULTS

Unadjusted associations among depression, obesity, and receiving screening

Lower education, smoking, and depressive symptoms were associated with fewer Paps and mammograms received (Table 1). Increasing age, body dissatisfaction, and obesity were associated with fewer Paps only while white, non-Hispanic race/ethnicity and never being married were associated with less mammography.

Among nondepressed women, the proportion of women receiving a Pap was 87% for non-obese women and 77% for obese women (Table 2). Among depressed women, 76% received a Pap whether or not they were obese. The proportion of women receiving a screening mammogram was higher among nondepressed compared to depressed women: 80% of non-obese women and 76% of obese women without depression, versus 61% of non-obese women, and 64% of obese women with depression. Additional sensitivity analyses for Pap results were conducted in which analyses were restricted to women aged 51 to 65 years to make sure the differences observed between Paps and mammography were not due to the age specifications of the cohorts; result were not changed.

Table 2 also shows the percentage of women who made primary care visits in the intervals examined. Of women who did not receive cervical or breast cancer screening, only 13% did not have a primary care visit during the time frame examined (data not shown).

Model results

In the univariate models, women were less likely to receive a Pap if they were obese (OR = 0.53, 95% CI= 0.41–0.69) or depressed (OR = 0.60, 95% CI= 0.42–0.87) (Table 3). When obesity and depression were both included in the model, only obesity remained significantly associated with lower Pap screening (OR = 0.56, 95% CI 0.42–0.73). Results were similar in the final model that also adjusted for covariates (OR = 0.67, 95% CI 0.49–0.93). There was no significant interaction between obesity and depression, but there was for obesity and race ($P=$.04). When examined by race, the only significant finding was an inverse relationship between obesity and receiving cervical cancer screening among white women (OR = 0.64, 95% CI 0.45–0.9).

In the univariate models, only depression was significantly associated with lower screening mammography (OR = 0.45, 95% CI 0.30–0.67). When obesity and depression were both included in the model, depression remained significantly associated with less screening mammography (OR = 0.46, 95% CI 0.31–0.70). Results were similar in the final model that also adjusted for covariates (OR = 0.49, 95% CI 0.31–0.76) with no significant interaction between obesity and depression or depression and race.

DISCUSSION

To our knowledge, this study is the first to evaluate the relative contributions of *both* depression and obesity to both breast and cervical cancer screening in an insured population that received screening reminders. In a large population-based sample of middle-aged women, unadjusted analyses find that obesity and depression are each associated with less cervical cancer screening and depression is associated with less breast cancer screening. Examining the distinct effects of obesity and depression, however, specific associations between obesity and lower likelihood of receiving Paps, and between depression and lower likelihood of receiving screening mammography were observed.

Compared to 86% of non-obese women, only 77% of obese women received a Pap within a 3-year period. These differences are highly significant from a public health perspective; intervention trials using patient reminders to increase cervical cancer screening have demonstrated median post-intervention increases of approximately 10 percentage points.²⁴ If the percentage of women aged 18–64 years screened in the last 3 years increased from 83% (2005 population average) to 90%, 620 extra lives could be saved annually across the U.S.²⁵

These data cannot explain why obese women are screened for cervical cancer less frequently. Obese women, especially those who were also depressed, had more primary care visits, so observed differences in screening cannot be attributed to reduced opportunity. Prior research suggests that patient discomfort or embarrassment, previous negative experiences, fear of stigmatization,^{26,27,28} provider bias²⁹ competing clinical demands at primary care visits (e.g., management of chronic conditions such as diabetes³⁰), or lack of appropriately sized specula or other equipment may account, in part, for decreased cervical screening among obese women. Using data from the National Health Interview Survey (NHIS), Ferrante et al. 2007 found obese women as likely as non-obese women to receive physician recommendations for cervical and breast cancer screening, but less likely to adhere to recommendations.³¹ Qualitative data from Amy and colleagues³² give insight into potential barriers. Obese women in their study reported disrespectful treatment, embarrassment, negative attitudes of providers and unsolicited advice to lose weight, and medical equipment too small to be functional as barriers to routine gynecologic cancer screening.

Women with clinically important levels of depression had significantly less screening mammography. Only 76% of women with moderately severe depressive symptoms had

received mammograms versus 84% of nondepressed women. It has been estimated that an additional 3700 lives would be saved each year if the portion of women aged ≥ 40 years who have been screened for breast cancer in the past 2 years increased from the population average of 67% to 90%.²⁵ In this study, obesity and depression appear to have specific effects on receipt of two different cancer screening tests. This may be because these tests differ in how much they are provider rather than patient initiated. As opposed to a Pap, receiving a mammogram entails more patient-initiated behavior: making a separate appointment at a special facility that may require motivation and energy lacking when depressed. Previous research by our group found that among primary care patients with diabetes, depression had a stronger negative effect on patient-initiated self-care (diet, exercise, medication adherence) than on physician-initiated preventive behaviors (eye and foot examinations).³³ Our findings are similar to those of the Study of Women's Health Across the Nation (SWAN) study where depressive symptoms were associated with screening for breast but not cervical cancer.⁹

The study confirmed some previously reported factors associated with lower cancer screening (e.g., race and education).^{7,34–36} As with the findings regarding cervical cancer screening, other studies examining the association between cancer screening and obesity have found a stronger relationship between obesity and low cancer screening in white women (e.g.,^{37,38}).

In this study, body dissatisfaction was associated with receiving less cervical cancer screening, but did not appear to account for the association between obesity and cervical cancer screening. The single-item measure may not have been adequate to detect mediation effects.

A limitation of this study is that it is cross-sectional, so it is possible to hypothesize only regarding causal relationships. Differences may exist between respondents (62% of those eligible) and nonrespondents to the survey, biasing the results. Depression diagnosis was not confirmed by structured diagnostic interview, however well-validated and reliable depression questionnaires were used. Height and weight were self-reported; however, there is some evidence that self-reports of height and weight are accurate, even among depressed obese women.³⁹ All women in the target age group received breast cancer screening reminders through a centralized program, and high rates of mammography use are observed in GHC; thus, findings may not be comparable to other settings. No underweight women were included; Reidpath et al, 2002 found that underweight women in Australia were less likely to have Paps, clinical breast exams, and mammograms.⁴⁰ This study was not able to examine participation in colorectal cancer screening because organizational recommendations for screening changed during the study period.

Nevertheless, this study has several notable strengths. Paps, mammography, and primary care visits were assessed by automated records as opposed to self-report. Differences in cancer screening were examined in a healthcare system where screening reminders were sent to all women. Much has already been published about how obesity and depression singly affect the receipt of preventive services. This study examines how both obesity and depression affect receipt of two different recommended preventive services in a single—real-world population. Therefore, these results help to disentangle the complex relationships among obesity, depression, and different types of cancer screening. The results of previous studies in this area may have been confounded by differences in insurance, screening reminders, or access to primary care. By contrast, all of the women in this study are insured, have a primary care provider or “medical home,” and were reminded to receive both of the preventive services that were investigated in the current study.

Guidelines and reminder systems are not sufficient to achieve high screening participation levels. These findings, like those of Ferrante et al.³¹, suggest that depression and obesity are clues to health disparities in cancer screening. Proactive outreach and follow-up may be needed

for these high-risk groups. Future research testing healthcare system or community delivered targeted and tailored interventions for these high-risk groups is needed.

These findings also suggest the importance of raising awareness among medical personnel providing Paps that obese women are less likely to get these tests. Treating depression might have the added benefit of increasing screening participation. Doctors or others who treat depression may need to explicitly talk to their patients about seeking mammography screenings.

Acknowledgments

This project was supported by NIH Research Grant #MH68127 funded by the National Institute of Mental Health and the Office of Behavioral Social Sciences Research. An earlier version of this article was presented in a poster at the annual meeting of the Society of Behavioral Medicine, San Diego, California, March, 2008. The funder had no role in design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript. The authors thank Rebecca Hughes for editing help. No financial disclosures were reported by the authors of this paper.

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Table 1

Characteristics of study participants

	Type of cancer screening			
	Cervical cancer screening, women aged 40–65 years		Breast cancer screening, women aged 51–65 years	
	<i>n</i>	% received in 3- year Interval (weighted)	<i>n</i>	% received in 2-year Interval (weighted)
<i>n</i>	3097	83	2163	77
Age (years)				
40–44	477	91	—	—
45–49	628	84	—	—
50–54	767	79	701	75
55–59	751	82	866	76
60–65	474	81	596	81
		p=0.002		p=0.17
Race/Ethnicity				
White, non-Hispanic	2490	83	1758	79
African American, non-Hispanic	235	78	164	64
Hispanic	98	78	60	60
Asian	139	83	83	67
Other	135	85	98	79
		p=0.58		p=0.005
Marital status				
Currently married	1997	83	1341	80
Wid/Sep/Div	729	82	628	74
Never married	371	82	194	66
		p=0.77		p=0.02
Education				
<4yr college grad	1495	77	1095	73
4yr college grad	1600	87	1067	80
		p<0.0001		p=0.01
Currently smoke				
No	2811	84	1994	78
Yes	259	67	153	65
		p<0.0001		p=0.01
Body dissatisfaction				
No	1329	85	922	78
Yes	1738	79	1222	77
		p=0.001		p=0.74
Rx Risk score				
<800	1025	84	342	73

	Type of cancer screening			
	Cervical cancer screening, women aged 40–65 years		Breast cancer screening, women aged 51–65 years	
	<i>n</i>	% received in 3- year Interval (weighted)	<i>n</i>	% received in 2-year Interval (weighted)
800–<1600	945	84	825	79
1600+	1127	80	996	77
		p=0.27		p=0.29
BMI				
<30	919	86	611	79
30+	2178	77	1552	74
		p<0.0001		p=0.09
PHQ score				
<5	1807	84	1272	80
5–9	842	83	584	78
10–14	302	76	203	67
15+	146	75	104	54
		P=0.04		P=0.0003

Table 2

Proportion of women who received cancer screening and primary care visit by obesity and depression status

	No depressive symptoms		Depressive symptoms	
	(PHQ<10)		(PHQ≥10)	
	Not obese (BMI<30)	Obese (BMI≥30)	Not obese (BMI<30)	Obese (BMI≥30)
Pap (aged 40–65 years)				
Unweighted <i>n</i>	841	1808	78	370
% received in 3-year interval(weighted)	86.8	76.8	76.0	75.5
Primary care visits (%)				
0	2	3	7	1
1–5	46	31	42	16
6+	52	66	51	83
Screening mammography (aged 51–65 years)				
Unweighted <i>n</i>	554	1302	57	250
% received in 2-year interval(weighted)	80.4	76.4	61.5	64.5
Primary care visits (%)				
0	6	5	5	1
1–5	61	43	63	36
6+	34	52	32	63

Table 3

Logistic regression model results: Unadjusted and adjusted ORs for the association of depression and obesity with receipt of cancer screening

		Pap, women aged 41–65 years	Screening mammography, women aged 51–65 years
		OR (95% CI)	OR (95% CI)
Univariate model	Obese ** Depressed [†]	0.53 (0.41–0.69) 0.60 (0.42–0.87)	0.78 (0.58–1.04) 0.45 (0.30–0.67)
Bivariable model	Obese ** Depressed [†]	0.56 (0.42–0.73) 0.69 (0.47–1.02)	0.85 (0.63–1.14) 0.46 (0.31–0.70)
Multivariable model ^a	Obese ** Depressed [†]	0.67 (0.49–0.93) 0.79 (0.53–1.19)	0.88 (0.62–1.25) 0.49 (0.31–0.76)

^a Adjusted for age (40–49, 50–59, 60–65 years), race (non-Hispanic white, African-American or Hispanic, Other), marital status, education, current smoker, comorbidity (<800, 800–<1600, 1600+), and body dissatisfaction.

** Compared to nonobese;

[†] Compared to nondepressed