Screening for Cervical and Breast Cancer: Is Obesity an Unrecognized Barrier to Preventive Care?

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Background: Compared with thinner women, obese women have higher mortality rates for breast and cervical cancer. In addition, obesity leads to adverse social and psychological consequences. Whether obesity limits access to screening for breast and cervical cancer is unclear.

Objective: To examine the relation between obesity and screening with Papanicolaou (Pap) smears and mammography.

Design: Population-based survey.

Setting: United States.

Participants: 11 435 women who responded to the "Year 2000 Supplement" of the 1994 National Health Interview Survey.

Measurements: Screening with Pap smears and mammography was assessed by questionnaire.

Results: In women 18 to 75 years of age who had not previously undergone hysterectomy ($n = 8394$), fewer overweight women (78%) and obese women (78%) than normal-weight women (84%) had had Pap smears in the previous 3 years ($P < 0.001$). After adjustment for sociodemographic information, insurance and access to care, illness burden, and provider specialty, rate differences for screening with Pap smears were still seen among overweight (−3.5% [95% CI, −5.9% to −1.1%]) and obese women (−5.3% [CI, −8.0% to −2.6%]). In women 50 to 75 years of age ($n = 3502$), fewer overweight women (64%) and obese women (62%) than normal-weight women (68%) had had mammography in the previous 2 years ($P < 0.002$). After adjustment, rate differences were −2.8% (CI, −6.7% to 0.9%) for overweight women and −5.4% (CI, −10.8% to −0.1%) for obese women.

Conclusions: Overweight and obese women were less likely to be screened for cervical and breast cancer with Pap smears and mammography, even after adjustment for other known barriers to care. Because overweight and obese women have higher mortality rates for cervical and breast cancer, they should be targeted for increased screening.

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Obese women have higher mortality rates for breast and cervical cancer than do thinner women (1, 2). Obesity also has important social, economic, and psychological consequences, including societal discrimination and poor self-perception (3–8). Whether these consequences influence the quality of medical care received by obese patients is unclear.

Recent studies suggest that obese women receive preventive services, such as Papanicolaou (Pap) smears and clinical breast examinations, less often than normal-weight women (9, 10). Other studies suggest that physicians and other health care providers have negative attitudes toward and biases against obese patients, which may explain some of the disparities in care (11–14). Obese women also seem to have poorer self-esteem and body images than their thinner counterparts (5, 6). Poor self-concept may be influenced by ethnicity (6–8, 15). White women are more likely than black women of similar weight to perceive themselves as overweight (6), and this poor self-perception may influence attitudes toward screening with Pap smears and mammography.

Because obesity is associated with higher mortality rates for cardiovascular disease and cancer of the cervix, breast, and colon, barriers to preventive screening and counseling in obese patients can have dire medical and economic consequences (2, 16, 17). In particular, barriers to Pap smears and mammography may contribute to the more than 50 000 deaths attributed to cervical and breast cancer each year (18). We used data from a nationally representative sample to examine screening with Pap smears and mammography among overweight and obese women.

Methods

Data Source

The National Health Interview Survey is a continuing, in-person household survey of the civilian, noninstitutionalized U.S. population that is conducted by the Census Bureau for the National Cen-

See editorial comment on pp 732-734.

ter for Health Statistics (19). In 1994, the overall response rate was 94%. Approximately 116 000 persons (including children) from approximately 46 000 households responded to the core survey, which elicited information on sociodemographic factors, insurance coverage, basic health status, number of days spent hospitalized or home in bed, height, and weight. Respondents were also asked whether they had a usual place for health care, whether they had a usual provider, and what the provider's specialty was.

In addition, a supplemental survey ("Year 2000 Supplement") was administered to one randomly selected adult, 18 years of age or older, from 50% of the responding households ($n = 19\,738$). Respondents were queried about use of preventive health services, including Pap smears and mammography. Women were asked, "About how long has it been since your last Pap smear test?" and "How long ago has it been since you had a mammogram?" The response rate for the supplement was 88% (11 435 respondents).

Our use of the National Health Interview Survey database was approved by the Committee on Clinical Investigations at Beth Israel Deaconess Medical Center, Boston, Massachusetts.

Use of Papanicolaou Smears and Mammography

Women 18 to 75 years of age who had not had a hysterectomy were considered eligible for analysis of screening with Pap smears. According to generally accepted guidelines (18), women who reported having a Pap smear in the previous 3 years were classified as having been screened.

Women 50 to 75 years of age were considered eligible for analysis of breast cancer screening; those who reported having mammography in the previous 2 years were classified as having been screened (18). We limited our sample to women 50 to 75 years of age because mammography reduces mortality rates for breast cancer by 20% to 39% in this age group (20).

Factors of Interest

We defined our main variable of interest, body mass index (BMI), as body weight in kilograms divided by height in meters squared. We hypothesized that women with higher BMIs would be less likely to be screened. However, because we were not certain that a linear or dose–response effect existed, we used published definitions to classify women as underweight ($BMI < 18.5\ kg/m^2$), normal weight (BMI, 18.5 to $<25\ kg/m^2$), overweight (BMI, 25 to $<30\ kg/m^2$), or obese (class I [BMI, 30 to $<35\ kg/m^2$], class II [BMI, 35 to $<40\ kg/m^2$], or class III [$BMI \geq 40\ kg/m^2$]) (21). Women who were underweight made up approximately 3% of the sample and were included in all analyses; however, for reasons of simplicity, we did not report their results.

We considered several factors thought to be highly correlated with preventive care as potential confounders in our analyses (22, 23). These included such sociodemographic factors as age (continuous variable), ethnicity/race (white, black, Hispanic, other), marital status (married, never married, divorced or widowed), education (less than high school, high school graduate, some college, graduate of a 4-year college or more), annual income (<$15 000, $15 000 to <$20 000, $20 000 to <$25 000, $25 000 to 50 000, >$50 000), insurance type (managed care, fee-for-service, Medicare, Medicaid, other, uninsured), and region of the United States (Northeast, Midwest, South, West). We adjusted for illness burden by using available surrogate markers, such as self-reported health status (excellent, very good, good, fair, poor), number of days hospitalized in the previous year (0, 1 to 7, >7), number of days spent in bed (0, 1 to 7, 8 to 30, >30), and number of visits to a physician (0, 1 to 2, 3 to 4, >4). In addition, we accounted for the specialty of the usual provider and for having a usual place to receive medical care (general internist or family practitioner, gynecologist, other specialist, other provider, no usual provider but usual place for care, no usual place for care).

Statistical Analysis

Using Wald chi-square statistics, we performed bivariable analyses to separately characterize factors associated with use of Pap smears, use of mammography, and BMI. Two-tailed P values less than or equal to 0.05 were considered statistically significant. To examine the relation between BMI and Pap smears or mammography, we built a series of multivariable logistic regression models for each separate outcome. Normal-weight women served as the reference. First, we developed an unadjusted model that included only categories of BMI as the independent variable. We then developed a fully adjusted model that controlled for factors previously shown or believed to affect screening: sociodemographic variables (except income), insurance type, illness burden, and provider specialty (22, 23).

We performed several secondary analyses to examine the stability of our findings. First, because information on income was unavailable for more than 20% of respondents, we examined the confounding effect of income in a smaller group of women who had complete data. Second, to address the appropriateness of adjusting for variables that are potential intermediary factors and not true confounders of BMI, we developed a series of models by removing one factor at a time from the fully adjusted model and examined the confounding ef-

Table 1. Characteristics of Women 18 to 75 Years of Age without Hysterectomy Who Were Eligible for Analysis of Papanicolaou Smears

Characteristic*	Overall Sample (n =7857)†	Normal-Weight Women (n =4161)†‡	Overweight Women (n =1942)†§	Obese Women (n =1393)†‖
Rate of Papanicolaou smear screening, %	81	84	78	78
Demographic characteristics				
Portion of the weighted sample, %	100	54	24	17
Mean age ± SD, *y*	39 ± 18	37 ± 18	43 ± 18	42 ± 17
Ethnicity/race, %				
White	73	77	69	63
Black	12	8	16	23
Married, %	62	63	63	60
Education, %				
Less than high school	5	3	7	8
College graduate	21	25	18	11
Yearly income < $15 000, %	21	17	23	29
Illness burden, %				
Health status				
Very good/excellent	64	73	58	44
Fair/poor	10	6	11	20
≥1 hospitalization in the past year	5	5	6	7
>7 days spent in bed	12	10	12	17
>2 physician visits	42	39	44	50
Insurance type/access to care, %				
Uninsured	13	13	13	15
Managed care	26	28	24	23
Fee-for-service	28	31	25	22
Usual provider, %				
General internist/family practitioner	60	59	63	62
Gynecologist	7	8	6	4

* All characteristics except portion of the weighted sample and mean age differ significantly across categories of body mass index ($P \leq 0.05$).
† Numbers of participants may vary, depending on factor of interest.
‡ Body mass index, 18.5 to <25 kg/m.
§ Body mass index, 25 to <30 kg/m^2.
‖ Body mass index ≥ 30 kg/m^2.

fect of that factor on BMI. For example, obesity may pose a barrier to care because obese women are denied health insurance as a result of discrimination; therefore, adjusting for insurance in this case may inappropriately mask differences in use of preventive care according to BMI. Third, to explore the potential effect of recall bias, we performed an analysis that adjusted for time since the respondents' last general physical examination (when Pap smears and mammography were most likely to have been performed). Finally, to test the hypothesis that the effect of BMI on use of preventive care may differ according to ethnicity/race, we introduced interaction terms between ethnicity/race and BMI in a subset of black and white women.

All analyses used SAS-callable SUDAAN software, version 7.5 (Research Triangle Institute, Research Triangle Park, North Carolina), to obtain proper variance estimations that accounted for the complex sampling design (24). To reflect U.S. population estimates, results were weighted to adjust for nonresponse. We used Taylor series linearization to estimate standard errors (24, 25). For adjusted analyses, we converted the odds ratios into standardized risks or rates (weighted to the U.S. population) and subtracted the adjusted rates of normal-weight women from the rates of overweight and obese women to arrive at adjusted rate differences. Confidence intervals were computed by using the method of Flanders and Rhodes (26), adjusted for the complex design.

Results

Obesity and Papanicolaou Smears

Of the 8394 women who were eligible for Pap smear analysis, 7857 had complete data on height, weight, and performance of Pap smears. More than 50% of these women had normal BMIs (**Table 1**). Overweight women (BMI, 25 to <30 kg/m^2) and obese women (BMI ≥ 30 kg/m^2) reported significantly lower rates of screening with Pap smears in the previous 3 years than did normal-weight women (78% and 78% compared with 84%, respectively; $P < 0.001$). Heavier women were usually older, were less likely to be white or to have private health insurance, and had lower socioeconomic status. They reported a greater illness burden and were more likely to receive their usual health care from general internists and family practitioners than from gynecologists.

Table 2 shows the adjusted rates and rate differences for screening with Pap smears, according to BMI, for women who had complete data on all covariates (n = 7405). Adjusted results were similar to unadjusted rates. Overweight and obese women

Table 2. Adjusted Rates and Rate Differences for Papanicolaou Smear Screening according to Body Mass Index*

Model	Normal-Weight Women (n = 3936)†‡	Overweight Women (n = 1816)†§	Obese Women, Class I (n = 851)†‖	Obese Women, Class II (n = 288)†¶	Obese Women, Class III (n = 173)†**
Overall (n = 7405)					
Rate, %	83.3 (81.8 to 84.8)	79.7 (77.7 to 81.8)	77.2 (74.3 to 80.3)	79.0 (74.4 to 84.0)	79.6 (73.7 to 86.0)
Rate difference, %	0	−3.5 (−5.9 to −1.1)	−6.0 (−9.2 to −2.8)	−4.2 (−9.2 to 0.7)	−3.7 (−9.8 to 2.5)
Subanalysis (n = 6454)					
White women only					
Rate, %	83.1 (81.4 to 84.8)	79.7 (77.1 to 82.3)	73.7 (69.8 to 77.8)	74.8 (69.2 to 80.9)	74.3 (66.7 to 82.8)
Rate difference, %	0	−3.4 (−6.4 to −0.5)	−9.4 (−13.5 to −5.2)	−8.3 (−14.2 to −2.3)	−8.8 (−16.9 to −0.7)
Black women only					
Rate, %	90.6 (87.6 to 93.8)	88.2 (84.0 to 92.5)	90.4 (87.3 to 93.7)	90.1 (83.5 to 97.2)	92.3 (86.8 to 98.3)
Rate difference, %	0	−2.5 (−8.0 to 3.1)	−0.2 (−4.5 to 4.1)	−0.5 (−7.8 to 6.8)	1.7 (−5.0 to 8.4)

* All adjusted for age, ethnicity/race, marital status, education, region of the country, insurance type, number of visits to a physician, specialty of usual health provider, health status, number of days hospitalized, and number of days spent in bed. Numbers in parentheses are 95% CIs.
† Number refers to women included in the primary analysis only.
‡ Body mass index, 18.5 to <25 kg/m^2.
§ Body mass index, 25 to <30 kg/m^2.
‖ Body mass index, 30 to <35 kg/m^2.
¶ Body mass index, 35 to <40 kg/m^2.
** Body mass index ≥ 40 kg/m^2.

reported similar rates of screening. However, these rates were significantly lower than those among normal-weight women, even after we controlled for sociodemographic factors, health insurance and access to care, illness burden, and provider specialty. Compared with an 88.3% adjusted rate of screening in normal-weight women, the combined adjusted rate difference among all three classes of obese women was −5.3% (95% CI, −8.0% to −2.6%). The adjusted rates were 3.5% (CI, 1.1% to 5.9%) lower for overweight women and 5.3% (CI, 2.6% to 8.0%) lower for obese women. Our results did not change substantially when we removed individual confounders or mediators from the fully adjusted model or when we adjusted for income and time since the respondents' last general physical examination.

Table 2 also shows the relation between BMI and Pap smears in white and black women after adjustment. Overall, black women reported an adjusted Pap smear rate that was 9.5% (CI, 7.0% to 12.1%) higher than that of white women. In our multivariable model with interaction terms for ethnicity/race and BMI, we found a particularly strong association between BMI and Pap smears in white women. Although the adjusted rate among normal-weight white women was 83.1%, the rates among overweight and obese women were significantly lower, ranging from 73.7% to 79.7%. In addition, among white women, a dose–response relation seemed to exist between BMI and Pap smears; however, this effect was not demonstrated among women overall. Among black women, the adjusted rate was 90.6% for those of normal weight, but BMI was not a significant correlate of Pap smear screening in any weight category. Nevertheless, the interaction between ethnicity/race and BMI was not statistically significant.

Obesity and Mammography

Of the 3397 women eligible for analysis of mammography who had complete height, weight, and mammography data, more than 50% of the weighted sample was considered overweight or obese (**Table 3**). Overall, the unadjusted rate of mammography use in the preceding 2 years was 65%. Overweight and obese women were less likely than normal-weight women to report previous mammography (64% and 62% compared with 68%, respectively; $P < 0.002$). Heavier women were also significantly less likely to be white, married, and highly educated and to have higher income and private insurance. Furthermore, overweight and obese women reported a greater illness burden and visited their physicians more frequently.

Among eligible women with complete data on all covariates, the adjusted rates and rate differences for screening mammography were lower in overweight and obese women than in normal-weight women (**Table 4**). However, these differences did not reach statistical significance for any individual weight category. Overall, obese women were significantly less likely to have mammography (adjusted rate difference, −5.4% [CI, −10.8% to −0.1%]). Our results were consistent when we removed confounders individually from the model and when we adjusted for income and time since the respondents' last general physical examination.

Table 4 also shows the adjusted rates and rate differences according to BMI for our subanalysis of white and black women. Black women overall were as likely to have mammography as white women; the adjusted rate difference for mammography among black women was 5.2% (CI, 3.2% to 10.8%). In our multivariable model with interaction terms for ethnicity/race and BMI, above-normal BMI seemed to be associated with less frequent mam-

mography use in white women; however, the CIs included 1.0 (**Table 4**). In black women, the association was less consistent. As in the Pap smear analysis, the relation between ethnicity/race and BMI was not statistically significant.

Generalizability

We excluded 989 of 8394 eligible women (12%) from our primary multivariable analyses of Pap smears because information was missing for one or more covariates. However, excluded women and study women reported similar rates of screening (79% compared with 81%).

For adjusted analyses of mammography, we excluded 425 of 3502 eligible women (12%) because of missing information. Excluded women had lower rates of mammography than women included for analysis (58% compared with 65%). They were also less likely to be white (74% compared with 82%), were more likely to be in poor health (8% compared with 6%), and were hospitalized more often (13% compared with 10%). Excluded women were less likely to be privately insured (36% compared with 40%) and were less likely to see gynecologists (1% compared with 3%) but were similar in other respects (age, BMI, education, income, marital status, provider specialty, days spent in bed, and visits to the physician in the preceding year).

Discussion

We found that overweight and obese women were less likely to report age-appropriate screening for cervical and breast cancer with Pap smears and mammography. These findings persisted even after we controlled for sociodemographic factors, access to health care, provider specialty, and illness burden. Mammography rates decreased as BMI increased, although borderline statistical significance was reached only for the differences between women whose BMIs were at least 30 kg/m^2 and those whose BMIs were normal. For Pap smears, adjusted rates decreased significantly among women whose BMIs were greater than 25 kg/m^2; however, rates were similar for all categories of overweight and obese women. For Pap smears and mammography, the rate differences according to BMI seemed stronger among white women than black women.

Previous studies examining obesity and use of preventive care have reported conflicting results. At one academic practice, Lubitz and colleagues (27) found no BMI-related differences in performance of Pap smears. In that study, however, the overall rate of screening with Pap smears was only 20%, substantially lower than national rates (28). More recently, Fontaine and colleagues (9) found that obese women in an earlier national sample were more

Table 3. Characteristics of Women 50 to 75 Years of Age Who Were Eligible for Analysis of Mammography

Characteristic*	Overall Sample (n = 3397)†	Normal-Weight Women (n = 1418)†‡	Overweight Women (n = 1124)†§	Obese Women (n = 778)†‖
Rate of mammography use, %	65	68	64	62
Demographic characteristics				
Portion of the weighted sample, %	100	43	32	22
Mean age ± SD, *y*	62 ± 8	61 ± 8	62 ± 8	61 ± 9
Ethnicity/race, %				
White	81	86	78	74
Black	10	5	11	19
Married, %	63	66	61	59
Education, %				
Less than high school	12	8	13	15
College graduate	14	18	13	8
Yearly income < $15 000, %	24	21	26	30
Illness burden, %				
Health status				
Very good/excellent	47	57	45	32
Fair/poor	21	15	20	34
≥1 hospitalization in the past year	10	9	10	15
≥7 days spent in bed‖	14	12	13	19
≥2 physician visits	51	46	50	62
Insurance type/access to care, %				
Uninsured	6	4	8	7
Managed care	16	18	15	15
Fee-for-service	24	27	23	20
Usual provider, %				
General internist/family practitioner	73	72	73	75
Gynecologist	3	4	2	1

* All characteristics except portion of the weighted sample and mean age differ significantly across categories of body mass index ($P \leq 0.05$).
† Numbers of participants may vary, depending on factor of interest.
‡ Body mass index, 18.5 to <25 kg/m^2.
§ Body mass index, 25 to <30 kg/m^2.
‖ Body mass index ≥ 30 kg/m^2.

Table 4. Adjusted Rates and Rate Differences for Use of Mammography according to Body Mass Index*

Model	Normal-Weight Women (n = 1296)†‡	Overweight Women (n = 1017)†§	Obese Women, Class I (n = 477)†‖	Obese Women, Class II (n = 144)†¶	Obese Women, Class III (n = 76)†**
Overall (n = 3077)					
Rate, %	67.8 (65.0 to 70.8)	65.0 (62.3 to 67.7)	62.5 (57.8 to 67.6)	63.3 (56.5 to 70.9)	59.1 (46.8 to 74.5)
Rate difference, %	0	−2.8 (−6.7 to 0.9)	−5.3 (−11.1 to 0.5)	−4.5 (−12.5 to 3.4)	−8.8 (−22.9 to 5.3)
Subanalysis (n = 2858)					
White women only					
Rate, %	67.3 (64.2 to 70.5)	65.9 (63.1 to 68.9)	62.9 (58.0 to 68.2)	58.2 (50.0 to 67.7)	56.4 (42.1 to 75.6)
Rate difference, %	0	−1.4 (−5.6 to 2.9)	−4.4 (−10.5 to 1.6)	−9.2 (−18.7 to 0.4)	−10.9 (−28.0 to 6.2)
Black women only					
Rate, %	74.0 (66.0 to 83.0)	65.6 (58.2 to 74.0)	67.1 (56.8 to 79.1)	84.6 (72.7 to 98.5)	73.1 (53.7 to 99.4)
Rate difference, %	0	−8.4 (−19.0 to 2.2)	−7.0 (−20.4 to 6.5)	10.6 (−5.1 to 26.3)	−0.9 (−24.8 to 22.9)

* All analyses adjusted for age, ethnicity/race, marital status, education, region of the country, insurance type, number of visits to a physician, specialty of usual health provider, health status, number of days hospitalized, and number of days spent in bed. Numbers in parentheses are 95% CIs.
† Number refers to women included in the primary analysis only.
‡ Body mass index, 18.5 to <25 kg/m^2.
§ Body mass index, 25 to <30 kg/m^2.
‖ Body mass index, 30 to <35 kg/m^2.
¶ Body mass index, 35 to <40 kg/m^2.
** Body mass index ≥ 40 kg/m^2.

likely to delay Pap smears, but not mammography. Their analysis of mammography, however, differed from ours in several important ways. The authors classified women who had not had mammography in 3 years as having delayed screening, whereas we chose a screening interval of 2 years to be consistent with current guidelines (18). In addition, their analyses were not adjusted for use of health care services, provider specialty, or illness burden and included women younger than 40 years of age and women older than 75 years of age, for whom mammography is not routinely recommended.

Our finding of lower rates of preventive care in overweight and obese women is of particular concern given the increasing national prevalence of obesity and its strong association with death from breast and cervical cancer (2, 16, 17). Barriers to early diagnosis in this high-risk population can adversely affect health outcomes. We estimate that during a 3-year screening interval, a national reduction in cervical cancer screening of 3.5% in overweight women and 3.7% to 6.0% in obese women could result in missed or delayed diagnoses for 1219 women with invasive cervical cancer (data available from the authors) (18). Similarly, among overweight and obese women 50 to 75 years of age, national differences in adjusted mammography rates of 2.8% and 4.5% to 8.8%, respectively, could result in more than 3027 additional deaths from breast cancer by 80 years of age (data available from the authors) (29).

Previous research shows that advanced breast cancer is diagnosed more frequently in obese women than in thinner women (30–33). Although clinical breast examinations may be less sensitive for detecting breast cancer in obese women than in thinner women, mammography seems to be equally sensitive in both groups. One study found that in cases of breast cancer diagnosed by screening mammography, BMI was not associated with breast cancer stage (33). We speculate that the decreased frequency of mammography in obese women suggested by our study may contribute to the later stage at which obese women present with breast cancer, as observed by others (30–33).

Although we demonstrated an inverse relation between body weight and preventive care in U.S. women, we can only speculate on the reasons for this observation. We found that obesity was highly correlated with known barriers to care, such as less education, lower income, lack of health insurance, and greater illness burden (22, 23). Among overweight and obese women, however, our results document lower rates of preventive care use that are independent of these factors, although some of the observed differences may be caused by residual confounding.

Patient factors may also explain the BMI-related disparities in screening rates. Lower weight may reflect a healthier lifestyle or health-seeking behaviors; similarly, our findings may reflect a difference in patient preferences. Competing medical priorities may lead patients to neglect screening recommendations. Because of their body habitus or associated diseases, obese women may also experience more discomfort during Pap smears and mammography and may therefore be reluctant to undergo these procedures. The question of whether knowledge and beliefs about cancer and screening also differ according to BMI has not been studied. Our finding that the relation between BMI and cancer screening may differ by ethnicity/race further supports the importance of patient factors and preferences.

Physician behavior may also contribute to lower screening rates in overweight and obese women. Given time constraints, limited reimbursement, and competing medical priorities, physicians may be less attentive to the preventive care needs of heavier

patients. This may be especially true for procedures that might be more technically difficult to perform in obese patients, such as Pap smears. In one Connecticut study, a minority of providers admitted that they were less likely to pursue pelvic examinations in obese patients (10). In that same survey, heavier women reported being more reluctant than thinner women to undergo pelvic examinations, and physicians reported that they were less likely to pursue pelvic examinations if their patients were reluctant (10).

Our findings were based on a nationally representative sample and are directly generalizable to U.S. women. This generalizability is limited by our exclusion of women with missing information, who seemed to be sicker and had lower socioeconomic status. Our analyses were also limited in other ways. First, information for the National Health Interview Survey was self-reported and may have been subject to reporting errors. For example, some women may have mistaken previous pelvic examinations for Pap smears, accounting for the higher than expected screening rates. However, it is unlikely that this misclassification differed across categories of BMI. Patients may have also been subject to recall bias. Overweight respondents may have underestimated their weight and overestimated their height to a larger degree than thinner respondents (34). These reporting biases would have decreased our ability to detect any differences across categories of BMI; therefore, our findings probably underestimate actual differences. Second, we were unable to control adequately for comorbid illnesses, which are highly correlated with BMI (16, 17). However, adjusting for markers of illness did not diminish our findings. Third, we were unable to account for some cancer risk factors. Consequently, we chose minimum screening recommendations so that risk factors would be less likely to influence our outcomes. Finally, although we controlled for provider specialty, we were not able to control for other provider-related factors, such as physician sex, that may be associated with increased preventive care (35).

In summary, our results demonstrate that overweight and obese women are less likely to undergo screening for cervical and breast cancer with Pap smears and mammography. These findings raise concern that obesity may be an unrecognized barrier to preventive care. Further studies are necessary to determine whether this phenomenon occurs with other medical services or whether it is restricted to women or to certain ethnic groups. Because overweight and obese women are at increased risk for death from breast and cervical cancer, they should be targeted for increased screening.

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