

Socioeconomic Disparities Across Ethnicities: An Application to Cervical Cancer Screening

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In the United States, age-standardized mortality rates for cervical cancer fell from 5.6 deaths per 100,000 women in 1975 to 2.3 per 100,000 in 2010.¹ Preventive screening was instrumental in this reduction in mortality. The differences in mortality rates across socioeconomic groups^{2,3} and racial/ethnic groups^{4,5} have also been linked to differences in screening utilization across these groups. Age-standardized cervical cancer mortality rates among non-Hispanic black (termed “black”) and Hispanic women were 4.2 per 100,000 individuals and 2.9 per 100,000 individuals, respectively, compared with 2.2 per 100,000 individuals among non-Hispanic white (termed “white”) women.¹ Although disparities across ethnic groups in cervical cancer treatment may explain some of the differences in mortality,⁶ lower screening rates among nonwhite women in the past may also explain these mortality differences.

Examining screening disparities between groups can aid in understanding the nature of barriers to screening and in developing appropriate policy responses. Although evidence shows that cervical screening utilization differs between both ethnic and socioeconomic groups in the United States,⁷⁻¹⁰ there is a dearth of research examining how socioeconomic disparities may differ across ethnicities, with limited research on socioeconomic status on its own. There is evidence that higher income and private health insurance are predictors of screening for white and Hispanic women, but these play a small (insignificant) role for black women.⁷ Income and education disparities have also been shown to be greater among white women relative to other groups.¹¹

More detailed analyses of these relationships have not been pursued in these studies, in part, perhaps, because of limitations in the data used with respect to a fuller range of sociodemographic variables. Similarly, no attempt has been made to quantify or compare socioeconomic disparities between groups to inform discussions on relationships. If differences in socioeconomic disparities exist between ethnicities,

ABSTRACT

Objectives: Our aim is to investigate socioeconomic disparities in cervical cancer screening utilization among and between ethnic groups in the United States.

Study Design: Observational study.

Methods: Data on 26,338 women aged 21 to 64 years were obtained from the 2007 to 2011 years of the Medical Expenditure Panel Survey. Data on cervical cancer screening utilization in the preceding 12 months and 3 years, and a range of sociodemographic characteristics were included. Analyses were undertaken for all women and across racial/ethnic grouping (ie, white, black, Hispanic, and other). Concentration indices were used to measure the socioeconomic gradient across ethnic groups. Probit regression analyses were used to examine variations in utilization related to socioeconomic factors across ethnic groups controlling for a range of pertinent characteristics.

Results: Annual utilization rates are high in the United States (60.15%) and greatest among black women (66.25%). Disparities, as measured by concentration indices (CIs), are large in the United States, with the largest being for white women (CI, 0.179) relative to black (CI, 0.103) and Hispanic (CI, 0.081) women. Screening differences across income, education and insurance status are also greater amongst white women.

Conclusions: Uptake of cervical cancer screening is common in the United States, with large socioeconomic disparities also evident. Those from lower socioeconomic or uninsured groups who are most likely to have, and to die from, cervical cancer, are least likely to use preventive screening. Disparities differ across ethnic groups and are greatest amongst white women. Incorporating organized screening may serve to improve both the systems efficiency and address disparities between and within groups.

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Take-Away Points

Annual utilization of cervical cancer screening is high in the United States, but significant socioeconomic disparities are especially evident among white women.

- Factors underlying utilization differ between whites and other ethnicities.
- Those least well-served by current arrangements appear to be poor white women.
- Expanding access may be neither efficient nor serve to address the relative disadvantage experienced by poorer whites.
- An organized national screening program may better serve to address both efficiency and equity issues.

this would add to our understanding and prompt more effectively tailored policy instruments. In this paper, we augment an analysis using regression techniques with an examination of the socioeconomic gradient in cervical cancer screening. We separately examined concentration indices (CIs) to shed further light on the issue of disparities; whereas CIs measure disparities across income, complementary probit regressions measure disparities controlling for a range of other pertinent variables.

METHODS

Data Sources and Participants

Data from the 2007 to 2011 years of the Medical Expenditure Panel Survey (MEPS) were used in the analysis. MEPS is a nationally representative survey of respondents' health, healthcare usage, and range of sociodemographic characteristics. The years 2007 to 2011 were chosen in order to increase the number of observations available. Years prior to 2007 were not included as they do not incorporate the same explanatory variable relating to total household income, and 2011 corresponds to the most recent year available. In the MEPS survey design, individuals are included in 2 consecutive waves of the survey. To prevent double counting in our pooled sample, only individuals in their second wave were included.

Main Dependent Variables

Within MEPS, women are asked if they screened for cervical cancer: 1) in the past year, 2) within the past 2 years, 3) within the past 3 years, 4) within the past 5 years, 5) more than 5 years ago, or 6) never screened. Using this variable, screening in the preceding 12 months and 3 years were analyzed among women aged 21 to 64 years, producing 27,238 observations. There were 12,282 women categorized as white; 5451 as black; 7248 as Hispanic; and 2257 as other ethnicities (including Asian and Native American, native Hawaiian/Pacific Islander, and multiple races). This age group is recommended for screening by the American Cancer Society (ACS) and the US Pre-

ventive Services Task Force (USPSTF).^{12,13} Survey weights based on the probability of being sampled in the survey were used to facilitate the robust extrapolation of results to the overall population. We examined utilization at 12 months and 3 years to ascertain the stability of observed relationships at different intervals. Furthermore, although the USPSTF and ACS recommend screening using Pap tests every 3 years for women aged 21 to 64 years, annual screening is common in the United States.¹⁴ Under the Affordable Care Act (ACA), 26 states mandate annual screening for privately insured women.¹⁵

Concentration Indices

Socioeconomic disparities were calculated using CIs, which allowed us to measure the extent to which screening utilization in different income groups reflects their proportionate representation in the population. CIs are one of the foremost methods for calculating and comparing socioeconomic disparities,¹⁶ including for cervical cancer screening^{17,18} and other forms of screening.¹⁹ As CIs present a summary statistic of disparity, they should, however, be handled with some care as the population level at which the statistic is calculated may serve to conceal material differences in disparities at the subgroup level. Nevertheless, the CI in its own right allows for disparities to be easily conveyed to policy makers and also allows for disparities to be compared across population groups.

A continuous measure of socioeconomic status enables the most precise calculation of CIs.²⁰ The total household income variable (FAMINC) in MEPS provides the measure of socioeconomic status in our analysis. Using this variable offers greater comparability among women in paid employment and those who are homemakers, for instance. Income is further equalized to allow for more meaningful comparisons between women with different sized households where disposable income might vary. (In our sample, the family sizes for white, black, Hispanic, and other is 2.76, 2.98, 3.91, and 3.33 members per household, respectively.) The OECD equivalence scale (square root of the number of people in the household) was chosen, and it is this equalized income variable that is thus used to rank women from the poorest to the richest in the sample.

The CI calculates a disparity estimate between -1 (screening disproportionately higher among poor) and $+1$ (screening disproportionately higher among rich), with 0 representing an equal distribution of screening across the ranking variable. The CI can be expressed as twice the

covariance between screening (y) and income (R) divided by the mean of screening (μ):

$$\frac{CI = 2cov(yR)}{\mu}$$

For binary variables (whether a woman was screened in the preceding 12 months or 3 years) the CI above is no longer bounded between -1 and $+1$. Therefore, it is further divided by 1 minus μ to allow for the inequality to be measured between -1 and $+1$. This is known as the Wagstaff correction.²¹ The CI used in our analysis is thus expressed as:

$$\frac{CI = (2cov(yR)/\mu)}{(1-\mu)}$$

Our analyses were undertaken in Stata version 13.0 (StataCorp LP, College Station, Texas) with the CIs computed using applicable Stata code from O'Donnell et al.²²

Regression Analyses

Probit regression analyses were also undertaken, allowing for adjusted socioeconomic disparities to be calculated, controlling for other potential confounders, and allowing for the measurement of differences across education, marital status, and health insurance status. Results are presented as marginal effects with standard errors clustered at the region level. Although odds ratios allow for greater ease of interpretation, they cannot accurately be compared across groups within a model^{23,24}; therefore, marginal effects are calculated in this study. The explanatory variables included were educational attainment (college degree or higher, high school degree, and less than high school); marital status (married/cohabiting or not), age (5-year age groups), geographic regions (northeast, midwest, south, and west), and ethnicity (white, black, Hispanic, and other); and whether the woman had a usual source of care. Although the insurance plan of the woman was available, for ease of comparison, the health insurance status is included as any private insurance, only public insurance, and uninsured. Additionally, while continuous equivalized household income is used to calculate the CIs, to allow for ease of interpretation of income, it is partitioned into quintiles in the regression.

RESULTS

Table 1 presents the descriptive statistics for the study sample. Whites constitute 45.43% of the sample, 19.92% are black, 26.47% are Hispanic, and 8.18% are other. Ad-

Table 1. Descriptive Statistics

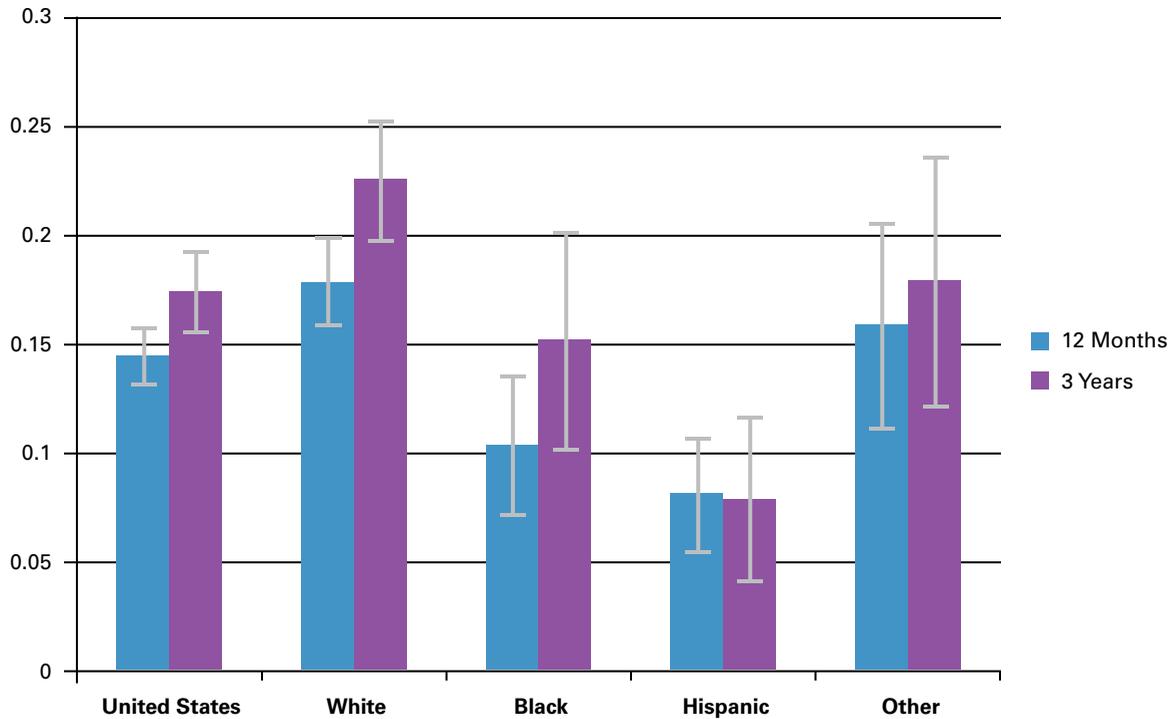
	Mean	Observations
Overall	100%	26,338
Ethnicity		
White	45.43%	11,965
Black	19.92%	5247
Hispanic	26.47%	6972
Other	8.18%	2154
Income quintile		
Income 1 (lowest)	22.50%	5926
Income 2	19.81%	5218
Income 3	19.39%	5106
Income 4	19.52%	5141
Income 5 (highest)	18.78%	4947
Education		
College degree or higher	33.24%	8755
High school degree	44.88%	11,820
Less than high school	21.88%	5763
Marital status		
Married/cohabitating	53.82%	14,174
Unmarried	46.18%	12,164
Insurance status		
Private insurance	61.54%	16,208
Public insurance	17.58%	4629
Uninsured	20.89%	5501
Usual source of care		
Yes	75.62%	20,406
No	24.38%	6580
Age group, years		
21-24	8.50%	2239
25-29	11.60%	3054
30-34	12.03%	3169
35-39	12.00%	3161
40-44	12.11%	3189
45-49	12.39%	3263
50-54	11.90%	3133
55-59	10.73%	2826
60-65	8.75%	2304
Region		
Northeast	15.13%	3984
Midwest	20.05%	5280
South	38.69%	10,189
West	26.14%	6885

ditionally, 33.24% had at least a college degree, 53.82% were married or cohabiting, 61.54% had private health insurance, and 20.89% were uninsured. There were 75.62% women with a usual source of care.

Table 2. Percentage Utilization of Cervical Cancer Screening in the United States (partitioned by ethnicity) in the Preceding 12 Months

Observations	12 Months					3 Years				
	United States (N = 26,338)	White (N = 11,965)	Black (N = 5247)	Hispanic (N = 6972)	Other (N = 2154)	United States (N = 26,338)	White (N = 11,965)	Black (N = 5247)	Hispanic (N = 6972)	Other (N = 2154)
Overall	60.15%	60.22%	66.25%	58.36%	52.20%	85.88%	85.53%	90.14%	86.68%	79.81%
Income quintiles										
Income 1 (lowest)	53.17	49.30	61.50	54.78	46.26	81.38	76.92	88.09	85.02	77.05
Income 2	51.51	47.92	62.62	55.65	39.43	80.44	78.07	87.08	84.58	69.16
Income 3	57.69	56.35	68.41	57.95	48.87	84.62	83.18	92.17	86.40	79.28
Income 4	63.11	63.53	69.20	58.26	55.53	88.05	88.25	91.51	88.55	79.82
Income 5 (highest)	68.22	68.46	73.54	70.97	59.65	90.53	90.62	93.73	92.16	85.86
Education										
College degree or higher	66.96	67.58	72.41	63.66	58.60	90.70	90.99	93.94	90.57	84.71
High school degree	57.00	55.78	65.02	58.89	45.67	83.48	82.44	89.04	86.03	74.82
No high school degree	49.18	42.22	57.96	54.32	43.44	78.65	71.07	86.17	84.95	73.08
Marital status										
Married/cohabitating	62.23	62.35	68.89	61.46	56.09	88.27	87.55	93.26	90.97	85.03
Unmarried	57.34	56.77	64.96	54.25	46.14	82.66	82.26	88.61	80.99	71.64
Insurance status										
Private insurance	64.84	64.86	71.60	64.22	55.65	89.19	89.00	93.15	90.85	82.94
Public insurance	57.36	50.71	68.09	61.49	52.59	83.20	76.97	90.03	89.14	83.05
Uninsured	39.40	33.59	43.81	47.78	32.32	71.83	66.70	79.13	79.01	59.09
Usual source of care										
Yes	63.39	62.73	68.87	64.96	57.11	88.00	87.19	91.65	91.01	83.97
No	47.64	48.17	57.01	44.64	37.29	77.70	77.56	84.83	77.67	67.16
Age group, years										
21-24	60.82	64.37	70.71	49.70	40.37	83.41	87.82	87.53	74.66	60.58
25-29	67.74	69.70	73.52	61.10	57.35	91.56	93.21	94.33	88.31	80.98
30-34	67.04	67.66	72.98	64.34	59.33	93.40	92.86	96.57	94.18	90.35
35-39	63.09	64.26	69.85	59.02	53.36	90.17	90.17	93.43	90.20	85.18
40-44	61.91	60.51	72.89	62.46	53.72	88.23	88.02	94.13	87.90	80.41
45-49	58.07	57.55	64.58	57.08	53.53	84.56	93.28	90.34	87.05	86.40
50-54	55.96	55.41	58.98	57.77	53.13	82.33	82.10	86.57	83.24	74.79
55-59	54.69	55.19	55.57	54.77	46.48	79.87	78.57	83.11	85.73	80.43
60-65	51.20	51.86	51.45	48.92	44.30	77.53	77.58	80.35	79.34	68.36
Region										
Northeast	64.33	64.26	69.79	64.29	57.12	88.68	88.26	91.85	89.39	86.79
Midwest	60.01	59.55	66.85	61.57	51.59	85.09	84.39	91.91	88.68	78.57
South	59.98	60.50	65.82	53.00	50.18	85.51	85.29	89.35	84.22	76.33
West	57.31	56.79	61.36	60.52	51.28	85.05	84.87	88.75	87.56	79.03

Figure. Concentration Indices for Cervical Cancer Screening in Previous 12 Months and 3 Years (95% CI)



Determinants of Cervical Cancer Screening Utilization

Table 2 presents utilization rates for cervical cancer screening in the preceding 12 months and 3 years, with results partitioned across ethnicities. In the 12-month period, utilization in the United States was 60.15%; black women had higher utilization (66.25%) than whites (60.22%) and Hispanics (58.36%). Utilization was higher among those in the highest income quintile compared with those in the poorest income quintile (68.22% vs 53.17%). Although an income gradient exists for each group, the differential between the richest and poorest women was larger for whites (68.46% vs 49.30%) than for blacks (73.54% vs 61.50%) and Hispanics (70.97% vs 54.78%). Disparities are also greater for white women across education and insurance status. Lower-educated blacks (57.96%) and Hispanics (54.32%) had greater 12-month utilization than similar whites (42.22%). Blacks with private health insurance (71.60%) had higher utilization than whites (64.86%) and Hispanics (64.22%) with private health insurance. Uninsured white women had far lower utilization (33.59%) than uninsured black (43.81%) and Hispanic (47.78%) women. Screening across regions also differed across ethnicities, although utilization for each ethnic group is greatest in the northeast.

Overall utilization in the preceding 3 years in the United States is 85.88%. Utilization is greater for black (90.14%) women than for Hispanic (86.68%) and white (85.53%) women. Although white, black, and Hispanic women in the richest group have similar utilization, the poorest black (88.09%) and Hispanic (85.02%) women have higher utilization than the poorest white (76.92%) women. Once more, lower-educated black (86.17%) and Hispanic (84.95%) women and uninsured black (79.13%) and Hispanic (79.01%) women have greater utilization than similar white women (71.07% had no high school degree; 66.70% were uninsured). Marital status for Hispanic and other ethnic women increases utilization by 9.98 and 13.39 percentage points, respectively, though marital status is not as important for black and white women.

The **Figure** presents CIs for screening in the preceding 12 months and 3 years partitioned by ethnic group. Across all ethnic groups, pro-rich patterns (eg, screening being disproportionately higher among the rich) exist. In the United States, CI, 0.144 ($P < .01$) and CI, 0.174; $P < .01$) are observed at 12 months and 3 years, respectively. There are marked differences across ethnic groups; the largest disparities are observed among white women for the 12-month (CI, 0.179; $P < .01$) and 3-year (CI, 0.224; P

Table 3. Marginal Effects Following a Probit Regression Cervical Cancer Screening Utilization in the Preceding 12 Months and 3 Years in the United States

	12 Months					3 Years				
	United States	White	Black	Hispanic	Other	United States	White	Black	Hispanic	Other
Income quintiles										
Income 1 (lowest)	-0.081*** (0.027)	-0.091*** (0.029)	-0.051*** (0.019)	-0.078* (0.045)	-0.046 (0.042)	-0.028 (0.018)	-0.049** (0.020)	0.003 (0.013)	0.002 (0.021)	-0.001 (0.039)
Income 2	-0.112*** (0.025)	-0.135*** (0.028)	-0.051*** (0.015)	-0.082** (0.037)	-0.134*** (0.035)	-0.052*** (0.016)	-0.064*** (0.021)	-0.018 (0.017)	-0.017 (0.013)	-0.076*** (0.021)
Income 3	-0.089*** (0.022)	-0.097*** (0.022)	-0.037 (0.049)	-0.092*** (0.032)	-0.056* (0.029)	-0.045*** (0.018)	-0.057*** (0.018)	0.005 (0.009)	-0.022 (0.018)	-0.015 (0.030)
Income 4	-0.054*** (0.017)	-0.048*** (0.017)	-0.045* (0.027)	-0.105*** (0.025)	-0.026 (0.042)	-0.025** (0.011)	-0.022 (0.016)	-0.017 (0.017)	-0.025*** (0.007)	-0.048* (0.029)
Income 5 (highest)	Base									
Education										
College degree or higher	Base									
High school degree	-0.064*** (0.013)	-0.072*** (0.019)	-0.044*** (0.012)	-0.002 (0.026)	-0.077** (0.034)	-0.047*** (0.008)	-0.054*** (0.011)	-0.028** (0.011)	-0.012 (0.023)	-0.036 (0.029)
No high school degree	-0.098*** (0.020)	-0.151*** (0.029)	-0.083*** (0.028)	-0.029* (0.016)	-0.122 (0.081)	-0.074*** (0.013)	-0.117*** (0.013)	-0.040*** (0.009)	-0.019 (0.017)	-0.102 (0.071)
Marital status										
Married or cohabitating	0.031*** (0.005)	0.020 (0.013)	0.023* (0.013)	0.058** (0.027)	0.060* (0.033)	0.042*** (0.009)	0.028*** (0.005)	0.034*** (0.009)	0.079*** (0.014)	0.092*** (0.031)
Unmarried	Base									
Insurance status										
Private insurance	Base									
Public insurance	-0.030** (0.009)	-0.055*** (0.018)	-0.004 (0.031)	-0.002 (0.018)	0.078** (0.030)	-0.034*** (0.007)	-0.056*** (0.013)	-0.020 (0.013)	-0.002 (0.019)	0.062** (0.023)
Uninsured	-0.192*** (0.018)	-0.237*** (0.021)	-0.228*** (0.006)	-0.089*** (0.020)	-0.112*** (0.039)	-0.125*** (0.007)	-0.147*** (0.005)	-0.100*** (0.006)	-0.075*** (0.016)	-0.129*** (0.034)
Usual source of care										
Yes	0.138*** (0.010)	0.130*** (0.014)	0.114*** (0.008)	0.169*** (0.016)	0.185*** (0.028)	0.085*** (0.013)	0.081*** (0.017)	0.059*** (0.011)	0.097*** (0.011)	0.127*** (0.004)
No	Base									

(continued)

<.01) periods. However, significant disparities also exist for blacks at 12 months (CI, 0.103; $P < .01$) and 3 years (CI, 0.151; $P < .01$), Hispanics at 12 months (CI, 0.081; $P < .01$) and 3 years (CI, 0.079; $P < .01$), and other at 12 months (CI, 0.159; $P < .01$) and 3 years (CI, 0.178; $P < .01$).

Table 3 illustrates the marginal effects following a probit regression of cervical cancer screening in the United States. Utilization for black and Hispanic women is 10.6 and 7 percentage points higher compared with white

women, controlling for other variables, and is lower for the other ethnicity group (marginal effects [ME], -0.083; $P < .01$). Income disparities are greatest for whites, thereby confirming that the results of the CIs and women with lowest income have an ME of -0.091; $P < .01$) compared with the richest white women. In the United States, compared with those with a degree, lower screening utilization is seen for the lowest education group (ME, -0.098; $P < .01$) with differences greatest for white women (ME, -0.1519; P

Table 3. Marginal Effects Following a Probit Regression Cervical Cancer Screening Utilization in the Preceding 12 Months in the United States (*continued*)

	12 Months					3 Years				
	United States	White	Black	Hispanic	Other	United States	White	Black	Hispanic	Other
Age group, years										
21-24	Base									
25-29	0.039** (0.015)	0.015 (0.010)	0.001 (0.040)	0.103*** (0.022)	0.137** (0.056)	0.066*** (0.007)	0.038* (0.020)	0.040** (0.014)	0.073*** (0.005)	0.112*** (0.018)
30-34	0.004 (0.032)	-0.040 (0.031)	-0.026 (0.047)	0.118*** (0.008)	0.089** (0.036)	0.078*** (0.006)	0.020 (0.020)	0.058*** (0.004)	0.104*** (0.004)	0.144*** (0.018)
35-39	-0.046* (0.026)	-0.082*** (0.025)	-0.070** (0.033)	0.051*** (0.006)	0.034 (0.036)	0.046** (0.017)	-0.019 (0.027)	0.023** (0.011)	0.068*** (0.013)	0.104*** (0.016)
40-44	-0.067** (0.030)	-0.130*** (0.031)	-0.045 (0.041)	0.078*** (0.009)	0.048*** (0.017)	0.025 (0.024)	-0.055 (0.038)	0.026** (0.010)	0.049*** (0.002)	0.076* (0.036)
45-49	-0.108*** (0.032)	-0.160*** (0.027)	-0.125** (0.056)	0.020 (0.024)	0.066*** (0.024)	-0.003 (0.026)	-0.110*** (0.039)	-0.008 (0.022)	0.042*** (0.001)	0.133*** (0.032)
50-54	-0.146*** (0.050)	-0.199*** (0.048)	-0.195*** (0.036)	0.015 (0.017)	0.058* (0.032)	-0.036 (0.035)	-0.142*** (0.050)	-0.046** (0.023)	0.010 (0.016)	0.049* (0.024)
55-59	-0.163*** (0.036)	-0.205*** (0.029)	-0.235*** (0.053)	-0.011*** (0.004)	-0.026 (0.053)	-0.058* (0.034)	-0.187*** (0.035)	-0.087*** (0.039)	0.031*** (0.006)	0.072*** (0.024)
60-65	-0.195*** (0.031)	-0.236*** (0.024)	-0.270*** (0.034)	-0.068** (0.032)	-0.048** (0.023)	-0.079*** (0.032)	-0.200*** (0.029)	-0.100*** (0.025)	-0.017 (0.025)	-0.012 (0.069)
Region										
Northeast	Base									
Midwest	-0.032*** (0.001)	-0.031*** (0.002)	-0.024*** (0.002)	-0.034*** (0.004)	-0.030*** (0.002)	-0.025*** (0.001)	-0.026*** (0.002)	0.005** (0.002)	-0.021*** (0.003)	-0.074*** (0.008)
South	-0.015*** (0.004)	-0.001 (0.002)	-0.014*** (0.004)	-0.069*** (0.007)	-0.017*** (0.005)	-0.021*** (0.002)	-0.007*** (0.002)	-0.016*** (0.003)	-0.024*** (0.005)	-0.064*** (0.006)
West	-0.044*** (0.006)	-0.058*** (0.001)	-0.096*** (0.002)	-0.020*** (0.004)	-0.033*** (0.006)	-0.024*** (0.002)	-0.022*** (0.001)	-0.033*** (0.002)	-0.010*** (0.003)	-0.074*** (0.007)
Ethnicity										
White	Base	-	-	-	-	Base	-	-	-	-
Black	0.106*** (0.006)	-	-	-	-	0.067*** (0.005)	-	-	-	-
Hispanic	0.070*** (0.023)	-	-	-	-	0.049*** (0.007)	-	-	-	-
Other	-0.083*** (0.013)	-	-	-	-	-0.062*** (0.005)	-	-	-	-

Robust standard errors in parenthesis.

"*" indicates 90% statistical significance; "***" 95% statistical significance; "****" 99% statistical significance.

<.01). Being married correlates strongly with screening for Hispanic women (ME, 0.058; $P < .05$). However, the largest disparities are observed across insurance status. In the US sample, uninsured women's probability of screening is far lower than women with private insurance (ME, -0.192; $P < .01$), with the difference between insurance status greatest for white (ME, -0.237; $P < .01$) and black (ME, -0.228; $P < .01$) women—far greater than that observed for Hispanic women (ME, -0.089; $P < .01$). No difference in the probabil-

ity is seen between private and public health insurance for black and Hispanic women, though differences are observed with the white group. For white and black women living in the west, there is a reduced probability of screening by the greatest amount (ME, -0.058; $P < .01$ and ME, -0.096; $P < .01$, respectively), while for Hispanic women, the lowest utilization is in the south (ME, -0.69; $P < .01$).

Within the 3-year period, some differences with the 12-month results are observed. Blacks (ME, 0.067; $P < .01$)

and Hispanics (ME, 0.049; $P < .01$) have a greater probability of screening compared with whites, and again, the other ethnicity group is the least likely to screen. Although income disparities exist in the United States as a whole and for white women, little or no income disparities in screening utilization are observed for black and Hispanic women, as well as for women from other ethnicities for the 3-year period. However, significant disparities are still observed across education with the lowest educated group having a lower probability of screening in the United States (ME, -0.074 ; $P < .01$) amongst whites (ME, -0.117 ; $P < .01$) and blacks (ME, -0.040 ; $P < .05$), but not among Hispanics. The largest disparities are observed across insurance status, with these disparities once more greatest for whites (uninsured: ME, -0.147 ; $P < .01$) relative to blacks (ME, -0.100 ; $P < .01$ uninsured) and Hispanics (uninsured: ME, -0.075 ; $P < .01$). Interestingly, although white women with public insurance have a 5.6-percentage point lower probability of screening compared with private insurance, no differences across private and public insurance are observed for the other ethnic groups. Screening was highest in the northeast, though the difference between regions was lower compared with the 12-month period.

DISCUSSION

This study found evidence of significant disparities in cervical cancer screening utilization across socioeconomic groups in the United States, supporting the findings of previous studies. These disparities, as measured by CIs, are larger than those observed in many other countries.^{17,18} Controlling for other variables, the probability of screening is higher among black and Hispanic women, which also supports the findings of previous studies.^{3,8,10} Furthermore, this study adds to the small body of literature which has examined within- and between-group differences related to ethnicity and socioeconomic status.

This study finds that women with high income (as measured by CIs and regression analyses), a college degree, or private health insurance have the largest probability to screen. The probability of women screening in each of these high socioeconomic groups differs little, regardless if they are white, black, or Hispanic (some differences are observed with other ethnicities). However, among lower socioeconomic women, those in lower-income groups who are uninsured, or those who have low educational attainment, utilization rates are higher for blacks and Hispanics than for white women. Only by partitioning the analysis across ethnic groups, rather than analyzing the United States as a single entity, has this novel result become known.

Age-adjusted 5-year survival for low socioeconomic (measured by area-level poverty rates) black women was 65.2% versus 70% for white, and 81% for Hispanic women.²⁵ The largest difference between the most and least deprived (9.2 percentage points) was observed among white women.²⁵ Therefore, as lower-socioeconomic women, black women currently have a greater probability of acquiring and dying from cervical cancer than poorer white and Hispanic women. Risk perception may partially explain their decision to screen, although it is unlikely to explain all of the differences observed in our results.

Policy Recommendations

Although screening utilization at 12 months and 3 years is high in the United States by international standards,^{17,26-28} this conceals large socioeconomic disparities. The high utilization among socioeconomically advantaged women and/or those with private health insurance also demonstrates that too-frequent screening may be taking place, despite recommendations not to do so.^{3,12,14,29} This may largely be due to how screening is delivered and the large incentive for some practitioners to offer and recommend annual screening. While the USPSTF and the American Cancer Society both recommended Pap smears every 3 years, 92% of obstetricians and gynecologists' stated that they recommend annual screening to women³⁰ and, as noted above, the ACA mandates this in many states for insured women. It follows that issues of both overscreening and underscreening are evident in the United States.

Whereas the nature of the healthcare system—and the importance of insurance in acquiring a screening—may underlie many of the disparities observed in this study, the lack of an organized screening program is also likely to be a significant factor. Organized population-based screening, such as that seen in Europe, has been shown to reduce socioeconomic disparities in cervical cancer screening.^{31,32} Additionally, organized programs are more cost-effective. For example, the United States has 4 times as many cervical cancer screens as the organized Netherlands screening program, but the extra screens have not led to improved mortality rates.³³ Using a timely screening interval—such as every 3 years rather than annually—would result in an estimated savings of \$404 million in the United States.³⁴ Reducing too-frequent screening would additionally reduce unnecessary nonpecuniary costs and psychological harms for overscreened women associated with false positives. Policy should focus not on facilitating the too-frequent screening of some groups, but on encouraging screening among women who never or rarely screen.³⁵ It

is the low-utilization women that make up the majority of all cervical cancer deaths in the United States, and most of these women are in the lowest socioeconomic groups.³⁶ Organized screening programs could more accurately include these poorer, underscreened women; an organized program may also help to reduce screening for women with short life expectancies; many of whom screen at a high rate with little chance of the screen reducing the probability of dying from cervical cancer.³⁷

Cancer researchers and policy advocates in the United States have increasingly acknowledged that organized screening is superior to the opportunistic approach currently in place.^{38,39} A key element of organized programs—invitations to screen—can be tailored to individual risk at timely intervals and would aid in the screening of low utilization (poorer) groups while reducing too frequent screenings in other groups.^{39,41} An organized program may additionally serve to reduce any stigma that might be associated with cervical cancer screening that may serve to deter utilization across groups. As the effectiveness of early diagnosis is contingent upon early access to treatment, any organized programs should also strive to offer quick access to treatment to women regardless of insurance status.

As these results show that uninsured women have utilization rates much lower than their publicly or privately insured counterparts, the expansion of Medicaid under the ACA is likely to reduce the number of underscreened women. Our results suggest that this may be especially true for black and Hispanic women where no difference in screening is observed across publicly and privately insured women. The failure of half of the states to expand Medicaid following the ACA is likely to be a significant barrier in reducing the disparities observed in this study and increase screening for those poorer women who need it the most.

CONCLUSIONS

Owing to the lower screening rates and higher incidence and death rates among black and Hispanic women, greater utilization of screening among these women is welcome, although overscreening among more affluent black and Hispanics is still a concern; however, improving utilization for poorer blacks and Hispanics should be the focus of women's policy. Disparities in screening are greatest for whites, and screening rates for poorer whites are far lower than their black and Hispanic counterparts. It is clear from these results that interventions are needed to improve screening among poorer white women. A system of organized cancer screening may simultaneously serve to improve efficiency and reduce the disparities in

screening. However, due to the differences in screening behavior both across ethnic and socioeconomic groups, a multifaceted policy with a strong focus on poor white women is needed to achieve parity in screening utilization the United States.

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