Women's Health Issues 25-3 (2015) 246–253

WOMEN'S HEALTH ISSUES
www.whijournal.com

Original article

Disparities in Receipt of Breast and Cervical Cancer Screening for Rural Women Age 18 to 64 with Disabilities

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Article history: Received 3 August 2014; Received in revised form 26 January 2015; Accepted 9 February 2015

A B S T R A C T

Background: Previous research has found breast and cervical cancer screening disparities between women with and without disabilities, and between women living in rural versus urban areas. Living in a rural area may add to the barriers women with disabilities experience when attempting to obtain screening for breast and cervical cancer. The purpose of this study was to examine the combination of disability status and rurality in association with receipt of breast and cervical cancer screening among women age 18 to 64 in the United States.
Methods: We conducted cross-sectional analyses of data from the Medical Expenditure Panel Survey, using pooled annual data files from 2002 through 2008. We compared recent receipt of breast and cervical cancer screening among four groups: 1) urban women without disabilities, 2) urban women with disabilities, 3) rural women without disabilities, and 4) rural women with disabilities.
Findings: Overall, women with disabilities were less likely to be up to date with mammograms and Pap tests compared with women with no disabilities. Similarly, women in rural areas were less likely to have received breast or cervical cancer screening within recommended timeframes. Women who both had a disability and lived in a rural area were the least likely to be current with screening.
Conclusions: Our findings suggest that living in rural regions compounds disparities in receipt of cancer screening among women with disabilities. Increased attention is needed to improve receipt of cancer screening among rural women with disabilities.

Studies during the past two decades have found disparities between women with and without disabilities in timely receipt of breast and cervical cancer screening (e.g., Nosek & Howland, 1997; Iezzoni, McCarthy, Davis, Harris-David, & O'Day 2001; Legg, Clement, & White, 2004; Armour, Thierry, & Wolf, 2009; Horner-Johnson, Dobbertin, Andresen, & Iezzoni, 2014a). Barriers to screening include difficulty finding a provider willing to treat individuals with disabilities (despite legal requirements of the Americans with Disabilities Act); provider misperceptions about the need for screening among patients with disabilities; and insufficient time, training, and assistance for conducting screening examinations (Armour et al., 2009). Further, women with disabilities often encounter physical access barriers, including lack of adjustable height examination tables and accessible mammography machines (Armour et al., 2009; Courtney-Long, Armour, Frammartino, & Miller, 2011; Iezzoni, Kilbridge, & Park, 2010). Transportation difficulties and lack of accessible parking may present additional barriers (Armour et al., 2009; Courtney-Long et al., 2011; Yankaskas, 2010).

Living in a rural area may add to the barriers women with disabilities experience when attempting to obtain screening services. Research in the general U.S. population has found cancer screening disparities between rural and urban women (Coughlin, Thompson, Hall, Logan, & Uhler, 2002; Coughlin, Leadbetter, Richards, & Sabatino, 2008; Leung, McKenzie, Martin, & McLaughlin, 2014). Rural women face greater travel distances and tend to be of lower socioeconomic status, which is associated with underutilization of preventive services (Peek & Han, 2004). Qualitative research on health care experiences

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http://dx.doi.org/10.1016/j.whi.2015.02.004

of rural residents with disabilities suggests having a disability exacerbates typical hurdles to obtaining health care in rural areas (Iezzoni, Killeen, & O'Day, 2006). One prior study examined breast and cervical cancer screening disparities in relation to both rurality and disability and found that women with disabilities in less-populated areas were significantly less likely to have been screened within recommended timeframes (Schootman & Fuortes, 1999). Conversely, Parish, Swaine, Son, and Luken (2013) found higher screening rates among women with intellectual disabilities in rural communities compared with those in urban areas. Each of these studies was limited to data from a single state. A recent national study found disparities in colorectal cancer screening for rural adults with disabilities (Horner-Johnson, Dobbertin, Lee, & Andresen, 2014b). However, we are unaware of any research using national data to explore the intersection of disability and rurality for breast and cervical cancer screening.

The purpose of the present study was to examine differences in receipt of breast and cervical cancer screening in relation to both disability status and rural versus urban residence among women in the United States. Our hypothesis was that women with disabilities in rural areas would be the least likely to be current with breast and cervical cancer screening.

Methods

Data Source

We analyzed data from the household component of the Medical Expenditure Panel Survey (MEPS). The Agency for Healthcare Research and Quality (AHRQ) conducts the MEPS to gather nationally representative data on health care use and expenditures. MEPS data are collected via in-person interviews with households selected from those sampled for the previous year's National Health Interview Survey. Households participate in five interviews across a 2-year period. The survey uses an overlapping panel design, with a new panel enrolled each year (Cohen, Cohen, & Banthin, 2009; Ezzati-Rice, Rohde, & Greenblatt, 2008). The AHRQ creates annual data files combining data from two panels, weighted to represent the U.S. population. We pooled annual files from 2002 through 2008.

Sample

The 2002 through 2008 sample included a total of 86,989 women age 18 or older. Our analyses focused on women ages 18 to 64 years for Pap testing, and 40 to 64 for mammography. Routine Pap testing is not recommended beyond age 64, and we selected age 18 as the youngest age at which women would likely need Pap testing under U.S. Preventive Services Task Force (USPSTF) recommendations applicable to our study period (USPSTF, 2003). We based our age range for mammography on USPSTF recommendations in effect when our data were collected, when routine mammograms were recommended beginning at age 40 (USPSTF, 2002). Most adults 65 years and older have Medicare and their health care access issues differ from those of younger adults; therefore, we excluded women over 64 years of age (n = 15,734) from mammography as well as Pap analyses. Within our target age range for Pap testing, we excluded 5,749 women with missing data for variables of interest, resulting in an analytic sample of 65,506. For mammography analyses, the additional age restriction resulted in an analytic sample of 34,187.

Measures

Dependent variable

During the study period, the USPSTF recommended that Pap tests be conducted every 3 years, starting within 3 years after sexual debut or at age 21, whichever came first (USPSTF, 2003). Given that many women begin sexual activity in their teens, we included women age 18 to 20 in our Pap analyses because some women could have exceeded 3 years after sexual debut before reaching age 21. We created a binary variable coded: 0) more than 3 years since last Pap test, or never (not up to date) or 1) 3 years or less since last Pap test (up to date). For the 2002 through 2008 timeframe, the USPSTF recommended biennial mammograms beginning at age 40. Therefore, we coded receipt as 0) more than 2 years since last mammogram, or never (not up to date) or 1) 2 years or less since last mammogram (up to date).

Primary independent variables

Disability was defined by presence of limitations in basic actions involving physical functions, vision, hearing, or cognition. The concept of basic action difficulties was initially described by Altman and Bernstein (2008), and has been applied in previous studies using MEPS data (e.g., Horner-Johnson, Dobbertin, Lee, & Andresen, 2013; Horner-Johnson et al., 2014b). Basic action difficulties were identified by affirmative responses to one or more MEPS survey questions about 1) limitations in physical functions such as walking, standing, bending, lifting, reaching, or grasping; 2) cognitive limitations such as confusion, memory loss, or difficulty making decisions; 3) difficulty seeing (while wearing glasses, if used); and 4) difficulty hearing (with a hearing aid, if used). We categorized women with any reported degree of difficulty as having a disability. Residence in a Metropolitan Statistical Area (MSA; yes or no) was used as an indicator of urban versus rural location. To examine the combination of disability status with rural/urban status, we created a variable with four categories: 1) urban women without disabilities, 2) urban women with disabilities, 3) rural women without disabilities, 4) rural women with disabilities.

Covariates

Our covariates included age, race/ethnicity (non-Hispanic White, non-Hispanic Black, non-Hispanic American Indian/Alaskan Native, non-Hispanic Asian/Native Hawaiian/Pacific Islander, non-Hispanic Multiple Races, Hispanic of any race), marital status (married, widowed/divorced/separated, never married), and region of the United States (Northeast, Midwest, South, West). We also included socioeconomic status variables, specifically education (bachelor's degree and higher, other degree, General Educational Development [GED]/high school diploma [HS], no GED/HS); and family income as percent of the Federal Poverty Level (≥400%, 200%–<400%, 125%–<200%, 100%–<125%, <100%). Health care access covariates were health insurance (privately insured all year, publicly insured all year, uninsured part of year, uninsured all year) and presence of a usual source of health care (yes/no). Last, based on prior research indicating reduced screening of women with more severe disabilities (Andresen et al., 2013; Horner-Johnson et al., 2014b), we added a covariate indicating whether women had a complex activity limitation (yes/no), defined as a restriction in ability to participate in social role or self-care activities (Altman & Bernstein, 2008). We coded women as having a complex activity limitation if they had an affirmative response to one or more MEPS items about needing assistance with activities of daily

living (e.g., bathing, dressing) or instrumental activities of daily living (e.g., paying bills, going shopping), or having limitations in work, housework, social, or recreational activities.

Statistical Analysis

We used Stata 12.1 (StataCorp, 2011) to account for the complex survey design of MEPS. First, we conducted χ^2 analyses comparing women with and without disabilities to determine whether our data supported previous findings of disability-related disparities in cancer screening. Similarly, we used χ^2 tests to compare women living in an MSA to those not living in an MSA, regardless of disability status. Last, we conducted logistic regression analyses using our four-category variable to compare women with and without disabilities in urban and rural areas. We modeled the odds of being up to date with each type of screening (i.e., having received a Pap test within the past 3 years; having had a mammogram within the past 2 years). We conducted both unadjusted (bivariate) analyses and multivariable models that adjusted for the covariates described above. A p value of $< .05$ was used as the cutoff to determine statistical significance.

Results

Women in our analytic sample did not differ from those excluded owing to missing data in the percent who had received a Pap test within the past 3 years, 85.5% vs. 86.1%; χ^2 (1, 450) = 0.40, $p = .53$. However, women with complete data were significantly more likely to have had a mammogram within the past 2 years, 74.4% vs. 70.6%; χ^2 (1, 441) = 4.70, $p = .031$. The mammography difference between those with complete and partial data did not reach statistical significance for women with disabilities, 72.0% vs. 67.9%; χ^2 (1, 452) = 1.12, $p = .290$, but was significant for women without disabilities, 75.4% vs. 68.3%; χ^2 (1, 444) = 10.37, $p = .001$. Similarly, the difference was not significant for rural women, 69.27% vs. 64.4%; χ^2 (1, 208) = 0.89, $p = .347$, but was for urban women, 75.5% vs. 71.5%; χ^2 (1, 431) = 4.66, $p = .031$.

Across urban/rural settings, 20.6% of the women in our analysis sample had a disability. The proportion of disability was higher among rural women (24.4%) than among urban women (19.9%). Rural women constituted 16.5% of our overall sample. Of the women with disabilities in our sample, 19.5% were living in a rural area, compared with 15.7% of women without disabilities. Sample demographics are shown in Table 1, subdivided by presence of disability and urban/rural residence. In both urban and rural settings, higher proportions of women with disabilities were in the older age groups, and in the widowed/divorced/separated marital status group, compared with women without disabilities. Rural women, both with and without disabilities, were much more likely to be non-Hispanic White. Relatively high proportions of rural women were living in the Midwest and South and fewer lived in the Northeast and West. Compared with nondisabled urban women, both rural women and women with disabilities had lower income.

The proportions and 95% CIs of women in each group who were current with each type of screening are shown in Table 2. Overall, women with disabilities were significantly less likely to be up to date with Pap testing ($\chi^2 = 143.43$; $p < .0001$) and mammography ($\chi^2 = 18.90$; $p < .0001$). Regardless of disability status, rural women were significantly less likely than urban women to be current with both Pap testing ($\chi^2 = 27.78$; $p < .0001$) and mammography ($\chi^2 = 5.97$; $p < .0001$). When considering the intersection of disability and rurality, nondisabled urban women had the highest proportion current with Pap testing, followed by nondisabled rural women, then urban women with disabilities, and then rural women with disabilities. For mammography, nondisabled urban women again had the highest proportion screened within the recommended time frame, followed by urban women with disabilities, then nondisabled rural women and rural women with disabilities. For both tests, the combination of disability and rurality was associated with the lowest proportion of women being current with screening. However, for mammography, the CIs for rural women with and without disabilities overlapped.

In unadjusted regression analyses with nondisabled urban women as the reference group, nondisabled women in rural areas had significantly lower odds of being up to date with Pap testing (odds ratio [OR], 0.80; 95% CI, 0.72–0.89; $p < .01$) and mammography (OR, 0.73; 95% CI, 0.64–0.82; $p < .01$). Women with disabilities in urban areas had even lower odds for Pap testing (OR, 0.67; 95% CI, 0.62–0.72; $p < .01$), and also had reduced odds of being current with mammography (OR, 0.85; 95% CI, 0.77–0.93; $p < .01$). Rural women with disabilities had the lowest odds of being up to date with each type of screening (Pap: OR, 0.50; 95% CI, 0.44–0.58; $p < .01$; mammography: OR, 0.63; 95% CI, 0.56–0.72; $p < .01$).

After controlling for covariates, disparities in Pap testing remained apparent for all three groups compared with nondisabled urban women. Rural women with disabilities continued to have the lowest adjusted OR (AOR) of being current with recommended cervical cancer screening (Table 3). For mammography, the difference between urban women with and without disabilities was no longer significant when controlling for covariates. Rural women continued to have lower adjusted odds of mammography screening; AORs and CIs were similar for rural women with and without disabilities (see Table 4).

Several of the covariates in our adjusted models were significant (Tables 3 and 4). Older women had a lower AOR of being current with Pap testing but higher odds of recent mammogram. Black and Hispanic women had higher AOR of reporting each type of screening, whereas women in the Asian/Native Hawaiian/other Pacific Islander group were significantly less likely to be up to date with either breast or cervical cancer screening. Multiracial women had significantly lower odds of current mammography. Women not currently married were less likely to be current with screening than married women. Region had no significant effect for Pap testing, but women in the Midwest, South, and West had lower adjusted odds of recent mammogram compared with women in the Northeast. Less educated women were less likely to have received either screening within the recommended time frame. Women in lower income groups were less likely to be current with mammography. For Pap testing, the income effect was significant for women at 200%–400% and at 125%–200% of the Federal Poverty Level; women below 125% did not differ significantly from the reference group. Women who were uninsured all year were less likely to be current with Pap testing, whereas women who were uninsured part or all of the year were less likely to be up to date with mammography. Women without a usual source of care had substantially lower adjusted odds of being current with either type of screening. Women with complex activity limitations had significantly reduced odds of a Pap test within the past 3 years, but did not differ from women without complex activity

Table 1
Characteristics of Women with and without Disabilities in Urban and Rural Areas, Unweighted n (Weighted %)

Characteristic	No Disability, Urban	No Disability, Rural	Disability, Urban	Disability, Rural	Total
Age (y)					
18–29	12,302 (28.4)	2,472 (26.9)	1,353 (13.3)	290 (9.0)	16,417 (24.9)
30–39	11,113 (24.3)	1,963 (22.1)	1,605 (13.6)	465 (14.2)	15,146 (21.9)
40–49	10,065 (23.6)	2,010 (24.3)	2,956 (26.8)	824 (26.6)	15,855 (24.4)
50–59	7,162 (17.8)	1,555 (19.0)	3,541 (31.9)	1,047 (33.7)	13,305 (20.9)
60–64	2,192 (5.9)	579 (7.6)	1,530 (14.4)	482 (16.5)	4,783 (8.0)
Race and ethnicity*					
White	19,813 (64.2)	5,767 (81.4)	5,731 (67.3)	2,215 (83.1)	33,526 (67.6)
Black	7,066 (12.6)	1,183 (8.4)	2,385 (15.4)	466 (8.5)	11,100 (12.4)
American Indian/Alaskan Native	139 (0.3)	119 (1.4)	86 (0.8)	45 (1.5)	389 (0.6)
Asian/Native Hawaiian/Pacific Islander	2,613 (6.1)	108 (1.3)	331 (3.1)	20 (0.7)	3,072 (4.8)
Multiple races	468 (1.1)	108 (1.3)	268 (2.4)	81 (2.3)	925 (1.4)
Hispanic	12,735 (15.7)	1,294 (6.2)	2,184 (11.0)	281 (4.0)	16,494 (13.2)
Marital status					
Married	23,901 (57.2)	5,146 (64)	4,850 (47.1)	1,571 (56.6)	35,468 (56.4)
Widowed, divorced, separated	6,860 (15.2)	1,418 (15)	3,682 (30.9)	1,078 (30.2)	13,038 (18.4)
Never married	12,073 (27.6)	2,015 (21)	2,453 (21.9)	459 (13.2)	17,000 (25.2)
Region of United States					
Northeast	7,231 (20.6)	717 (11.5)	1,735 (17.4)	237 (10.3)	9,920 (18.5)
Midwest	7,738 (20.5)	2,204 (31.3)	2,174 (21.3)	724 (29.3)	12,840 (22.4)
South	15,419 (34.4)	4,331 (42.9)	4,283 (37.0)	1,721 (47)	25,754 (36.4)
West	12,446 (24.4)	1,327 (14.4)	2,793 (24.2)	426 (13.4)	16,992 (22.7)
Education					
Bachelor's degree or lower	10,275 (31.6)	1,258 (19.1)	1,782 (20.7)	297 (12.8)	13,612 (27.4)
Other degree	3,252 (8.7)	730 (10.4)	907 (9.2)	245 (9.3)	5,134 (9.0)
GED/HS	19,842 (46.4)	4,775 (56.8)	5,697 (54.3)	1,755 (59.6)	32,069 (49.5)
No GED/HS degree	9,465 (13.3)	1,816 (13.8)	2,599 (15.7)	811 (18.3)	14,691 (14.0)
Family income†					
≥400%	14,673 (45.4)	2,205 (33.9)	2,844 (34.9)	516 (24.3)	20,238 (41.3)
200%–<400%	12,355 (30.1)	2,693 (36.0)	2,940 (28.8)	768 (30.4)	18,756 (30.6)
125%–<200%	6,573 (11.2)	1,482 (14.0)	1,642 (12.7)	579 (17.3)	10,276 (12.0)
100%–<125%	2,244 (3.2)	546 (4.2)	675 (4.8)	244 (5.5)	3,709 (3.7)
<100%	6,989 (10.2)	1,653 (11.9)	2,884 (18.9)	1,001 (22.6)	12,527 (12.3)
Health insurance					
Private all year	24,444 (68.1)	4,733 (64.8)	5,019 (55.5)	1,199 (49.3)	35,395 (64.8)
Public all year	4,111 (6.3)	807 (6.4)	2,861 (19.3)	901 (21.8)	8,680 (9.1)
Uninsured part of year	5,786 (11.8)	1,242 (12.9)	1,392 (12.0)	381 (12.1)	8,801 (12.0)
Uninsured all year	8,493 (13.8)	1,797 (15.8)	1,713 (13.2)	627 (16.7)	12,630 (14.1)
Usual source of care					
Yes	31,747 (77.8)	6,641 (81.0)	9,149 (84.5)	2,666 (87.2)	50,203 (79.7)
No	11,087 (22.2)	1,938 (19.0)	1,836 (15.5)	442 (12.8)	15,303 (20.3)
Complex activity limitation					
No	41,834 (97.8)	8,316 (97.3)	5,739 (55.4)	1,441 (51.6)	57,330 (88.9)
Yes	1,000 (2.2)	263 (2.7)	5,246 (44.6)	1,667 (48.4)	8,176 (11.1)
Total	42,834 (66.9)	8,579 (12.5)	10,985 (16.6)	3,108 (4.0)	65,506 (100)

Abbreviation: GED/HS, General Education Development or High School diploma.
* Except Hispanic, all race and ethnicity categories are ethnically non-Hispanic.
† Family income as percent of the Federal Poverty Level.

limitations in odds of having had a mammogram within the past 2 years.

Discussion

Overall, women with disabilities were less likely to be up to date with mammograms and Pap tests compared with women without disabilities. This finding is consistent with previous studies that found similar disparities (Armour et al., 2009; Horner-Johnson et al., 2014a; Iezzoni et al., 2001; Legg et al., 2004; Nosek & Howland, 1997). Similarly, women in rural areas were less likely to have received breast or cervical cancer screening within recommended timeframes, confirming previous findings (Coughlin et al., 2002; Coughlin et al., 2008; Leung

Table 2
Weighted Percentages (95% CI) of Women Current with Cervical and Breast Cancer Screening

Characteristic	No Disability	Disability	Total
Pap within last 3 years			
Urban	87.13 (86.61, 87.63)	81.89 (80.73, 83.00)	86.08 (85.57, 86.59)
Rural	84.43 (83.15, 85.64)	77.35 (75.09, 79.46)	82.71 (81.44, 83.90)
Total	86.70 (86.22, 87.17)	81.01 (79.97, 82.00)	85.53 (58.05, 85.99)
Mammogram within past 2 years			
Urban	76.42 (75.50, 77.31)	73.25 (71.65, 74.80)	75.54 (74.70, 76.35)
Rural	70.24 (67.78, 72.58)	67.29 (64.70, 69.77)	69.27 (67.22, 71.25)
Total	75.38 (74.50, 76.24)	72.04 (70.63, 73.41)	74.42 (73.63, 75.20)

Table 3
Adjusted Odds of Pap Test within the Last 3 Years, Women 18 to 64 Years

Characteristic	AOR	95% CI	*p* Value
Disability and urbanicity			
No disability, urban	Ref.	–	-
No disability, rural	0.83	0.74–0.93	<.01
Disability, urban	0.87	0.78–0.96	.01
Disability, rural	0.69	0.59–0.81	<.01
Age (y)			
18–29	Ref.	–	-
30–39	1.18	1.06–1.32	<.01
40–49	0.82	0.74–0.92	<.01
50–59	0.51	0.46–0.58	<.01
60–64	0.42	0.37–0.49	<.01
Race/ethnicity*			
White	Ref.	–	-
Black	2.22	2.01–2.46	<.01
American Indian/Alaskan Native	1.07	0.75–1.51	.72
Asian/Native Hawaiian/Pacific Islander	0.44	0.38–0.51	<.01
Multiple races	0.95	0.72–1.25	.72
Hispanic	1.39	1.25–1.54	<.01
Marital status			
Married	Ref.	–	-
Widowed, divorced or separated	0.74	0.68–0.81	<.01
Never married	0.38	0.35–0.42	<.01
Region			
Northeast	Ref.	–	-
Midwest	0.95	0.83–1.08	.41
South	0.94	0.83–1.07	.33
West	0.93	0.81–1.06	.29
Education			
Bachelor's degree or lower	Ref.	–	-
Other degree	0.57	0.49–0.67	<.01
GED/HS	0.48	0.43–0.53	<.01
No GED/HS degree	0.28	0.25–0.32	<.01
Family income†			
≥400%	Ref.	–	-
200%–<400%	0.85	0.77–0.93	<.01
125%–<200%	0.83	0.74–0.93	<.01
100%–<125%	0.95	0.82–1.10	.51
<100%	1.09	0.96–1.23	.19
Insurance			
Privately insured all year	Ref.	–	-
Publicly insured all year	0.99	0.89–1.10	.82
Uninsured part of the year	0.93	0.85–1.03	.18
Uninsured all year	0.47	0.43–0.51	<.01
Usual source of care			
Yes	Ref.	–	-
No	0.51	0.47–0.55	<.01
Complex activity limitation			
No	Ref.	–	-
Yes	0.72	0.64–0.80	<.01

Abbreviations: AOR, adjusted odds ratio (adjusted for all other variables in model); GED/HS, General Education Development or High School diploma.
* Except Hispanic all race & ethnicity categories are ethnically non-Hispanic.
† Family income as percent of the Federal Poverty Level.

Table 4
Adjusted Odds of Mammogram within the Last 2 Years, Women 40–64 Years

	AOR	95% CI	*p* Value
Disability and urbanicity			
No disability, MSA	Ref.	–	-
No disability, Non-MSA	0.79	0.69–0.90	<.01
Disability, MSA	0.94	0.84–1.04	.24
Disability, Non-MSA	0.79	0.68–0.91	<.01
Age (y)			
40–49	Ref.	–	-
50–59	1.67	1.55–1.80	<.01
60–64	1.95	1.72–2.22	<.01
Race/ethnicity*			
White	Ref.	–	-
Black	1.49	1.34–1.67	<.01
American Indian/Alaskan Native	0.74	0.49–1.10	.14
Asian/Native Hawaiian/Pacific Islander	0.74	0.62–0.87	<.01
Multiple races	0.74	0.57–0.96	.03
Hispanic	1.41	1.24–1.59	<.01
Marital status			
Married	Ref.	–	-
Widowed, divorced, or separated	0.86	0.79–0.95	<.01
Never married	0.73	0.64–0.83	<.01
Region			
Northeast	Ref.	–	-
Midwest	0.75	0.65–0.86	<.01
South	0.77	0.68–0.87	<.01
West	0.71	0.61–0.81	<.01
Education			
Bachelor's degree or lower	Ref.	–	-
Other degree	0.82	0.72–0.94	<.01
GED/HS	0.77	0.70–0.85	<.01
No GED/HS degree	0.67	0.59–0.77	<.01
Family income†			
≥400%	Ref.	–	-
200%–<400%	0.66	0.61–0.73	<.01
125%–<200%	0.58	0.52–0.66	<.01
100%–<125%	0.56	0.48–0.66	<.01
<100%	0.53	0.47–0.61	<.01
Insurance			
Privately insured all year	Ref.	–	-
Publicly insured all year	0.85	0.75–0.97	.02
Uninsured part of the year	0.63	0.57–0.70	<.01
Uninsured all year	0.37	0.33–0.41	<.01
Usual source of care			
Yes	Ref.	–	-
No	0.36	0.32–0.39	<.01
Complex activity limitation			
No	Ref.	–	-
Yes	0.92	0.82–1.04	.17

Abbreviations: AOR, adjusted odds ratio (adjusted for all other variables in model); GED/HS, General Education Development or High School diploma.
* Except Hispanic, all race and ethnicity categories are ethnically non-Hispanic.
† Family income as percent of the Federal Poverty Level.

et al., 2014). Our hypothesis that rural women with disabilities would be least likely to be up to date with screening was supported in unadjusted analyses, and was supported for Pap testing in adjusted analyses. However, when controlling for covariates, mammography differences between women with and without disabilities were no longer significant, although rural differences remained significant.

Our measurement of disability included women with relatively mild impairments as well as those impacting daily activities and social role participation. This is consistent with other studies that have also used very broad indicators of disability (e.g., any activity limitation in Armour et al., 2009; Courtney-Long, et al., 2011). However, previous research has found some differences in cancer screening associated with level of disability (Chevarley, Thierry, Gill, Ryerson, & Nosek, 2006; Horner-Johnson et al., 2014a; Iezzoni et al., 2001). We therefore included disability complexity as a covariate. We found no difference between women with complex activity limitations and those with basic activity limitations in odds of receiving a mammogram in the past 2 years. That may have been owing to the more restricted sample size for mammography analyses. Alternatively, potentially greater barriers to mammography for women with more complex disabilities may have been offset by the greater frequency with which these women see health care providers (Gulley & Altman, 2008) and the associated increased opportunity to receive a recommendation for a mammogram. Conversely, the significantly reduced odds of receiving a recent Pap test for women with complex disabilities may be attributable

at least in part to assumptions that these women are not sexually active and not at risk for cervical cancer (Armour et al., 2009).

Urban and rural populations of women differ in important ways, including racial and ethnic composition and income level. These characteristics are also associated with screening rates, and the interplay among multiple characteristics is complex. However, the fact that we found significant disparities both with and without adjusting for other factors indicates that rurality is a major dimension to consider in ongoing efforts to address health care disparities.

Our findings suggest that the combination of disability and rurality is associated with especially daunting barriers to cervical cancer screening. To receive Pap testing, women with disabilities must be able to get into and around in a doctor's office, and get onto an examination table. In rural areas, doctors' offices may be in older, less accessible buildings and women have fewer options when attempting to locate an accessible clinic. Socioeconomic factors such as poverty are also significant issues for women with disabilities and for those in rural areas (Iezzoni et al., 2006; Peek & Han, 2004), but controlling for these factors did not account for the disparities in screening. Instead, reduced rates of cervical cancer screening may be explained by physical and attitudinal barriers for women with disabilities identified in previous research (Armour et al., 2009), combined with limited selection and greater travel distances to health care sites for women in rural areas.

The fact that controlling for covariates did account for the mammography differences between women with and without disabilities presents the interesting possibility that disability-related disparities in breast cancer screening may not be related so closely to inaccessible health care sites. Rather, differences in demographic, socioeconomic, and geographic characteristics may explain substantial portions of previously observed disability disparities. Our findings are in contrast to those of Courtney-Long et al. (2011), who found significant differences in mammography use for women with disabilities in Behavioral Risk Factor Surveillance System data, even when controlling for a range of sociodemographic and health variables. However, that study did not control for urban/rural differences, which were an important factor in our study.

Although controlling for sociodemographic differences between groups is helpful for highlighting disparities specific to disability and rurality, it is important not to lose sight of the fact that substantial income, education, and health insurance gaps exist. Women with disabilities, rural women, and especially rural women with disabilities face numerous challenges to obtaining screening based on their socioeconomic status in addition to their disability and/or geographic location. Difficulty affording time off and travel costs to obtain screening may be compounded by distance from health care and by disability status. In addition, women with disabilities often cope with multiple health issues, and their limited resources may well be prioritized toward acute care needs rather than preventive care (Horner-Johnson et al., 2014a). Thus, interventions to address screening disparities for these women need to take into account the complexity of their lives and the many factors that may impede receipt of cancer screening (Peterson, Suzuki, Walsh, Buckley, & Krahn, 2012).

Our findings are subject to certain limitations. The MSA designation available in MEPS is only a broad indicator of urbanicity versus rurality. People not living in major metropolitan statistical areas may reside in smaller urban areas as opposed to truly rural settings. Thus, our findings may be a conservative estimate of the extent of screening disparities for women in the most rural areas. Additional research with datasets allowing more gradations of population density is needed to better understand disparities faced by women with and without disabilities across a range of urban, suburban, rural, and frontier settings. Our operational definition of disability was also limited by the sparse MEPS data available on cognitive limitations and may not have captured adequately women with developmental disabilities. On the other hand, our definition was quite broad with regard to physical and sensory limitations. By including women with mild limitations that might not typically be conceptualized as disabling, our findings may underestimate the magnitude of disability-related disparities in breast and cervical cancer screening.

Our analyses focused specifically on women ages 18 to 64 (40–64 for mammography). However, screening mammography continues to be important for women age 65 and older. The decision to exclude that age range from this set of mammography analyses was based on differences in insurance coverage for these women relative to younger women. We are currently in the process of assessing disparities in receipt of screening mammography in older women as part of a separate study. We also excluded women with missing data on the covariates in our analyses. This may have resulted in some bias with regard to mammography findings, because women with missing data were also less likely to have received a recent mammogram. The difference between women with missing and complete data was of similar magnitude for urban and rural women (although not significant in the smaller rural sample). However, the magnitude of the difference was somewhat greater for women without disabilities than for women with disabilities, potentially leading to a slight overestimate of disability-related disparities in mammography. Further, MEPS relies on self-reported receipt of cancer screening which may reflect bias in respondent reporting (Cronin et al., 2009; Rauscher, Johnson, Cho, & Walk, 2008). Last, our analyses covered the time period before 2009, when the USPSTF changed recommendations regarding mammography (USPSTF, 2009). A reexamination of screening patterns pertaining to rurality and disability following the revised guidelines is warranted once enough years of data after 2009 are available to provide a sufficient sample size of women with disabilities in rural areas.

Implications for Policy and/or Practice

Pap testing is conducted within primary care settings, whereas women must visit separate imaging centers to obtain mammograms. Hence, breast cancer screening is particularly susceptible to geographic variations in availability of specialized services. Our study found regional differences associated with mammography but not Pap testing, suggesting that availability of mammography facilities may be an important determinant of screening. Elkin et al. (2010) found significantly lower odds of recent mammography within U.S. counties that had fewer than 1.2 mammography machines per 10,000 women age 40 or older. Consistent with our results, the Northeast had the greatest density of counties with more mammography machines (Elkin et al., 2010). Increasing the concentration of mammography facilities in the South, Midwest, and West could alleviate a key barrier to screening. However, we saw urban/rural differences even when controlling for regional variation. Thus, increasing mammography access in rural areas throughout the country should be emphasized. Ensuring that those facilities and machines are accessible to women with disabilities is also

important, particularly in light of the relatively high proportion of women with disabilities living in rural areas.

Barriers to cervical cancer screening for women with disabilities can be reduced through physician training on the importance of screening regardless of disability status, and through improved accessibility of primary care clinics, including addition of adjustable height examination tables (Armour et al., 2009). New standards pertaining to accessibility of diagnostic equipment (United States Access Board, 2013) may help to address some physical barriers to screening, but these standards have not yet been finalized. Further, once final standards are available, it will likely be several more years before the Department of Justice issues rules regarding availability of accessible equipment. Financial incentives may be necessary to encourage clinics—particularly small practices in rural areas—to purchase accessible equipment that will facilitate full access to cancer screening for all women.

Efforts to improve access may be complemented by outreach and education directly targeting women with disabilities. Such interventions can help to raise awareness of the importance of routine breast and cervical cancer screening and provide women with tools and strategies for communicating with their doctors about screening, prioritizing regular screenings, and overcoming barriers to screening (Centers for Disease Control and Prevention, 2012; Peterson et al., 2012).

Conclusion

This study is the first to examine the combination of rural residence and disability status in association with breast and cervical cancer screening at a national level. Our findings support previous research on disparities related to disability and rurality separately, and indicate that the combination of the two results in even greater disparity specifically for cervical cancer screening. Increased attention is needed to improve the receipt of recommended cancer screening services among rural women with disabilities.

Acknowledgments

This research was supported in part by cooperative agreement #U59DD00942 from the National Center on Birth Defects and Developmental Disabilities (NCBDDD), Centers for Disease Control and Prevention (CDC); grant #90DD0684 from the Administration on Intellectual and Developmental Disabilities; and by the Institute on Development & Disability at Oregon Health & Science University. Development of the analytic dataset used in this study was supported in part by grant #H133A080031 from the National Institute on Disability and Rehabilitation Research (NIDRR), U.S. Department of Education. Additional support for Dr. Horner-Johnson's time was provided by grant #K12HS022981 from the Agency for Healthcare Research and Quality (AHRQ). The content of this material does not necessarily reflect the views and policies of CDC, NCBDDD, NIDRR, or AHRQ.

Both Dr. Horner-Johnson and Mr. Dobbertin had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

The authors have no financial conflicts of interest to disclose.

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