

# Distribution of Cardiovascular Disease and Associated Risk Factors by County Type and Health Insurance Status: Results from the 2008 Ohio Family Health Survey

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## ABSTRACT

**Objectives.** Epidemiologic studies have documented a disproportionate burden of chronic diseases in Appalachia, showing the area to be underserved by the health-care system. Nothing is known about how the health status of the Appalachian population compares with other rural or non-rural populations in the same state. We examined the associations among county type, health insurance category, and health outcomes in poorer adult Ohioans.

**Methods.** We obtained data from the 2008 Ohio Family Health Survey, a complex landline- and cell phone-based survey of 50,944 noninstitutionalized households. We constructed bivariate analyses examining health status measures across various insurance categories and metropolitan, suburban, rural, and Appalachian counties in Ohio.

**Results.** Medicaid enrollees living in Appalachian and rural counties tended to be in poorer health and have a greater prevalence of smoking than non-Medicaid enrollees. Within rural and Appalachian regions, Medicaid enrollees were more likely than non-Medicaid enrollees to have lower self-rated health (54.8%, 95% confidence interval [CI] 44.1, 65.5 in rural regions and 52.1%, 95% CI 44.7, 59.5 in Appalachian regions). Appalachian and rural Medicaid enrollees were at an increased likelihood of having several chronic diseases compared with non-Medicaid enrollees.

**Conclusion.** Our findings suggest that rural and Ohio Appalachian Medicaid enrollees were more likely to have hypertension, cardiovascular disease, and overall poorer health than non-Medicaid enrollees. These findings have important policy implications for health-care reform, highlighting regional disparities in provider coverage. These underserved regions would need an increase in the provider base to positively impact proposed Medicaid expansion programs.

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Regional disparities in health insurance coverage play an important role in determining health use and access patterns.<sup>1,2</sup> In particular, preventive services and appropriate treatment may not be equitable for those with public health insurance coverage based on their region of residence.<sup>3</sup> Inadequate insurance or lack of health insurance results in increased difficulty receiving medical care and accessing medical services as well as delays in care and poorer quality of care.<sup>4-6</sup>

In Ohio, an estimated 1.2 million adults are without health insurance, with about 200,000 uninsured in Appalachia.<sup>7,8</sup> The southeastern Ohio Appalachian region has been characterized as being more impoverished than the rest of the state, with lower median incomes, poorer infrastructure, fewer health-care providers, and increased barriers to care. Compounding these effects is an overall lower education level, higher unemployment rates, and an increased prevalence of adults engaging in unhealthy behaviors (e.g., tobacco use, poor diet, and risky sexual behaviors). The fact that 20 of the 29 Appalachian counties are considered economically depressed undoubtedly contributes to the increased risk for adverse health outcomes for Ohioans residing in Appalachia.<sup>9,10</sup>

To date, no study has examined the relationship between health insurance coverage and adverse health outcomes for Appalachian, metropolitan, rural, and suburban residents within the same state. It would be important to identify populations at higher risk for adverse outcomes based on their region of residence and insurance category. With Ohio's recent expansion of Medicaid, these findings could serve as a useful way to highlight underserved and at-risk populations in Ohio.

## METHODS

We obtained data for this study from the Health Policy Institute of Ohio's 2008 Ohio Family Health Survey (OFHS).<sup>11</sup> The study was a complex landline- and cell phone-based survey of 50,944 noninstitutionalized households, collecting information on demographics, socioeconomic status (SES), insurance coverage, use of services, and health status. Interviews were conducted with an adult in each household, and information was collected for adults and by proxy for children when available. To generate estimates of the Ohio population, data were weighted based on a stratified sample design of counties and on an oversample of African American, Asian American, and Hispanic adults. The analysis was limited to adults and did not include children, defined as those aged  $\leq 17$  years.

The OFHS was designed to collect information on

health status variables and health use patterns for the insured/uninsured population of Ohio across county type levels. County types were defined by key characteristics such as population density, industry type, geographic location, and residential type. Counties were grouped to represent suburban, metropolitan, Appalachian, and rural non-Appalachian characteristics, as defined in 2008 by the U.S. Census and Section 403 of the U.S. code (Figure 1).<sup>12,13</sup> The survey was a follow-up to the 1998 and 2004 OFHSs; however, the survey's cross-sectional nature did not allow for the inclusion of survey samples from previous years.

To evaluate the differences among those with Medicaid, private insurance, or no insurance, we constructed summary tables. Health outcome variables included heart disease and hypertension as well as selected risk factors. We constructed initial summary tables to examine health status measures across the various insurance categories. To standardize comparisons, we limited analyses to 90% of the 2007 federal poverty level (FPL). Results were presented as cross-tabulations between insurance coverage and the variable of interest. In addition, regional variations were also accounted for within these tables.

### Study sample

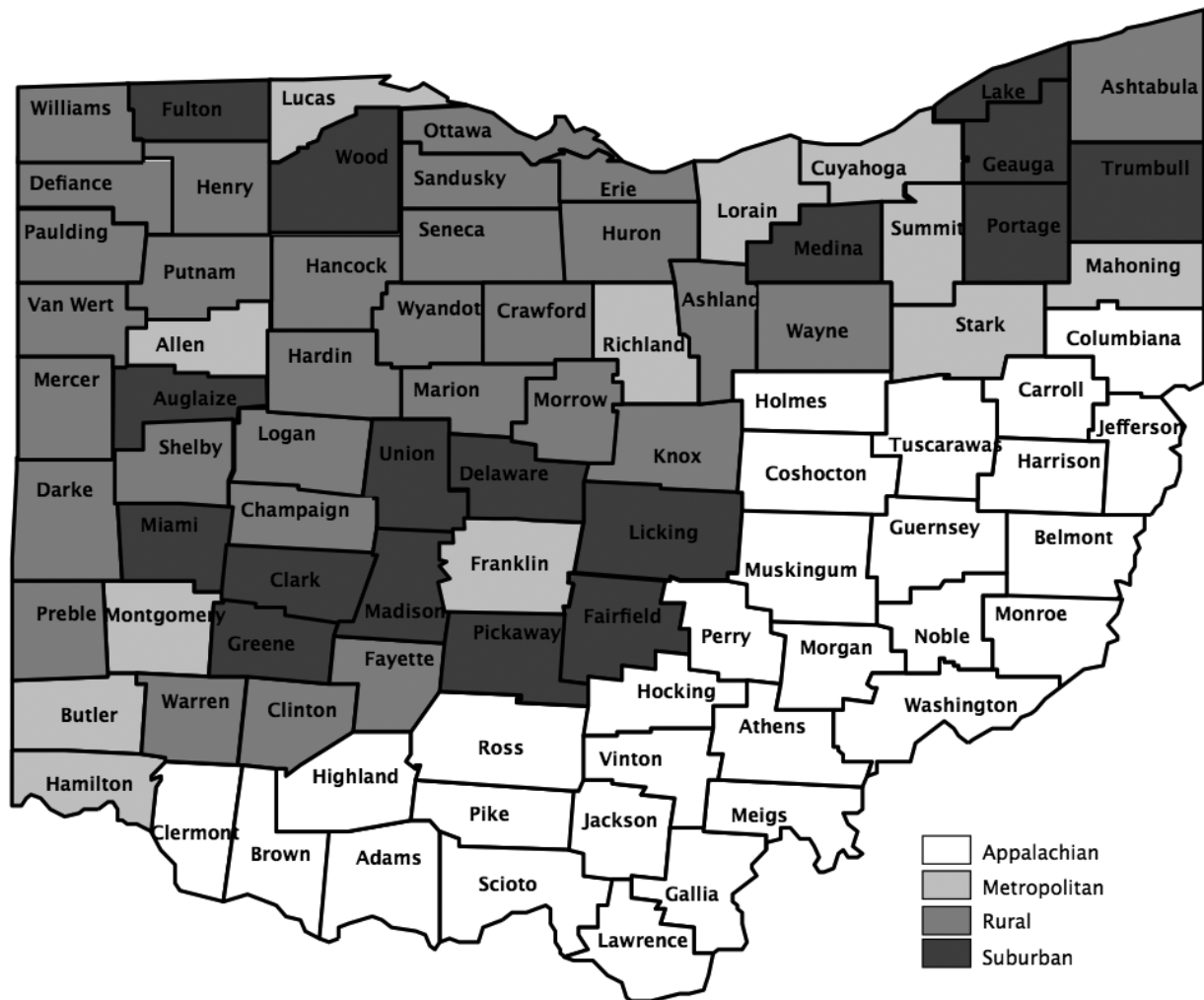
We limited the analysis to adults aged 18–64 years. Individuals enrolled in both Medicare and Medicaid were excluded from the analyses, as Medicare would be their primary insurance provider.

### Analytical variables

**Insurance coverage categories.** We defined four types of insurance coverage categories for this study: Medicaid, private insurance, uninsured, and noncontinuous coverage. All groups were continuously enrolled unless otherwise specified.

The Medicaid category included three subgroups: Healthy Start/Healthy Families (HS/HF); Aged, Blind, and Disabled (ABD); and other Medicaid. The HS/HF Medicaid category was defined as adults enrolled in the HS/HF program for the past year. Eligibility criteria for this category were families with children whose income was up to 200% FPL or pregnant women with an income up to 200% FPL. Those aged 18–20 years were considered HS/HF eligible.

The ABD Medicaid category was defined as adults requiring long-term care, such as a need for day-to-day assistance, special therapies, personal care, domestic care, and/or social and emotional care. Dual Medicare/Medicaid-eligible individuals were not included in this category. The other Medicaid category was defined as individuals enrolled in Medicaid who did not fall into

**Figure 1. Regional map of Ohio<sup>a</sup>, classified according to the U.S. Census and Section 403 of the U.S. Code, 2008**

<sup>a</sup>Ohio Family Health Survey regions are classified as Appalachian, metropolitan, rural, and suburban counties.

the previous categories. We defined the private insurance category as adults covered by job-based insurance, directly purchased insurance, or some other type of nongovernmental insurance. Adults covered by their spouse's insurance, either privately purchased or job-based insurance, were also included in this category. The uninsured category was defined as adults who indicated they were not enrolled in any insurance coverage program for at least one week prior to being interviewed. Those with noncontinuous coverage were defined as adults who had no coverage for part of the previous year or who switched between insurance categories (e.g., from Medicaid to private insurance).

**Health variables.** We assessed overall health by asking respondents to rate their health status from excellent to poor, with "good to excellent" defined as being in

good health and "poor to fair" defined as not being in good health. We identified diseases by asking the participants, "Has a doctor or nurse ever told you that you have. . ." for particular conditions. In this study, we focused on hypertension and coronary heart disease. In addition to examining health status variables, we assessed risk factors (e.g., current or history of smoking and obesity) and comorbidity variables (e.g., diabetes and hypertension). Demographic variables included age, sex, race/ethnicity, education, employment status, and county type.

## RESULTS

Demographic characteristics are presented in Table 1. Overall, the respondents tended to be female (57.2%) and had a mean age of 35.8 years. Approximately

**Table 1. Demographic and socioeconomic characteristics of adult Ohioans,<sup>a</sup> by insurance status: Ohio Family Health Survey, 2008<sup>b</sup>**

Demographic characteristic	Medicaid <sup>c</sup> Percent (SD)	Private insurance Percent (SD)	Uninsured Percent (SD)	Noncontinuous coverage Percent (SD)	Overall Percent (SD)
Mean age (in years)	34.9 (0.5)	38.5 (0.7)	35.1 (0.5)	35.7 (0.7)	35.8 (0.3)
Gender					
Male	25.7 (1.8)	49.4 (2.4)	55.4 (1.8)	30.9 (2.7)	42.8 (1.1)
Race/ethnicity					
Black	28.7 (1.7)	18.4 (1.9)	28.2 (1.7)	22.3 (2.3)	25.5 (0.9)
Asian	0.5 (0.2)	3.3 (0.7)	1.0 (0.3)	1.3 (0.5)	1.4 (0.2)
Hispanic	3.6 (0.5)	3.3 (0.7)	10.3 (0.8)	4.3 (0.8)	6.3 (0.4)
Education					
<High school	39.9 (1.9)	10.5 (1.6)	32.1 (1.7)	28.3 (2.6)	29.2 (1.0)
High school	38.4 (1.8)	42.4 (2.4)	42.6 (1.8)	35.4 (2.6)	40.4 (1.0)
Some college	19.1 (1.4)	25.2 (2.1)	19.1 (1.4)	26.6 (2.5)	21.4 (0.9)
Bachelor's degree	1.3 (0.4)	13.4 (1.6)	4.6 (0.8)	5.6 (1.3)	5.6 (0.5)
Graduate degree	0.4 (0.1)	8.5 (1.2)	1.2 (0.1)	4.1 (0.1)	2.9 (0.3)
Married	18.7 (1.5)	47.4 (2.4)	20.8 (1.4)	29.0 (2.5)	26.8 (0.9)
Employed	22.2 (1.6)	63.5 (2.3)	34.3 (1.7)	37.6 (2.7)	37.6 (0.1)

<sup>a</sup>Adult Ohioans were defined as respondents aged 18–64 years.

<sup>b</sup>Analysis was restricted to individuals at 90% of the federal poverty level.

<sup>c</sup>Includes Healthy Start/Healthy Families; Aged, Blind, and Disabled; and other Medicaid insurance categories

SD = standard deviation

one-quarter (25.5%) of respondents were African American and nearly one-third of respondents (29.2%) had less than a high school education. As shown in Table 2, individuals with private (84.9%) and no (68.8%) insurance coverage tended to be in better health than those in other insurance categories, rating themselves as being in either good or excellent health. Of those enrolled in Medicaid and with noncontinuous coverage, only 61.3% of respondents in each group reported being in good health. Hypertension was

more prevalent in Medicaid enrollees (33.5%) than in those listing other insurance categories (range: 21.6%–31.3%). Risk factors such as obesity were greater in the Medicaid group (40.0%) and those with noncontinuous coverage (33.6%) than in other insurance groups. Medicaid enrollees (52.9%), those with noncontinuous coverage (45.8%), and the uninsured (48.1%) were more likely to be current smokers than those with private insurance (28.3%).

**Table 2. Prevalence of self-reported good health status, hypertension, coronary heart disease, diabetes, obesity, and current smoking among adult Ohioans,<sup>a</sup> by insurance status: Ohio Family Health Survey, 2008<sup>b</sup>**

Variable <sup>c</sup>	Medicaid <sup>d</sup> Percent (SD)	Private insurance Percent (SD)	Uninsured Percent (SD)	Noncontinuous coverage Percent (SD)
Good health status <sup>e</sup>	61.3 (1.2)	84.9 (1.3)	68.8 (1.2)	61.3 (1.8)
Hypertension	33.5 (1.7)	21.6 (1.8)	25.2 (1.5)	31.3 (2.4)
Coronary heart disease	5.6 (0.8)	3.5 (0.9)	3.6 (0.6)	4.3 (0.9)
Obese	40.0 (1.9)	21.7 (1.9)	28.1 (1.6)	33.6 (2.6)
Diabetes	14.4 (1.0)	7.6 (1.1)	8.4 (0.9)	12.2 (1.6)
Current smoker	52.9 (1.9)	28.3 (2.2)	48.1 (1.8)	45.8 (2.8)

<sup>a</sup>Adult Ohioans were defined as respondents aged 18–64 years.

<sup>b</sup>Analysis was restricted to individuals at 90% of the federal poverty level.

<sup>c</sup>Defined as binary yes/no variables

<sup>d</sup>Includes Healthy Start/Healthy Families; Aged, Blind, and Disabled; and other Medicaid insurance categories

<sup>e</sup>Good health status rating was defined as a binary yes/no variable, with respondents who answered good, very good, or excellent defined as being in good health and those answering poor to fair defined as not being in good health.

SD = standard deviation

### Good health status by county type classifications

To examine whether health disparities varied by geography for Medicaid and non-Medicaid populations, we constructed summary tables by county type, examining specific health variables by insurance type. Within each county type, Medicaid enrollees reported lower health ratings, with the lowest percentage observed among Appalachians (52.1%, 95% confidence interval [CI] 44.7, 59.5), followed closely by rural residents (54.8%, 95% CI 44.1, 65.5). The uninsured had higher self-reported health ratings than those with noncontinuous coverage across all county types, whereas those who were privately insured reported the highest health ratings (Table 3).

### Disease variables

Appalachians were more likely than non-Appalachians to be hypertensive (30.4%, 95% CI 26.4, 34.3); among them, Medicaid enrollees reported the largest percentage of individuals with hypertension (38.6%, 95% CI 31.6, 45.5). Rural (23.1%, 95% CI 18.8, 27.4) and suburban (25.3%, 95% CI 19.9, 30.7) residents were less likely to have hypertension than those in metropolitan or Appalachian counties. Among suburban and rural residents, those with private insurance coverage were less likely to be hypertensive (suburban: 17.5%, 95% CI 8.5, 26.4; rural: 13.8%, 95% CI 7.6, 20.0) than those in other insurance categories (Table 3).

In the case of coronary heart disease, percentages were relatively similar among the four different county types. Individuals living in suburban areas were slightly more likely than those in metropolitan, suburban, or Appalachian areas to have coronary heart disease (4.6%, 95% CI 2.4, 6.8). Among suburban residents, individuals with non-continuous coverage were more likely than those in other insurance groups to report having coronary heart disease (12.8%, 95% CI 3.1, 22.5) (Table 3).

Diabetes was most prevalent in Appalachian residents (11.9%, 95% CI 9.3, 14.5), and, among them, Medicaid enrollees reported a high prevalence of diabetes (17.0%, 95% CI 12.0, 21.9%). Although the lowest overall percentage of diabetes was observed among rural residents (9.8%, 95% CI 6.6, 13.1), Medicaid enrollees in rural counties had the highest proportion of diabetes (19.0%, 95% CI 9.2, 28.8) (Table 3).

### Risk factors

Obesity was prevalent across all insurance categories. Obesity percentages were highest among Appalachian (33.8%, 95% CI 29.6, 38.0) and suburban (35.8%, 95% CI 29.6, 42.0) residents. Medicaid enrollees in suburban county types were more likely than non-Medicaid

enrollees to be obese (51.6%, 95% CI 38.3, 65.0). Across all county types, the privately insured were the least likely to be obese, with the lowest likelihood found among those residing in rural areas (18.1%, 95% CI 10.0, 26.1) (Table 3).

Smoking was common in Appalachia and rural counties, with nearly half of Appalachians reporting being smokers (49.5%, 95% CI 44.9, 54.1). Across several county types, Medicaid enrollees were the most likely to be smokers, with percentages as high as 65.2% (95% CI 55.1, 75.3) in rural counties. Those who were privately insured reported the lowest percentage of smoking with the lowest observed proportion in suburban residents (21.2%, 95% CI 10.8, 31.6). With the exception of the privately insured, within each county type, all insurance categories had smoking percentages of  $\geq 40\%$  (Table 3).

## DISCUSSION

Findings from the survey showed that the distribution of health outcomes was not uniform across the different insurance categories. Analyses revealed that more than 80% of adults with private insurance were in good health compared with nearly 70% of uninsured adults and 60% of Medicaid enrollees. These findings support existing studies indicating that lower-income adult Medicaid populations are more likely to be in poorer health than either the uninsured or those with private insurance.<sup>14</sup> Specifically, enrollment in Medicaid is often linked to rules that expand eligibility requirements for the disabled and medically needy.<sup>15</sup> If the unhealthy are enrolled by their health-care providers in Medicaid, leaving the healthy but Medicaid eligible without insurance, we should expect Medicaid adults to have overall lower health status. This phenomenon reflects a selection bias, as sick individuals who previously may have been uninsured are now qualified for supplemental security income and, thus, for Medicaid. Interestingly, the results also suggest that having non-continuous coverage or interruptions in health-care coverage could be associated with poorer health status. Like the uninsured, having noncontinuous coverage could translate to increased barriers to care, delays in receiving treatment, and inability to obtain treatment due to cost.<sup>16</sup>

To reduce the effect of confounding due to the low SES of the Medicaid population, analyses were limited to individuals at 90% FPL—the Ohio financial qualifying limit for Medicaid eligibility. For this impoverished group, private insurance was again associated with positive health outcomes. These results are not surprising given the fact that most adults obtain their

private insurance through their employers, implying that these individuals are healthy enough to work. Medicaid enrollees were found to have a greater likelihood of reporting hypertension and heart disease, possibly due to poorer health prior to enrolling in Medicaid. The uninsured were in no worse health than those on Medicaid but reported poorer health outcomes than those with noncontinuous coverage. Typically, the

uninsured are the least likely to use preventive care services.<sup>17</sup> Factors such as lack of coverage and cost are important reasons uninsured low-income individuals cite for not receiving necessary medical care.<sup>18</sup>

A more notable finding from the analyses, however, was the importance of county type and insurance category on health status. In the county type analyses, Medicaid enrollees from Appalachian and rural counties

**Table 3. Prevalence of self-reported good health status, hypertension, coronary heart disease, diabetes, obesity, and current smoking among adult Ohioans,<sup>a</sup> by insurance status and county type classification: Ohio Family Health Survey, 2008<sup>b</sup>**

Insurance category	County type classification			
	Suburb Percent (95% CI)	Rural Percent (95% CI)	Metropolitan Percent (95% CI)	Appalachia Percent (95% CI)
Good health status rating <sup>c</sup>				
Medicaid	64.3 (52.4, 76.1)	54.8 (44.1, 65.5)	65.1 (60.5, 69.7)	52.1 (44.7, 59.5)
Private	90.2 (83.2, 97.2)	86.8 (79.4, 94.1)	84.7 (80.4, 89.0)	75.7 (66.0, 85.3)
Uninsured	71.6 (61.2, 82.0)	69.3 (60.4, 78.2)	68.3 (64.2, 72.5)	68.4 (61.3, 75.7)
Noncontinuous coverage	56.2 (40.9, 71.4)	68.3 (55.4, 81.1)	61.3 (54.0, 68.5)	60.2 (49.8, 70.7)
Overall	72.6 (67.1, 78.1)	70.9 (66.0, 75.9)	69.4 (67.0, 71.9)	62.9 (58.6, 67.2)
Hypertension <sup>d</sup>				
Medicaid	30.0 (18.2, 41.8)	32.9 (22.9, 42.9)	32.4 (27.9, 36.9)	38.6 (31.6, 45.5)
Private	17.5 (8.5, 26.4)	13.8 (7.6, 20.0)	23.7 (18.7, 28.8)	29.9 (19.7, 40.0)
Uninsured	24.8 (15.0, 34.5)	22.6 (15.2, 30.0)	26.1 (22.2, 30.0)	23.5 (17.3, 29.7)
Noncontinuous coverage	35.9 (21.5, 50.3)	28.2 (16.0, 40.0)	31.3 (24.8, 37.7)	29.9 (19.8, 40.0)
Overall	25.3 (19.9, 30.7)	23.1 (18.8, 27.4)	28.1 (25.7, 30.5)	30.4 (26.4, 34.3)
Coronary heart disease <sup>d</sup>				
Medicaid	4.8 (1.1, 8.4)	7.1 (1.1, 13.0)	5.4 (3.4, 7.4)	6.0 (3.5, 8.4)
Private	1.4 (-0.2, 3.0)	1.3 (-0.1, 2.6)	5.2 (2.1, 8.3)	2.3 (0.3, 4.4)
Uninsured	3.5 (-0.2, 7.2)	4.6 (1.2, 7.9)	3.7 (2.0, 5.4)	2.2 (0.8, 3.6)
Noncontinuous coverage	12.8 (3.1, 22.5)	3.6 (-0.1, 7.4)	2.1 (0.8, 3.3)	7.0 (1.6, 12.4)
Overall	4.6 (2.4, 6.8)	4.0 (2.1, 6.0)	4.2 (3.1, 5.3)	4.2 (2.9, 5.5)
Diabetes <sup>d</sup>				
Medicaid	13.7 (6.4, 21.1)	19.0 (9.2, 28.8)	12.7 (9.8, 15.7)	17.0 (12.0, 21.9)
Private	4.4 (-0.4, 9.2)	6.7 (2.2, 11.2)	8.8 (5.5, 12.0)	8.0 (3.3, 12.6)
Uninsured	11.3 (4.2, 18.4)	7.1 (2.5, 11.7)	8.3 (6.1, 10.5)	8.0 (4.0, 12.1)
Noncontinuous coverage	16.1 (5.0, 27.2)	8.6 (3.7, 13.5)	11.5 (7.4, 15.7)	14.2 (6.6, 21.8)
Overall	10.5 (6.9, 14.1)	9.8 (6.6, 13.1)	10.0 (8.6, 11.5)	11.9 (9.3, 14.5)
Obesity <sup>d</sup>				
Medicaid	51.6 (38.3, 65.0)	30.4 (21.0, 39.7)	40.1 (35.2, 45.0)	39.1 (32.1, 46.1)
Private	25.7 (15.1, 36.3)	18.1 (10.0, 26.1)	20.1 (15.3, 25.0)	29.0 (19.0, 39.0)
Uninsured	33.1 (21.9, 44.2)	31.6 (22.2, 40.9)	25.8 (22.0, 29.7)	31.5 (23.9, 39.1)
Noncontinuous coverage	39.6 (24.1, 55.0)	30.0 (17.2, 42.6)	33.3 (26.6, 40.2)	32.5 (22.7, 42.3)
Overall	35.8 (29.6, 42.0)	27.1 (22.2, 32.1)	29.7 (27.2, 32.1)	33.8 (29.6, 38.0)
Current smoker <sup>d</sup>				
Medicaid	50.6 (37.3, 63.9)	65.2 (55.1, 75.3)	51.4 (46.4, 56.4)	51.9 (44.5, 59.4)
Private	21.2 (10.8, 31.6)	47.7 (36.0, 59.4)	22.0 (16.8, 27.3)	37.8 (26.1, 49.5)
Uninsured	49.9 (38.0, 61.9)	47.3 (37.1, 57.4)	46.8 (42.2, 51.4)	52.9 (44.8, 61.1)
Noncontinuous coverage	49.8 (34.3, 65.3)	51.9 (36.9, 66.9)	43.4 (36.0, 50.9)	47.1 (36.2, 58.0)
Overall	41.3 (34.9, 47.7)	52.0 (46.2, 57.8)	43.0 (40.2, 45.6)	49.5 (44.9, 54.1)

<sup>a</sup>Adult Ohioans were defined as respondents aged 18–64 years.

<sup>b</sup>Analysis restricted to individuals at 90% of the federal poverty level.

<sup>c</sup>Good health status rating was defined as a binary yes/no variable, with respondents who answered good, very good, or excellent defined as being in good health and those answering poor to fair defined as not being in good health.

<sup>d</sup>Defined as binary yes/no variables

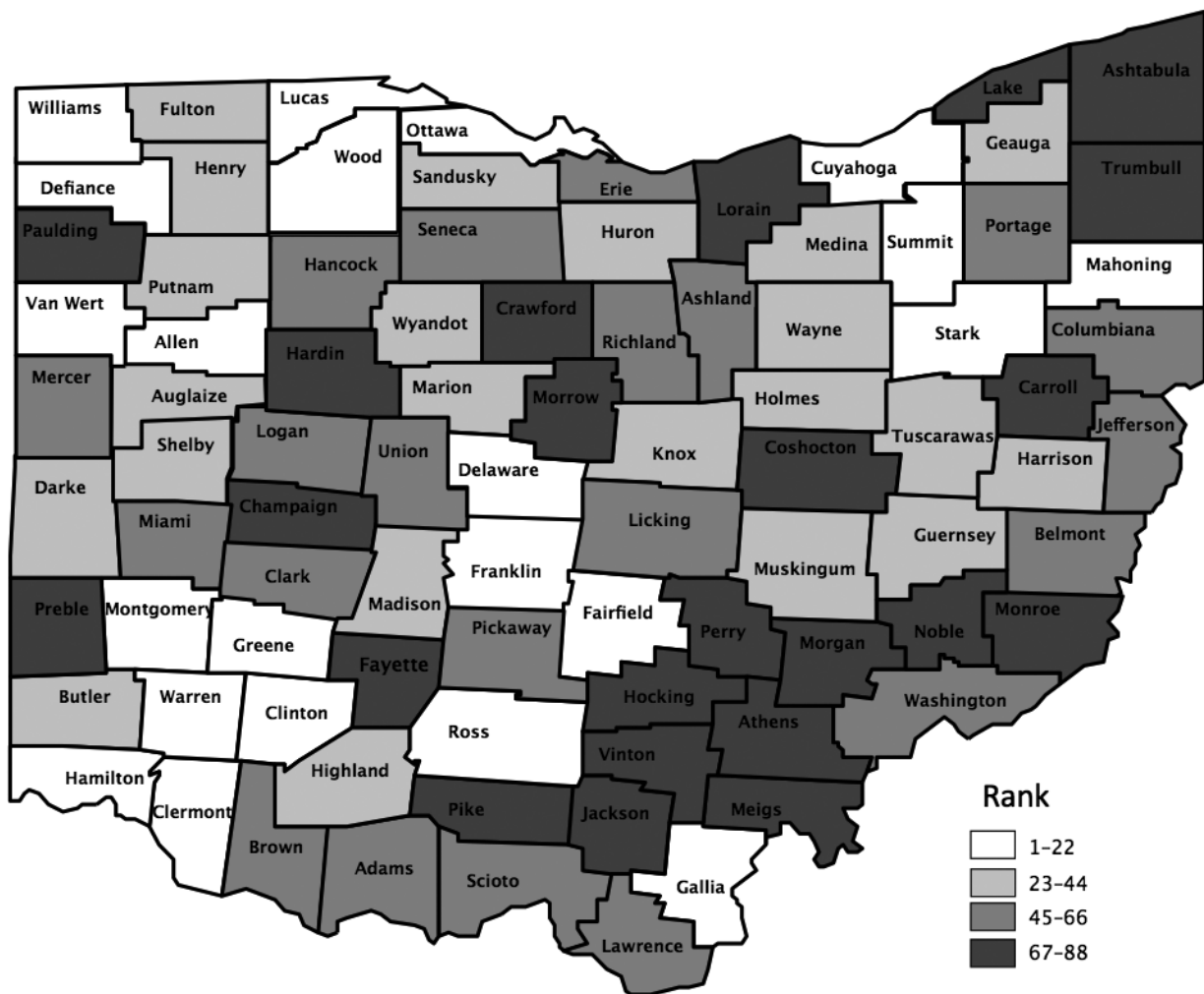
CI = confidence interval

tended to have a greater percentage of respondents with poorer overall health, hypertension, diabetes, and heart disease. Additionally, smoking proportions were highest among Medicaid enrollees, with high percentages observed for Medicaid enrollees living in Appalachian and rural counties. These findings reinforce the results of other studies: Appalachian residents often characterized by lower income and limited education are at an increased risk for health problems.<sup>19,20</sup> Our results contribute to the literature by suggesting that, even with similar public health coverage, Medicaid enrollees in rural and Appalachian counties are more likely to report poorer health outcomes, specifically as related to hypertension, diabetes, and cardiovascular disease, than Medicaid enrollees in other regions. Medicaid enrollees in Appalachian and rural counties may experience more barriers to care due to fewer primary

care providers and geographic isolation, causing them to have to travel long distances for care.<sup>21</sup>

Although studies have demonstrated Medicaid's effectiveness in reducing the health services use gap between the publicly and privately insured (e.g., having a usual source of care and the number of physician visits), disparities in access to care persist, particularly with respect to the inability to receive care.<sup>22-24</sup> Medicaid's low payment rates to providers may limit beneficiaries' choice of providers.<sup>25</sup> In addition, the presence of fewer specialists in rural or isolated regions may compound difficulties in reaching an already limited number of primary care physicians.<sup>26,27</sup> In areas such as rural and Appalachian Ohio counties, fewer primary care providers per capita could translate into greater barriers to care, particularly among an already vulnerable population (Figure 2).

**Figure 2. Ranking of Ohio counties by access to care, 2008<sup>a</sup>**



<sup>a</sup>Ranking of access to care is based on the ratio of primary care physicians to the population at the county level. Sources: County Health Rankings and Roadmaps: University of Wisconsin Population Health Institute and the Robert Wood Johnson Foundation

### Limitations

This study was subject to several limitations. For one, because our analysis was cross-sectional, focusing on survey results from 2008 only, we failed to take into account baseline health and relied instead on health status reported at the time of the survey. A more appropriate analysis would have examined improvement in health as a result of health insurance coverage. Health data collected during several years could have attenuated selection bias, as it would have allowed for the adjustment of health status before the start of insurance coverage. Furthermore, because health insurance selection was nonrandom, endogeneity bias was a possibility. Some researchers have argued that only randomized trials can provide information on the causal relationship between health insurance and health status.<sup>3</sup> Although we tried to minimize confounding due to low SES by restricting our sample to 90% FPL, this restriction was based only on income and did not reflect assets, education level, or employment status. To better control for the effect of low SES on our results, the construction of an SES index variable may have been more appropriate.

Another limitation of our study was that health outcomes were based on self-reports rather than actual medical examinations. The self-report was dependent on whether or not the respondent saw a physician and his/her personal health status assessment. Such self-reported measures could have biased the results, as respondents may not have accurately reported their health status, either due to infrequent doctor visits or, possibly, self-diagnosis.

### CONCLUSION

The majority of Appalachian residents at 90% FPL are enrolled in Medicaid. However, their health status on average is worse than Medicaid enrollees in either suburban or metropolitan counties. These findings raise the possibilities of more entrenched demographic difficulties and a limited provider network in Appalachia and rural areas compared with other regions. Medicaid expansion in these underserved counties could encounter shortages of participating providers; policies aimed at increasing health insurance coverage should also attempt to increase the region's primary care provider base.

Health-care reform is expanding Medicaid eligibility up to 133% FPL. This expansion will be very important for low-income rural populations. Medicaid expansion would reduce economic barriers to care but, in itself, may not be a sufficient enough method for improving overall health status for this low-income rural popula-

tion. Other factors such as additional primary care providers, better access to care, and increased availability of services are also necessary for the improvement of health for this at-risk population. Expanding Medicaid without addressing these factors could stress an already strained system in rural areas of the United States.

The study was approved by the Institutional Review Board of The Ohio State University.

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