

# Rural Versus Urban Use of Traditional and Emerging Tobacco Products in the United States, 2013–2014


Megan E. Roberts, PhD, Nathan J. Doogan, PhD, Cassandra A. Stanton, PhD, Amanda J. Quisenberry, PhD, Andrea C. Villanti, PhD, MPH, Diann E. Gaalema, PhD, Diana R. Keith, PhD, Allison N. Kurti, PhD, Alexa A. Lopez, PhD, Ryan Redner, PhD, Antonio Cepeda-Benito, PhD, and Stephen T. Higgins, PhD

**Objectives.** To examine urban–rural differences in US prevalences of traditional and emerging tobacco product use as well as dual or polytobacco use of these products.

**Methods.** Our data were derived from wave 1 (2013–2014) of the Population Assessment of Tobacco and Health (PATH) Study. We estimated weighted prevalences of adult tobacco use across urban–rural geographies and examined prevalences classified by gender, poverty level, and region of the country.

**Results.** Nationally, cigarette use and smokeless tobacco use, as well as dual or polytobacco use of traditional products, were more prevalent in rural than in urban areas. Conversely, cigarillo and hookah use and dual or polytobacco use of emerging products were higher in urban areas. There was no significant urban–rural difference in use of e-cigarettes. Gender, poverty, and region of the country did not seem to be driving most urban–rural differences, although differences related to cigarillo use and dual or polytobacco use of emerging products became nonsignificant after control for covariates.

**Conclusions.** Our findings highlight important urban–rural differences in tobacco use. Whether the changing tobacco product landscape will contribute to a continuation of rural health disparities remains to be seen. (*Am J Public Health*. 2017;107:1554–1559. doi: 10.2105/AJPH.2017.303967)

 See also Erwin, p. 1533.

The United States has been paying increased attention to the status of rural America, from its economy, to the opioid epidemic, to its role in the 2016 presidential election.<sup>1–4</sup> Yet the public health community has long considered rural communities to be vulnerable populations owing to the disparities that place them at risk for relatively poor morbidity and mortality outcomes. In comparison with nonrural individuals, rural individuals are more likely to have lower incomes and educational attainment, to have more limited access to medical resources, and to be underserved by local health policies.<sup>5–9</sup> Researchers have also discussed a “rural culture” in which many determinants of poor health behaviors are embedded and reinforced.<sup>10</sup>

Enmeshed in these disparities, rural areas of the United States have among the highest

cigarette and smokeless tobacco use rates in the country.<sup>11</sup> For example, in a recent study using national data, the prevalence of daily cigarette use among rural residents was 16.3%, whereas the prevalence among urban residents was 12.3%.<sup>12</sup> Rural past-30-day use of cigarettes and smokeless tobacco was also higher, although there were no urban–rural differences at the national level in use of menthol cigarettes, cigars, or pipes.<sup>12</sup> Other

work examining national trends from 2007 to 2014 has shown that although the prevalence of cigarette smoking is declining in the United States, the decline is more pronounced in urban than in rural populations.<sup>13</sup>

These urban–rural tobacco use differences do not appear to be fully explained by differences in income,<sup>12,13</sup> although prevalences are often highest among the rural poor.<sup>12</sup> Urban–rural differences in tobacco use are also present for both men and women alone (with tobacco use prevalence being particularly high among rural men), and the largest differences appear in the South region of the country.<sup>14</sup> Such findings underscore that there is something unique about rurality as a risk factor given that other factors interact with—but do not seem to drive—urban–rural differences in use of cigarettes and smokeless tobacco.

## EMERGING TOBACCO PRODUCTS

Cigarettes remain the primary product of tobacco use among adults in the United States.<sup>15</sup> However, over the past decade, several emerging products have increased in popularity. These products, primarily e-cigarettes, hookah, and cigarillos, have produced a shift in the tobacco product

### ABOUT THE AUTHORS

Megan E. Roberts, Nathan J. Doogan, and Amanda J. Quisenberry are with the Center of Excellence in Regulatory Tobacco Science, Ohio State University, Columbus. Cassandra A. Stanton is with Westat, Center for Evaluation and Coordination of Training and Research in Tobacco Regulatory Science, Rockville, MD. Andrea C. Villanti, Diann E. Gaalema, Diana R. Keith, Allison N. Kurti, Alexa A. Lopez, Antonio Cepeda-Benito, and Stephen T. Higgins are with the Vermont Center on Tobacco Regulatory Science, University of Vermont, Burlington. Ryan Redner is with the Rehabilitation Institute, Southern Illinois University, Carbondale.

Correspondence should be sent to Megan E. Roberts, PhD, College of Public Health, Ohio State University, Columbus, OH 43210 (e-mail: roberts.1558@osu.edu). Reprints can be ordered at <http://www.ajph.org> by clicking the “Reprints” link.

This article was accepted June 9, 2017.

doi: 10.2105/AJPH.2017.303967

landscape that previously comprised cigarettes, smokeless tobacco, pipes, and cigars. As all emerging tobacco products bear their own health risks and offer additional possibilities for dual or polytobacco use, it is critical to monitor rural trends in the use of these products. However, most research on emerging tobacco products has focused on either overall national trends<sup>15–18</sup> or heavily populated areas,<sup>19–21</sup> with very little emphasis on use of these products in rural areas.

Likewise, although rates of both cigarette and smokeless tobacco use are extremely high in rural populations (e.g., one study on daily tobacco users in Appalachia showed that one third of male participants used smokeless tobacco<sup>22</sup>), research has paid little attention to rural individuals engaged in dual or polytobacco use. In particular, we know of no work showing how emerging tobacco products have been incorporated into rural dual or polytobacco use.

Surveillance of all tobacco product use is critical in addressing and reducing rural health disparities. For example, it is important that any new tobacco policies do not disproportionately benefit urban communities and thereby inadvertently exacerbate existing urban–rural disparities. Prevalence estimates not only provide a better scope of the problem but will help policymakers understand the current reach of tobacco product popularity across all geographies.

## OVERVIEW

Our aim in the present study was to examine urban–rural differences in US use prevalences of both traditional and emerging tobacco products as well as dual or polytobacco use. Given the potential for emerging tobacco products to affect overall rates and urban–rural differences in tobacco use, we sought to distinguish use of traditional products from use of emerging products. In addition, given that previous findings indicate important differences by gender, poverty level, and region of the country,<sup>12,14</sup> we examined urban–rural prevalence further classified according to these key demographic factors.

Our analyses were conducted with adult restricted-use data from the first wave (2013–2014) of the Population Assessment

of Tobacco and Health (PATH) Study.<sup>23</sup> Because PATH is a large, nationally representative study, we were able to conduct a detailed examination of the prevalence of tobacco use in rural American populations.

## METHODS

The PATH Study is an ongoing household-based, nationally representative, longitudinal cohort study of US youths and adults. The purpose of the study, launched in 2011 and sponsored by the National Institutes of Health and the Food and Drug Administration (FDA), is to inform the FDA's regulatory activities under the Family Smoking Prevention and Tobacco Control Act (Public Law 111-31). Data from the first wave (the data used in our study) were collected from September 2013 to December 2014. The study sampled more than 150 000 mailing addresses that (via a 4-stage stratified sampling design) yielded a sample of 45 971 civilian, noninstitutionalized youth and adult respondents. We used data from the 32 320 participating adults (18–90 years of age). An overview by Hyland et al.<sup>24</sup> provides more detailed information on the PATH data, sampling method, and weighting procedures.

## Measures

**Urban and rural.** The PATH sampling procedure employed geographical units called segments, which were based on US Census blocks. A segment was classified as “urban” if the majority of its total population resided in areas classified as urban according to the 2010 census (i.e., a minimum population density of at least 2500 people); all other segments were classified as “not urban” (referred to as “rural” here).

**Tobacco use.** We used the PATH-derived variable for daily cigarette use, which was having smoked at least 100 cigarettes in one's lifetime and now smoking every day. We also used the PATH-derived variable for past-30-day use of cigarettes, e-cigarettes, cigars, cigarillos, pipes, hookah, and smokeless tobacco, which was having used the product at least once within the past 30 days (smokeless tobacco included loose snus, moist snuff, dip, spit, and chewing tobacco). We defined past-

30-day menthol cigarette use as smoking cigarettes within the past 30 days and answering yes to the question “Is your regular brand flavored to taste like menthol or mint?”

**Dual and polytobacco use.** More than 300 unique dual or polytobacco use combinations were reported for this sample.<sup>18</sup> As our main interest was to distinguish use of traditional from emerging tobacco products, we grouped behaviors into 3 dual or polytobacco use types. *Traditional only* referred to individuals who reported using only 2 or more traditional tobacco products (cigarettes, menthol cigarettes, smokeless tobacco, pipes, or cigars) within the past 30 days, *emerging only* referred to individuals who reported using only 2 or more emerging tobacco products (e-cigarettes, cigarillos, or hookah) within the past 30 days, and *mixed* referred to individuals who used 1 or more traditional tobacco products and 1 or more emerging tobacco products within the past 30 days. These 3 dual or polytobacco use categories were mutually exclusive; however, dual or polytobacco users were included among the any-tobacco users described in the preceding paragraph.

**Demographic characteristics.** We used PATH-imputed variables for gender, age, and race/ethnicity. Imputation was performed by initially considering information provided in the PATH household screener and then using statistical imputation methods (a full description of the imputation methods is available in the PATH user guide). Poverty was a PATH-derived variable based on annual household income and dichotomized (below the poverty level versus at or above the poverty level) according to household size and 2015 Department of Health and Human Services poverty guidelines.<sup>25</sup> US Census classifications were used to define the region of the country where the participant resided (Northeast, South, Midwest, or West).

## Analyses

We accessed restricted-use PATH data remotely via a virtual data enclave managed by the Interuniversity Consortium for Political and Social Research. The adult data file provided weights to adjust for nonresponse and PATH's complex sampling design. We weighted our analyses via the methods recommended in the PATH user guide

(balanced repeated replication with Fay’s adjustment set to 0.3).

After demographic information had been obtained, design-based F tests (i.e., corrected weighted Pearson  $\chi^2$  statistics) were used to compare rural versus urban weighted national prevalences for all tobacco products and dual or polytobacco use categories. Next, for each tobacco product and dual or polytobacco use category, we tested for rural versus urban differences within each level of our demographic variables of interest: gender, poverty, and region. Additional analyses involved logistic regression, with urban–rural status predicting tobacco product use while controlling for the effects of potential covariates (age, gender, poverty, and region). All analyses were conducted in Stata version 15 (StataCorp LP, College Station, TX). Because of the multiple comparisons being made, we a priori set a conservative statistical significance threshold of  $P < .01$ .

## RESULTS

Weighted prevalence values for this nationally representative sample indicated an average age of 46.6 years (SD = 0.4; range = 18–90 years). The sample was 52% female and 66% non-Hispanic White, and 25% of the sample was classified as living below the federal poverty level. A more complete description of the PATH sample is available elsewhere.<sup>18</sup> Overall, 21% of the sample was classified as rural, a percentage that aligns closely with national figures reported by the US Census Bureau.<sup>26</sup> Table 1 provides national product-specific weighted

prevalence estimates for each tobacco product and dual or polytobacco use category.

### Urban–Rural Differences

As shown in Table 1, any current use of cigarettes (both daily and in the past 30 days) and smokeless tobacco was more prevalent in rural areas than in urban areas. Among the more pronounced differences, the prevalence of any daily cigarette use was 18.3% in rural areas and 13.5% in urban areas. Smokeless tobacco use was 3 times more prevalent in rural than urban areas (6.3% vs 2.1%). Traditional dual or polytobacco use was also more prevalent in rural areas.

Conversely, use of cigarillos and hookah, as well as dual or polytobacco use of emerging tobacco products, was higher in urban areas. There were no significant urban–rural differences in use of menthol cigarettes, e-cigarettes, cigars, or pipes or in mixed dual or polytobacco use. For all dual or polytobacco use, it was most common for urban individuals to be using at least 2 products from the following combinations: cigarettes and e-cigarettes (5.3%) and cigarettes and cigarillos (3.3%). Among rural individuals, the categories were cigarettes and e-cigarettes (5.2%), cigarettes and cigarillos (2.9%), and cigarettes and smokeless tobacco (2.2%; data not shown in tables).

### Gender, Poverty, and Region

Separate analyses of urban–rural differences among men and women showed that prevalences were generally higher among men (Table 2; Figure A, available as a supplement to the online version of this article at <http://www.ajph.org>). For example, the

prevalence of smokeless tobacco use was 12.0% among rural men and 4.3% among urban men; the corresponding figures among women were 0.7% and 0.2%. The prevalence of e-cigarette use, menthol cigarette use, and mixed dual or polytobacco use was higher among urban than among rural men.

Many urban–rural differences remained when prevalences were categorized according to poverty level (Table 2). For example, daily cigarette use, smokeless tobacco use, and traditional dual or polytobacco use remained higher in rural areas regardless of poverty level. Strikingly, past-30-day use of cigarettes was at 43.3% for rural individuals living below the poverty level. Among those living at or above the poverty level, there was also a slightly higher prevalence of e-cigarette use among urban (6.1%) than among rural (5.1%) participants.

Finally, when urban–rural rates were examined across each region of the country, many national differences remained (Table 2). In particular, rural smokeless tobacco use was higher across all regions, as was urban hookah use. Urban–rural differences in daily cigarette use remained significant among those in the Northeast and South regions; however, there were no significant differences in past-30-day use of cigarettes in any region of the country.

There were also no significant urban–rural differences in e-cigarette, cigar, or pipe use in any region. However, some differences emerged that had not been seen at the national level: there was a higher prevalence of menthol cigarette use in urban areas of the Northeast and Midwest, as well as a higher prevalence of mixed dual or polytobacco use in urban areas of the Northeast. Exploratory

**TABLE 1—National, Rural, and Urban Weighted Prevalences of Adult Tobacco Product Use: Population Assessment of Tobacco and Health (PATH) Study, United States, 2013–2014**

Category	Traditional Tobacco Product Use, % (SE)						Emerging Tobacco Product Use, % (SE)			Dual or Polytobacco Use, % (SE)		
	Cigarettes (Daily)	Cigarettes	Menthol Cigarettes	Smokeless Tobacco	Cigars	Pipes	E-Cigarettes	Cigarillos	Hookah	Traditional Only	Emerging Only	Mixed
Overall	14.4 (0.25)	22.5 (0.31)	6.6 (0.14)	3.0 (0.10)	3.6 (0.10)	0.9 (0.05)	6.7 (0.15)	4.4 (0.10)	2.2 (0.09)	1.4 (0.05)	0.4 (0.03)	8.5 (0.17)
Rural	18.3 (0.73)	24.6 (0.91)	5.8 (0.41)	6.3 (0.31)	3.2 (0.19)	0.9 (0.11)	6.2 (0.31)	3.8 (0.19)	0.9 (0.09)	2.2 (0.14)	0.2 (0.04)	7.8 (0.35)
Urban	13.4 (0.23)	22.0 (0.30)	6.9 (0.15)	2.1 (0.11)	3.6 (0.11)	0.9 (0.05)	6.8 (0.16)	4.6 (0.12)	2.5 (0.11)	1.2 (0.05)	0.4 (0.03)	8.7 (0.19)
Difference test P	<.001	.005	.03	<.001	.07	.74	.08	<.001	<.001	<.001	.005	.02

Note. All values are for past-30-day use unless otherwise specified.

**TABLE 2—Rural and Urban Weighted Prevalences of Adult Tobacco Product Use, by Gender, Poverty, and Region: Population Assessment of Tobacco and Health (PATH) Study, United States, 2013–2014**

Variable	Traditional Tobacco Product Use, % (SE)						Emerging Tobacco Product Use, % (SE)			Dual or Polytobacco Use, % (SE)		
	Cigarettes (Daily)	Cigarettes	Menthol Cigarettes	Smokeless Tobacco	Cigars	Pipes	E-Cigarettes	Cigarillos	Hookah	Traditional Only	Emerging Only	Mixed
<b>Gender and area of residence</b>												
Male rural	19.4 (0.84)*	26.6 (1.1)	5.8 (0.53)*	12.0 (0.71)*	5.6 (0.33)	1.5 (0.18)	6.1 (0.35)*	5.7 (0.29)	1.1 (0.14)*	3.9 (0.30)*	0.3 (0.08)	9.0 (0.44)*
Male urban	15.6 (0.29)*	25.8 (0.40)	7.5 (0.21)*	4.3 (0.22)*	6.5 (0.21)	1.6 (0.10)	7.9 (0.23)*	6.6 (0.22)	3.1 (0.16)*	2.2 (0.11)*	0.5 (0.05)	11.3 (0.30)*
Female rural	17.3 (0.86)*	22.7 (1.0)*	5.9 (0.40)	0.7 (0.16)*	0.9 (0.12)	0.3 (0.07)	6.2 (0.40)	1.9 (0.21)*	0.7 (0.09)*	0.5 (0.10)	0.1 (0.03)*	6.6 (0.39)
Female urban	11.4 (0.29)*	18.5 (0.36)*	6.3 (0.19)	0.2 (0.04)*	1.0 (0.06)	0.2 (0.03)	5.8 (0.19)	2.8 (0.10)*	2.0 (0.10)*	0.3 (0.04)	0.3 (0.04)*	6.4 (0.18)
<b>Poverty level status and area of residence</b>												
Below rural	32.0 (1.79)*	43.3 (1.92)*	11.6 (0.84)	7.1 (0.80)*	4.6 (0.43)	1.5 (0.20)	11.4 (0.73)	7.9 (0.61)	1.9 (0.25)*	3.7 (0.33)*	0.3 (0.36) *	15.2 (0.80)
Below urban	20.4 (0.56)*	34.7 (0.70)*	11.8 (0.41)	2.2 (0.18)*	4.5 (0.21)	1.5 (0.11)	9.4 (0.39)	9.3 (0.35)	4.4 (0.25)*	1.6 (0.12)*	0.7 (0.21) *	14.3 (0.50)
At or above rural	15.1 (0.64)*	20.2 (0.84)	4.6 (0.40)	6.3 (0.32)*	3.1 (0.19)	0.7 (0.11)	5.1 (0.32)*	2.8 (0.21)	0.6 (0.09)*	1.9 (0.19)*	0.2 (0.13)	6.1 (0.38)
At or above urban	11.4 (0.26)*	18.4 (0.31)	5.6 (0.15)	2.3 (0.12)*	3.5 (0.13)	0.7 (0.05)	6.1 (0.17)*	3.2 (0.12)	2.0 (0.10)*	1.1 (0.06)*	0.3 (0.08)	7.2 (0.19)
<b>Region and area of residence</b>												
Northeast rural	16.6 (1.16)*	21.9 (1.45)	5.1 (0.56)*	4.4 (0.67)*	3.5 (0.40)	1.1 (0.24)	4.5 (0.38)	3.2 (0.45)	0.8 (0.11)*	1.8 (0.15) *	0.3 (0.09)	6.1 (0.42)*
Northeast urban	12.9 (0.63)*	21.3 (0.77)	7.5 (0.36)*	1.3 (0.19)*	4.4 (0.26)	0.6 (0.10)	5.0 (0.35)	4.2 (0.29)	2.9 (0.28)*	1.2 (0.14) *	0.4 (0.07)	7.6 (0.34)*
Midwest rural	19.1 (1.8)	25.8 (1.77)	5.2 (0.92)*	6.9 (0.58)*	3.9 (0.41)	1.0 (0.30)	8.0 (0.78)	3.8 (0.36)*	0.9 (0.13)*	2.9 (0.43)*	0.3 (0.12)	8.7 (0.74)
Midwest urban	16.5 (0.54)	24.6 (0.66)	8.2 (0.40)*	2.4 (0.16)*	3.7 (0.23)	1.0 (0.11)	7.4 (0.37)	4.9 (0.24)*	2.1 (0.16)*	1.5 (0.11)*	0.4 (0.09)	9.5 (0.40)
South rural	20.0 (1.18)*	26.8 (1.50)	7.2 (0.65)	7.3 (0.52)*	2.9 (0.32)	0.8 (0.11)	6.2 (0.41)	4.3 (0.30)*	0.9 (0.18)*	2.2 (0.19) *	0.2 (0.05)*	8.4 (0.56)
South urban	14.0 (0.50)*	23.3 (0.64)	7.9 (0.30)	2.6 (0.24)*	3.7 (0.18)	0.9 (0.08)	7.4 (0.28)	5.5 (0.27)*	2.4 (0.18)*	1.2 (0.07) *	0.4 (0.05)*	9.7 (0.35)
West rural	12.3 (1.4)	17.6 (2.4)	2.8 (0.32)	4.0 (0.96)*	2.7 (0.29)	1.0 (0.27)	5.2 (0.94)	2.3 (0.27)*	1.1 (0.24)*	... <sup>a</sup>	... <sup>a</sup>	... <sup>a</sup>
West urban	10.4 (0.57)	18.7 (0.81)	4.0 (0.27)	1.8 (0.20)*	2.9 (0.19)	0.8 (0.12)	6.7 (0.39)	3.5 (0.23)*	2.8 (0.26)*	... <sup>a</sup>	... <sup>a</sup>	... <sup>a</sup>

Note. All values are for past-30-day use unless otherwise specified.

<sup>a</sup>One or more cell sizes for this urban–rural comparison did not meet the minimum threshold for disclosure.

\* $P < .01$  (for urban–rural comparison).

analyses examining use among young adults (18–28 years of age) indicated that although prevalences in both rural and urban areas were higher than the national average, the pattern of significant urban–rural differences was very similar to what was found nationally; the exception was cigarillo use, in which there were no urban–rural differences.

We found a very similar pattern in our logistic regression analyses, which examined the effects of urban–rural status while controlling for age, gender, poverty, and region (Table 3). Specifically, we found that the prevalence of any current cigarette use (both daily and in the past 30 days), smokeless tobacco use, and traditional dual or polytobacco use was significantly higher among individuals living in rural compared with urban areas. Hookah use remained higher among

those in urban areas. The only major divergences from the results presented in Table 1 were that urban–rural differences in cigarillo use and dual or polytobacco use of emerging products were no longer significant.

## DISCUSSION

Consistent with previous research,<sup>11–14</sup> we found that current cigarette use and smokeless tobacco use were more prevalent in rural areas than in urban areas. This study is among the first to report that dual or polytobacco use of traditional products is also more prevalent in rural areas. Novel findings of our study are that current cigarillo use and hookah use, as well as dual or polytobacco

use of emerging products, appear to be higher in urban areas.

We found few urban–rural differences in use of e–cigarettes (with the exception of a slightly higher prevalence among men and individuals above the poverty level). However, the prevalence of e–cigarette use was not negligible; the value was as high as 11.4% among rural individuals living below the poverty level. Moreover, the most common dual or polytobacco use combination in both urban and rural areas was use of at least both cigarettes and e–cigarettes. Such findings suggest that the use of e–cigarettes extends well beyond urban centers. There are likely a multitude of factors contributing to why e–cigarettes have been equally adopted in rural and urban areas, including a desire to quit smoking and product marketing.

**TABLE 3—Odds Ratios for the Effects of Urban–Rural Status in Logistic Regressions Predicting Tobacco Product Use: Population Assessment of Tobacco and Health (PATH) Study, United States, 2013–2014**

Dependent Variable	Urban–Rural (Ref: Urban), OR (95% CI)
<b>Traditional tobacco product use</b>	
Cigarettes (Daily)	1.50 (1.36, 1.66)
Cigarettes	1.25 (1.13, 1.38)
Menthol Cigarettes	0.86 (0.74, 1.01)
Smokeless Tobacco	3.35 (2.81, 3.99)
Cigars	0.93 (0.82, 1.05)
Pipes	1.07 (0.83, 1.38)
<b>Emerging tobacco product use</b>	
E-Cigarettes	1.07 (0.96, 1.20)
Cigarillos	0.93 (0.83, 1.04)
Hookah	0.48 (0.37, 0.62)
<b>Dual or polytobacco use</b>	
Traditional Only	1.93 (1.63, 2.29)
Emerging Only	0.81 (0.54, 1.22)
Mixed	1.02 (0.92, 1.12)

Note. CI = confidence interval; OR = odds ratio. All values are for past-30-day use unless otherwise specified. Analyses controlled for age, gender, poverty, and region.

Future research will need to investigate the factors contributing to uptake of emerging tobacco products among rural populations.

Current use of some tobacco products, including smokeless tobacco, tended both to be more prevalent and to show greater urban–rural percentage point differences among men. Depending on the product, urban–rural differences were also often more pronounced for a particular poverty level or region of the country. Yet, the fact that most differences remained when further classified according to demographic variables suggests that these additional variables were not driving urban–rural effects. For example, although past-30-day cigarette use was higher among individuals living below the poverty level, use remained significantly higher among the rural (43.3%) versus the urban poor subgroups (34.7%). This interpretation regarding demographic variables was also supported by our logistic regression analyses, which indicated greater rural use of cigarettes and smokeless tobacco and greater traditional dual or polytobacco use after controlling for covariates.

Findings for hookah, cigars, and pipes were consistent: across all demographic levels

tested, hookah use was significantly higher in urban areas, whereas cigar use and pipe use did not exhibit any significant urban–rural differences. Urban–rural differences in cigarillo use and dual or polytobacco use of emerging products became nonsignificant after control for covariates. Overall, our findings support previous arguments that there may be something unique about rurality as a risk factor<sup>12,13</sup> and suggest that tailored interventions accounting for “rural culture”<sup>10</sup> may have promise.

### Public Health Implications

Our results have important implications for tobacco-related health disparities. Specifically, our findings suggest that the higher prevalence of rural, compared with urban, cigarette and smokeless tobacco use that has been reported in previous research<sup>11–14</sup> still persists. Likewise, given that dual or polytobacco use of traditional tobacco products (e.g., using both cigarettes and smokeless tobacco) is higher in rural areas, this discrepancy may increase health risks<sup>27</sup> and interfere with cessation.<sup>28,29</sup>

Although our findings suggest that use of certain products (menthol cigarettes, cigarillos, hookah) is more common in urban populations, the use of e-cigarettes appears to have similar prevalence in urban and rural populations. Longitudinal data are needed to examine whether use of e-cigarettes will create a shift away from the predominance of cigarette and smokeless tobacco use that has been the mainstay of rural tobacco users for decades. The question of whether e-cigarette use aids cessation is complex and continues to be debated<sup>30,31</sup>; how the use of e-cigarettes and other emerging tobacco products will contribute to the rise or decline of rural tobacco use remains to be seen. More broadly, how the changing landscape of tobacco products will contribute to the currently higher rural rates of tobacco-related morbidity and mortality<sup>14,32,33</sup> is a question for future research.

Our results also underscore the importance of regulatory policies that will benefit both urban and rural communities. Signed into law in 2009, the Family Smoking Prevention and Tobacco Control Act gives the FDA authority to regulate the manufacturing, distribution, and marketing of cigarettes and

traditional smokeless tobacco products. Yet a subsequent “deeming rule” has only recently extended the FDA’s authority to regulate emerging tobacco products as well as pipes and cigars. Given the prevalences we found for these products, it is critical that the FDA fully implement the deeming rule and build on it by imposing restrictions that are in accordance with the emerging evidence on the products’ health effects.

Furthermore, it is vital that any new tobacco policies do not inadvertently exacerbate existing urban–rural disparities by disproportionately benefiting urban communities. Empirically driven research results, including the findings of this study, are critically important in guiding the FDA’s ability to implement regulations.

### Limitations

In this study, we relied on the PATH-defined urban–rural dichotomy, which belies a more continuous distinction in urbanicity versus rurality. For example, because the greatest health differences are often seen between rural and suburban areas,<sup>14,34</sup> future work involving more nuanced taxonomies may reveal sharper disparities. Likewise, although data confidentiality restrictions prevented us from parsing our groupings into smaller units (e.g., high-poverty men, division of the country rather than region), it is worth focusing on such groups in targeted studies. We used broad categories to examine dual or polytobacco use in terms of traditional-only versus emerging-only products. Although a more nuanced examination of specific dual or polytobacco use combinations was beyond the scope of our study, such analyses have been conducted at the national level in other research.<sup>18,35</sup>

### Conclusions

Rural Americans remain an at-risk segment of the US population in need of more attention from tobacco control efforts. Overall, our results support previous findings of greater cigarette use and smokeless tobacco use in rural areas and extend these findings by indicating that dual or polytobacco use of traditional products is greater in rural areas as well. In addition, our results indicate that e-cigarette use is similar in urban and rural US communities. Understanding urban–rural

differences in use of tobacco products will provide a clearer picture of an important contributor to health disparities in the United States. **AJPH**

## CONTRIBUTORS

M. E. Roberts conducted the statistical analyses and drafted the article. M. E. Roberts and N. J. Doogan participated in the design of the study. All of the authors read and edited drafts of the article.

## ACKNOWLEDGMENTS

This work was supported by the National Cancer Institute (grant P50CA180908), the National Institute on Drug Abuse (grant P50DA036114), and the Center for Evaluation and Coordination of Training and Research in Tobacco Regulatory Science (grant 1U54CA189222-01).

## HUMAN PARTICIPANT PROTECTION

No protocol approval was needed for this study because de-identified data were used.

## REFERENCES

- Keller J, Pearce A. This small Indiana county sends more people to prison than San Francisco and Durham, N.C., combined. Why? Available at: <http://www.nytimes.com/2016/09/02/upshot/new-geography-of-prisons.html>. Accessed July 5, 2017.
- O'Brien D. Overcoming opioid overdose in rural America. Available at: <https://www.whitehouse.gov/blog/2015/09/21/overcoming-opioid-overdose-rural-america>. Accessed July 5, 2017.
- Badger E, Bui Q, Pearce A. The election highlighted a growing rural-urban split. Available at: <http://www.nytimes.com/2016/11/12/upshot/this-election-highlighted-a-growing-rural-urban-split.html>. Accessed July 5, 2017.
- Keyes KM, Cerdá M, Brady JE, Havens JR, Galea S. Understanding the rural-urban differences in nonmedical prescription opioid use and abuse in the United States. *Am J Public Health*. 2014;104(2):e52-e59.
- Byun S, Meece JL, Irvin MJ. Rural-nonrural disparities in postsecondary educational attainment revisited. *Am Educ Res J*. 2012;49(3):412-437.
- Caldwell JT, Ford CL, Wallace SP, Wang MC, Takahashi LM. Intersection of living in a rural versus urban area and race/ethnicity in explaining access to health care in the United States. *Am J Public Health*. 2016;106(8):1463-1469.
- US Department of Agriculture. Geography of poverty. Available at: <https://www.ers.usda.gov/topics/rural-economy-population/rural-poverty-well-being/geography-of-poverty.aspx>. Accessed July 5, 2017.
- McMillen R, Breen J, Cosby AG. Rural-urban differences in the social climate surrounding environmental tobacco smoke: a report from the 2002 Social Climate Survey of Tobacco Control. *J Rural Health*. 2004;20(1):7-16.
- Northridge ME, Vallone D, Xiao H, et al. The importance of location for tobacco cessation: rural-urban disparities in quit success in underserved West Virginia counties. *J Rural Health*. 2008;24(2):106-115.
- Hartley D. Rural health disparities, population health, and rural culture. *Am J Public Health*. 2004;94(10):1675-1678.
- Vander Weg MW, Cunningham CL, Howren MB, Cai X. Tobacco use and exposure in rural areas: findings from the Behavioral Risk Factor Surveillance System. *Addict Behav*. 2011;36(3):231-236.
- Roberts ME, Doogan NJ, Kurti AN, et al. Rural tobacco use across the United States: how rural and urban areas differ, broken down by census regions and divisions. *Health Place*. 2016;39:153-159.
- Doogan NJ, Roberts ME, Wewers ME, et al. A growing geographic disparity: rural and urban cigarette smoking trends in the United States. *Prev Med*. 2017 [Epub ahead of print].
- Meit M, Knudson A, Gilbert T, et al. The 2014 update of the Rural-Urban Chartbook. Available at: [https://www.cdc.gov/nchs/data/data\\_access\\_files/2014-rural-urban-chartbook-update.pdf](https://www.cdc.gov/nchs/data/data_access_files/2014-rural-urban-chartbook-update.pdf). Accessed July 5, 2017.
- Agaku IT, King BA, Husten CG, et al. Tobacco product use among adults—United States, 2012–2013. *MMWR Morb Mortal Wkly Rep*. 2014;63(25):542-547.
- Bonhomme MG, Holder-Hayes E, Ambrose BK, et al. Flavoured non-cigarette tobacco product use among US adults: 2013–2014. *Tob Control*. 2016;25(suppl 2):ii4-ii13.
- Popova L, Ling PM. Alternative tobacco product use and smoking cessation: a national study. *Am J Public Health*. 2013;103(5):923-930.
- Kasza KA, Ambrose BK, Conway KP, et al. Tobacco-product use by adults and youths in the United States in 2013 and 2014. *N Engl J Med*. 2017;376(4):342-353.
- Anand V, McGinty KL, O'Brien K, Guenther G, Hahn E, Martin CA. E-cigarette use and beliefs among urban public high school students in North Carolina. *J Adolesc Health*. 2015;57(1):46-51.
- Latimer LA, Batanova M, Loukas A. Prevalence and harm perceptions of various tobacco products among college students. *Nicotine Tob Res*. 2014;16(5):519-526.
- Mantey DS, Harrell MB, Case K, Crook B, Kelder SH, Perry CL. Subjective experiences at first use of cigarette, e-cigarettes, hookah, and cigar products among Texas adolescents. *Drug Alcohol Depend*. 2017;173:10-16.
- Wewers ME, Ahijevych KL, Chen MS, Dresbach S, Kihm KE, Kuun PA. Tobacco use characteristics among rural Ohio Appalachians. *J Community Health*. 2000;25(5):377-388.
- US Department of Health and Human Services. Population Assessment of Tobacco and Health (PATH) Study restricted-use files. Available at: <http://www.icpsr.umich.edu/icpsrweb/NAHDAP/studies/36231>. Accessed July 5, 2017.
- Hyland A, Ambrose BK, Conway KP, et al. Design and methods of the Population Assessment of Tobacco and Health (PATH) Study. *Tob Control*. 2017;26(4):371-378.
- Burwell SM. Annual update of the HHS poverty guidelines. *Fed Regist*. 2015;80:3236-3237.
- US Census Bureau. 2010 census urban and rural classification and urban area criteria. Available at: <https://www.census.gov/geo/reference/ua/urban-rural-2010.html>. Accessed July 5, 2017.
- Teo KK, Ounpuu S, Hawken S, et al. Tobacco use and risk of myocardial infarction in 52 countries in the INTERHEART study: a case-control study. *Lancet*. 2006;368(9536):647-658.
- Messer K, Vijayaraghavan M, White MM, et al. Cigarette smoking cessation attempts among current US smokers who also use smokeless tobacco. *Addict Behav*. 2015;51:113-119.
- Tomar SL, Alpert HR, Connolly GN. Patterns of dual use of cigarettes and smokeless tobacco among US males: findings from national surveys. *Tob Control*. 2010;19(2):104-109.
- Harrell PT, Simmons VN, Correa JB, Padhya TA, Brandon TH. Electronic nicotine delivery systems ("e-cigarettes"): review of safety and smoking cessation efficacy. *Otolaryngol Head Neck Surg*. 2014;151(3):381-393.
- Kalkhoran S, Glantz SA. E-cigarettes and smoking cessation in real-world and clinical settings: a systematic review and meta-analysis. *Lancet Respir Med*. 2016;4(2):116-128.
- Singh GK, Williams SD, Siahpush M, Mulhollen A. Socioeconomic, rural-urban, and racial inequalities in US cancer mortality: part i—all cancers and lung cancer and part ii—colorectal, prostate, breast, and cervical cancers. *J Cancer Epidemiol*. 2011;2011:107497.
- James WL. All rural places are not created equal: revisiting the rural mortality penalty in the United States. *Am J Public Health*. 2014;104(11):2122-2129.
- Eberhardt MS, Pamuk ER. The importance of place of residence: examining health in rural and nonrural areas. *Am J Public Health*. 2004;94(10):1682-1686.
- Lee YO, Hebert CJ, Nonnemaker JM, Kim AE. Multiple tobacco product use among adults in the United States: cigarettes, cigars, electronic cigarettes, hookah, smokeless tobacco, and snus. *Prev Med*. 2014;62:14-19.