Short communication

Tobacco Quitline utilization compared with cigarette smoking prevalence in Virginia across rurality and Appalachian Status, 2011–2019

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ABSTRACT

Introduction: While cigarette smoking rates have declined, rural and Appalachian populations in the United States have not seen similar decreases. Quitline programs are promising strategies in reducing disparities in these areas, but research on their usage is limited.

Methods: We employed Small Area Estimation on the Virginia Behavioral Risk Factor Surveillance System (2011–2019) to estimate county-level smoking prevalence and utilized The Quit Now Virginia Quitline data (2011–2019) to estimate Quitline users. We analyzed differences in Quitline utilization by rurality and Appalachian status using statistical t-tests. Stepwise regression assessed the absolute estimate of county features, including poverty rate, tobacco retailer density, physician availability, coal mining industry, and tobacco agriculture, on Quitline usage.

Results: While the average smoking rate overall was 15.3 %, only 7.4 % of smokers accessed Quitline services from 2011 to 2019. Appalachian regions exhibited higher smoking rates (20.9 %) and lower quitline usage (4.8 %) compared to non-Appalachian areas (14 % smoking prevalence, 8 % quitline usage). Rural regions had higher smoking prevalence (19.0 %) than urban areas (12.9 %), but no significant difference in Quitline utilization (7.6 % vs. 7.2 %, p = 0.7). Stepwise regression revealed counties with more tobacco agriculture had 3.2 % (p = 0.04) lower Quitline utilization. Also, more physicians availability in the county was associated with 3.9 % higher Quitline usage (p = 0.03) and Appalachian counties exhibited a 3.6 % lower Quitline usage rate compared to non-Appalachian counties.

Conclusion: A significant gap exists between cigarette smoking prevalence and Quitline utilization, particularly in underserved rural and Appalachian areas, despite no clear barriers to accessing this remote cessation resource.

Implication: The study underscores persistent disparities in smoking rates, with rural and Appalachian regions in the United States facing higher smoking prevalence and limited utilization of Quitline services. Despite no clear barriers to access, the gap between smoking prevalence and Quitline usage remains significant, particularly in underserved areas. Tailoring interventions to address regional disparities and factors like tobacco agriculture and physician availability is essential to reduce smoking rates and improve Quitline utilization in these communities.

1. Introduction

While overall prevalence of cigarette smoking among adults has decreased dramatically (Cornelius et al., 2023), those with lower incomes and individuals residing within underserved areas such as rural areas and have not experienced these declines (Nighbor et al., 2018). Rural areas face distinct challenges, including limited healthcare access, fewer smoking cessation programs, cultural norms that reinforce smoking, and economic reliance on tobacco agriculture (Centers for Disease Control and Prevention, 2023). This disparity if particularly evident in rural Appalachian, a region in the eastern side of the United States (US) that includes 13 states and follows the Appalachian mountains (Cornelius et al., 2023). Perhaps due to a blend of socioeconomic disadvantage (Gupta et al., 2020), rurality, and historical ties to resource extraction industries like coal mining, smoking rates in Appalachia rank among the highest in the nation (Pilehvari et al., 2023).

Individuals living in Appalachia begin smoking at an earlier age, report higher rates of daily smoking (Pinsker et al., 2015), and have lower rates of achieving abstinence (Cardarelli et al., 2021). As a result, adult smokers living in rural Appalachia show disparate rates of disease attributable to smoking (Beatty et al., 2019), potentially due to limited access to smoking cessation resources in these medically underserved areas (Anderson and Zhu, 2007). Tobacco quitlines have been identified as a means for overcoming tobacco use disparities among underserved populations such as rural and Appalachian areas.

Individuals utilizing quitline services are 60 % more likely to achieve abstinence relative to those making an unaided quit attempt (Fiore, 2009). However, there is limited research examining the extent to which quitline services are utilized by tobacco users residing in rural or Appalachian regions. This study utilizes 2011 to 2019 data from the Quit Now Virginia Quitline (VAQL), a state quitline within the eastern region of the US, to test whether individuals in rural, Appalachian regions have lower VAQL utilization controlling for unique county features such as presence of tobacco agriculture and coal mining industries.

2. Methods

2.1. Data

Quitline Users. The data on individuals who were cigarette users aged 18 + years old and used the Quitline services per county was acquired from VAQL for the years 2011 and 2019. Only the first engagement call per person was utilized.

Cigarette Smoking Prevalence. We estimated the prevalence of cigarette smoking at the county level in the state of Virginia within the US using the restricted access Behavioral Risk Factor Surveillance System (BRFSS) data from 2011 to 2019. Current cigarette smokers were defined as adults (at least 18 years of age) who reported having smoked more than 100 cigarettes in their lifetime and currently smoked either "every day" or "some days." Since the BRFSS survey is primarily designed to provide reliable estimates at the state level, the sample sizes for smaller areas such as counties are insufficient to produce accurate estimates. To overcome this limitation, we utilized the Small-Area Estimation (SAE) method (Rao and Molina, 2015) to estimate smoking prevalence rates at the county level. For counties with missing or small sample sizes, we followed standard procedures and combined BRFSS data from 2011 to 2019 into three time periods (2011–2013, 2014–2016, 2017–2019) to ensure reliable estimates. In our SAE analysis, we adhered to the established methodology established by Park et al., 2004 (Park et al., 2004), and frequently used in the literature (Zhang et al., 2014), and used county-level poverty rates (below 150 % of the federal poverty level) derived from the American Community Survey 5-year estimates as our county characteristics. All analyses incorporated survey weights. By utilizing the smoking prevalence rates estimated for each county and the county population data published by the US Census Bureau, we calculated the total population of cigarette users for each county.

County Quitline Utilization Rate Per Cigarette Smoking Population. We determined the proportion of cigarette users who sought assistance from the Quitline service, by dividing the number of Quitline callers by the population of cigarette smokers in each county.

2.2. Other variables

County Socioeconomic Features. We obtained socioeconomic data for counties from the US Census Bureau, sourced from 5-year estimates of the American Community Survey Data for the years 2013, 2016, and 2019, to be aligned with the end year of our BRFSS combined time interval. The chosen socioeconomic indicators include percentage of the population with a high school diploma or less, the percentage of the population below the poverty line, the unemployment rate, and the percentage of uninsured individuals.

Urban-Rural Classification. We classified counties as urban or rural using the U.S. Rural-Urban Continuum Codes (2013), with code values 1–3 classified as urban and code values 4–9 classified as rural. Counties were considered Appalachian or non-Appalachian based on the Appalachian Regional Commission database.

Tobacco Agriculture. Using the latest available tobacco agriculture data (2017) from the U.S. Department of Agriculture's National Agricultural Statistics service, we identified counties with commercial tobacco agriculture harvest.

Physician Availability. The number of physicians per 100,000 residents at county level (2019) was obtained from Area Health Resource files administered by Health Resources and Services Administration (Area Health Resources Files. Accessed June 27, 2023).

Coal Mining Industry. The presence of coal mining industry in each county was obtained from the Quarterly Mine Employment and Coal Production Report (2015) of the U.S. Department of Labor (Mine Safety and Health Administration (MSHA), 2023).

Density of Tobacco Retailers. The density of tobacco retailers was defined as number of tobacco retailers per 1000 residents in a county (Counter Tobacco, 2023).

2.3. Statistical analysis

We conducted statistical t-tests to examine statistical distinctions in VAQL service utilization and cigarette smoking prevalence between counties by rurality and Appalachian status. Multiple regression analyses were used to examine the impact and association of various county features on VAQL utilization rates while controlling for rurality and Appalachia status. County-level clustered robust standard errors were used in all analysis (Wooldridge, 2010). To account for potential dependency between the different county features such as percentage of population with less than high school education and percentage of population below the poverty line or unemployment rate, we performed stepwise multiple regression to select the statistically significant predictors and refine our models automatically within the regression analyses (Frank, 2015). The stepwise regression provides absolute estimation of the contribution of county features on VAQL utilization. We performed all the analyses and mapping in Stata version 16 (StataCorp., 2019). Study procedures were approved by the Virginia Department of Health and the University of Virginia Institutional Review Boards.

3. Results

Fig. 1 provides a comprehensive overview of the cigarette usage patterns and VAQL service utilization across different counties in Virginia, with a particular focus on the rural and Appalachian regions. It reveals a disparity between high smoking prevalence and low VAQL service usage in these counties. Table 1 presents the summary statistics of VAQL utilization rate and cigarette smoking prevalence, and county features by Appalachian status and rurality.

Overall, while the average rate of cigarette smoking in Virginia was 15.3 %, only 7.4 % of smokers sought help from the VAQL services from 2011 to 2019. This discrepancy was highest in the Appalachian areas, where smoking prevalence was an average of 20.9 % and where only 4.8 % of cigarette smokers in this region utilized the VAQL services. Conversely, non-Appalachian regions had a cigarette usage rate of 14 %, with 8.0 % of individuals utilizing VAQL services. There was a statistically significant difference in the utilization of VAQL services between Appalachian and non-Appalachian counties (p < 0.01, Panel A Table 1). In terms of the other county characteristics, Appalachian regions exhibited a greater proportion of individuals with less than a high school education, a lower count of physicians, and a higher percentage of uninsured residents as compared with non-Appalachian regions. Additionally, Appalachian areas had a higher density of tobacco retailers, a higher presence of the coal mining industry, and higher prevalence of
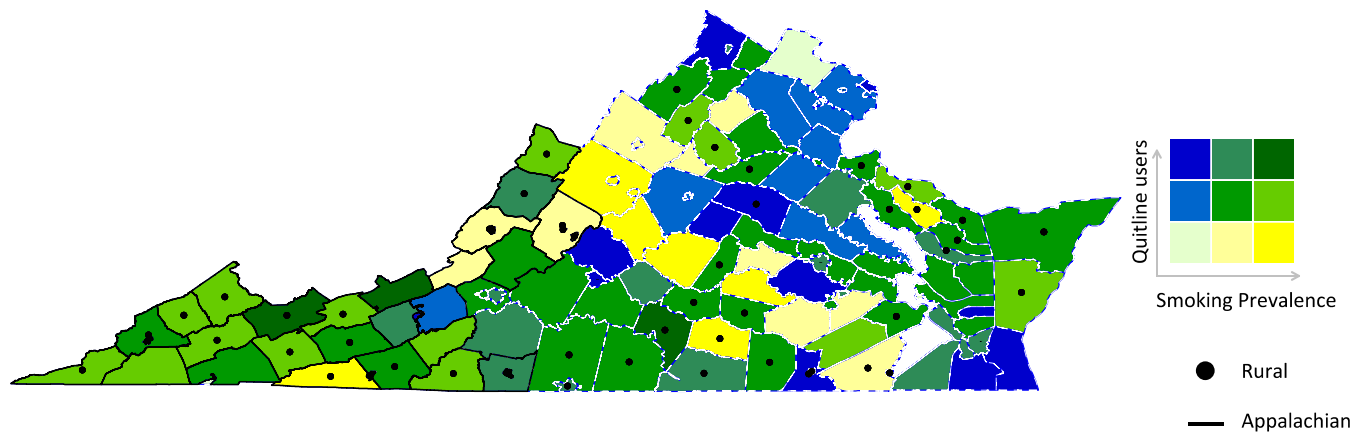
Fig. 1. Quitline usage rate among cigarette smoker and cigarette smoking prevalence across Virginia by Appalachian status and Rurality between 2017 and 2019. Note: The cigarette smoking prevalence was estimated using the small area estimation method. The Quitline service utilization was obtained from the Quit Now Virginia Quitline (VAQL) collected between the years 2017 through 2019. We based urban–rural classifications on the 2013 urban–rural continuum codes developed by the Department of Agriculture and the Rural Health Research Center. Counties with code values of 1–3 are classified as urban, and those with code values of 4–9 are considered as rural. We obtained county centroid locations from US Census Bureau shapefiles.

Table 1

Summary statistics of smoking prevalence and proportion of Quitline users by rurality and Appalachian status and Multiple regression analysis of county-level features associated with VAQL usage rate, 2011–2019.

	Panel A: Unadjusted analysis								Panel B: Adjusted Analysis	
	Appalachian Status			Rurality				Overall	Multiple regression	
	Non-Appalachian	Appalachian	P-value	Rural	Urban	P-value			Full model	Stepwise regression
VAQL utilization rate [a]	8.0 (13.2)	4.8 (3.9)	<0.0	7.6 (13.4)	7.2 (11.1)	0.7		7.4 (12.0)		
% of Cigarette smokers	14.0 (8.2)	20.9 (6.5)	<0.0	19.0 (9.0)	12.9 (6.8)	<0.0		15.3 (8.3)		
% of Population with less than high school education	14.3 (5.5)	17.9 (5.7)	<0.0	18.8 (4.9)	12.5 (4.9)	<0.0		15.0 (5.7)	−0.0 (0.2)	
Physician availability per 100,000 population	266.0 (372.1)	124.3 (77.5)	<0.0	137.5 (132.0)	305.8 (412.7)	<0.0		238.7 (340.6)	3.7 (3.3)	3.9** (1.7)
% of Population below poverty line	14.2 (6.9)	16.8 (5.1)	<0.0	17.5 (5.3)	12.8 (6.8)	<0.0		14.7 (6.7)	0.4 (0.3)	0.4*** (0.1)
% of Population with no health Insurance	11.3 (3.4)	11.5 (3.0)	0.7	12.6 (3.0)	10.5 (3.3)	<0.0		11.3 (3.3)	0.3 (0.5)	
Unemployment rate	6.6 (2.7)	6.9 (2.4)	0.3	7.5 (2.9)	6.1 (2.3)	<0.0		6.7 (2.7)	−0.2 (0.4)	
Tobacco retailor density per 1,000 population	1.2 (0.5)	1.4 (0.4)	<0.0	1.5 (0.5)	1.1 (0.4)	<0.0		1.2 (0.5)	2.4 (2.2)	2.3* (1.3)
% of counties with coal mining industry	0 -	30 -	<0.0	10 -	0.0 -	0.01		5 % -	0.6 (1.8)	
% of counties with tobacco agriculture	15 -	36 -	<0.0	30 -	10 -	<0.0		20 % -	−3.1** (1.5)	−3.2** (1.6)
Urban									0.3 (1.7)	
Appalachian									−3.5** (1.5)	−3.6** (1.5)
2014–2016 [b]									−1.9 (1.5)	−2.0 (1.4)
2017–2019 [b]									−8.7*** (2.2)	−9.0*** (1.4)
Observations (%)	310.0 (80.7 %)	74.0 (19.3 %)		153.0 (39.8 %)	231.0 (60.2 %)			384.0 (100 %)	380	380

Note: Panel A shows the subgroup mean (over the study period from 2011 to 2019), accompanied by standard deviations in parentheses. a VAQL utilization rate is defined as the proportion of cigarette users who sought assistance from the Quitline service, by dividing the number of Quitline callers by the population of cigarette smokers in each county. Panel B provides the multiple regression. The dependent variable was calculated as the percentage of Quitline users in relation to the smoking population. b The reference time period is 2011–2013. Standard errors are presented within parentheses. Significance levels are denoted using asterisks: * for p < 0.1, ** for p < 0.05, and *** for p < 0.001.

tobacco agriculture in contrast to non-Appalachian areas.

Findings also showed a disparity in smoking prevalence and VAQL usage between rural and urban areas. On average, rural areas had a higher smoking prevalence (19.0 %) compared with urban areas (12.9

%; p < 0.01). Despite this significant difference in smoking, there was not a statistically significant difference in VAQL utilization by rurality (7.6 % vs. 7.2 %, p = 0.7). Regarding the remaining county characteristics, rural areas exhibited higher proportions of individuals with less

than a high school education, fewer physicians, elevated rates of poverty and unemployment, as well as a larger percentage of uninsured individuals compared with urban areas (p < 0.01). Additionally, these areas displayed greater concentrations of tobacco retailers and a higher prevalence of tobacco agriculture when compared to urban regions.

Panel B of Table 1 shows estimation results of the multiple regression analysis on factors affecting VAQL service use among Virginia cigarette smokers. Across the county characteristics examined, only the presence of tobacco agriculture significantly impacted VAQL use, resulting in a 2.1 % lower utilization rate (p = 0.04). Additionally, Appalachian counties displayed a 3.5 % lower utilization compared to non-Appalachian counties.

The last column in panel B of Table 1 provides the stepwise regression estimations. Physician availability exhibited a significant positive association (coef. = 3.9, p = 0.03), suggesting that areas with more physicians have higher percentages of VAQL users. Higher percentage of population below poverty was also associated with slightly higher VAQL utilization rate (coef. = 0.4, p < 0.001). Higher tobacco retailer density was associated with 2.3 % higher VAQL utilization rate (p = 0.08). Additionally, the counties with tobacco agriculture have 3.2 % lower VAQL users as compared to counties without tobacco agriculture (p = 0.04). Again, Appalachian counties showed 3.6 % lower VAQL utilization rate as compared with non-Appalachian counties. The time period from 2017 to 2019 showed a substantial 9 % decrease in VAQL utilization rate as compared to 2011–2013 (p < 0.001).

4. Discussion

Most smokers in Virginia are not accessing VAQL services (7.4 %). Additionally, despite significantly higher smoking rates in rural and Appalachian regions, these populations are not accessing VAQL services at proportionate levels. The availability of physicians, poverty rates, the presence of tobacco agriculture, and the density of tobacco retailers were predictive of VAQL usage. Therefore, this disparity could stem from limited awareness about the availability and benefits of VAQL services, cultural perceptions around seeking smoking cessation resources, or potentially inadequate marketing and outreach efforts targeting these communities. Addressing this gap is crucial for designing effective public health campaigns that tailor resources and support to the unique needs of rural and Appalachian populations, ultimately aiming to reduce smoking rates and improve overall health outcomes in these areas.

This study indicates that tailored intervention and policy efforts may be necessary, strategically targeting these identified geographic disparities to enhance the uptake of quitline services, especially in the Appalachian and rural areas. To achieve this aim, health organizations, community partners, and researchers could develop and test strategies for increasing quitline utilization or other smoking cessation resource utilization in rural and Appalachian communities. Furthermore, in these areas with limited physician availability, other models of facilitating referrals to the quitline and other smoking cessation resources might be necessary (e.g., pharmacists (Fahey et al., 2023). To fund these important public health efforts, it may be necessary to increase funding in Virginia for tobacco control activities, with most recent data ranking Virginia 31st for total expenditures compared to national recommendations (Centers for Disease Control and Prevention, 2023).

Strengths of this study include utilizing numerous data sources to address the research question and the robustness of findings validated across various models. Additionally, the study visualizes VAQL utilization and cigarettes smoking prevalence by overlaying them on rurality and Appalachian status, spotlighting geographic areas with notable needs. Despite these strengths, this study is not without limitations. First, our sample within the Appalachian regions had a small sample size, as our investigation was confined to the state of Virginia, which comprised only 25 counties within the Appalachian region. Thus, it will be important to determine the extent to which these results are generalizable to other states with Appalachian counties. Second, the decline in VAQL utilization does not provide enough basis for definitive conclusions, especially since smoking rates also decreased during this period. Additionally, the study analysis is at the aggregate-level, rather than a longitudinal design of individual-level data, might not accurately reflect the true trends in VAQL utilization rates.

In sum, our study identifies the disproportionately low rate of VAQL utilization in rural and Appalachian regions, particularly given the dramatically higher rates of cigarette smoking in these areas. Notably, these low rates of VAQL utilization in rural and Appalachian areas remain, after controlling for potentially relevant county features such as physician availability, high poverty rate, density of tobacco retailers, and presence of tobacco agriculture and coal mining. Future efforts will be necessary to address these geographic health disparities.

5. Disclosure of Funding and Conflicts of Interest

CRediT authorship contribution statement

AP: Data curation, conceptualization, writing-original-draft, writing-review & editing, visualization, validation, formal analysis, methodology. **RK:** Conceptualization, writing- review & editing. **KW:** Conceptualization, writing- review & editing. **ML:** Conceptualization, funding acquisition, supervision, resources, writing- review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

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