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RURAL-URBAN DIFFERENCES E-CIGARETTE EVER USE, THE PERCEPTION OF HARM, AND E-CIGARETTE INFORMATION SEEKING BEHAVIORS AMONG U.S. ADULTS IN A NATIONALLY REPRESENTATIVE STUDY

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Abstract

Adults living in rural areas, compared to their urban counterparts, are at an increased risk of using tobacco-related products and mortality due to tobacco-related diseases. The harms and benefits of e-cigarette use are mixed, and similarly obscure messaging about these harms and benefits have a critical influence on e-cigarette uptake and perceptions. However, little is known about rural-urban differences in the prevalence of adult e-cigarette daily usage. Using the Health Information National Trends Survey-Food and Drug Administration (HINTS-FDA) cycles 1 and 2, we conducted weighted logistic regressions to assess rural-urban differences in the prevalence of adult e-cigarette daily usage, perceived harm, and e-cigarette information seeking behaviors. This analysis included adults aged 18 years and older in the United States (N=4229). Both rural and urban respondents reported a similar history of e-cigarette use. Rural respondents were

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significantly more likely than urban respondents to trust religious organizations and leaders and tobacco companies for information about e-cigarettes. Rural and urban respondents were equally as likely to believe e-cigarettes are addictive, perceive e-cigarette use as harmful, and believe e-cigarettes are more harmful than tobacco cigarettes. Respondents were equally as likely to look for information on e-cigarettes, the health effects of e-cigarettes, and cessation; and, to seek e-cigarette information from healthcare professionals, family and friends, and health organizations and groups. Given our findings, it will be pertinent to continue to research the potential harms of e-cigarette use and develop accurate health communication messages to avoid rural-urban disparities observed for cigarette smoking-related outcomes.

Keywords

Rural health; smoking; prevalence; information seeking behavior; health communication; Electronic Nicotine Delivery Systems

INTRODUCTION

Tobacco smoking is estimated to contribute to approximately 30% of all cancer types and is the leading cause of preventable diseases for adults.[1] Rural residents report higher rates of daily cigarette, chew, and snuff use compared to urban residents.[2] Further, rates of smoking cessation uptake are lower among rural adults than urban adults.[2] Considering this higher smoking prevalence and decreased rate of smoking cessation among rural residents, rural-urban disparities in cigarette use, tobacco-related diseases (e.g. cancer), and mortality are at risk of widening.[2–4] These disparities in smoking-related outcomes are largely driven by characteristics commonly associated with rural communities, including limited access to care, a growing older adult population, lower socioeconomic conditions,[3, 5], and increased exposure to tobacco advertisement.[4]

Recently, interest in electronic cigarette (e-cigarette) use has increased nationally. Previous findings reveal both potential harms (e.g. an increased risk of acute coronary) [6] and benefits (e.g. decreased diastolic blood pressure) associated with e-cigarette use.[7] Additionally, innovative marketing techniques have obscured the potential risks of e-cigarette usage.[8]. Data from the 2015 Health Information National Trends Survey (HINTS) reported that adults who believed e-cigarettes were less addictive than tobacco cigarettes were almost 2.5 times more likely to try e-cigarettes than those who believed e-cigarettes were equally or more addictive than tobacco cigarettes, and adults who searched for information about e-cigarettes were 10 times more likely to try e-cigarettes than those who did not search for e-cigarette information.[9] To date, little is known about rural-urban differences in e-cigarette vaping-related behaviors. To address this gap, this study used the HINTS-Food and Drug Administration (HINTS-FDA) to report differences in rural-urban e-cigarette ever use, the perception of harm, and e-cigarette information seeking behaviors. These findings aim to inform practitioners and policymakers on e-cigarette use of medically underserved rural adults.

MATERIALS AND METHODS

Study Design and Respondents:

We performed cross-sectional analyses using data from the HINTS-FDA, a nationally representative sample of non-institutionalized United States adults aged 18 and older. We pooled responses from HINTS-FDA 2015 and 2017 cycle 2. The detailed methodology of the HINTS sampling scheme is described elsewhere.[10] Included respondents had valid responses to items regarding ever hearing of e-cigarettes, age, income, race, and gender, for 4,229 total respondents. This study protocol was considered exempt by the Institutional Review Board of Washington University School of Medicine, as individuals represented in this dataset are deidentified and the data are publicly available.

Measures

Urban/Rural Designation: To classify the residence of respondents, we utilized the 2013 Rural-Urban Continuum Codes (RUCC). The 2013 RUCC classifies metropolitan counties by population size and nonmetropolitan counties by the degree of urbanization and proximity to a metropolitan area.[11] Respondents in metro counties with codes 1 through 3 were classified as urban, while all nonmetro counties with codes 4-9 were classified as rural.

Outcome Measures: We examined rural versus urban differences in questionnaire items pertaining to cigarette and e-cigarettes ever and never use, perceived harmfulness, and e-cigarette information seeking. Ever smoking status was defined as lifetime smoking of at least 100 cigarettes and/or a current smoker. All other respondents were categorized as never smokers. Respondents indicating e-cigarettes in response to the item: “*Which of the following tobacco products have you tried?*” were identified as e-cigarette ever users. We included self-reported age, gender, race/ethnicity, marital status, education, annual household income, and health insurance status as potential confounders.

We dichotomized responses regarding the perceived harmfulness of e-cigarette use from the following questions: (1) “*How harmful do you think electronic cigarette use is to a person’s health?*”, by harmful (moderately and very) versus not at all harmful; (2) “*Overall, how addictive do you believe using electronic cigarettes or e-cigarettes is?*” by addictive (moderately and very) versus not at all addictive; and (3) “*Compared to smoking cigarettes, would you say that electronic cigarettes are, less or much less harmful than smoking cigarettes versus more or much more harmful than cigarettes.*”

E-cigarette information seeking was derived from the survey question: “*Have you ever looked for information on electronic cigarettes from any source?*” and dichotomized as yes or no. We also dichotomized yes/no responses to the survey question: “*What did you look for the most recent time you looked for info about e-cigarettes?*” to include the responses: 1) the health effects of e-cigarettes and 2) the use of e-cigarettes for tobacco smoking cessation. Trusted sources of e-cigarette-related health information were ascertained by asking “*How much would you trust info about the health effects of e-cigarettes from* (healthcare professional, family or friends, government health agencies, health organizations or groups,

religious organizations and leaders, tobacco companies, or electronic cigarette companies?”. These responses were categorized as affirmative (a lot, some, and a little) versus not at all.

Statistical Methods

All analyses used appropriate HINTS sampling statistical strata and weights to generate nationally representative estimates. A full-sample weight calculated adult population estimates and the jackknife variance estimation method calculated 100 replicate weights to compute standard errors. Differences in demographic characteristics by rural/urban status were compared by weighted chi-square tests for categorical variables and t-test for continuous variables. We fit weighted logistic regression models for assessing differences in survey outcomes by rural/urban status. Due to the limited sample size, sociodemographic factors previously reported as associated with cigarette use (age and gender),[1] with an association with rural/urban status (race) and one indicator for socio-economic status (income) were included in the fully adjusted model. Two-tailed p-values <0.05 were considered significant. All statistical analyses were conducted in SAS version 9.4 (SAS Institute Inc., Cary, NC).

Results

Overall, the HINTS survey respondents were on average 55 years old, mostly White, married or living as married, and had healthcare coverage or insurance. Approximately 15% of the respondents resided in rural areas (Table 1). Rural respondents were more likely to be older, White (83.6% vs. 66.0%) and married (64.0% vs. 56.2%) than urban respondents, but less likely to be college graduates (21.5% vs. 40.5%) or have an annual household income exceeding \$75,000 (24.0% vs. 42.8%).

Rural respondents were more likely to report a history of cigarette smoking (OR: 1.38, 95% CI: 1.09 – 1.75) when compared to urban respondents (Table 2). However, both rural and urban respondents have a similar history of e-cigarette use (OR: 0.92, 95% CI: 0.60 – 1.41).

Rural respondents were equally as likely as urban respondents to believe e-cigarettes are addictive (OR: 0.67, 95% CI: 0.36-1.24). Rural and urban respondents perceived e-cigarette use as harmful (OR: 0.89, 95% CI: 0.53-1.50). Rural respondents were just as likely as urban respondent to believe e-cigarettes are more harmful than smoking cigarettes (OR: 0.87, 95% CI: 0.36-2.06).

Rural and urban respondents were equally as likely to look for information on e-cigarettes and the health effects of e-cigarettes and cessation. However, rural respondents were significantly more likely to trust information about e-cigarettes from religious organizations and leaders (OR: 1.35, 95% CI: 1.02-1.81); and marginally more likely to trust information about e-cigarettes from tobacco companies, (OR: 1.31, 95% CI: 0.99-1.81) compared to other sources. Rural and urban respondents were equally as likely to seek information on e-cigarettes from healthcare professionals, family and friends, and health organizations and groups.

Discussion

From the HINTS-FDA 2015 and 2017 surveys, we assessed urban and rural differences on factors related to tobacco and e-cigarette use, perceived harmfulness of e-cigarette use, and e-cigarette information seeking behaviors among respondents who reported ever hearing about e-cigarettes. To our knowledge, this is the first study to report rural-urban differences in adult e-cigarette use, perceived harmfulness, and health information seeking behaviors of e-cigarette use. Rural and urban respondents were equally likely to have a history of e-cigarettes use and seeking information about e-cigarettes. Rural respondents were more likely to trust religious organizations and leaders and tobacco companies regarding information about e-cigarettes. Overall, there were no rural versus urban differences in perceived harmfulness of e-cigarettes or in the perception that e-cigarette use is more harmful than smoking cigarettes.

Compared to urban respondents, rural respondents were 35% more likely to trust religious organizations for e-cigarette information. While similar studies using Tobacco Products and Risk Perception Surveys conducted by Georgia State University Tobacco Center of Regulatory Science data found that doctors, health organizations, the Centers for Disease Control and Prevention, health researchers, the National Institutes of Health, the FDA, and family and friends were trusted resources for e-cigarettes information,[12] this is the first study to identify rural-urban differences in trusted e-cigarette information sources. In rural settings, community organizations, healthcare institutions, and government health agencies often develop partnerships with religious organizations to disseminate health education materials and implement health (e.g. cancer) screenings.[13] Religious organizations are reported as trusted health resources by racially and ethnically diverse cohorts of rural residents [13] and are a readily accessible conduit of health information in rural communities. Religious organizations have an active role in rural health as resources for implementing physical activity interventions,[14] exploring determinants that impact HPV vaccination uptake,[15] and promoting early detection for breast cancer.[16] Our findings support the use of religious organizations as intervention locations for e-cigarette cessation or education in rural communities. However, due to collaborations between religious organizations, health organizations, and government health agencies, there is a risk of misclassification bias for responses to this associated survey item. Many rural residents may not be aware of- and able to- discriminate between the role of health organizations and government health agencies in health services and resources provided by religious organizations.

This current study also found that rural residents were 31% more likely to trust tobacco companies about e-cigarette information than their urban counterparts. One potential explanation for this finding is that tobacco is grown in the rural regions of tobacco-growing states. The influence of tobacco companies on rural life extends to school-sponsored activities,[17] athletics sponsorship, and local employment.[18] Resultantly, rural residents may identify tobacco companies as trusted resources. Future studies might seek to replicate our findings through stratification by residence in tobacco-growing areas to discriminate differences in trusted e-cigarette information sources between rural subpopulations. Secondly, tobacco companies have used targeted marketing strategies designed to appeal to

urban communities to sell menthol cigarettes, which has resulted in distrust between urban residents and tobacco companies.[19] Related to the non-significant finding that e-cigarette companies are less trusted resource of e-cigarette information for rural than urban respondents, responses may be biased by the lack of distinction between e-cigarette and tobacco companies. Several major brands of e-cigarettes, including Njoy and Vuse, are owned by tobacco companies, potentially compromising the precision of responses and respondents' ability to discriminate e-cigarette information between e-cigarette or tobacco companies.[20] A broader examination for future studies is the assessment of the public knowledge of tobacco companies' involvement in e-cigarette production, marketing, and policy development.

The strengths of this study includes the use of a nationally representative sample, ascertainment of rural-urban area codes, and cancer health information survey items. However, this secondary analysis containing HINTS-FDA 2015 and 2017 data is limited to items found in both cycles. The study design is also cross-sectional and findings are not sufficient for assessing causality. Lastly, further analysis of nonmetro-urban counties (RUCC 4-7) and nonmetro-completely rural counties (RUCC 8 and 9) were not explored due to the small representation of respondents from counties identified by codes 8 and 9 (n=78). Future studies with a larger rural population have the potential to further explore the associations between trusted sources of e-cigarette information and the level of nonmetro rural residence.

Conclusion

This study adds to the current literature on rural-urban e-cigarette-related disparities regarding adult e-cigarette use, perceived harm, and trusted information sources. Although there is a higher prevalence of tobacco cigarette smoking among rural adults compared to urban adults, this difference, to date, is not consistent with e-cigarette usage. The long-term harmful effects of e-cigarettes remain an interest for practitioners, researchers, policymakers, and the lay public. To prevent the emergence of rural-urban disparities among e-cigarette users, similar to persisting tobacco cigarette use trends, there is a need for targeted public health promotion, interventions, and evidence-based policy change using trusted sources of health information. Results from this study provide important information regarding the under-investigated area of e-cigarette use in rural areas.

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Table 1.Population characteristics of HINTS-FDA respondents by urban or rural residence.^a N=4,229

	Urban (Total N=3304) ^b		Rural (Total N=925) ^b	
	n	Weighted % ^c	n	Weighted % ^c
Age				
Mean (SD)	54.3 (16.1)	-	56.5 (16.1)	-
18-34	473	28.9	118	25.6
35-49	717	30.0	156	24.7
50-64	1132	26.4	347	28.7
65-74	677	9.7	191	13.1
75	305	5.0	113	7.9
Sex				
Male	1406	49.1	378	47.6
Female	1898	50.9	547	52.4
Race				
White	2499	66.0	761	83.6
Black	195	10.5	33	7.1
Hispanic	220	15.5	31	5.7
Other	241	8.0	50	3.7
Marital Status				
Married or living as married	1937	56.2	546	64.0
Divorced	507	7.9	160	9.2
Widowed	256	3.7	103	5.4
Separated	66	1.3	19	1.7
Single	521	30.9	96	19.7
Education Status				
High School Graduate or Less	602	24.4	284	37.6
Vocational or Technical	237	9.8	94	10.6
Some College	720	25.2	224	30.4
College Graduate or More	1742	40.5	319	21.5
Annual Household Income				
Less than \$20,000	424	14.2	193	19.5
\$20,000 to <\$35,000	391	11.5	152	17.2
\$35,000 to <\$50,000	406	13.2	152	15.2
\$50,000 to <\$75,000	631	18.2	201	24.1
\$75,000 or More	1452	42.8	227	24.0
Health care coverage or insurance				
No	163	7.1	60	9.5
Yes	3127	92.9	863	90.5

Abbreviations: HINTS, Health Information National Trends Survey; SD, standard deviation.

^aRepresents a weighted frequency of 385,574,465 participants (328,577,559 urban and 56,996,906 rural participants).

^bSubgroups may not equal Total N due to participants with missing data.

^cSurvey weighted percentages.

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Table 2. The association of residential location with e-cigarette information seeking, perceived harmfulness, and ever use from HINTS-FDA respondents 18 years of age.^a

Survey Question (Outcome)	Urban participants N=3304 (85.22% ^b)		Rural participants N=925 (14.78% ^b)		Adjusted Model ^c (Urban ref)	
	Responding Affirmatively N (% ^d)	Total Respondents N	Responding Affirmatively N(% ^d)	Total Respondents N	OR (95% CI)	Total Respondents N
Tobacco Smoking and E-Cigarette Vaping History						
Ever Tobacco Smokers	1397 (38.12)	3251	464 (51.26)	906	1.38 (1.09 – 1.75)	906
Have a history of e-cigarette use	510 (23.93)	3269	169 (23.43)	916	0.92 (0.60 – 1.41)	916
Perceived Harm						
E-cigarettes are harmful to a person's health	206 (7.61)	2905	79 (9.12)	816	0.89 (0.53 – 1.50)	816
E-cigarettes are addictive	170 (11.17)	1955	46 (14.42)	522	0.67 (0.36 – 1.24)	522
E-cigs are more harmful than smoking cigarettes	136 (6.57)	3234	41 (5.13)	901	0.87 (0.36 – 2.06)	901
E-cigarette Information Seeking Behavior						
Looked for info on electronic cigarette	453 (15.50)	3282	125 (15.90)	917	1.01 (0.69 – 1.48)	917
Looked for Health effects/cessation	412 (13.98)	3304	115 (14.05)	925	0.99 (0.68 – 1.46)	925
Looked for Health effects/cessation recently	262 (8.84)	3228	66 (7.48)	898	0.85 (0.52 – 1.39)	898
Trust Health Info About E-Cigarettes From:						
Healthcare professional	3066 (95.13)	3228	855 (96.34)	897	1.48 (0.85 – 2.56)	897
Family/Friends	2519 (80.32)	3217	721 (79.57)	896	0.95 (0.66 – 1.37)	896
Government health agencies	2978 (92.26)	3225	824 (92.97)	899	1.21 (0.81 – 1.81)	899
Health orgs/groups	3006 (93.90)	3213	828 (94.44)	894	1.20 (0.74 – 1.95)	894
Religious org/leaders	1649 (53.58)	3210	529 (61.17)	896	1.35 (1.02 – 1.81)	896
Tobacco Companies	883 (31.81)	3225	305 (38.89)	899	1.31 (0.99 – 1.73)	899
E-cig Companies	904 (34.93)	3227	293 (36.84)	899	1.03 (0.79 – 1.35)	899

Abbreviations: HINTS, Health Information National Trends Survey; OR, odds ratio; CI, Confidence Interval.

- ^a All analyses survey weight adjusted.
- ^b Weighted proportion.
- ^c Models adjusted for age, gender, race, and income.
- ^d Weighted proportion for within strata.

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