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Cancer-related Beliefs and Preventive Health Practices among Residents of Rural vs. Urban Counties in Alabama

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Abstract

Higher prevalence of cancer-related risk factors, e.g., tobacco-use, obesity, poor diet, and physical inactivity, are observed in the U.S. Deep South and likely contribute to its increased cancer burden. While this region is largely rural, it is unknown whether cancer-related beliefs and lifestyle practices differ by rural-urban status or are more influenced by other factors. We contacted 5,633 Alabamians to complete a cross-sectional survey to discern cancer-related beliefs and lifestyle

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practices, and compared data from respondents residing in rural- versus urban-designated counties. Findings were summarized using descriptive statistics; rural-urban subgroups were compared using two-tailed, chi-square and t-tests. Multivariable logistic regression models were used to explore associations by rural-urban status and other sociodemographic factors. Surveys were completed by 671 rural- and 183 urban-county respondents (15.2% response rate). Overall, the prevalence for overweight and obesity (77.8%) and sugar-sweetened beverage intake (273-364 Calories/day) was higher than national levels. Most respondents (58%) endorsed raising the state tobacco tax. Respondents from rural- versus urban-designated counties were significantly more likely to be racial/ethnic minority, have lower education, employment, income, food security and internet access, and endorse fatalistic cancer-related beliefs (p -values<0.05) (though regression models suggest that cancer belief differences are more strongly associated with education than counties of residence). Lifestyle practices were similar among rural-urban subgroups. Few rural-urban differences in cancer-related beliefs and lifestyle practices were found among survey respondents, though the high overall prevalence of fatalistic health beliefs and suboptimal lifestyle behaviors suggests a need for statewide, cancer prevention campaigns and policies- including increased tobacco taxation.

Keywords

rural; lifestyle; obesity; physical activity; diet; cancer; prevention

INTRODUCTION

The United States' (U.S.) Deep South is a five-state region stretching from the Appalachian Mountains to the flood plains of the Mississippi Delta. The state of Alabama sits at the center, flanked by Georgia and South Carolina to the east, and Mississippi and Louisiana to the west. This region is characterized by higher rates of poverty and lower levels of education, and a higher concentration of the Black population and residents of rural counties that manifest in a number of health disparities. This region is acknowledged by the Centers for Disease Control and Prevention (CDC) for its increased prevalence of several chronic diseases, such as cardiovascular disease (<https://www.cdc.gov/dhdsp/maps/atlas/index.htm>) and diabetes (<https://www.cdc.gov/diabetes/data/center/slides.html>). The burden of cancer in Alabama also is higher than the rest of the nation; 2013–2017 standardized annual incidence rates are 451.5 versus 448.7 and rates of cancer mortality are 175.8 versus 158.3, respectively (all rates expressed per 100,000 persons) (<https://statecancerprofiles.cancer.gov>).

The health disparities observed in the Deep South may be attributed to a preponderance of unhealthy lifestyle practices. As in previous years, the 2018 Behavioral Risk Factor Surveillance System (BRFSS) shows that the five Deep South states are consistently overrepresented amongst the top states for physical inactivity, low vegetable and fruit consumption, and tobacco use (<https://www.cdc.gov>). Moreover, higher proportions of residents have Body Mass Indexes (BMI) at 25 kg/m² or above, indicating overweight and obesity, and fewer are protected from smoke-free legislation as evaluated by the 2020

American Non-Smoker's Rights Foundation (<https://no-smoke.org/materials-services/lists-maps>).

In recent years, data suggest that rural, in comparison to urban populations, have a far greater prevalence of the risk factors noted above, e.g., physical inactivity,[1, 2] poor diet,[2–4] obesity,[2–4] and tobacco use.[5–7] Moreover, surveys in rural populations, such as the three state initiative conducted by Vanderpool et al.[8] among 1,891 Appalachian residents, suggest that while there is a fair amount of variation across rural America, negative or fatalistic cancer-related beliefs and perceptions are common in the rural sector. Public health efforts aimed at cancer prevention indicate that it is important to determine if rurality influences risk factors, as well as the underlying cancer-related beliefs which drive them, or if factors such as age or race share stronger associations and confound these relationships. Effective public health strategies and policies rely on a comprehensive understanding of the issues that underlie cancer disparities in order to optimize both the design and delivery of interventions. To that end, we conducted a survey study across all 67 counties in Alabama, of which 82% are classified as rural and 18% are considered urban. Based on the literature, we hypothesized that individuals residing in rural, as compared to urban counties, would have poorer lifestyle behaviors and weight status, and more fatalistic health beliefs; moreover, we expected that these associations would be just as significant, if not more so, than other factors such as age and race.

METHODS

The cross-sectional survey was administered April through November 2019. It was approved by the University of Alabama at Birmingham Institutional Review Board (IRB-300002366). Given the minimal risk nature of this survey study and protections taken to assure confidentiality, consent was assumed if the individual completed the survey after reading or listening to a brief description of the purpose of the voluntary survey, measures taken to preserve confidentiality, potential risks, and remuneration. Thus written consent was waived under 45 CFR 46 Section 46.117 (c) of the Office of Human Research Protections.

Using a direct mail database that has coverage across Alabama (Caldwell List Company, Roswell, GA), a probability-based sample was drawn that was representative of the state's demographics with regard to race, ethnicity and sex, and which double sampled individuals in 34-of-the-67 counties for which cancer incidence and/or mortality rates were higher than state averages. At the time of the survey, 55-of-67 Alabama counties were categorized as rural, whereas the remaining 12 were urban (see below); there was an even distribution of high cancer burden counties within each of these sectors. Because the ultimate intent of the survey was to use data to inform potential interventions (which likely would be delivered on a county-by-county basis via partnerships with county health departments), we elected not to assign Rural Urban Continuum Codes based on individual addresses, but rather chose to accept rural-urban designations on the county level. Thus, we used the rural-urban designations employed by both the Office of Primary Care and Rural Health within the Alabama Department of Public Health and the Alabama Rural Health Association (<https://arhaonline.org/analysis-of-urban-vs-rural>). County indices are based on three factors: 1) the percent of total employment comprised of employees of public elementary and secondary

schools; 2) the dollar value of agricultural production and the population per square mile of land; and 3) the population of the largest city.

Participation in the survey was largely solicited using letters of invitation (n=8,836) and offered assessment either via the web (with provision of a link) or by telephone (with provision of a toll-free number to volunteer or opt-out). An exception occurred for residents of rural Clay County where an intensive face-to-face cancer prevention and control effort was underway; there, paper surveys were administered randomly to individuals in the community (e.g., dollar store, senior center, health department); paper-based surveys also were administered in the more urban Mobile County area to achieve balance in survey mode between rural: urban counties and adequate representation across counties. Given that the survey also collected data on cancer screening (data reported in another article),[9] solicitations were directed toward county residents who were 50–80 years of age. Individuals not opting-out or not completing the survey within two weeks were telephoned up to six times. Given substantial numbers of undeliverable returned letters and non-working telephone numbers, contact was only considered viable if the following conditions were met: 1) the letter was not returned as undeliverable; 2) a working telephone number could be reached (though not always answered); and 3) addressees were not found to have moved and/or have a medical condition that precluded survey completion (e.g., dementia, severe hearing loss, or aphasia) and/or deceased. Contact was confirmed among 5,633 addressees. Respondents received \$5 for completing web- or paper-based surveys without interviewer assistance and \$2 for completing the telephone survey with interviewer assistance (completion was defined as answering at least 34-of-the-58 survey items).

Survey:

This survey was undertaken as part of the Round Two - National Cancer Institute (NCI)-sponsored Population Health Assessment in Cancer Center Catchment Areas Initiative.[10] Much of the survey was comprised of questions recommended by the NCI, and consisted of validated items from the Health Information National Trends Survey (HINTS, <https://hints.cancer.gov>), the BRFSS (<https://www.cdc.gov/brfss/index.html>), and the National Health Interview Survey (<https://www.cdc.gov/nchs/nhis/index.htm>). Data for this report was obtained from 27 items on demographics (age, sex, race, ethnicity, marital and employment status, educational attainment, annual household income, perceived income adequacy, food security, housing stability, internet access), previous cancer diagnoses, general health and cancer-related beliefs, lifestyle practices (current cigarette, E cigarette and smokeless tobacco use, physical activity, and sugar-sweetened beverage consumption) and BMI (derived by soliciting self-reported heights and weights in common measures and then making appropriate conversions and calculations to kg/m², as well as personal perceptions of weight status). See Supplemental Tables 1 and 2 for specific items and anchors. In addition, single items on tobacco tax and sugar-sweetened beverage tax were captured via the following questions, which were vetted for face validity by investigators and the survey team: 1) In the U.S., the average state tax rate for a pack of cigarettes is currently \$1.75 as compared to 84¢ in Alabama. Which of the following statements do you agree with most (anchors: a) we should lower the taxes on cigarettes in Alabama; b) we should keep taxes on cigarettes at the current level in Alabama; and c) we should raise the taxes on

cigarettes in Alabama); and 2) do you think there should be a sales tax on sugar-sweetened beverages? (yes/no).

Statistical Analysis:

Sample Size/Power: The original power calculations were based on attaining a total sample size of 1,957 with proportions of minority: majority being 27%:73% and rural: urban 67%:33%. This would provide 80% power at a 0.05 significance level using a two-sided z test to detect minimum differences of 0.13 – 0.14 or differences that are considered small as defined by Cohen.[11] Having achieved a sample size of 855, we had 80% power at a 0.05 significance level using a two-sided z test to detect differences of 0.20 – 0.23 or of the magnitude considered small to medium as defined by Cohen.[11]

Analysis Plan: To determine whether survey respondents differed from non-respondents with regard to race/ethnicity or gender, chi-square tests were performed; t-tests were conducted to test for potential differences in age. Frequencies (percent) and means ($\pm$ SD) were used to summarize categorical and continuous variables, respectively. Rural-urban comparisons were conducted using independent samples *t*-tests, Mann-Whitney U tests, and chi-square tests. Univariate and multivariable logistic regression models were used to evaluate associations between cancer belief variables and sociodemographic factors. For models, we estimated the unadjusted measures of association, as well as multivariable adjusted models. The interaction between rural-urban county status and different independent variables (e.g., race/ethnicity, employment, education) in relation to dependent variables (e.g., health beliefs that differed according to rural-urban status) was tested. Backward binary logistic regression also was used to select statistically significant variables and possible confounding factors associated with cancer beliefs. Significant factors were included in the final model. The multi-collinearity of predictor variables was assessed using the variance inflation factor, with a threshold of five (for example, food insecurity and income were found to be collinear, thus income [the more powerful predictor was reported]). Analyses were performed using Statistical Package for Social Sciences (SPSS, version 24, IBM, Armonk, NY) and Statistical Analysis System (SAS, version 14, SAS Institute Inc., Cary, NC). Given the exploratory nature of this survey, there was no correction made for multiple testing and statistical significance was declared at p -value <0.05 .

RESULTS

Eight hundred-fifty-five Alabamians from all 67 state counties completed the survey, generating a response rate of 15.2%. There were no differences between respondents and non-respondents in terms of rural-urban county status, race, or ethnicity; however, as compared to non-respondents, respondents were significantly more likely to be female (35.2% versus 49.8%) and older (mean age of 62.1 years versus 63.6 years)(p -values <0.001). Characteristics of the overall sample, and by rural-urban county status are provided in Table 1.

The mean age of the sample was approximately 64 years, and about half were female, married (or stable union), and reported education beyond high school. Respondents were evenly distributed regarding employment status, with roughly one-third employed, one-third

retired, and one-third disabled or unemployed. More than one-third of the sample reported annual household incomes less than \$20K, though almost half reported “living comfortably,” and most conveyed stable housing, food security, and access to the internet. About one-out-of-four respondents reported a previous cancer diagnosis. Owing largely to the fact that our sampling framework targeted counties with increased cancer burden and that most counties in Alabama are rural, 79% of our sample resided in rural-designated counties. Additionally, given that non-Hispanic Blacks comprised a significantly higher proportion of respondents from rural counties as compared to those who resided in urban counties, over 42% of respondents were racial/ethnic minorities.

Subgroup comparisons between rural-urban county respondents revealed that the sample was similar in terms of age, gender, marital status, stable housing, and previous cancer diagnosis. However, residents from rural counties, as compared to urban counties, reported significantly lower educational attainment, employment, income, perceived income adequacy, food security, and internet access.

Table 2 compares data from rural versus urban county respondents related to cancer beliefs, body weight status, and lifestyle practices and compares the two groups using bivariate statistics. With regard to general and cancer-related beliefs, significant differences were detected between respondents from rural versus urban counties on three sentinel fatalistic beliefs indicating that respondents from rural counties are much more likely to believe that everything causes cancer, that prevention recommendations are confusing, and that little can be done to lower cancer risk; albeit, a majority of all respondents voiced agreement with the first two of these fatalistic beliefs, yet surprisingly most disagreed that little can be done to reduce the risk of cancer. No rural-urban differences were observed regarding the impact of science on health and access to health-related information, where a clear majority of the sample endorsed that research favorably influences health and reported confidence that they could access guidance if needed. Moreover, no significant rural-urban differences were noted on the attribution of lifestyle factors on cancer risk where slightly more than half of urban respondents and slightly less than half of rural respondents agreed that, “*Cancer is most often caused by a person’s behavior or lifestyle.*”

For tobacco-related beliefs and behaviors, respondents from rural counties were significantly less likely to endorse an increase of the state cigarette tax, though of note, most respondents from each faction favored this legislation. No significant differences were detected between respondents from rural versus urban county respondents in any other tobacco-related beliefs or behaviors. A clear majority of both rural and urban county-dwelling respondents acknowledged the causal relationship between smoking and cancer, though almost 12% of respondents reported that they currently smoked, with the overall prevalence of smokeless tobacco and e-cigarette use being approximately 7% and 2%, respectively. Cigarette smokers overall were significantly less likely to acknowledge the strong causal relationship between smoking and cancer ($p<0.001$), as less than half (42%) of smokers conceded that smoking increases cancer risk “a lot,” whereas this attribution was reported by 76% of non-smokers.

No significant between-group differences were noted in either weight status, the perception of body weight status, or responses related to sugar-sweetened beverages. The average BMI

across the sample was in the obese range (30.1 kg/m²) and over 75% of those surveyed had overweight or obesity. Of note, while significant associations were detected between BMI and the perception of body weight status ($p < 0.001$), data show that a significant proportion of the sample with obesity and overweight misclassify their weight status and view themselves as normal weight and even underweight. Over one-third (39.7%) of respondents with BMI's of 25–29.9 (overweight) perceived that they were “just about the right weight” (28.7%) or even underweight (11%); and 13.9% of respondents with BMI's of 30 or more (obese) perceived that they were “just about the right weight” (9.7%) or underweight (4.2%). Less than one-third of all respondents endorsed a tax on sugar-sweetened beverages, and the median consumption of sugar-sweetened beverages (a key source of empty Calories) ranged from 18–24 ounces per day. Additionally, unlike data related to cigarette smoking and non-support of raising the tobacco tax, no significant associations were detected between support of taxation on sugar-sweetened beverages and body weight status.

No between-group differences were detected for any items on physical activity, where it was noted that most respondents did not adhere to Centers for Disease Control and Prevention (CDC) recommendations of at least 150 minutes per week of moderate-to-vigorous physical activity. Moreover, while most respondents acknowledged a causal relationship between low levels of physical activity and cancer, the most common response was that risk was only affected “a little.” Respondents reporting higher levels of physical activity were more likely to endorse the association between lack of physical activity and cancer risk ($p < 0.001$).

Because respondents from rural versus urban counties differed with regard to several sociodemographic factors, further analyses were performed to disentangle whether statistically significant differences noted in cancer-related beliefs and cigarette taxation were primarily the result of county of residence or whether they were confounded by sociodemographic factors. Table 3 features the results of logistic regression on select items from Table 2 which were dichotomized for this analysis. In all cases, other factors such as age, race, educational attainment, and income status appeared more highly correlated with beliefs than rural-urban county of residence. Unsurprisingly, current smoking status was the most significant factor associated with beliefs about the statewide tobacco tax, where a strong negative association was found.

DISCUSSION

The primary findings of this survey study in the Deep South comparing responses between residents of rural versus urban counties shows that while some differences in cancer-related beliefs were detected, no differences were found with respect to assessed lifestyle practices. Furthermore, while rural-urban differences were noted in some cancer-related beliefs, these differences were no longer significant when other factors, such as educational status, were considered. These data clearly do not support our hypothesis and are in direct contrast to previously cited findings.[1–4, 6, 7] However, this study is not the first to report an absence of rural-urban differences in health behaviors and beliefs. A recent report by Hughes et al. [12] on over 300,000 U.S. adults also reported no differences in physical activity, weight status or current smoking by rural-urban status. Likewise in an analysis of the 2011–2014 waves of the HINTS survey ($n = 14,188$), Robertson and colleagues,[13] also found no rural-

urban differences in total physical activity, though differences in leisure-time resistance training activity (a question not included in our survey) were observed. Indeed, with the exception of physical activity, the most striking observation in our study is how unhealthy the behaviors of Alabamians are, regardless of rurality, or at least the behaviors of respondents to this survey.

Overall, 11.8% of respondents reported cigarette use which is lower than the 21.1% age-adjusted rate obtained for Alabama in 2019 by the BRFSS (https://nccd.cdc.gov/BRFSSPrevalence/rdPage.aspx?rdReport=DPH_BRFSS.ExploreByLocation&rdProcessAction=&SaveFileGenerated=1&irbLocationType=States&isLocation=01&isState=&isCounty=&isClass=CLASS17&isTopic=TOPIC15&isYear=2019&hidLocationType=States&hidLocation=01&hidClass=CLASS17&hidTopic=TOPIC15&hidTopicName=Current+Smoker+Status&hidYear=2019&irbShowFootnotes=Show&rdICL-icIndicators=_RFSMOK3&icIndicators_rdExpandedCollapsedHistory=&icIndicators=_RFSMOK3&hidPreviouslySelectedIndicators=&DashboardColumnCount=2&rdShowElementHistory=divYearUpdating%3dHide%2cisYear%3dShow%2c&rdScrollX=0&rdScrollY=200&rdRnd=63248); likewise E-cigarette use of roughly 2% is lower than the 4.9% captured by the 2017 BRFSS survey (https://www.cdc.gov/pcd/issues/2019/18_0362.htm). The lower reported rates of cigarette use in this survey may be due to the relatively higher level of educational attainment and older age of the study sample compared to Bureau of Census data that exist for Alabama (<https://www.census.gov/quickfacts/AL>). In contrast, the overall use of smokeless tobacco (6.9%) was similar to the 6.3% reported in the 2019 BRFSS report for the state. It is important to acknowledge that the increased mortality due to tobacco-related cancers among citizens of this state, in which the 2013-2017 standardized annual mortality rate (per 100,000 persons) due to lung cancer alone, is significantly higher than the national average, e.g. 50.4 (95% Confidence Interval [CI]: 49.6, 51.2) versus 40.2 (CI: 40.1, 40.3) (<https://statecancerprofiles.cancer.gov>). Such data point to a need for smoking prevention and cessation interventions and tobacco control policies. The most broad-sweeping, effective and durable of these is to increase the cigarette tax.[14] Data from this survey which show that 58% of respondents support increasing the state cigarette tax are encouraging and will add to the armamentarium to convince state politicians to support the health and expressed desires of their constituency rather than policies influenced by the tobacco industry. An outline of potential future steps to aid in the translation of these survey findings to effective policies aimed at reducing the cancer burden within Alabama are provided in Table 4.

Additionally, the weight status of survey respondents was alarming. Here, the average BMI of 30.1 kg/m² was in the obese range, and data show that 77.8% of respondents had overweight or obesity. These numbers on overweight and obesity compare to 72.7% and 69.6% reported for the state and the nation in the 2018 BRFSS, respectively (<https://www.cdc.gov/obesity/data/prevalence-maps.html>). Clearly, respondents to this survey have a prevalence of obesity that is far greater than the nation, and our data show that the proportion of individuals with overweight and obesity is either increasing over time or is the result of our survey being administered in a majority female, older population. Data on the accurate perception of body weight is also a concern since almost 40% of respondents who

were overweight and 14% of respondents with obesity reported that they were “just about at the right weight” or even underweight. These findings resonate with a 2014 report by Robinson and Kirkham,[15] who, in a series of studies of over 350 adults found that as exposure to obesity increases, our perceptions of what actually constitutes “obesity” becomes distorted and “normalized.” Hence, efforts to educate and recalibrate weight status perceptions that re-align with data-driven health guidelines are needed.

Data on sugar-sweetened beverage consumption shows that our Alabamian respondents had median consumption of 1.5 to 2 servings, or 273-364 Calories/day from these sources as compared to 145 Calories/day reported for the average American (<https://www.cdc.gov/nutrition/data-statistics/sugar-sweetened-beverages-intake.html>). Given that sugar-sweetened beverages constitute a significant source of empty calories, such data call for intervention. While taxation of sugar-sweetened beverages is clearly not supported by the majority of our respondents, lower calorie substitutes for these beverages (e.g., plain or flavored water, unsweetened tea or coffee, or diet soft drinks) should be promoted and could result in an energy deficit that promotes weight loss of at least a half-pound per week or at least curbs further weight gain. Other means, such as limiting offerings of vending machines in public institutions, particularly those that promote citizen health, e.g., schools and universities, health care organizations, and governmental agencies, are imperative. Similarly, physical activity interventions also are important for curbing weight gain,[16] and could benefit this population. The data from this survey suggest there is a need to educate Alabamians on the significant role that physical activity exerts on cancer risk,[17] in order to motivate greater levels of exercise, since insufficient physical activity levels were noted by most respondents.

In crafting these interventions, it is important to consider the cancer-related beliefs that were fielded by this survey. The fact that the majority of respondents agreed that research has improved the health of Americans and indicated that they could gain access to appropriate health information if needed suggests that these potential barriers are not prevalent in Alabama. Instead, there is a need for more focus and funding on a state and federal policy level. To address the specific needs of Alabamians, public health policies should focus on messaging that emphasizes that many cancers are preventable through engagement in healthy lifestyle behaviors. Here the need for prioritizing and simplifying messaging is amplified, since the current survey results clearly show that significant proportions of survey respondents resonate with the beliefs that “*everything causes cancer*,” and “*there are so many recommendations that it is difficult to know which ones to follow*.” Previous studies suggest that the former is a marker of *fatalistic thinking*, or the belief that there is little a person can do to prevent or treat an illness,[18] and the latter suggests *information overload* or feeling overwhelmed by the amount of information.[19] Thus, opportunities exist for simplifying messages regarding cancer prevention and healthy lifestyle. Information overload, particularly on topics of diet and nutrition, for which contradictory information often exists, is particularly problematic.[20] Moreover, mounting evidence shows that both beliefs are negatively related to the practice of cancer preventive behaviors,[20–22] and that these associations may be especially strong among individuals with lower educational attainment.[22] As observed in our findings, while we did detect stronger associations between fatalistic cancer beliefs and rural residence, these beliefs seemed to be influenced

more by educational status. Such data may call for targeted prevention approaches appropriate for lower literacy audiences.

In generalizing these findings, it is important to acknowledge the limitations of this study for which the primary weakness is the modest response rate overall which may have introduced bias and over-inflated the reporting of favorable findings, such as the lower rates of cigarette use and higher rates of physical activity (<https://www.cdc.gov/physicalactivity/data/inactivity-prevalence-maps/index.html>). While we did not achieve our targeted response rate, our performance was similar to other published reports,[8] and the number of respondents and their distribution between subgroups still provided ample power to detect differences of small to medium magnitude. Other limitations include data that were unweighted and the county-based designation of rural-urban status. While both of these were purposeful decisions, and based on the desire for representation of all counties and a resulting need to produce county-specific data, there is the potential for additional bias and results that may differ from analyses that assign rural-urban status on an individual level and which classify suburban residents differently. Additionally, while we strove to measure health beliefs and practices using the briefest means possible (often one-item), this may have compromised our ability to fully capture these domains. Moreover, given that we limited our sample to ages 50-80, our findings may not generalize to persons outside of this age range, and the sex-specific bias in the response rate also suggests that our results may not generalize to males. Finally the exploratory nature of our analysis is yet one more limitation; therefore, our findings that there are very few differences between individuals residing in rural versus urban counties as related to cancer prevention practices and cancer related beliefs (and that the few differences that do exist may be due to underlying differences in educational status and racial/ethnic disparities), is a finding that needs to either be refuted or corroborated by other investigations. The strengths of this survey study, however, are its relatively large sample size and that it utilized validated items from national surveys and employed random sampling methods.

In summary, this survey study found relatively few differences in cancer-related beliefs and behaviors among respondents from rural versus urban counties in Alabama, a sentinel state in the U.S. Deep South. Nonetheless, the survey uncovered data that the state has far to go in achieving optimal health behaviors that could potentially reduce its high burden of cancer and other chronic diseases. Statewide efforts are needed to educate all residents on cancer prevention, with focused campaigns on cancer as a preventable illness, underscoring CDC communications that 40% of cancers are due to tobacco-use (<http://www.cdc.gov/vitalsigns/tobaccouse/smoking/infographic.html>), and that an equal proportion are due to obesity and physical inactivity (<https://www.cdc.gov/vitalsigns/obesity-cancer/index.html>). Such campaigns are particularly needed for increased physical activity and weight control, since there is low recognition that these modifiable risk factors play a key role in cancer prevention. Prioritization of messages and reduction of complexity, however, are critical to prevent information overload and feelings of helplessness. Moreover, results of this survey continue to show that citizens are looking toward legislators to help them with cancer control and to tax industries that threaten their lives (see Table 4 for future steps to increase awareness and enhance accountability among lawmakers).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Sample characteristics in the overall sample and by rural/urban status

Characteristic *	Overall (n=854)	Rural County (n=671)	Urban County (n=183)	Significance
Age - Years (SD)	63.7 (10.15)	63.7 (10.34)	63.9 (9.47)	N.S.
Female Gender - % (n)	57.0% (486)	58.1 (389)	52.7% (96)	N.S.
Race/Ethnicity - % (n)				<0.001
non-Hispanic White	57.7% (486)	27.8% (99)	57.6% (102)	
Hispanic White	1.3% (11)	1.1% (4)	0.6% (1)	
non-Hispanic Black	38.0% (320)	68.3% (243)	40.7% (72)	
Mixed Race/Other	3.0% (25)	2.8% (10)	1.1% (2)	
Rural/Urban Status - % (n)				
rural	78.5% (671)			
urban	21.4% (183)			
Stable Union Marital Status - % (n)	54.1% (461)	54.9% (367)	51.1% (93)	N.S
Education - % (n)				0.003
<12 years	13.8% (117)	14.9% (99)	9.8% (18)	
High school (HS) graduate	29.9% (253)	31.8% (211)	23.0% (42)	
Post HS education/training	56.3% (477)	53.2% (353)	67.2% (123)	
Employment - % (n)				<0.001
Employed/full-time student	33.7% (288)	30.0% (201)	47.0% (86)	
Retired	37.2% (318)	37.9% (254)	35.0% (64)	
Disabled	20.7% (177)	22.7% (152)	13.7% (25)	
Unemployed	8.4% (72)	9.5% (64)	4.3% (8)	
Annual Household Income - % (n)				<0.001
<\$19,999	36.7% (289)	38.7% (243)	28.2% (46)	
\$20,000-\$74,999	39.5% (312)	40.3% (225)	36.8% (60)	
\$75,000	23.8% (188)	20.8% (130)	35.0% (57)	
Perceived Income Adequacy- % (n)				0.005
Difficulty	14.4% (122)	15.5% (103)	10.6% (19)	
Getting by	39.2% (331)	41.0% (273)	32.4% (58)	
Living comfortably	46.4% (392)	43.5% (289)	57.0% (102)	
Problems w/ Stable Housing - % (n)	1.3% (11)	1.6% (10)	0% (0)	N.S.
Problems w/ Food Security - % (n)				0.047
Often	4.6% (39)	4.8% (32)	3.8% (7)	
Sometimes	13.5% (115)	15.0% (100)	8.2% (15)	
Never	81.9% (695)	80.2% (534)	88.0% (160)	

Characteristic *	Overall (n=854)	Rural County (n=671)	Urban County (n=183)	Significance
Previous Cancer Diagnoses - % (n)	25.0% (213)	25.1% (168)	24.7% (45)	N.S.
Access to Internet - % (n)	64.9% (550)	62.2% (414)	74.6% (135)	0.002

* missing data did not differ by urban/rural status, total counts are as follows: age=16; race=6; ethnicity=19; rural/urban status=1 (homeless); education=8; income=66; income adequacy=10; stable housing=3; food security=6; previous cancer diagnosis=3; and access to the internet=7; SD: Standard Deviation; N.S.: Not Significant

Table 2.

Differences in cancer-related beliefs and lifestyle practices by rural/urban status

		Rural (n=671)	Urban (n=183)	Significance
General Health Beliefs				
<i>How much has research on health and illness improved the health of people in general in the US today?</i>				N.S.
	Not at all/ A little	6.7% (45)	2.2% (4)	
	Some	26.0% (174)	25.4% (46)	
	A great deal/ Completely	67.3% (450)	72.4% (131)	
<i>How confident are you that you could get advice or information about health topics if you needed it?</i>				N.S.
	Not at all/ A little	8.5% (57)	9.3% (17)	
	Somewhat	25.5% (169)	20.2% (37)	
	Very/ Completely	66.0% (438)	70.5% (129)	
<i>It seems like everything causes cancer</i>				<0.001
	Strongly agree	23.2% (153)	15.2% (27)	
	Somewhat agree	47.6% (314)	47.2% (84)	
	Somewhat disagree	18.3% (121)	30.3% (54)	
	Strongly disagree	10.9% (72)	7.3% (13)	
<i>So many recommendations about preventing cancer, it's hard to know which ones to follow</i>				0.012
	Strongly agree	38.9% (257)	27.4% (49)	
	Somewhat agree	43.1% (285)	55.9% (100)	
	Somewhat disagree	12.9% (85)	10.6% (19)	
	Strongly disagree	5.1% (34)	6.1% (11)	
<i>There's not much you can do to lower your chances of getting cancer</i>				<0.001
	Strongly agree	12.9% (85)	4.5% (8)	
	Somewhat agree	26.2% (173)	20.9% (37)	
	Somewhat disagree	31.4% (207)	42.9% (76)	
	Strongly disagree	29.5% (195)	31.6% (56)	
<i>Cancer is most often caused by a person's behavior or lifestyle</i>				0.518
	Strongly agree	10.5% (69)	15.2% (27)	
	Somewhat agree	34.3% (226)	47.2% (84)	
	Somewhat disagree	30.7% (202)	30.3% (54)	
	Strongly disagree	24.5% (161)	7.3% (13)	
Tobacco-related Beliefs and Behaviors				
<i>Smoking increases a person's chances of getting cancer</i>				N.S.
	Not at all	5.1% (34)	3.8% (7)	
	A little	19.4% (130)	19.3% (35)	
	A lot	75.5% (505)	75.9% (140)	

		Rural (n=671)	Urban (n=183)	Significance
<i>The Alabama sales tax on cigarettes is < of the national average. What action do you agree with most regarding the state tax on cigarettes?</i>				0.029
	Lowered	11.1% (72)	6.3% (11)	
	Kept the same	33.3 (217)	27.6% (48)	
	Raised	55.6% (362)	66.1% (115)	
<i>Current Cigarette Use (Everyday/Some Days)</i>		12.1% (81)	10.6% (19)	N.S.
<i>Current E Cigarette Use (Everyday/ Some Days)</i>		2.1% (14)	1.6% (3)	N.S.
<i>Current Smokeless Tobacco-Use (Everyday/Some Days)</i>		7.0% (47)	6.6% (12)	N.S.
<i>Diet-related Beliefs, Behaviors, and Body Weight Status</i>				
<i>Agree with a tax on sugar-sweetened beverages</i>		30.4% (198)	32.8% (57)	N.S.
<i>Median daily intake of sugar sweetened beverages (IQR for 12 oz servings))</i>		2.00 (1-3)	1.50(1-2)	N.S.
<i>BMI (kg/m²)</i>	X (SD)	30.1 (6.98)	30.0 (6.50)	N.S.
	Range	17-81	21-44	
<i>BMI Categories</i>	Underweight (<18.5)	1.4% (9)	1.1% (2)	N.S.
	Healthy (18.5-24.9)	20.1% (130)	23.6% (42)	
	Overweight (25-29.9)	35.5% (230)	28.1% (50)	
	Obese (≥ 30)	43.0% (278)	47.2% (84)	
<i>Physical Activity-related Beliefs and Behavior</i>				
<i>Not getting much exercise increases a person's chances of getting cancer</i>				N.S
	Not at all	31.2% (208)	33.7% (7)	
	A little	43.5% (290)	45.9% (35)	
	A lot	25.3% (169)	20.4% (140)	
<i>Get at least 150 min/week of Physical Activity</i>		41.3% (270)	41.6% (74)	N.S.
<i>Median min/week of Physical Activity (IQR)</i>		105 (30-240)	116 (30-240)	N.S.

SD: Standard Deviation; IQR: Inter quartile Range; N.S.: Not Significant

Table 3.

Logistic Regression models of factors found to differ by rural-urban status in bivariate testing

Factor	P value	Odds ratio	Confidence Interval		Model significance
			Lower bound	Upper bound	
Agreement on statement that: <i>Research on health and illness has improved the health of people in general in the US today.</i>					
Gender (Female)	0.326	1.355	0.739	2.481	X ² = 28.271 P =<0.001
Race/ethnicity (Minority)	0.364	0.753	0.408	1.389	
Age (65 yrs.)	0.609	0.847	0.449	1.597	
Education (12 yrs.)	0.001*	0.314	0.158	0.627	
Residence (Rural)	0.083	0.395	0.138	1.131	
Employment (Unemployed)	0.135	0.510	0.211	1.235	
Agreement on statement that: <i>It seems like everything causes cancer.</i>					
Gender (Female)	0.030*	1.408	1.034	1.918	X ² = 21.524 P =0.001*
Race/ethnicity (Minority)	0.022*	0.692	0.506	0.947	
Age (65 yrs.)	0.003*	0.628	0.463	0.851	
Education (12 yrs.)	0.207	1.224	0.894	1.677	
Residence (Rural)	0.091	1.364	0.952	1.954	
Agreement on statement that: <i>There are so many recommendations about preventing cancer, it's hard to know which ones to follow.</i>					
Gender (Female)	0.012*	0.605	0.409	0.895	X ² = 21.005 P =0.004*
Race/Ethnicity (Minority)	0.454	0.860	0.579	1.277	
Age (65 yrs.)	0.022*	1.639	1.073	2.502	
Education (12 yrs.)	0.023*	1.658	1.072	2.564	
Residence (Rural)	0.932	0.980	0.616	1.558	
Employment (Unemployed)	0.790	1.062	0.681	1.656	
No internet access	0.004*	1.974	1.240	3.143	
Agreement on statement that: There's not much you can do to lower your chances of getting cancer.					
Gender (Female)	0.518	1.109	0.811	1.517	X ² = 98.699 P =<0.001*
Race/Ethnicity (Minority)	0.325	1.171	0.855	1.604	
Age (65 yrs.)	0.406	0.869	0.623	1.211	
Education (12 yrs.)	0.000*	3.247	2.376	4.438	
Residence (Rural)	0.052	1.486	0.997	2.214	
Employment (Unemployed)	0.001*	1.914	1.314	2.789	
<i>Agreement that the Alabama cigarette tax should be raised.</i>					
Gender (Female)	0.956	0.985	0.593	1.686	X ² = 76.140 P =<0.001*
Race/Ethnicity (Minority)	0.585	1.178	0.654	2.119	
Age (65 yrs.)	0.427	0.795	0.451	1.401	
Education (12 yrs.)	0.021*	0.495	0.272	0.901	
Residence (Rural)	0.376	0.751	0.399	1.414	
No internet access	0.560	0.824	0.430	1.580	
Current smoker	<0.001*	0.089	0.043	0.181	

Table 4.

Future steps to increase awareness and enhance accountability among lawmakers

Timeline	Strategies
Time 0: Acceptance of Article	<ol style="list-style-type: none"> 1) Authors prepare policy brief 2) When final, obtain approval of the O'Neal Comprehensive Cancer Left (OCCC) Director and the Board of Directors. 3) Enlist the support of the OCCC Director of Public Relations (PR) to circulate a confidential draft to key stakeholders within the state (e.g., other cancer lefts, advocacy groups, and educational institutions). 4) Collaborate with the Director of Public Relations to prepare a press release. 5) Circulate the confidential draft and obtain support from the Alabama Comprehensive Coalition for Cancer Control.
Time 1: Publication of Article (Awareness Phase)	<ol style="list-style-type: none"> 1) PR Director activates the press release to correspond to the lifting of the embargo. 2) Express mailings that include the policy brief, along with a copy of the scientific article and a cover letter (signed by all endorsing stakeholders) are mailed to all congressmen, the two senators, and the governor of the state. 3) Simultaneously, face-to-face appointments (via zoom or other means) are requested and which include as many authors and stakeholders as possible.
Times 2-12: Follow-up (Accountability Phase)	<ol style="list-style-type: none"> 1) Follow-up monthly with lawmakers to check on progress 2) Invite them to present their progress at Cancer Left Rounds to mark the 1-year anniversary date of the initial meeting (Time 1)