Are State Patterns of Smoking Different for Different Racial/Ethnic Groups? An Application of Multilevel Analysis

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SYNOPSIS

Objectives. Tobacco use research has often assumed "average" effects across place, race, and socioeconomic position. We explored and mapped the variation in smoking prevalence for racial/ethnic groups by gender and state after adjusting for demographic factors.

Methods. We executed a cross-sectional, weighted, two-level multilevel multiple regression analysis (individuals in states), with current smoking as the outcome, using the 1995–1996 Current Population Survey Tobacco Use Supplement, for non-Hispanic (NH) whites, NH blacks, and Hispanics. We also calculated adjusted smoking prevalence, 95% confidence intervals, Spearman correlations, and state residual-based maps to examine state patterns.

Results. We found different smoking patterns for each racial group. Black women's smoking rates were markedly lower than the national subgroup rate in six clustered states in the deep South. Smoking rates for whites were higher than the subgroup national rate in several Great Lakes states, Texas, Nevada, and North Carolina. For white women, several rural Midwest states displayed lower-than-expected smoking rates (Idaho, Utah, South Dakota, and Nebraska). We documented positive correlations for smoking prevalence between men and women within each racial group, but not between racial groups, indicating a race-specific pattern of smoking. We found that state tobacco variables (taxation and agriculture) did not account for remaining state smoking variance after inclusion of demographic variables.

Conclusion. Multilevel modeling may enhance surveillance of tobacco use patterns. Focusing on race-specific state smoking patterns may illuminate why racial/ethnic minority groups exhibit lower smoking prevalence compared to their white counterparts, by examining context of smoking that may be race-specific.

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Smoking is the single leading preventable cause of death in the United States,[1] contributing to one in every six fatalities.[2] Although smoking prevalence appears to be lower among African Americans, Hispanics, and Asians compared with whites and Native Americans early in life,[3] the relationships may shift in adulthood.[4] Moreover, substantial variations in smoking occur for different demographic groups within each racial/ethnic group, making it difficult to generalize about racial patterns absent information on gender, age, nativity, and geography. Since the lower smoking rates for racial/ethnic groups have not been explained by individual-level demographic characteristics,[5] an important question arises: What is it about minority group status in America that may protect certain minority populations from smoking? This question is intriguing given the harsher life contexts that Americans of color may face. To answer this question requires moving beyond the individual level to analyze context, and including individual variables that have not received adequate attention in racial/ethnic health analyses, such as nativity and socioeconomic position (SEP).[6,7]

Place may play an important role for smoking that hasn't been sufficiently explored in the tobacco control literature. Examining whether and how smoking prevalence is patterned for different racial groups across the states might shed light on why certain racial groups are more or less likely to smoke than others, as well as whether these patterns hold across the U.S. or just in certain places. Smoking prevalence differs greatly among the different states, with over a two-fold difference between the highest and lowest states.[1] This difference might be explained simply by the different individuals who reside in that state (e.g. composition), or by something other than individual factors, for example presence or strength of tobacco industry marketing or state tobacco policies. However, there is a dearth of state smoking prevalence reporting by race. Reports or studies that have produced race/state-specific smoking figures have not modeled the complex interactions of race and gender,[8] and/or have not accounted for socioeconomic position.[9]

Given the variation in smoking prevalence for racial groups by demographic characteristics for the U.S. as a whole, and given the variation in state smoking prevalence by state, this article explores whether there are race-specific patterns of smoking across the U.S., or whether similar patterns arise for all racial/ethnic groups with respect to certain states or areas of the country, and/or traditional tobacco states.

WHY FOCUS ON STATE RACIAL/ETHNIC SMOKING PATTERNS?

We highlight four reasons why describing and mapping race/ethnic-specific patterns of smoking across the 50 states using multilevel modeling is valuable for public health scholarship: surveillance, etiologic hypothesis generation, implementation of programs and policy, and influential states driving national prevalence.

Surveillance

Monitoring smoking patterns by race and place is necessary for identifying and eliminating disparities in health. Eliminating health disparities is one of the major goals of Healthy People 2010,[10] and is important for improving population health and ensuring proper compliance with civil rights laws.[11] Monitoring smoking patterns aids those studying smoking as a cause of disease to monitor where cases of these diseases (e.g., cancer, stroke, heart disease) are likely to manifest in the future.[12]

Examining model-based smoking estimates by state is important for understanding and documenting different dimensions of smoking inequalities. Although some tobacco investigators have highlighted smoking inequalities, this is not the main thrust of the tobacco literature. The National Academy of Sciences identifies four dimensions of inequality for collection of data to monitor health disparities: race, ethnicity, SEP, and nativity (acculturation and language). These axes contribute independent information for smoking patterns, and also interact complexly.[11] But most racial smoking prevalence data are presented without adjusting for socioeconomic position or other demographic factors. For instance, being foreign born and/or being a racial minority are both protective for smoking, but these associations are modified by age, gender, and SEP. Because minorities are disproportionately likely to be of lower SEP than whites, crude racial smoking data obscure the lower rates of smoking among racial minorities. Therefore, it is unclear from prior literature what the racial smoking patterns are, before and after adjusting for SEP, nativity, and age, across the 50 states, or to what extent individual (compositional) factors may drive state racial differences.

Etiologic hypotheses generation

State descriptive patterns of smoking may provide clues regarding the causes of smoking. Examining geographic variation in smoking across the states helps to formulate etiologic hypotheses for future epidemiologic research, i.e., targeting hypothesis-testing studies.[12] Furthermore, monitoring state patterns of smoking may inform causes of smoking that may be operating at the state level. Finding that the state matters above and beyond its individual demographic composition for smoking implicates a non-individual focus for tobacco prevention, intervention, and treatment efforts. As Diez Roux argues, the assumption underlying considerable health research seems to be that health (e.g., smoking) differs by place because of the different types of people who live in different places.[13] Focusing on the state directs attention to state-level structural causes of smoking and inequalities in smoking.

Policy and program planning

States directly implement and evaluate health programs to ensure the health of their populations, and therefore this is a relevant level for tobacco-related intervention. Identifying geographic patterns in smoking allows the prioritizing of programs and resources for prevention programs and policy, treatment of high-risk (smoking or former smoker) populations, and future smoking-related disease programs.

Examining racial/ethnic-specific patterns of smoking may inform policies that may be race/ethnic specific. Modeling the average effect of being a racial minority, which has been the standard for smoking research up to this point, does not focus attention on how place matters differently for different racial/ethnic groups. Moreover, state patterns in smoking (without regard to race) are dominated by whites, so place-specific averages, without racial breakouts, tell us little about racial differences across the states. We argue that place may modify the social and economic context of racial minorities, so examination of racial/ethnic-specific smoking patterns is warranted.

Influential states

Finally, given the geographic concentration of racial minority and immigrant groups in the U.S., it is feasible that one or a few states with large concentrations of minority groups are driving national minority smoking patterns. By examining state patterns, we can determine how well the national estimate represents each state. Finding that one or a few states are driving the racial differences in smoking could focus the tobacco control movement in these areas to reduce national smoking rates among certain racial groups.

METHODS

We utilized the Tobacco Use Supplement to the Current Population Survey (TUS-CPS) fielded in September 1995, January 1996, and May 1996.[14] The TUS-CPS is a multistage probability sample, representative of the U.S. state and national non-institutionalized, civilian population aged 15 years and older. The TUS was created by the National Cancer Institute, and is conducted three times over the course of nine months by the U.S. Census Bureau as a supplement to the monthly CPS employment survey.

Our outcome variable was current smoking, measured as having smoked 100 cigarettes in lifetime and currently smoking every day or some days,[3] modeled dichotomously, with non-smokers (never and former smokers) as referent. The main predictor variable was race/ethnicity, which was self-reported according to federal government guidelines, and recoded into three mutually exclusive categories of the three largest racial/ethnic groups: non-Hispanic white, non-Hispanic black, and Hispanics of any race. Other racial groups were excluded due to small sample sizes in the majority of states.

Socioeconomic position was operationalized as occupation, education, and income, included in analyses as confounders.[3,15] Routine labor force questions were used to determine the employment status and occupation of respondents, modeled in seven standard occupational/employment categories, using technicians/support/sales as the reference group (Table 1 provides additional detail). Education was measured as highest level of school completed, contrast coded in six groups, with high school graduates as referent. Income was measured as total annual household earnings, divided into quartiles and modeled as categorical variables, including a category for those not reporting income, with the lowest income category ($0–19,999) as referent. Nativity was modeled dichotomously: either born in the U.S. (including Puerto Rico or American territory) or foreign born, with U.S. (native) born as referent. Since smoking rates differ greatly by gender, and since the gender/smoking association is modified by race/ethnicity,[4,16] we stratified models by gender.[2,16,17] Age also modifies the race/ethnicity-smoking association.[4,18] We modeled age with parametric terms (age, age-squared, and in most cases age-cubed) since the association between age and smoking was nonlinear on the logit scale.[19] All age terms were centered at the mean for the full sample, age 44. Last, we modeled marital status in four categories, contrast coded with married people as the referent group.

We analyzed how smoking behavior was patterned at two levels—individual and state—using multilevel multiple logistic regression with MLwiN 2.0 software.[20] We applied the estimation of Marginalized Quasi Likelihood (MQL) first order linearization, combined with Markov Chain Monte Carlo (MCMC) estimation, as implemented in MLwiN. The analysis was adjusted for

Table 1. Descriptive statistics, Tobacco Use Supplement to the Current Population Survey 1995–1996

		n	*Percent of sample*	*Percent current smokers (weighted)*[a]
Total[b]		235,654	100.00	22.54
Gender	Male	108,926	46.22	24.80
	Female	126,728	53.78	20.45
Nativity	Native born	216,418	91.84	23.25
	Foreign born	19,236	8.16	15.62
Race/ethnicity	Non-Hispanic white	194,411	82.50	23.46
	Non-Hispanic black	22,869	9.70	21.55
	Hispanic	18,374	7.80	16.51
Income	$0–19,999	60,121	25.51	28.06
	$20,000–34,999	66,654	28.28	25.17
	$35,000–59,999	42,944	18.22	20.46
	$60,000+	45,687	19.39	14.97
	Missing	20,248	8.59	19.45
Education	8th grade or less	17,152	7.28	18.73
	Some high school	29,685	12.60	29.20
	High school grad	75,608	32.08	28.51
	Some college/associates	57,356	24.34	23.17
	Bachelors	32,988	14.00	12.77
	Graduate school	15,873	6.74	9.10
	Still in school and age <25	6,992	2.97	10.51
Occupation	Professional specialty	23,360	9.91	12.46
	Executive, administrative, managerial	21,421	9.09	20.39
	Technicians/related support, sales, admin support/clerical	46,270	19.63	22.74
	Service: private household, protective service	21,651	9.19	28.88
	Blue collar	38,493	16.33	34.48
	Farming, forestry, fishing	5,296	2.25	24.09
	Not in labor force, unemployed, formerly in armed forces	79,163	33.59	17.99
Marital status	Married	135,185	57.37	20.51
	Widowed	17,158	7.28	16.10
	Separated/divorced	26,798	11.37	37.65
	Single/never married	56,513	23.98	21.90
Age	15–19	18,883	8.01	13.92
	20–24	17,640	7.49	24.98
	25–29	20,906	8.87	25.35
	30–34	24,462	10.38	27.75
	35–39	25,938	11.01	28.56
	40–44	23,835	10.11	26.78
	45–49	21,602	9.17	26.32
	50–59	29,862	12.67	24.41
	60–69	24,115	10.23	18.32
	70–79	19,486	8.27	10.96
	80+	8,925	3.79	5.19

[a]Tobacco Use Supplement to the Current Population Survey (TUS-CPS) non-response weights applied

[b]Sample excludes Asians, Native Americans, and those with indeterminant smoking status.

NH = non-Hispanic

the CPS sampling frame to reflect state and national estimates, using raw sampling weights supplied by CPS. We built a null multilevel model (with no variables to examine the amount of state-level variance, Model 1), and then added each variable in turn, stratified by race and gender. We assessed whether state random smoking variation remained after compositional variables were added (Model 2). We then calculated the predicted probability of smoking for each state and gender/race subgroup based on this model's state-level residuals (from Model 2). We correlated these state-level predicted probabilities across all six subgroups with the Spearman Rank Correlation Test. Last, using the mapping software ArcInfo 9.0, we generated maps to display the model-based predicted probability of smoking in each state for each racial and gender group after adjusting for demographic factors, based on those residuals (Figure).[21] The maps displayed whether the smoking rate for each subgroup for each state significantly differed from the national gender/race-specific subgroup average (based on whether the national subgroup smoking prevalence point estimate fell within or outside the state's 95% confidence interval).

RESULTS

The original TUS-CPS 1995–1996 dataset contained 247,088 observations. We excluded 1,220 observations missing on the smoking status variable (0.49% of sample), as well as Native Americans (1.02%) and Asians (3.12%), for a sample size of 235,654.

As Table 1 shows, 23% of our sample were current smokers in 1995–1996. Men smoked more than women (25% vs. 20%); native born (23%) more than foreign born (16%); and non-Hispanic whites (23%) more than other racial/ethnic groups (NH Black 22%, Hispanic 17%).

Examination of the data in multidimensional cross tabulations showed marked variability in smoking patterns by race/gender subgroups. For instance, there were stark age patterns, of an inverse-U shape with regard to age, across all racial/gender groups (figure not shown). Foreign-born women smoked at much lower rates than foreign-born men across all age groups. There was a much smaller difference in smoking prevalence between native-born women and men than among their foreign-born counterparts, although men are still more likely to smoke than women across both native and foreign-born groups.

Table 2 displays average smoking prevalence estimates from the two-level logistic regression models stratified by race/ethnicity and gender. These models included all individual-level demographic factors, including age, occupation, income, education, nativity, and marital status (Model 2).

Table 2 demonstrates that all demographic variables were significant with smoking in final models for all racial/ethnic and gender groups (although occupation was marginally or non-significant for Hispanics). Even after accounting for all demographic factors in our model, there continue to be differential smoking patterns by race/ethnicity. Among women, a gradient exists, with Hispanic women smoking least, followed by black women, and white women smoking the most. Among men, Hispanic men display the lowest smoking prevalence, followed by white men and black men with approximately comparable smoking prevalence. But as stated prior, the average association for each racial group was modified substantially by demographic characteristics, so one summary estimate of smoking prevalence does not sufficiently capture the variability of smoking for each racial group.

Table 3 displays the state random effects of smoking in null models (Model 1) and in models adjusted for all demographic variables (Model 2). All Model 1 state variances in smoking are significant from zero for women, suggesting that states display significant variance in smoking for all three racial groups, but for men only whites had significant variance. In final models, Hispanic men and women's variance is not significant from zero, and black men's is only marginally significant. The magnitude of state smoking variance was largest for black and Hispanic women, at approximately twice the size of white women and white men.

Table 4 provides the predicted probability of smoking, after adjusting for demographic and socioeconomic factors, for the different racial/gender groups, across the states and nationally, based on the state-level residuals from Model 2. The Figure displays these predicted probabilities on U.S. maps. These smoking prevalence estimates were calculated for the reference group (native-born, age 44, married, high school graduate, earning $0–19,000 annually, in sales/tech occupations).

The Figure highlights states that are significantly different from the gender/race subgroup national predicted probability smoking prevalence average, by mapping the adjusted smoking prevalence from Table 4. For instance, in the Figure for whites, we observed four states above the national rate for both men and women for predicted probability of smoking, including Nevada, Michigan, North Carolina, and Texas. White women additionally displayed higher than their U.S. average smoking prevalence in Florida and Indiana, while white men additionally displayed state rates higher than their national average in Illinois, Ohio, and Virginia. White women exhibited lower predicted smoking prevalence rates than expected in Idaho, Nebraska, South Dakota, and Utah, while no states show smoking prevalence rates below the national mean for white men. In all, 10 states differed from the national smoking rate for white women, while seven differed for white men.

The Figure displays fewer states significantly different from the national rate of predicted probability

Table 2. Logistic regression results from gender and racial/ethnic stratified models, odds of current smoking,

Fixed effects from Model 2

			Women							
			NH White (n=103,314)				*NH Black (n=13,543)*			
Variable	*Reference group*	*Parameter*	*Odds ratio*		*Logit parameter estimate*	*Standard error parameter*	*Odds ratio*		*Logit parameter estimate*	*Standard error parameter*
Intercept		intercept	—	***	−0.504	0.034	—	***	−0.945	0.094
Age		age	0.98	***	−0.024	0.001	0.99	**	−0.007	0.003
		age-squared	1.00	***	−0.002	0.000	1.00	***	−0.003	0.000
		age-cubed	1.00	***	0.000	0.000	1.00	***	0.000	0.000
Occupation	Technician/sales	professional specialty	0.79	***	−0.236	0.035	1.06		0.055	0.112
		executive administrative	1.12	**	0.113	0.031	1.05		0.048	0.114
		service	1.27	***	0.240	0.027	1.14	*	0.131	0.079
		blue collar	1.46	***	0.377	0.034	1.06		0.063	0.093
		farm fish forestry	0.72	**	−0.325	0.088	3.97	**	1.378	0.436
		Not in labor force	1.09	**	0.084	0.023	1.14	*	0.135	0.072
Income	$0–19,000	$20–34,000	0.78	***	−0.247	0.022	0.80	***	−0.223	0.062
		$35–59,000	0.60	***	−0.517	0.026	0.72	***	−0.332	0.090
		$60,000 and over	0.49	***	−0.711	0.028	0.54	***	−0.613	0.120
		income not reported	0.63	***	−0.463	0.033	0.71	**	−0.349	0.089
Education	High school grad	grammar school	0.87	**	−0.141	0.043	1.04		0.037	0.108
		some high school	1.39	***	0.331	0.027	1.51	***	0.412	0.067
		some college	0.74	***	−0.297	0.020	0.92		−0.085	0.063
		bachelor's degree	0.38	***	−0.978	0.031	0.52	***	−0.653	0.110
		graduate/prof'l school	0.31	***	−1.176	0.051	0.49	***	−0.718	0.180
		still in school (< age 25)	0.54	***	−0.621	0.068	0.49	**	−0.715	0.259
Nativity	U.S. born	foreign born	0.78	***	−0.252	0.043	0.17	***	−1.792	0.176
Marital status	Married	widow	1.73	***	0.547	0.035	1.42	***	0.350	0.096
		divorced or separated	1.99	***	0.686	0.023	1.72	***	0.541	0.065
		single or never married	1.27	***	0.243	0.028	1.48	***	0.389	0.067

NOTE: For age-square and age-cube terms, when noted as significant, parameter estimates and standard errors listed as 0.000 were very small,

NH = Non-Hispanic

p-value # = $p<0.10$; * = $p<0.05$; ** = $p<0.01$; and *** = $p<0.001$

Models weighted by raw non-response weights

of smoking for racial minorities (compared to the maps for whites). Black women displayed the most variability among minorities, with seven states exhibiting predicted probability of smoking different from the national rate for black women. A clear pattern emerged for black women whereby all six states significantly lower than expected were clustered together in the Southeast: South Carolina, Georgia, Alabama, Mississippi, Louisiana, and Florida. New York was the one state significantly higher than the national mean for black women. Hispanic women, Hispanic men, and black men showed very little variability from the national mean, with only one or two states per group differing from the national rate. Illinois displayed significantly higher adjusted predicted smoking rates than the national rate among black men. California displayed significantly lower adjusted predicted smoking rates than the national rate for Hispanic women and Hispanic men. New Mexico displayed higher-than-expected adjusted rates for Hispanic women. These states are also listed in Table 5.

To examine further smoking patterns across states, we analyzed correlations between men and women for the six racial/ethnic gender groups, using the predicted probability of smoking derived from the residuals of Model 2 (using the estimates in Table 4).

fixed effect parameters

				Men											
Hispanic (n=9,871)				NH White n=91,097)				NH Black (n=9,326)				Hispanic (n=8,503)			
Odds ratio		Logit parameter estimate	Standard error parameter	Odds ratio		Logit parameter estimate	Standard error parameter	Odds ratio		Logit parameter estimate	Standard error parameter	Odds ratio		Logit parameter estimate	Standard error parameter
—	***	−1.100	0.122	—	***	−0.236	0.038	—	*	−0.248	0.106	—	***	−0.695	0.119
0.98	*	−0.016	0.005	0.98	***	−0.016	0.001	1.01	***	0.011	0.002	1.00		0.003	0.003
1.00	***	−0.002	0.000	1.00	***	−0.002	0.000	1.00	***	-0.002	0.000	1.00	***	-0.001	0.000
1.00	***	0.000	0.000	1.00	***	0.000	0.000	—	—	—	—	—	—	—	—
0.67	*	−0.395	0.187	0.76	***	−0.271	0.041	0.71	*	−0.347	0.161	0.79		−0.234	0.188
1.11		0.107	0.161	1.02		0.021	0.032	1.01		0.015	0.143	1.12		0.117	0.147
1.08		0.073	0.109	1.20	***	0.178	0.036	1.35	**	0.303	0.105	1.10		0.097	0.112
0.91		−0.096	0.131	1.33	***	0.286	0.025	1.26	*	0.230	0.091	1.17	#	0.161	0.095
0.89		−0.113	0.383	0.81	**	−0.217	0.048	1.21		0.190	0.201	1.08		0.076	0.139
1.05		0.051	0.093	1.13	**	0.122	0.032	1.17		0.161	0.101	0.94		−0.062	0.115
0.78	***	−0.243	0.082	0.70	***	−0.357	0.024	0.72	***	−0.333	0.064	0.91	*	−0.092	0.065
0.82	#	−0.197	0.117	0.53	***	−0.630	0.028	0.57	***	−0.567	0.087	0.65	***	−0.426	0.095
0.77	#	−0.257	0.140	0.47	***	−0.756	0.029	0.41	***	−0.899	0.110	0.69	***	−0.373	0.119
0.87		−0.145	0.139	0.59	***	−0.522	0.035	0.57	***	−0.556	0.093	0.86		−0.154	0.113
0.78	*	−0.245	0.105	1.00		0.004	0.039	1.12		0.110	0.099	1.13		0.123	0.080
1.19	*	0.177	0.091	1.42	***	0.348	0.027	1.17	*	0.155	0.070	1.13		0.125	0.079
0.81	*	−0.210	0.095	0.74	***	−0.299	0.022	0.80	***	−0.228	0.068	0.81	*	−0.208	0.085
0.64	*	−0.440	0.170	0.40	***	−0.908	0.030	0.42	***	−0.873	0.130	0.58	***	−0.543	0.148
0.80		−0.223	0.270	0.30	***	−1.188	0.047	0.51	*	−0.673	0.186	0.39	**	−0.938	0.246
0.29	***	−1.234	0.332	0.58	***	−0.540	0.066	0.38	***	−0.957	0.210	0.48	**	−0.734	0.216
0.40	***	−0.915	0.076	0.94		−0.065	0.043	0.38	***	−0.965	0.126	0.72	***	−0.331	0.061
1.81	**	0.596	0.165	1.60	***	0.472	0.060	1.72	**	0.544	0.143	1.46		0.378	0.254
1.80	***	0.585	0.088	1.91	***	0.648	0.026	1.48	***	0.395	0.072	1.79	***	0.585	0.090
1.38	***	0.321	0.094	1.20	***	0.183	0.026	1.23	**	0.208	0.070	1.14	#	0.134	0.077

although they round to 0.000 when presented with 3 decimal places.

We found a pattern here similar to the pattern that resulted when analyzing crude smoking rates (results not shown). For each racial group, men and women's predicted smoking rates were significantly positively correlated. For whites, this association was moderate to large (0.64, $p<0.0001$), while for blacks (0.37, $p=0.0074$) and Hispanics (0.44, $p=0.0013$) it was smaller. So there seems to be a geographic patterning of smoking associated with race/ethnicity, after adjusting for demographic factors. We also found that in no instance are racial/ethnic rates of smoking correlated with any other group (correlations other than these listed were not significant; results not shown).

DISCUSSION

As prior literature has noted, average smoking prevalence rates by race are difficult to summarize with one estimate because they are modified substantially by gender, SEP, nativity, and age.[22] Our analysis confirmed a race-specific geographic patterning of smoking across the U.S. with mapping and correlation analyses of adjusted rates of smoking, within and between racial groups by gender. For all three racial groups, we found men's and women's adjusted state smoking rates were significantly correlated; that is, high smoking states for black men were also high for black women, high smoking states for white men were also high for white

Table 3. Logistic regression results from gender and race/ethnic stratified models, random effects: state intercept variance components of current smoking

	Women									*Men*								
	NH White (n= 103,314)			*NH Black* (n=13,543)			*Hispanic* (n=9,871)			*NH White* (n=91,097)			*NH Black* (n=9,326)			*Hispanic* (n=8,503)		
	$\sigma^2\mu o$	*(SE)*	p *value*	$\sigma^2 mo$	*(SE)*	p *value*	$\sigma^2 mo$	*(SE)*	p *value*	$\sigma^2 mo$	*(SE)*	p *value*	$\sigma^2 mo$	*(SE)*	p *value*	$\sigma^2 mo$	*(SE)*	p *value*
Null Model 1	0.026	0.007	***	0.037	0.017	*	0.111	0.046	*	0.029	0.007	***	0.021	0.012	#	0.019	0.013	
Model 2	0.022	0.006	***	0.056	0.022	*	0.051	0.030	#	0.017	0.004	***	0.019	0.012	#	0.011	0.010	

NOTES: p-value # = $p<0.10$; * = $p<0.05$; ** = $p<0.01$; *** = $p<0.001$. Models weighted by raw non-response weights. All models result from Markov Chain Monte Carlo estimation.

NH = Non-Hispanic

SE = standard error

women, and high smoking states for Hispanic men were also high for Hispanic women. These patterns were racially unique in that the pattern of smoking for whites across the states was not significantly associated with the pattern for blacks or Hispanics. Additional analysis (results not shown) also found that these state/race smoking patterns were not driven by individual composition of the states (e.g., differential income or foreign-born composition), since model-based smoking rates and crude smoking rates were strongly correlated for each subgroup. So demographics that we analyzed here do not account for why certain states are high or low for smoking prevalence for each group. This suggests that what matters for state smoking rates differs by race, and/or differs by state on some other unaccounted-for factor, above and beyond the differential distribution of racial groups by SEP, age, nativity, or marital status.

Mapping adjusted smoking rates is helpful for surveillance since the maps display data in a digestible manner, and adjust for the different distributions of demographic variables among racial groups (age, socioeconomic position, marital status) that may obscure racial smoking patterns. Our mapping analysis highlighted states that were higher and lower than the national race/gender subgroup rate for smoking. We found a striking cluster of six states in the deep South with significantly lower smoking rates than the national subgroup rate for black women. For white women and white men, Nevada, North Carolina, Michigan, and Texas exhibited higher smoking prevalence than the national subgroup rates. California exhibited lower smoking prevalence for Hispanic men and women, while New Mexico remained higher for Hispanic women before and after adjusting for demographics. Black women exhibited a higher smoking rate in New York state than their national subgroup average; these state patterns are driven by New York City residents, since they comprise 78% of the black women's New York state sample. These results suggest that there may be something about these states that is acting above and beyond compositional factors to affect smoking. What could be driving these different patterns we observed for different racial groups? This analysis constitutes a first step to identify race/gender-specific state patterns, providing a foundation for future studies that may explain these patterns.

Black women in the Deep South

The lower-than-expected smoking prevalence clustering of six states for black women in the southeast U.S. emerged as an important finding here. The tobacco industry has strong and complex historical ties with African Americans. For instance, although many free blacks and slaves worked on tobacco farms in the 18th and 19th centuries, as a result of the segregation of cigarette manufacturing, black women were relegated to and concentrated in the dirtiest, least healthy, and lowest-paying jobs in the tobacco industry from the close of the 19th century.[2] On the other hand, unionization of blacks played an important role in improving the status and working conditions of blacks in the tobacco industry in the 1960s, including desegregated work environments.[2] The fact that the tobacco industry offered jobs for blacks where other industries did (or would) not may indicate that blacks hold more positive views about the industry or its products. But this explanation would predict higher use among blacks than whites, not lower use. The deep southern states contain high numbers and proportions of blacks, a compositional phenomenon that might confer contextual effects (above and beyond

Table 4. Model 2 residual-based predicted smoking probability by state, race/ethnicity, and gender, TUS-CPS 1995–1996

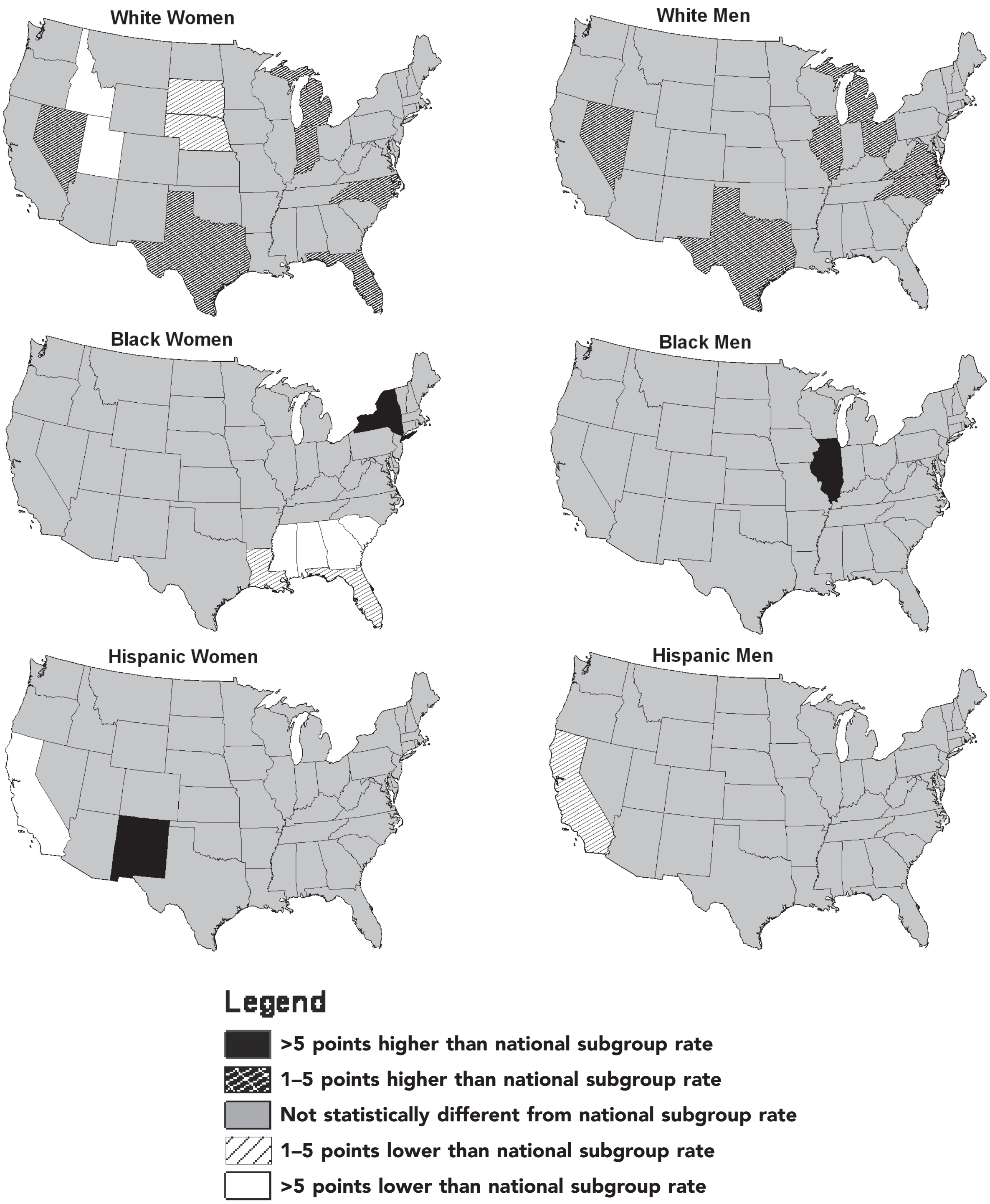
State	White women: Predicted smoking prevalence (95% CI)	Black women: Predicted smoking prevalence (95% CI)	Hispanic women: Predicted smoking prevalence (95% CI)	White men: Predicted smoking prevalence (95% CI)	Black men: Predicted smoking prevalence (95% CI)	Hispanic men: Predicted smoking prevalence (95% CI)
U.S. Total	37.7% (36.8%, 38.4%)	28.0% (26.0%, 29.7%)	25.0% (22.8%, 27.4%)	44.1% (43.2%, 45.0%)	43.8% (41.4%, 47.1%)	33.3% (31.2%, 36.0%)
AL	36.6% (33.7%, 39.6%)	21.5% (17.6%, 25.9%)	25.3% (18.3%, 34.0%)	44.7% (41.6%, 47.7%)	42.1% (37.6%, 46.7%)	33.7% (29.2%, 38.6%)
AK	37.7% (34.4%, 41.1%)	28.1% (20.5%, 37.2%)	23.2% (16.7%, 31.4%)	40.8% (37.5%, 44.2%)	45.2% (38.7%, 51.8%)	33.6% (29.4%, 38.1%)
AZ	38.9% (35.9%, 42.0%)	27.5% (20.4%, 35.9%)	23.0% (18.5%, 28.1%)	45.4% (42.3%, 48.5%)	44.4% (38.4%, 50.6%)	32.9% (29.5%, 36.4%)
AR	37.8% (35.0%, 40.8%)	26.4% (21.4%, 32.1%)	26.2% (18.7%, 35.5%)	45.3% (42.4%, 48.2%)	45.6% (40.5%, 50.7%)	33.0% (28.8%, 37.6%)
CA	36.0% (34.2%, 37.9%)	27.3% (23.4%, 31.7%)	19.4% (16.7%, 22.3%)	42.3% (40.4%, 44.3%)	44.0% (39.9%, 48.2%)	30.3% (27.5%, 33.3%)
CO	37.0% (34.2%, 40.0%)	31.7% (24.3%, 40.3%)	27.2% (21.8%, 33.5%)	44.4% (41.5%, 47.3%)	44.1% (38.1%, 50.2%)	33.9% (30.2%, 37.8%)
CT	39.1% (35.7%, 42.5%)	29.0% (22.3%, 36.7%)	23.7% (18.0%, 30.6%)	41.9% (38.5%, 45.4%)	43.0% (37.4%, 48.9%)	32.6% (28.5%, 37.0%)
DE	39.6% (36.3%, 43.1%)	29.6% (24.1%, 35.7%)	23.4% (16.8%, 31.7%)	47.5% (44.1%, 51.0%)	41.7% (36.4%, 47.2%)	33.5% (29.3%, 38.1%)
DC	40.5% (35.4%, 45.7%)	30.2% (26.6%, 34.1%)	24.7% (18.1%, 32.6%)	45.8% (40.8%, 50.9%)	44.1% (40.3%, 47.9%)	32.7% (28.6%, 37.2%)
FL	39.9% (37.8%, 41.9%)	23.6% (19.9%, 27.7%)	25.7% (21.8%, 29.9%)	45.0% (43.0%, 47.1%)	41.9% (37.8%, 46.1%)	34.2% (31.2%, 37.3%)
GA	37.9% (35.1%, 40.8%)	21.0% (17.4%, 25.3%)	24.5% (17.8%, 32.7%)	44.9% (42.1%, 47.8%)	41.7% (37.4%, 46.2%)	33.6% (29.4%, 38.1%)
HI	35.8% (31.3%, 40.6%)	28.0% (19.8%, 38.0%)	24.3% (17.7%, 32.4%)	45.3% (40.8%, 50.0%)	44.6% (38.2%, 51.2%)	33.5% (29.3%, 37.9%)
ID	31.8% (29.2%, 34.5%)	29.5% (21.0%, 39.8%)	24.5% (18.2%, 32.1%)	41.0% (38.3%, 43.7%)	44.6% (38.1%, 51.2%)	33.3% (29.4%, 37.5%)
IL	39.2% (37.1%, 41.3%)	28.6% (25.0%, 32.6%)	24.8% (20.1%, 30.2%)	48.1% (46.0%, 50.2%)	49.3% (44.3%, 54.3%)	32.4% (29.1%, 36.0%)
IN	40.5% (37.8%, 43.2%)	31.3% (24.7%, 38.7%)	25.0% (17.9%, 33.6%)	46.2% (43.4%, 49.0%)	44.3% (38.6%, 50.1%)	33.4% (29.3%, 37.9%)
IA	35.7% (33.0%, 38.5%)	27.6% (20.0%, 36.8%)	25.6% (18.5%, 34.4%)	43.0% (40.1%, 45.8%)	44.1% (37.9%, 50.6%)	33.6% (29.2%, 38.3%)
KS	40.3% (37.3%, 43.3%)	28.7% (22.1%, 36.3%)	28.5% (21.2%, 37.2%)	46.0% (43.0%, 48.9%)	46.1% (40.0%, 52.3%)	33.6% (29.5%, 38.0%)
KY	40.3% (37.5%, 43.1%)	29.0% (22.6%, 36.4%)	24.6% (17.5%, 33.3%)	46.6% (43.9%, 49.4%)	42.9% (37.1%, 48.9%)	33.2% (28.9%, 37.7%)
LA	36.7% (33.7%, 39.9%)	23.5% (19.5%, 27.9%)	25.9% (18.8%, 34.5%)	46.3% (43.2%, 49.5%)	41.8% (37.1%, 46.5%)	33.7% (29.4%, 38.2%)
ME	35.1% (32.3%, 38.0%)	27.9% (19.7%, 38.1%)	24.8% (17.8%, 33.5%)	44.3% (41.5%, 47.2%)	43.4% (37.0%, 50.1%)	33.2% (29.0%, 37.7%)
MD	39.9% (36.6%, 43.2%)	27.2% (22.5%, 32.5%)	23.3% (16.9%, 31.3%)	46.2% (42.7%, 49.6%)	39.4% (33.8%, 45.3%)	33.4% (29.2%, 37.8%)
MA	38.8% (36.6%, 41.0%)	28.4% (22.2%, 35.6%)	20.4% (14.9%, 27.4%)	40.4% (38.1%, 42.8%)	43.5% (38.0%, 49.2%)	32.8% (28.9%, 37.0%)
MI	40.0% (38.0%, 42.0%)	29.4% (25.5%, 33.7%)	27.3% (20.8%, 34.8%)	46.4% (44.4%, 48.4%)	45.5% (41.2%, 49.8%)	34.2% (29.9%, 38.8%)
MN	35.7% (33.1%, 38.4%)	34.1% (25.0%, 44.4%)	24.8% (18.0%, 33.1%)	42.9% (40.2%, 45.6%)	45.2% (38.8%, 51.7%)	33.5% (29.3%, 38.1%)
MS	35.7% (32.5%, 38.9%)	20.8% (17.2%, 24.9%)	24.4% (17.2%, 33.4%)	43.8% (40.5%, 47.1%)	43.3% (39.1%, 47.6%)	33.7% (29.3%, 38.4%)
MO	40.1% (37.2%, 43.1%)	25.9% (20.3%, 32.4%)	24.1% (17.2%, 32.6%)	46.1% (43.1%, 49.2%)	42.0% (36.5%, 47.7%)	33.7% (29.4%, 38.4%)
MT	36.2% (33.5%, 39.0%)	28.2% (19.9%, 38.2%)	26.8% (19.5%, 35.6%)	38.0% (35.2%, 40.8%)	44.1% (37.7%, 50.7%)	32.8% (28.6%, 37.3%)
NE	33.9% (31.3%, 36.7%)	28.7% (21.4%, 37.3%)	23.9% (17.7%, 31.5%)	40.7% (37.8%, 43.6%)	43.8% (37.6%, 50.1%)	33.9% (29.6%, 38.5%)
NV	41.4% (38.2%, 44.7%)	32.3% (24.6%, 41.1%)	25.9% (19.7%, 33.3%)	48.3% (45.0%, 51.6%)	44.2% (38.3%, 50.2%)	34.4% (30.4%, 38.6%)
NH	40.4% (37.3%, 43.6%)	27.1% (19.2%, 36.8%)	24.5% (17.6%, 32.8%)	41.2% (38.0%, 44.5%)	43.6% (37.2%, 50.3%)	33.6% (29.2%, 38.3%)
NJ	39.5% (37.2%, 41.8%)	30.6% (26.0%, 35.5%)	25.6% (21.1%, 30.8%)	45.1% (42.7%, 47.4%)	44.4% (39.8%, 49.1%)	33.2% (29.9%, 36.7%)
NM	39.9% (36.5%, 43.3%)	26.4% (19.2%, 35.1%)	30.0% (25.8%, 34.6%)	45.1% (41.7%, 48.6%)	44.3% (37.9%, 50.9%)	34.1% (30.9%, 37.4%)
NY	38.9% (37.0%, 40.8%)	34.1% (30.4%, 38.1%)	23.3% (20.0%, 26.8%)	43.0% (41.1%, 44.9%)	46.3% (42.3%, 50.3%)	31.8% (28.7%, 35.1%)
NC	40.1% (37.9%, 42.3%)	24.8% (21.4%, 28.6%)	24.4% (17.8%, 32.6%)	47.0% (44.8%, 49.2%)	45.7% (41.7%, 49.7%)	32.0% (27.7%, 36.6%)
ND	36.5% (33.7%, 39.3%)	27.6% (19.4%, 37.5%)	24.1% (17.1%, 32.7%)	43.6% (40.8%, 46.5%)	43.7% (37.2%, 50.4%)	33.1% (28.7%, 37.7%)
OH	38.5% (36.6%, 40.5%)	29.1% (24.9%, 33.6%)	24.6% (18.3%, 32.1%)	47.1% (45.2%, 49.0%)	41.4% (37.0%, 46.0%)	33.9% (29.7%, 38.3%)
OK	37.0% (34.3%, 39.7%)	31.2% (24.9%, 38.3%)	24.4% (17.9%, 32.2%)	43.2% (40.4%, 46.1%)	45.3% (39.7%, 51.1%)	33.3% (29.1%, 37.8%)
OR	36.6% (33.8%, 39.6%)	29.8% (21.6%, 39.6%)	22.5% (16.4%, 30.1%)	42.2% (39.2%, 45.2%)	43.7% (37.4%, 50.1%)	32.5% (28.4%, 36.8%)
PA	38.7% (36.8%, 40.6%)	30.4% (26.1%, 35.1%)	26.1% (20.3%, 32.9%)	43.1% (41.2%, 45.0%)	44.8% (40.4%, 49.3%)	34.0% (30.0%, 38.2%)
RI	37.5% (34.4%, 40.7%)	30.8% (22.8%, 40.1%)	26.7% (19.8%, 35.0%)	45.5% (42.2%, 48.7%)	43.3% (37.3%, 49.6%)	32.7% (28.7%, 36.9%)
SC	36.3% (33.1%, 39.7%)	21.4% (17.4%, 26.1%)	25.8% (18.5%, 34.8%)	47.2% (43.8%, 50.6%)	44.8% (40.3%, 49.4%)	33.4% (29.1%, 38.0%)
SD	34.3% (31.6%, 37.0%)	29.7% (21.0%, 40.2%)	27.0% (19.2%, 36.5%)	41.8% (38.9%, 44.7%)	45.1% (38.5%, 52.0%)	33.1% (28.9%, 37.7%)
TN	39.4% (36.5%, 42.4%)	26.0% (21.1%, 31.7%)	28.0% (20.0%, 37.7%)	46.2% (43.2%, 49.2%)	40.3% (34.6%, 46.3%)	33.4% (29.0%, 38.1%)
TX	39.9% (37.8%, 42.1%)	28.4% (24.3%, 32.8%)	22.4% (19.5%, 25.7%)	48.7% (46.5%, 50.9%)	42.1% (37.7%, 46.5%)	32.9% (30.3%, 35.5%)
UT	23.4% (20.7%, 26.2%)	26.8% (18.7%, 36.7%)	25.1% (19.1%, 32.1%)	35.5% (32.5%, 38.5%)	43.7% (37.3%, 50.3%)	34.7% (30.3%, 39.4%)
VT	39.1% (36.2%, 42.1%)	28.4% (20.2%, 38.4%)	24.3% (17.2%, 33.2%)	40.1% (36.9%, 43.3%)	43.6% (37.1%, 50.3%)	33.2% (28.8%, 37.8%)
VA	40.3% (37.4%, 43.3%)	28.6% (24.1%, 33.6%)	24.3% (17.9%, 32.2%)	48.1% (45.0%, 51.2%)	43.4% (38.9%, 48.0%)	34.1% (29.9%, 38.7%)
WA	38.0% (35.1%, 41.0%)	30.4% (22.3%, 39.9%)	27.9% (20.2%, 37.2%)	42.0% (39.0%, 45.1%)	44.7% (38.6%, 51.1%)	32.8% (28.7%, 37.2%)
WV	36.2% (33.7%, 38.8%)	27.2% (20.2%, 35.5%)	25.8% (18.3%, 34.9%)	45.0% (42.3%, 47.6%)	43.1% (36.9%, 49.5%)	33.7% (29.2%, 38.4%)
WI	39.1% (36.4%, 41.9%)	30.2% (23.2%, 38.1%)	23.3% (16.8%, 31.4%)	42.9% (40.2%, 45.6%)	45.4% (39.3%, 51.7%)	32.7% (28.5%, 37.2%)
WY	36.9% (34.2%, 39.7%)	28.2% (20.3%, 37.6%)	31.2% (23.6%, 40.0%)	42.0% (39.2%, 44.9%)	43.1% (36.7%, 49.8%)	33.3% (29.3%, 37.5%)

NOTE: Reference group is native-born, age 44, married, high school graduate, earning $0–19,000 annually, and in sales tech occupations.

TUS-CPS = Tobacco Use Supplement to the Current Population Survey

CI = confidence interval

Figure. Adjusted state smoking prevalence relative to the national gender and racial/ethnic rate (derived from residuals in Model 2), TUS-CPS 1995–1996



TUS-CPS = Tobacco Use Supplement to the Current Population Survey

Table 5. States different from gender and racial/ethnic national estimate of predicted probability of smoking, from Model 2 state-level residuals, TUS-CPS 1995–1996

		States higher than national subgroup prevalence		*States lower than national subgroup prevalence*	
Racial/ethnic gender subgroup	*Number of states different from national prevalence*	*Prevalence more than 5 points higher than national subgroup prevalence*	*Prevalence 1–5 points higher than national subgroup prevalence*	*Prevalence 1–5 points lower than national subgroup prevalence*	*Prevalence more than 5 points lower than national subgroup prevalence*
White women	10	—	FL, IN, MI, NV, NC, TX	NE, SD	ID, UT
Black women	7	NY	—	FL, LA	AL, GA, MS, SC
Hispanic women	2	NM	—	—	CA
White men	7	—	IL, MI, NV, NC, OH, TX, VA	—	—
Black men	1	IL	—	—	—
Hispanic men	1	—	—	CA	—

TUS-CPS = Tobacco Use Supplement to the Current Population Survey

the individual-level influences) by discouraging uptake of smoking, or encouraging quitting behaviors. These states were historically very segregated and continue to reflect vestiges of slavery and segregation. So perhaps something related to resistance against white smoking culture has developed for women in these states. It could also be that the occupational structure in these states is different, and may account for these patterns. Some authors have emphasized that cost may be a protective factor for blacks, especially among youth,[23] which may apply here since counties with the largest proportions of black-owned tobacco farms were also some of the poorest in the nation.[2] The fact that we did not observe lower smoking rates for men in these deep South states provides a gender-specific clue for understanding these patterns. For instance, if cost is a barrier, although our regression models adjusted for income, income was measured at the household level, which does not account for within-household income inequality, which might inhibit women's access to household funds for purchasing cigarettes. Alternately, Southern black women may be substituting other forms of tobacco use for smoking. For instance, Southern black women's use of smokeless tobacco was particularly high 30 to 40 years ago,[24] although it has declined to very low levels currently.[25]

White women in the rural West and Midwest

A number of rural states in the northern West and Midwest displayed lower-than-national smoking rates for white women (Idaho, Utah, South Dakota, Nebraska). Some aspects of rural culture may be protective for white women in these places—for example, fewer economic opportunities that translate to cost hurdles for purchasing cigarettes, or traditional gender norms that discourage smoking among women. It could also be the case that white women are protected from barrages of tobacco industry marketing because of the diffuse population density in rural areas (unlike their metropolitan-dwelling counterparts). There are very few minorities in these states, so it is not surprising that we did not detect comparable effects for minorities.

The role of immigration

Differential settlement patterns for immigrants, and/or differential contextual features affecting immigrants could be contributing to racial smoking patterns across the states, which is most relevant here for Hispanics. Given the vastly different geographic settlement patterns of different immigrant groups in the U.S., the state smoking variation that we found for Hispanics may be an artifact of immigrant settlement patterns, since immigrant status is protective for smoking, and since immigrants are so geographically concentrated in the U.S. Due to the large population of recent immigrants in southwestern and western states in particular, future studies should investigate immigrant composition (e.g., second-generation immigrants, or different countries of origin), acculturation processes, and/or tobacco industry targeting of immigrant or racial groups. For instance, the tobacco industry has a sophisticated understanding of the immigrant experience, and has leveraged this knowledge to target immigrants.[26] So our study may be picking up effects of enhanced tobacco marketing to Hispanic female immigrants in New Mexico.

Remaining state-level smoking variance

Although the primary motivation of our analysis was to describe state patterns of smoking for different racial/ethnic groups after adjusting for demographic and socioeconomic composition, we conducted a sensitivity analysis to examine how certain state-level tobacco variables might account for remaining state-level smoking variance. Such an exercise may generate hypotheses for future studies. We extracted average state cigarette excise tax per pack data in cents for 1995 from the ImpacTeen web site[27] and centered the variable about its mean. We also extracted the 1995 state tobacco agriculture cash receipts from the Centers for Disease Control and Prevention's State Tobacco Activities Tracking and Evaluation (STATE) System dataset.[28] Since this cash receipt variable was highly skewed, we recoded the agriculture cash receipts into an indicator variable equal to one if the state garnered more than $10 million annually from tobacco receipts, zero otherwise. We then separately entered each state-level variable into a multiple logistic regression with all variables from Model 2 (stratified by race/ethnicity and gender), and applied Markov Chain Monte Carlo estimation to examine whether these state tobacco variables were significant predictors of smoking after accounting for demographic factors, and whether the state-level smoking variance remained significant.

The 1995 state excise tax and state agriculture receipts were moderately correlated (−.49, p=0.0002, Spearman Correlation). As shown in Table 6 Model 3, state excise tax was associated with smoking for some groups, but the association varied by racial/ethnic group. Higher state excise tax was at least marginally associated with lower individual smoking odds for both Hispanic women and men, at approximately 0.94–0.95 odds of smoking for each $.10 higher tax rate. However, the associations were unexpectedly reversed for blacks and not significant for whites. Black men and women had significantly higher odds of smoking in states with higher tax rates (odds of 1.08 and 1.03 for women and men respectively, for each $.10 increased

Table 6. Logistic regression results of current smoking: addition of state-level variables

	Model 3						
	1995 State excise tax				*State variance estimate*		
	Parameter estimate[a]	*SE*	*OR*	*p*	*Parameter estimate*	*SE*	*p*
White women	0.004	0.014	1.004		0.023	0.006	***
Black women	0.074	0.022	1.077	***	0.034	0.017	*
Hispanic women	–0.060	0.037	0.942	#	0.041	0.027	
White men	–0.010	0.011	0.990		0.017	0.004	***
Black men	0.034	0.019	1.034	#	0.017	0.011	
Hispanic men	–0.053	0.026	0.948	*	0.009	0.008	
	Model 4						
	1995 State tobacco agriculture cash receipts				*State variance estimate*		
	Parameter estimate[b]	*SE*	*OR*	*p*	*Parameter estimate*	*SE*	*p*
White women	0.097	0.053	1.102	#	0.020	0.005	***
Black women	–0.174	0.102	0.840	#	0.053	0.022	*
Hispanic women	0.049	0.163	1.051		0.055	0.031	#
White men	0.130	0.034	1.139	**	0.014	0.004	***
Black men	–0.154	0.073	0.858	*	0.017	0.011	
Hispanic men	0.128	0.102	1.137		0.010	0.010	

[a]Parameter estimate refers to a 10-cent higher state cigarette tax; parameter estimate and standard error for state excise tax multiplied by 10. Models 3 and 4 include all individual-level covariates from Model 2 (Table 2).

[b]Parameter estimate refers to a state with more than $10 million annual tobacco agriculture cash receipts.

NOTES: p-value: # = p<0.10; * = p<0.05; ** = p<0.01; *** = p<0.001.

SE = standard error

OR = odds ratio

tax rate). As the second group of columns for Model 3 indicates, although the addition of state tax rate reduced the state variance for black women, state smoking variance remained significantly different from zero. Some significant unaccounted-for smoking variance remains across the states for black women. For Hispanic women and black men, state variance in smoking declined from marginally significant in Model 2 to non-significant in Model 3. We observed no reduction in state smoking variance for white men and women, which was expected since state tax had no significant association with smoking in these groups.

We also found unexpected effects among black men and women for associations of higher state tobacco agriculture cash receipts and individual smoking, where blacks' smoking odds were lower (odds ratio [OR]=0.84 for women and OR=0.86 for men) in states with more than $10 million in tobacco agriculture cash receipts, compared to states with less or no tobacco agriculture. We found associations in the expected direction for whites, and no effects for Hispanics, as listed in Table 6, Model 4. When we added state agriculture receipts to models, we found few changes in the state smoking variance estimates.

We did not find the hypothesized associations between state excise tax and state agricultural receipts for all three racial/ethnic groups. We did, however, find consistent results within racial group for each state measure tested. We believe we are observing these associations because of the cross-sectional design, which introduces many threats to validity for discerning causal associations. For instance, state tax policy may be endogenous, or reflect reverse causality. For instance, state legislators may raise taxes in response to high smoking rates. Alternately, states may introduce taxes because there is strong anti-tobacco sentiment within the state, and lower smoking rates may have been in place before enactment of higher taxes. Thus the cross-sectional relationship between state tax and smoking could reflect either phenomenon, or could reflect confounding by other state variables. To estimate effects of taxation (or other state-level variables) on smoking requires estimating change in the state variable of interest with change in smoking patterns, in a time series analyses. A substantial literature has documented that raising tobacco taxes lowers tobacco use.[2,29,30] Prior studies have also documented the effect of cigarette taxes on the smoking of different subgroups, finding that the elasticity of demand may be greater among NH black and Hispanic smokers compared to white smokers, greater among youth compared to older smokers, and greater among lower-income compared to higher-income populations.[30–32] Since we found a consistent reverse association among both black men and black women between smoking and both state tobacco variables tested, we believe there are other factors correlated with state tobacco tax and agriculture, running in the opposite direction, driving these patterns, which we cannot sort out with this cross-sectional design. We are thus very cautious about interpreting these state tobacco tax and agriculture smoking associations as anything other than descriptive.

Absence of expected effects

An important finding from this analysis includes the absence of some expected effects. We did not find that tobacco states displayed a higher smoking risk for all groups, and we did not find that California exhibited lower smoking for all groups. Whites living in tobacco agriculture states experienced a higher smoking risk after adjusting for demographics than whites living in states with little or no tobacco agriculture, but this pattern was not present for Hispanics, and was reversed for blacks. As indicated in the maps, although a few tobacco states conferred higher smoking risk for whites after adjusting for demographics (e.g., North Carolina), we did not observe a higher smoking rate for whites in the highest tobacco farming states (e.g., Kentucky, South Carolina, Georgia). We also did not observe that whites and blacks in California exhibited lower smoking rates than the national average (although Hispanics there did). This finding was unexpected given that California implemented strong indoor air laws and anti-tobacco media campaigns in the mid-1990s,[33] and it is unclear why racial/ethnic groups other than Hispanics are not demonstrating lower than national smoking rates.

Limitations

Our analysis is limited in several ways. Most importantly, although our multiple regression analysis adjusted for the sampling frame by applying sample weights, we did not fully adjust for the design effect of the CPS, since we did not adjust for the clustering. Although the National Cancer Institute recommends applying 80 replicate weights to adjust for the CPS sample design in multiple regression analyses (personal communication with Anne Hartman, NCI , March 23, 2005), neither MLwiN nor any other multilevel software program to our knowledge could apply the replicate weights simultaneously while modeling two levels of variance. The CPS also masks the primary sampling unit identifiers, which inhibits users from explicitly modeling the clustering. We addressed this issue by applying Markov Chain Monte Carlo estimation, which is a data simulation technique similar to boot strapping that calculates parameters and their standard errors based on repeated sampling of the data. Second, the cross-sectional study design allows for documenting only associations. Since the primary motivation for this analysis was descriptive, such a design was appropriate. Assessing whether state variables like cigarette taxes or tobacco agriculture affect smoking rates of different groups will require time-series analyses (e.g., state difference-in-difference analyses), to strengthen the ability to discern what might be causing differential racial state smoking patterns, in a way that cross-sectional analysis cannot. Third, although the TUS-CPS sample size is large and representative at national and state levels, and despite that its sample sizes are larger than most other national datasets for estimating state sub-group smoking prevalence, we experienced limited power in some states with small sample sizes for blacks or Hispanics. However, our mapping exercise attempted to control for this limited power by highlighting only states that were significantly higher or lower than the national mean.

CONCLUSIONS

Current smoking surveillance typically provides racial estimates of smoking, but rarely are these broken out by state or by gender, and rarely are these estimates adjusted by demographics or socioeconomics. Our analyses suggest that some states may confer protection from smoking for black women, indicated in the lower-than expected smoking rates in six southeastern (Deep South) U.S. states. Moreover, high smoking states for whites are not necessarily high smoking states for other racial groups. In fact, the pattern of smoking across the 50 states differs for each racial group. The fact that states are patterned for both women and men of the same racial group underscores the importance of race for state patterns of smoking. Descriptive variation studies such as ours may be helpful for surveillance purposes and policy/program implementation, as well as for understanding why place may matter differently for the smoking behavior of different racial/ethnic groups.

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