

Beliefs About Behavioral Determinants of Obesity in Appalachia, 2011-2014

Public Health Reports
2018, Vol. 133(4) 379-384
© 2018, Association of Schools and
Programs of Public Health
All rights reserved.
Reprints and permission:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/0033354918774064
journals.sagepub.com/home/phr



Elise L. Rice, PhD¹, Minal Patel, PhD¹, Katrina J. Serrano, PhD¹,
Chan L. Thai, PhD², Kelly D. Blake, ScD¹,
and Robin C. Vanderpool, DrPH³

Abstract

The populations of many Appalachian communities have high rates of unhealthy body weight. This study aimed to identify differences in beliefs about obesity between Appalachians and non-Appalachians. Our analyses explored health beliefs and behaviors among US adults aged ≥ 18 ($n = 14451$) who responded to the Health Information National Trends Survey (2011-2014), of whom 1015 (8%) resided within the 420 counties recognized as Appalachian by the Appalachian Regional Commission. Using weighted regression analyses and controlling for sociodemographic characteristics and general health, we determined that self-reported body mass index was higher among Appalachians than among non-Appalachians ($B = 0.75$, $P = .03$, 95% confidence interval, 0.08-1.47) and that Appalachians were less likely than non-Appalachians to believe that lifestyle factors were related to obesity ($B = -0.37$, $P = .03$, 95% confidence interval, -0.04 to -0.71). Results suggest that Appalachians may regard behavioral prevention differently from non-Appalachians, perhaps with less confidence in the effectiveness of certain behaviors to reduce obesity risk. Future research may determine whether such beliefs could complicate efforts to encourage healthy lifestyles throughout the region.

Keywords

Appalachia, rural health, obesity, preventive medicine, physical activity, healthy eating, smoking, health disparities

Complex geographic and socioeconomic factors underlie the elevated rates of obesity among the 25 million residents of the 13-state Appalachian region. These factors, which include limited availability of nutritious food and recreational facilities, limited access to health care, and low incomes,¹⁻⁴ may be complicated by health beliefs that potentially undermine the perceived importance of preventive behaviors. For example, some Appalachian residents may endorse beliefs that “everything causes cancer” or have limited understanding of cancer risks.^{5,6} Other research suggests that Appalachians may overestimate their own vitality and health status and underestimate the adverse health impact of certain behaviors (eg, smoking or drinking soda).^{7,8} Despite abundant evidence for the high prevalence of obesity in the Appalachian region, the underlying psychosocial factors are poorly understood. To our knowledge, our study is the first to explore Appalachians’ perceptions of the behavioral determinants of obesity.

Methods

We used data from 4 cross-sectional cycles (2011-2014; combined $n = 14451$) of the nationally representative Health

Information National Trends Survey (HINTS 4). Each cycle consisted of a single-mode mail survey based on a random sample of residential addresses; response rates ranged from 34% to 40%. Addresses located in Central Appalachia were oversampled in 2011 and 2012. A total of 1015 (8%) respondents in the final sample were residents of Appalachia. HINTS 4 was approved by the Westat Institutional Review Board and deemed exempt from institutional review board review by the National Institutes of Health Office of Human Subjects Research Protections. Further details about HINTS development and methodology are available elsewhere.^{9,10}

¹ Division of Cancer Control and Population Sciences, National Cancer Institute, National Institutes of Health, Rockville, MD, USA

² Department of Communication, College of Arts and Sciences, Santa Clara University, Santa Clara, CA, USA

³ Department of Health, Behavior & Society, College of Public Health, University of Kentucky, Lexington, KY, USA

Corresponding Author:

Elise L. Rice, PhD, National Institutes of Health, National Cancer Institute, Division of Cancer Control and Population Sciences, 9609 Medical Center Dr, Room 3E532, Bethesda, MD 20892, USA.

Email: elise.rice@nih.gov

Measures

Respondents to 2 cycles of HINTS 4 (2012 and 2014; $n = 7307$) were asked how much they thought “health behaviors like diet, exercise, and smoking determine whether a person will develop obesity.” Responses were given on a scale from 1 (not at all) to 4 (a lot). Respondents also completed an analogous item assessing the influence of genetics on risk of obesity. Respondents in all cycles reported on their general health (“In general, would you say your health is...”) and their self-efficacy for taking care of their health (“Overall, how confident are you about your ability to take good care of your health?”). Other items assessed fruit and vegetable consumption in a typical day (in cups), frequency of soda consumption in a typical week, duration of physical activity in a typical day and frequency of those bouts of physical activity in a typical week, frequency of strength training in a typical week, duration of leisure-time sedentary behavior during the past 30 days (in hours per day), and smoking status (current and lifetime). Sociodemographic questions assessed age (18-29, 30-49, 50-69, and ≥ 70), sex (male and female), race/ethnicity (non-Hispanic black, non-Hispanic white, Hispanic, and non-Hispanic other), education (<high school, high school or equivalent, some college or technical training, and \geq bachelor’s degree), and annual household income (<\$20 000, \$20 000-\$34 999, \$35 000-\$49 999, \$50 000-\$74 999, \$75 000-\$99 999, and \geq \$100 000) (imputed income data are included in the publicly available data set; full HINTS methodology reports are available elsewhere⁹). Body mass index (BMI) was calculated from self-reported height and weight as weight in kilograms divided by height in meters squared (kg/m^2), with $<18.5 \text{ kg}/\text{m}^2$ considered underweight, $18.5\text{--}24.9 \text{ kg}/\text{m}^2$ considered normal, $25.0\text{--}29.9 \text{ kg}/\text{m}^2$ considered overweight, and $\geq 30.0 \text{ kg}/\text{m}^2$ considered obese. Residential areas were classified as urban or rural based on 2003 rural-urban continuum codes,¹¹ and residence in Appalachia was determined by using the Appalachian Regional Commission’s designation of counties (Figure).¹²

Statistical Analyses

We analyzed data using SAS version 9.3.¹³ In all analyses, we incorporated jackknife replicate weights to estimate accurate variance estimates for statistical modeling. This method allows adjustment for demographic oversampling and survey nonresponse to provide representative estimates of the adult US population. We used weighted Wald χ^2 tests to determine sample differences between Appalachians and non-Appalachians. Then we used weighted least-squares regression analyses for continuous outcomes (eg, BMI) and weighted logistic regression analyses for ordinal outcomes (eg, beliefs about obesity) to test differences in BMI, beliefs about obesity, and obesity-related behaviors, controlling for age, sex, race/ethnicity, education, imputed income, rurality, and general health. We considered $P < .05$ to be significant.

Results

Most respondents were aged 50-69 ($n = 6153$, 30.6% of the weighted sample), female ($n = 8566$, 51.6% of the weighted sample), and non-Hispanic white ($n = 8108$, 66.8% of the weighted sample) (Table 1). Weighted Wald χ^2 tests revealed that Appalachian and non-Appalachian samples were not significantly different in terms of age ($P = .28$) or sex ($P = .43$), but the 2 groups did differ by race/ethnicity ($P < .001$; higher proportion of non-Hispanic white respondents in the Appalachian sample), highest level of education completed ($P = .003$; lower proportion of respondents with \geq bachelor’s degree in the Appalachian sample), annual household income ($P < .001$; higher proportions of respondents reporting low income levels in the Appalachian sample), and rurality ($P < .001$; higher proportion of respondents living in rural areas in the Appalachian sample).

Weighted least-squares regression analysis controlling for sociodemographic characteristics and general health revealed that average BMI was significantly higher among Appalachians ($28.6 \text{ kg}/\text{m}^2$) than among non-Appalachians ($27.7 \text{ kg}/\text{m}^2$) ($P = .03$) (Table 2). Further, similar ordinal regression analyses revealed that Appalachians were significantly less likely than non-Appalachians to report that health behaviors determine whether a person will develop obesity ($P = .03$). Appalachians did not differ from non-Appalachians in analogous beliefs about the extent to which genetics influence obesity risk ($P = .40$), nor did the 2 groups differ significantly in confidence in their ability to take care of their health ($P = .74$).

Weighted least-squares regression analyses revealed that Appalachians reported engaging in weekly strength training significantly less often than non-Appalachians ($P = .03$; Table 2). However, no significant differences were found in daily cups of fruit and vegetables ($P = .92$), frequency of non-diet soda consumption ($P = .28$), weekly minutes of physical activity ($P = .87$), daily hours of sedentary behavior during leisure time in a typical day ($P = .90$), or smoking status ($P = .50$).

A subsequent regression analysis revealed no significant association between beliefs about behavioral determinants of obesity and BMI ($P = .93$), controlling for Appalachian residence, sociodemographic characteristics, and general health. We also found no significant association between beliefs about obesity and BMI moderated by Appalachian residence ($P = .37$). However, similar models revealed that stronger beliefs that behaviors are related to obesity were associated with greater fruit and vegetable consumption ($P < .001$) and current nonsmoker status ($P < .001$).

Discussion

This study provides further context for previously documented disparities in BMI, revealing that Appalachians were less likely than non-Appalachians to believe that health behaviors



Figure. Counties within the Appalachian region designated in 2011 by the Appalachian Regional Commission.¹²

determine obesity risk, which aligns with lower self-efficacy documented in other health domains.^{5,6} Consistent with previous research,¹⁻⁴ residents of Appalachia had a slightly higher average BMI than non-Appalachians. Although BMI was not directly related to beliefs about behavioral determinants of obesity in our study, undetected mediators and moderators may exist; indeed, subsequent analyses revealed associations between fruit and vegetable consumption and nonsmoking status. Longitudinal data may prove

useful for exploring the indirect effects of beliefs about obesity on BMI through such health behaviors; the current cross-sectional data source is not well suited to evaluating such mechanisms or to determining causality. Aside from strength training (which is consistent with the scarcity of recreation and fitness facilities in the region¹⁴), Appalachians did not differ from non-Appalachians in terms of weight-related behaviors in our study, which is somewhat inconsistent with previous research.^{1,3,15-17}

Table 1. Sample distributions from the HINTS 4, cycles 1-4,^a by residence in Appalachia^b or non-Appalachia, 2011-2014 (n = 14451)

Characteristic	Full Sample		Appalachia		Non-Appalachia		P Value ^d
	No. (%)	95% CI	No. (%) ^c	95% CI	No. (%)	95% CI	
Age, y ^e							.27
18-29	1125 (20.2)	19.5-20.9	74 (20.9)	14.6-27.2	1051 (20.2)	19.3-21.1	
30-49	4111 (37.2)	36.5-37.9	248 (33.3)	28.3-38.2	3863 (37.6)	36.7-38.4	
50-69	6153 (30.6)	30.4-30.8	462 (33.3)	29.1-37.4	5691 (30.4)	30.0-30.8	
≥70	2590 (12.0)	11.8-12.1	196 (12.5)	10.4-14.6	2393 (11.9)	11.7-12.1	
Sex							.43
Male	5563 (48.4)	48.2-48.6	381 (46.5)	41.6-51.4	5182 (48.6)	48.1-49.1	
Female	8566 (51.6)	51.4-51.8	610 (53.5)	48.6-58.4	7956 (51.4)	50.9-51.9	
Race/ethnicity							<.001
Non-Hispanic black	2027 (11.0)	10.8-11.3	110 (6.4)	4.6-8.1	1917 (11.44)	11.1-11.7	
Hispanic	2023 (15.0)	14.8-15.2	29 (3.6)	1.1-6.1	1994 (16.0)	15.7-16.3	
Non-Hispanic white	8018 (66.8)	66.5-67.2	693 (86.6)	83.1-90.1	7325 (65.1)	64.7-65.6	
Non-Hispanic other	927 (7.2)	7.0-7.3	45 (3.5)	1.6-5.4	882 (7.5)	7.2-7.7	
Education							.003
<High school graduate	1325 (11.9)	11.4-12.4	119 (13.2)	10.0-16.4	1206 (11.8)	11.3-12.3	
High school graduate or equivalent	2929 (21.5)	20.6-22.4	248 (26.2)	21.6-30.8	2681 (21.1)	20.2-22.0	
Some college or technical training	4247 (32.9)	31.9-33.8	285 (34.1)	29.4-38.9	3962 (32.8)	31.8-33.7	
≥Bachelor's degree	5536 (33.7)	33.2-34.3	329 (26.5)	22.7-30.2	5207 (34.4)	33.7-35.0	
Annual household income, \$							<.001
<20 000	3340 (21.7)	20.6-22.8	263 (25.0)	20.2-29.8	3077 (21.5)	20.3-22.6	
20 000-34 999	2172 (14.9)	13.9-15.9	164 (15.7)	11.8-19.6	2008 (14.8)	13.8-15.8	
35 000-49 999	2051 (14.4)	13.4-15.3	153 (16.2)	12.2-20.2	1898 (14.2)	13.3-15.2	
50 000-74 999	2329 (17.0)	16.0-18.1	173 (20.0)	15.4-24.5	2156 (16.8)	15.7-17.9	
75 000-99 999	1646 (12.70)	11.9-13.6	101 (10.4)	7.7-13.1	1545 (13.0)	12.1-13.9	
≥100 000		18.2-20.2	133 (12.9)	10.0-15.7	2362 (19.7)	18.7-20.8	
Rural or urban designation							<.001
Rural	2177 (16.6)	15.7-17.5	394 (40.6)	35.6-45.7	1783 (14.5)	13.6-15.4	
Urban	12 274 (83.4)	82.5-84.3	621 (59.4)	54.3-64.4	11 653 (85.5)	84.6-86.4	

^aHealth Information National Trends Survey (HINTS) 4, cycles 1-4, 2011-2014.^{9,10}

^bResidence in an Appalachian county was coded according to the Appalachian Regional Commission's designation.¹²

^cThe number is the unweighted sample size and the percentage is the weighted population estimate.

^dP values pertain to the results of unadjusted Wald χ^2 tests comparing responses from Appalachians and non-Appalachians. $P < .05$ was considered significant.

^eAge is categorized for ease of presentation, but it was included in regression analyses (Table 2) as a continuous variable.

Notable limitations of our study primarily derived from the features of the data set. Specifically, the self-reported data may be subject to various social and cognitive biases, such as social desirability bias, which could motivate respondents to endorse beliefs or behaviors that they expect to be more socially acceptable (eg, more physical activity or greater consumption of fruit and vegetables). Another limitation of the study design was that the cross-sectional nature of the data did not enable inferences about the temporal order of variables of interest, let alone causality. Finally, one limitation that was specific to the key item assessing beliefs about the behavioral determinants of obesity was the imprecise design of the question stem, which provided "diet, exercise, and smoking" as exemplar behaviors. Although likely meant to aid respondents in understanding the question, this strategy may have introduced excess variability depending on how respondents interpreted the question. Some respondents may have reported on all 3 behaviors collectively, whereas others may have focused their responses on a subset of the behaviors, or other behaviors not mentioned in the stem.

The primary value of our findings may be in hypothesis generation, and future research may overcome the limitations of our study by using more fine-grained measures and/or qualitative methods to explore how life in Appalachia shapes the origins and implications of beliefs about obesity. For example, do some people embrace skepticism about the effectiveness of behavioral prevention to justify unhealthy lifestyles that feel inevitable and thereby reduce cognitive dissonance?¹⁸ Or do people who repeatedly fail to lose weight and observe the same failure among their peers in the absence of accessible supporting resources (eg, health care providers, readily available fruit and vegetables, venues for physical activity) learn to doubt the value of preventive health behaviors? Future research may also determine the prevalence of these beliefs across various subregions within Appalachia (ie, southern, central, or northern). Although concerns about sample size and statistical power precluded tests of differences across subregions in our study, it is worth exploring whether environmental or sociocultural differences in southern, central, or northern

Table 2. Adjusted differences^a between Appalachian and non-Appalachian respondents (n = 14451) on body mass index, beliefs about obesity, and health behaviors, HINTS 4, cycles 1-4, 2011-2014^b

Continuous Variable	No. ^c	Weighted Means ^d		B ^e (95% CI)	P Value
		Appalachian	Non-Appalachian		
Body mass index, kg/m ²	11 929	28.6	27.7	0.75 (0.08 to 1.42)	.03
Daily cups of fruit and vegetables	12 095	5.0	5.1	0.01 (-0.26 to 0.29)	.92
Weekly minutes of physical activity	6497	179.7	205.6	5.12 (-56.54 to 66.77)	.87
Weekly frequency of strength training, d/wk	9031	0.9	1.2	-0.21 (-0.40 to 0.02)	.03
Daily hours of sedentary behavior	11 639	3.8	3.8	-0.02 (-0.33 to 0.30)	.90

Categorical Variable	No.	Weighted Percentages		OR (95% CI)	P Value
		Appalachian	Non-Appalachian		
Think that behaviors influence obesity	6018			0.69 (0.49-0.97)	.03
Not at all		4.9	2.6		
A little		5.9	4.4		
Somewhat		20.1	14.4		
A lot		69.1	78.7		
Think that genes influence obesity a lot	6013			0.90 (0.71-1.15)	.40
Not at all		7.5	7.3		
A little		24.4	23.0		
Somewhat		42.2	41.4		
A lot		26.0	28.3		
Confidence in ability to take care of health	12210			1.04 (0.82-1.32)	.74
Not at all confident		1.0	1.4		
A little confident		4.6	4.7		
Somewhat confident		27.9	26.0		
Very confident		44.1	45.1		
Completely confident		22.4	22.9		
Frequency of (non-diet) soda consumption	5575			1.29 (0.85-1.95)	.28
I do not drink any regular soda or pop		35.2	39.0		
<1 day a week		18.4	22.6		
1-2 days a week		13.1	14.7		
3-4 days a week		6.9	8.6		
5-6 days a week		8.4	4.2		
Every day		18.0	10.8		
Have smoked ≥100 cigarettes	12 155	45.7	40.3	1.09 (0.85-1.38)	.50

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

^aResults of separate weighted regression analyses for each variable using listwise deletion. Continuous variables were submitted to linear regression analyses; categorical variables were submitted to ordinal regression analyses.

^bData source: HINTS.^{9,10}

^cDifferences in sample size across models are primarily due to the fact that not all variables were included in each of the 4 cycles of HINTS 4. See the *Methods* section for more information on measure repetition.

^dWeighted means are not adjusted for sociodemographic variables or general health.

^eUnstandardized regression coefficients, odds ratios, and 95% confidence intervals refer to differences in mean values between Appalachians and non-Appalachians, controlling for sociodemographic variables (age, sex, race/ethnicity, education, household income, and rural-urban designation) and general health. $P < .05$ was considered significant.

Appalachia contribute to varying belief patterns or behaviors. Additionally, in light of regional variation in discrepancies between objective and self-reported measures of BMI,¹⁹ it will be important to assess social norms and desirability pertaining to BMI among Appalachians. Although preliminary, our study reveals an important discrepancy, suggesting that preventive health behaviors in some domains may be regarded differently among Appalachians. Given the socioeconomic, health, and geographic challenges in Appalachia, public health officials should consider every opportunity to advance evidence-based,

behaviorally oriented obesity education and prevention strategies in the region.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The

University of Kentucky College of Public Health funded the Appalachian oversample via contract to Westat, Inc.

References

1. Behringer B, Friedell GH. Appalachia: where place matters in health. *Prev Chronic Dis.* 2006;3(4):A113-A117.
2. Highest rates of obesity, diabetes in the South, Appalachia, and some tribal lands [press release]. Atlanta, GA: Centers for Disease Control and Prevention; November 19, 2009. <https://www.cdc.gov/media/pressrel/2009/r091119c.htm>. Accessed June 14, 2017.
3. Schoenberg NE, Huang B, Seshadri S, Tucker TC. Trends in cigarette smoking and obesity in Appalachian Kentucky. *South Med J.* 2015;108(3):170-177.
4. Slack T, Myers CA, Martin CK, Heymsfield SB. The geographic concentration of US adult obesity prevalence and associated social, economic, and environmental factors. *Obesity (Silver Spring).* 2014;22(3):868-874.
5. Serrano KJ, Rice EL, Patel M, Thai C, Blake KD, Vanderpool R. Comparison of cancer beliefs between Appalachians and non-Appalachians and related sociodemographic characteristics. *Ann Behav Med.* 2017;51(1):S85-S86.
6. Vanderpool RC, Huang B. Cancer risk perceptions, beliefs, and physician avoidance in Appalachia: results from the 2008 HINTS Survey. *J Health Commun.* 2010;15(suppl 3):78-91.
7. Griffith BN, Lovett GD, Pyle DN, Miller WC. Self-rated health in rural Appalachia: health perceptions are incongruent with health status and health behaviors. *BMC Public Health.* 2011; 11:229.
8. Miller WC, Griffith BN, Bikman TJ, Meyer CM. Misconceptions about health and disease prevention behaviors of rural Appalachian Americans. *Int J Med (Dubai).* 2014;2(2):71-75.
9. Finney Rutten LJ, Davis T, Beckjord EB, Blake K, Moser RP, Hesse BW. Picking up the pace: changes in method and frame for the Health Information National Trends Survey (2011-2014). *J Health Commun.* 2012;17(8):979-989.
10. National Cancer Institute. Health Information National Trends Survey. <https://hints.cancer.gov>. Accessed December 6, 2016.
11. US Department of Agriculture, Economic Research Service. Rural-urban continuum codes. <https://www.ers.usda.gov/data-products/rural-urban-continuum-codes>. Published 2003. Accessed February 3, 2017.
12. Appalachian Regional Commission. Subregions in Appalachia. http://www.arc.gov/research/MapsofAppalachia.asp?MAP_ID=31. Published 2009. Accessed October 20, 2017.
13. SAS Institute, Inc. *SAS Version 9.3*. Cary, NC: SAS Institute, Inc; 2011.
14. US Department of Agriculture, Economic Research Service. Food environment atlas. <https://www.ers.usda.gov/foodatlas>. Published 2009. Accessed October 13, 2017.
15. Fisher JL, Engelhardt HL, Stephens JA, et al. Cancer-related disparities among residents of Appalachia Ohio. *J Health Dispar Res Pract.* 2008;2(2):61-74.
16. Wewers ME, Katz M, Paskett ED, Fickle D. Risky behaviors among Ohio Appalachian adults. *Prev Chronic Dis.* 2006;3(4): A127-A135.
17. Vanderpool RC, Huang B, Shelton BJ. Seeking cancer information: an Appalachian perspective. *J Health Dispar Res Pract.* 2007;2(1):79-100.
18. Festinger L. *A Theory of Cognitive Dissonance*. Stanford, CA: Stanford University Press; 1957.
19. Le A, Judd SE, Allison DB, et al. The geographic distribution of obesity in the US and the potential regional differences in misreporting of obesity. *Obesity (Silver Spring).* 2014;22(1):300-306.