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Prevalence of Obesity Among Adults From Rural and Urban Areas of the United States: Findings From NHANES (2005–2008)

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Abstract

Purpose—Rural residents have higher rates of chronic diseases compared to their urban counterparts, and obesity may be a major contributor to this disparity. This study is the first analysis of obesity prevalence in rural and urban adults using body mass index classification with measured height and weight. In addition, demographic, diet, and physical activity correlates of obesity across rural and urban residence are examined.

Methods—Analysis of body mass index (BMI), diet, and physical activity from 7,325 urban and 1,490 rural adults in the 2005–2008 National Health and Nutrition Examination Survey (NHANES).

Findings—The obesity prevalence was 39.6% (SE = 1.5) among rural adults compared to 33.4% (SE = 1.1) among urban adults ($P = .006$). Prevalence of obesity remained significantly higher among rural compared to urban adults controlling for demographic, diet, and physical activity variables (odds ratio = 1.18, $P = .03$). Race/ethnicity and percent kcal from fat were significant correlates of obesity among both rural and urban adults. Being married was associated with obesity only among rural residents, whereas older age, less education, and being inactive was associated with obesity only among urban residents.

Conclusions—Obesity is markedly higher among adults from rural versus urban areas of the United States, with estimates that are much higher than the rates suggested by studies with self-reported data. Obesity deserves greater attention in rural America.

Keywords

epidemiology; health disparities; obesity; rural; social determinants of health

Rural areas are home to approximately 70 million people, or 23% of the US population.[1] Compared to their urban counterparts, rural residents experience higher rates of chronic diseases and higher prevalence of all-cause mortality.[2–4] Rural-urban differences in obesity may be a major contributor to these geographic health disparities. Data from the 2000–2001 Behavior Risk Factor Surveillance System (BRFSS)[5] and the 1997–1998 National Health Interview Survey (NHIS)[6] revealed higher obesity prevalence in rural compared to urban counties. However, both the BRFSS and NHIS rely on self-reported height and weight, which underestimates obesity prevalence[7] and may influence the degree to which obesity rates differ across rural and urban settings. Rural populations are older[8] and appear to be heavier, and both of these factors are associated with inaccurate reporting of height and

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weight.[9,10] The only published analysis of objectively measured rural and urban obesity prevalence is over 3 decades old (NHANES II, 1976–1980) and used an outdated weight classification based on percentile scores.[11]

This study is the first examination of rural-urban differences in obesity prevalence using BMI classification based on *measured* height and weight in a nationally representative sample. This study also examines rural-urban differences in behavioral (diet and physical activity) determinants of obesity and the independent effects of demographic and behavioral determinants among rural versus urban adults.

METHODS

Sample

NHANES is conducted by the National Center for Health Statistics to assess the health and nutritional status of a representative civilian, non-institutionalized US population using a multistage, stratified, clustered probability design.[12] The sample in the current study included adults age 20 to 75 years who completed the examination component in 2005–2006 or 2007–2008. The response rate including completion of interview and examination across years was 71%. Pregnant women were excluded. Data were available for 7,325 urban and 1,490 rural adults. NHANES 2005–2008 received approval from the National Center for Health Statistics research ethics review board. Written informed consent was obtained.

Dependent Measure

Weight status—Height and weight were collected in a mobile examination center using standardized protocols. Obesity was defined as BMI ≥ 30.0 kg/m^2.

Independent Measures

Rural-urban residence—Rural and urban residence was classified at the county level using Urban Influence Code (UIC) groupings of the Economic Research Service of the US Department of Agriculture.[13] UICs 1 and 2 (metropolitan counties) were coded as urban and UICs 3–12 (non-metropolitan counties) were classified as rural. The UICs were obtained by linking the NHANES data to the Area Resource File.

Dietary intake—Two 24-hour dietary recall interviews were conducted where all foods and beverages consumed the previous 24 hours ending at midnight were solicited and recorded using the standardized Automated Multiple Pass Method.[14] The first dietary recall was collected in-person, and the second was collected by phone 3 to 10 days later on a different day of the week. A set of food measurement guides were provided to participants for assistance in estimating portion sizes during both the in-person and phone recalls. Data from the two 24-hour recalls were averaged to produce an estimate of daily energy (kcal/day) and percent kcal from fat.

Physical activity—Frequency and duration were assessed for moderate and vigorous recreational physical activities. Moderate intensity was described as “light sweating, moderate physical effort, or slight to moderate increases in breathing or heart rate,” and vigorous intensity was described as “heavy sweating, hard physical effort, or large increases in breathing or heart rate.”[15] A dichotomous physical activity variable was created based on whether or not the participant met national physical activity guidelines (≥ 150 minutes/week on ≥ 5 days/week of moderate intensity activity or ≥ 60 minutes/week on ≥ 3 days/week of vigorous intensity activity).[16] Those who met guidelines were classified as active and those who did not were classified as insufficiently active/inactive.

Demographic variables—Demographic variables included age, race/ethnicity, gender, marital status, education, and income. Individuals were grouped by age based on categories from NHANES national obesity prevalence reports:[17] 20–39 years, 40–59 years, and 60–75 years. Race and ethnicity were self-reported. The sample sizes for race/ethnicity categories other than non-Hispanic White and non-Hispanic Black were too small to create stable estimates and were therefore collapsed into "other race/ethnicity" for multivariate analyses.

Statistical Analyses

All analyses were performed using the combined sample weights for 2005–2006 and 2007–2008 to provide nationally representative results. Four-year data were combined using NHANES Analytic and Reporting Guidelines available at http://www.cdc.gov/nchs/nhanes/nhanes2003-2004/analytical_guidelines.htm. Analyses were performed using SAS (version 9.2, Copyright (c) 2002–2008 by SAS Institute Inc., Cary, North Carolina) and SUDAAN (Release 10.0.1, SAS-Callable Individual PC, x64 version, Research Triangle Institute, North Carolina). Wald chi-square or *t* tests were used to compare demographic, BMI, diet, and physical activity variables across rural and urban residence and to compare prevalence of obesity in rural and urban areas within gender, race (non-Hispanic White and Black only due to small sample size for other groups), age, and physical activity subgroups. Controlling for demographic, diet and physical activity variables, multiple logistic regression was used to examine rural-urban residence as a determinant of obesity. A single logistic model was conducted including interaction terms between rural-urban residence and all covariates with proportion of obesity being the outcome. Finally, separate logistic models were conducted to examine multivariate correlates of obesity within rural and urban groups.

RESULTS

In the weighted sample, 80.3% (SE = 3.7) were urban residents and 19.7% (SE = 3.7) were rural residents. Compared to urban participants, rural participants were more likely to be older, married, White non-Hispanic, and to report lower income (Table 1). Obesity prevalence significantly differed across rural and urban participants with 39.6% (SE = 1.5) of rural participants being obese compared to 33.4% (SE = 1.1) of urban participants ($P = .006$). Using BMI ≥ 25 kg/m^2 as the cut point, 70.8% (SE = 1.9) of rural residents were overweight/obese, compared to 67.1% (SE = 1.0) of urban residents ($P = .09$). In addition, rural participants reported a higher percent kcal from fat compared to urban participants ($P = .02$). The percentage of rural and urban participants meeting physical activity recommendations was not significantly different nor was daily energy intake.

Table 2 shows rural-urban proportional differences in obesity across categories within gender, race, and age. The rural-urban difference in obesity prevalence was significant among women (41.3% [SE = 1.5] and 35.1% [SE = 1.2], respectively; $P = .003$) and approached significance for men (37.8% [SE = 2.8] and 31.6% [SE = 1.4], respectively; $P = .08$). Obesity prevalence was higher for rural non-Hispanic Whites (38.4% [SE = 1.6]) compared to urban non-Hispanic Whites (32.1% [SE = 1.6]; $P = .02$), and for rural non-Hispanic Blacks (55.6% [SE = 2.8]) compared to urban non-Hispanic Blacks (43.2% [SE = 1.4]; $P = .03$). Rural adults age 20–39 had higher obesity prevalence than their urban counterparts (38.1% [SE = 3.8] and 27.9% [SE = 1.4], respectively; $P = .002$), but the rural-urban difference was not significant for adults age 40–59 or 60–75. Among participants who were active, obesity prevalence was higher among rural compared to urban residents (36.3% [SE = 4.5] and 25.5% [SE = 1.6], respectively; $P = .03$).

Multivariate correlates of obesity among the total sample are shown in Table 3. Rural residence remained a significant determinant of obesity controlling for sociodemographic, physical activity, and diet variables (odds ratio = 1.18 [95% CI = 1.01–1.38]; $P = .03$).

When including interaction terms in the model, the interaction between rural-urban residence and age categories was significant ($P = .02$). Due to a significant interaction term and an interest in examining multivariate correlates of obesity within rural and urban groups, separate logistic models were conducted for rural and urban participants (Table 4). For rural participants, being married (compared to never married), Black (compared to White non-Hispanic), and having higher daily energy intake or higher percent kcal from fat were associated with higher obesity prevalence, other factors held constant. Among urban participants, those who were Black, older than 20–39, with an educational level less than a college degree, inactive, and with higher percent kcal from fat had higher likelihood of obesity.

DISCUSSION

The major finding of this study is the significantly higher prevalence of obesity in rural compared to urban adults in the US. This is the first study comparing rural and urban obesity prevalence using BMI weight status classification based on measured height and weight. Higher obesity rates in rural compared to urban participants were found for both non-Hispanic Whites and Blacks. The effect of rural residence was strong and remained significant after controlling for the effects of demographic composition, indicating that rural residence is associated with higher obesity prevalence above and beyond the effects of age, education, income, race/ethnicity, marital status, as well as diet and physical activity. Although a significant rural-urban difference in obesity prevalence has been previously reported using self-reported data from NHIS 1997–1998 and BRFSS 2000–2001 (20–23% and 18–20% for rural and urban, respectively),[5,6] the difference in percentage points we observed with measured height and weight was larger (39.6% versus 33.4% for rural and urban, respectively). In addition, rates were dramatically higher compared to self-reported estimates and were consistent with overall national obesity prevalence of 34% from NHANES 2007–2008.[17] This highlights the importance of using measured height and weight when determining population estimates.

Rural participants consumed significantly higher percent kcal from fat. This finding supports largely qualitative reports indicating that rural cultural eating patterns (eg, “country cooking”),[18,19] as well as less access to healthful foods,[20] result in higher fat consumption. Percent kcal from fat was one of the strongest determinants of obesity and is a likely contributor to the rural-urban obesity disparity.

The proportion meeting physical activity recommendations did not differ across rural and urban participants. In contrast, the 1998 NHIS[6] and 2 national physical activity surveys conducted in the late 1990s based on modified BRFSS physical activity items[21,22] showed rural adults were less likely to meet physical activity recommendations than urban adults. However, a recent direct comparison of NHANES, BRFSS, and NHIS physical activity data revealed different prevalence estimates for physical activity across the different surveillance systems, ranging from 30% to 48%,[23] making comparisons across studies difficult.

The rural-urban obesity disparity was found among adults age 20–39 but not for adults age 40–59 or 60–75. Younger adults in rural areas may be more susceptible to weight gain due to changes in the environment over the past 30 years. Rural residents traditionally have consumed high fat, high calorie diets that were offset to some extent by high caloric expenditure during vigorous physical labor necessary for farming, logging, and other activities.[24,25] Increased mechanization of rural occupations has reduced these levels of caloric expenditure, which may impact the younger working adults the most.

For rural residents, marital status was significantly associated with obesity whereas education was not. In a rural environment where resources for healthy eating and physical activity may be more limited, factors related to access to resources such as education may have less impact on diet and physical activity behavior, whereas marital status (and corresponding lifestyle surrounding family meals) may have greater impact. Other factors such as parity, caregiving responsibilities, and environmental variables may further contribute to predicting obesity in the rural setting. Medical factors associated with higher co-morbid diseases among rural adults[4] may also be playing a causal role in their higher obesity prevalence; however, we believe the reverse is more likely with obesity being one of the driving forces for rural-urban chronic disease disparities.

This study has several limitations. NHANES is a cross-sectional survey, and diet and physical activity measures do not necessarily represent usual patterns over time that led to the individual's weight status at the time of the survey. In addition, it is unknown the extent to which rural versus urban residence impacts self-reporting bias of diet and physical activity measures. The sample size was larger for urban participants; however, by collapsing across 2 NHANES survey years, estimates were stable for the subgroup comparisons conducted. The rural sample size was not large enough for rural-urban comparison across racial/ethnic groups other than non-Hispanic White and non-Hispanic Black.

The findings of this study have significant public health implications for improving health outcomes among rural adults. Although some intervention research has begun to address obesity among rural adults and families,[26–29] greater attention needs to be focused on dissemination of effective programs to rural areas which contain some of the largest medically underserved communities in the nation.

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Table 1

Participant characteristics of rural and urban adults age 20–75 (NHANES 2005–2008)

Characteristic	Rural % (SE)	Urban % (SE)	*P* value
Total Sample	19.7 (3.7)	80.3 (3.7)	
BMI			.006
< 30, non-obese	60.4 (1.5)	66.6 (1.1)	
≥ 30, obese	39.6 (1.5)	33.4 (1.1)	
Age			<.001
20–39	31.8 (2.0)	41.8 (1.0)	
40–59	42.1 (1.7)	42.6 (0.8)	
60–75	26.1 (2.2)	15.6 (0.8)	
Gender			.83
Male	49.3 (0.7)	49.5 (0.5)	
Female	50.7 (0.7)	50.5 (0.5)	
Marital Status			.05
Married/Living with partner	72.2 (2.2)	64.5 (1.3)	
Divorced/Separated/Widowed	15.8 (0.9)	16.5 (0.7)	
Never married	12.0 (2.0)	19.0 (1.1)	
Race			.001
Non-Hispanic White	86.3 (3.4)	65.1 (2.8)	
Non-Hispanic Black	8.2 (3.2)	12.8 (1.5)	
Mexican American	1.8 (0.8)	10.1 (1.2)	
Other Hispanic	1.2 (0.4)	5.2 (0.9)	
Other Race/Ethnicity	2.5 (0.3)	6.9 (0.7)	
Education			.06
< High school	20.4 (3.6)	17.3 (1.0)	
High school/some college	61.3 (3.1)	54.3 (1.2)	
≥ College degree	18.3 (3.1)	28.4 (1.6)	
Income			<.001
< $20,000	20.0 (2.8)	16.1 (0.9)	
$20,000 – $44,999	34.6 (1.4)	25.9 (1.4)	
$45,000 – $64,999	16.4 (1.3)	17.0 (0.8)	
≥ $65,000	29.1 (2.3)	41.0 (2.1)	
Physical Activity			.63
Insufficiently active/Inactive	69.0 (4.2)	66.8 (1.4)	
Active	31.0 (4.2)	33.2 (1.4)	
Diet, Mean (SD)			
Daily energy (kcal/day)	2120 (25)	2158 (20)	.31
% kcal from fat	34.4 (0.3)	33.6 (0.2)	.02

Table 2

Percent Obese by Select Demographic Characteristics in Rural and Urban Adults

Characteristic	Rural % Obese (SE)	Urban % Obese (SE)	*P* value
Age			
20–39	38.1 (3.8)	27.9 (1.4)	.02
40–59	40.8 (2.4)	37.1 (1.5)	.20
60–75	39.3 (2.5)	37.9 (1.3)	.60
Gender			
Male	37.8 (2.8)	31.6 (1.4)	.08
Female	41.3 (1.5)	35.1 (1.2)	.003
Race[a]			
Non-Hispanic White	38.4 (1.6)	32.1 (1.6)	.02
Non-Hispanic Black	55.6 (2.8)	43.2 (1.4)	.03

[a]Insufficient sample size for Other Race/Ethnicity among rural adults to allow for rural-urban comparison

Table 3

Multivariate Correlates of Obesity, Total Sample*

Characteristic	Odds Ratio	95% CI	*P* value
Rural (ref = Urban)	1.18	1.01–1.38	.03
Age			.002
20–39	1.0	…	
40–59	1.34	1.14–1.58	
60–75	1.33	1.10–1.61	
Gender			.47
Male	1.0	…	
Female	1.06	0.90–1.25	
Marital Status			.07
Never married	1.0	…	
Married/Living with partner	1.23	1.03–1.47	
Divorced/Separated/Widowed	1.13	0.90–1.25	
Race			< .001
Non-Hispanic White	1.0	…	
Non-Hispanic Black	1.73	1.49–2.01	
Other Race/Ethnicity	1.11	0.87–1.41	
Education			< .001
< 12^{th} grade	1.05	0.89–1.25	
High school/some college	1.0	…	
≥ College degree	0.61	0.50–0.74	
Income			.54
< $20,000	1.00	0.80–1.24	
$20,000 – $44,999	0.98	0.82–1.18	
$45,000 – $64,999	1.11	0.92–1.33	
≥ $65,000	1.0	…	
Physical Activity			< .001
Insufficiently active/Inactive	1.0	…	
Active	0.75	0.65–0.87	
Diet†			
Daily energy (kcal/day)	1.0	1.0–1.0	.18
% kcal from fat	13.41	5.3–34.0	< .001

*Each variable adjusted for all other variables in the model.

†Diet variables are continuous.

Table 4

Multivariate Correlates of Obesity, Within Rural and Urban Adults

	Rural		Urban	
Characteristic	**Odds Ratio (95% CI)**	***P* Value**	**Odds Ratio (95% CI)**	***P* Value**
Age		.61		<.001
20–39	1.0		1.0	
40–59	0.97 (0.73–1.28)		1.47 (1.21–1.78)	
60–75	0.88 (0.63–1.25)		1.50 (1.23–1.82)	
Gender		.44		.64
Male	1.0		1.0	
Female	1.11 (0.85–1.44)		1.05 (0.86–1.27)	
Marital Status		.01		.53
Never married	1.0		1.0	
Married/Living with partner	1.81 (1.08–3.05)		1.12 (0.91–1.37)	
Divorced/Separated/Widowed	1.42 (0.67–3.03)		1.07 (0.86–1.34)	
Race		.002		<.001
Non-Hispanic White	1.0		1.0	
Non-Hispanic Black	2.06 (1.37–3.10)		1.69 (1.44–1.98)	
Other Race/Ethnicity	0.87 (0.40–1.91)		1.15 (0.89–1.49)	
Education		.38		<.001
< 12^{th} grade	1.19 (0.92–1.54)		1.02 (0.83–1.25)	
High school/some college	1.0		1.0	
≥ College degree	0.92 (0.46–1.82)		0.57 (0.46–0.69)	
Income		.57		.40
< $20,000	1.41 (0.81–2.47)		0.91 (0.74–1.11)	
$20,000 – $44,999	1.24 (0.87–1.78)		0.93 (0.76–1.14)	
$45,000 – $64,999	1.23 (0.81–1.89)		1.08 (0.88–1.34)	
≥ $65,000	1.0		1.0	
Physical Activity		.82		<.001
Insufficiently active/Inactive	1.0		1.0	
Active	0.96 (0.66–1.38)		0.69 (0.60–0.80)	
Diet[a]				
Daily energy (kcal/day)	1.0 (1.0–1.0)	.03	1.0 (1.0–1.0)	0.36
% kcal from fat	8.2 (1.9–35.2)	.01	16.4 (5.6–47.7)	<.001

[a]Diet variables are continuous.