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Impact of the food environment and physical activity environment on behaviors and weight status in rural U.S. communities

Alicia A. Casey, M.P.H.[a], **Michael Elliott, Ph.D.**[b], **Karen Glanz, Ph.D., M.P.H.**[c], **Debra Haire-Joshu, Ph.D.**[d], **Sarah L. Lovegreen, M.P.H.**[e], **Brian E. Saelens, Ph.D.**[f], **James F. Sallis, Ph.D.**[g], and **Ross C. Brownson, Ph.D.**[b]

a*Department of Communication Arts and Sciences, The Pennsylvania State University, University Park, PA 16802, USA*

b*Prevention Research Center in St. Louis, George Warren Brown School of Social Work, Washington University in St. Louis, St. Louis, MO 63110, USA*

c*Prevention Research Center, Rollins School of Public Health, Emory University, Atlanta, GA 30322, USA*

d*Obesity Prevention and Policy Research Center, Washington University in St. Louis, St. Louis, MO 63110, USA*

e*Oasis at the Center of Clayton, St. Louis, MO 63105, USA*

f*Department of Pediatrics, University of Washington School of Medicine and Children's Hospital and Regional Medical Center, Seattle, WA 98115, USA*

g*Active Living Research Program, San Diego State University, San Diego, CA 92182, USA*

Abstract

Objective—To examine the association between weight status and characteristics of the food and physical activity environments among adults in rural U.S. communities.

Method—Cross-sectional telephone survey data from rural residents were used to examine the association between obesity (body mass index [BMI] $\geq$ 30 kg/m^2) and perceived access to produce and low-fat foods, frequency and location of food shopping and restaurant dining, and environmental factors that support physical activity. Data were collected from July to September 2005 in Missouri, Arkansas, and Tennessee. Logistic regression models (N = 826) adjusted for age, education and gender comparing normal weight to obese respondents.

Results—Eating out frequently, specifically at buffets, cafeterias, and fast food restaurants was associated with higher rates of obesity. Perceiving the community as unpleasant for physical activity was also associated with obesity.

Conclusion—Adults in rural communities were less likely to be obese when perceived food and physical activity environments supported healthier behaviors. Additional environmental and behavioral factors relevant to rural adults should be examined in under-studied rural U.S. populations.

Corresponding author: Alicia A. Casey.

Keywords

Body mass index; eating; ecological; environment; exercise; obesity

Introduction

Thirty percent of U.S. adults 20 years of age and older are obese (Ogden et al., 2006), which increases their risk for health conditions such as hypertension, type 2 diabetes, coronary heart disease, and stroke. Obesity is the result of consuming more calories than the body expends, and this energy imbalance can be perpetuated by the individual's built environment, which includes urban design, land use, the transportation infrastructure, and available activity options for people within that space (Booth et al., 2005; Handy et al., 2002). Though biological, psychological, and social factors contribute to obesity, increasing emphasis has been placed on understanding the environmental influences that are considered mostly responsible for population increases in obesity (Hill and Peters, 1998).

Many researchers agree that changes in the environment are responsible for the rapid change in obesity rates (Jeffery and Utter, 2003). Neighborhood environment attributes have been associated with obesity and obesity-related behaviors, particularly physical activity. Living in walkable neighborhoods that promote active transportation (Heath et al., 2006) and having easy access to recreation facilities (Humpel et al., 2002) have been positively associated with physical activity and with lower risk of obesity (Frank et al., 2003; Giles-Corti et al., 2003; Saelens et al., 2003b). Food environments likely affect risk of obesity (Hill and Peters, 1998; Egger and Swinburn, 1997), but few studies have examined the role of both food and physical activity environments in relation to obesity status.

In addition, nearly all studies on obesogenic environments in the United States have been conducted in urban and suburban settings. This is despite the fact that rural adults have higher levels of obesity and are less active in their leisure time than urban and suburban U.S. adults (Eberhardt et al., 2001; Parks et al., 2003; Patterson et al., 2004). Rural adults are also more likely to have poor health outcomes due to low socioeconomic status and reduced access to healthcare (Eberhardt et al., 2001), which would increase their risks of obesity-related health conditions. Thus, it is important to determine the extent to which food and physical activity environments in rural settings can explain risk of obesity because such findings could point toward policy solutions affecting whole populations.

This study builds on previous work (Egger and Swinburn, 1999; Swinburn et al., 1999; Hill and Peters, 1998; Poston and Foreyt, 1999; French et al., 2001; Parks et al., 2003; Patterson et al., 2004) by examining the relationship of weight status to specific indicators of the built environment in rural Midwest communities. The goal of the current research was to examine how perceived physical activity environments, community food environments, and food shopping and dining patterns relate to obesity status among normal weight and obese adults living in rural areas.

Methods

Design and Sample

As part of an intervention research program, Project WOW (Brownson, et al., 2005), 12 rural communities in Missouri (6), Arkansas (2) and Tennessee (4) were identified. Project WOW (Walk the Ozarks to Wellness) aims to promote walking among overweight rural adults by integrating individual, interpersonal, and community-level interventions. Detailed methods of the intervention are described in detail elsewhere Brownson, et al. 2005). These communities

ranged in population size for adults (18 years and older) from 766 to 12,993 and in total, had 16.7% of residents below the poverty level, and include populations that have to travel greater distances to access health care. Rural areas were identified in accordance with the U.S. Census Bureau designation for all communities that do not fit the criteria for urbanized areas, thus having populations less than of 50,000 people and population density less than 1,000 people per square mile (U.S. Census Bureau, 1995; Cromartie & Bucholtz, 2008).

Using computer-assisted random-digit dial (RDD), a representative cohort was identified using a modified version of the Behavioral Risk Factor Surveillance System (BRFSS) interview protocol (Gentry et al., 1985; Remington et al., 1988) in 2003, 2004 and 2005. The present paper utilizes cross-sectional analyses of data collected from July to September 2005 in the third survey wave, 24 months after baseline measures were taken. Eligible households were identified as lying within a two-mile radius around one walking trail in each community. Most trails start in vacant lots within city limits and are usually asphalt and gravel that extend between .13 miles and 2.38 miles. Walking trail development is described in detail elsewhere (Wiggs et al., 2006). Due to the rural nature of the sample, the two-mile radius usually encompassed the entire town, meaning that most of the town residents had reasonable access to the trails. The telephone numbers were pre-called to screen out non-working or business phone lines and households outside of the defined target area (based on phone prefix and street address). A total of 1258 non-institutionalized, English-speaking adults age 18 years or older completed the survey. The response rate for the interview was 65.2% as calculated using the method of the Council of American Survey Research Organizations (1982).

Assessment Tool

The survey instrument was developed using a combination of questions from the BRFSS, along with questions developed in San Diego (Saelens et al., 2003a), South Carolina (Ainsworth et al., 2000; Kirtland et al., 2003), and St. Louis (Brownson et al., 1999; Brownson et al., 2001; Hoehner et al., 2005). The survey instrument contained 107 items, including skip patterns, with an average administration time of 35 minutes. Demographic characteristics were measured using BRFSS questions. Questions related to community food availability, shopping patterns, and use of various restaurant environments were from a questionnaire adapted from the work of Echeverria et al. (2004) and from previous surveys developed by the research team. These specific indicators include perceived access to produce and low-fat foods, frequency and location of food shopping, and frequency and location of restaurant dining. Throughout the survey, every effort was made to use intact scales when valid and reliable scales were documented in the literature and available. Psychometric properties of the questions and scales are reported in detail elsewhere (Saelens et al., 2003b; Brownson et al., 1999; Sallis et al., 1987; Eyler et al., 1999; Echeverria et al., 2004). In a few cases, adaptations were made from prior formats (e.g., written survey) to telephone administration (e.g., asking a “yes/no” question rather than a checklist that would be used in an in-person interview).

Respondents

The original sample included 1258 predominantly non-Hispanic, white females. Of these 1258, 34.9% were normal weight and 29.1% were obese. In accordance with the study’s specific goal of comparing normal weight and obese individuals, overweight individuals (BMI = 25.0-29.9) and underweight individuals (BMI <18.5) were excluded from analysis. This procedure yielded 826 respondents, which was the final sample size for this study (Table 1).

Obese respondents were more likely to be 50-59 years old, have less education, and have lower annual incomes in comparison to normal weight respondents. Obese respondents were also more likely to report their health as good, fair, or poor, whereas those of normal weight were more likely to report their general health status as excellent or very good.

Dependent Variable

Weight status was the dependent variable of interest and individuals' body mass index (BMI) was derived from self-reported height and weight. Respondents with BMI ≥ 30 kg/m^2 were considered obese and those with BMI = 18.5-24.9 kg/m^2 considered normal weight.

Food environments and shopping patterns

Perceived access to produce and low-fat foods in the community was assessed using 6 items asked on 5-point Likert scales (e.g., 1 = strongly agree to 5 = strongly disagree). A sum score for these items was derived based on methods developed by Echeverria et al. (2004), with a possible range of 6 to 30. Higher scores indicated a greater lack of access. Additionally, one item asked respondents to rate the cost of fresh fruits and vegetables where they shop on a scale from not expensive (3) to very expensive (1). Another item asked whether cost prohibited the purchase of fresh fruits and vegetables. Frequency and location of food shopping was assessed by asking respondents how frequently they shopped at six types of stores: supermarkets, Wal-Mart, convenience stores such as Quik Stops or Minute Marts, small grocery stores or markets, bakeries, or fruit/vegetable stores or farmers' markets. Small grocery stores differ from supermarkets in terms of the size of the store and the product selection. The response scale was never (1), occasionally (2), sometimes (3), and often (4). Based on the distribution of responses, answers were re-coded as a dichotomous variable in which responses of "often" were coded as one and all other responses were coded as zero.

Use of restaurants

Respondents were asked about frequency/location of out-of-home dining: sit down restaurant (restaurant with waiter or waitress service); buffet or cafeteria; fast food restaurant; deli (stand alone or in a shop); take-out foods from a convenience store; bar, tavern, or lounge; or coffee shop. The response scale was never (1), occasionally (2), sometimes (3), and often (4). Based on the distribution of responses, answers were recoded as a dichotomous variable in which responses of "often" were coded as one and all other responses were coded as zero.

Access to activity-friendly environments

Access to activity-friendly environments was assessed using 2 items asked on a 4-point Likert scale (e.g., 1 = strongly agree to 4 = strongly disagree) Most physical activity survey items have been evaluated for test-retest reliability (Brownson et al., 2005). A mean physical activity "access" variable was created by taking the mean score of all answered responses to places to be active, walk to many destinations, sidewalks present, shoulders of roads safe for walking, community pleasant for physical activity.

Statistical analyses

The associations between weight status and each of the sociodemographic and health covariates were assessed using chi-square tests. Given the close correlation between education and income (Spearman's rho=.568, $p<.001$), the data were stratified by education because of less missing data and higher reliability. Next, the association between these covariates and the dichotomous food and physical activity environment items were assessed using chi-square tests. In the final stage of model building, multivariate logistic analyses were used to examine the adjusted relationship of each individual measure of perceived food and physical activity environment with weight status, controlling for age, gender, education, and intervention status.

Results

Those with more than a high school education were more likely to report a large selection of fruits and vegetables (83.0% vs 77.8%); often shopping at supermarkets (90.6% vs. 79.1%)

and bakeries (17.5% vs 13.2%); and often eating at sit down restaurants (65.4% vs 43.5%), coffee shops (13.1 vs 7.5%), and bars or taverns (8.4 vs 5.2%) than those with less than a high school education (Table 2). Respondents with more than a high school education were also slightly more likely to rate the community as pleasant for physical activity (91.3% vs 86.1%). Those who had no more than a high school education were more likely to report often shopping at convenience stores (22.6% vs 11.9%) and often eating take-out food from convenience stores (18.0% vs 7.9%) and eating at buffets or cafeterias (30.7% vs 18.3%).

In the adjusted analyses, none of the locations where respondents shopped (small grocery stores, bakeries, and Wal-Mart) showed a statistically significant association with obesity (Table 3). Statistically significant higher rates of obesity were found for respondents who ate out more often than those who did not. These rates were associated at specific types of establishments, such as buffets, cafeterias, and fast food restaurants.

The overall rating of the physical activity environment (mean score), as well as one specific component of the perceived physical activity environment were associated with obesity (Table 3). Specifically, perceiving the community as not pleasant for physical activity was associated with higher rates of obesity. Though not statistically significant, perceiving the community as having few places to be active was also associated with higher rates of obesity.

Discussion

This study found that obesity was related to frequency of use of specific food outlets that may encourage overeating, such as buffets, cafeterias, and fast food restaurants. Obese rural adults reported living in communities that were not “activity-friendly” or supportive of physical activity. Characteristics of the perceived physical activity environment associated with obesity among this sample included the perception that the community was not pleasant for physical activity. Thus, both physical activity environments and patterns of use of food environments were related to obesity among rural adults. Food environment characteristics per se were not related to weight status in the present study.

Though there were relatively few disparities in perceived access to healthful food options in the community between low and high educated rural adults, those with a high school education or less reported lower access to a large selection of fruits and vegetables and were more likely to report often shopping at convenience stores. They also reported more often eating at buffets and cafeterias. Perhaps individuals with less education, also likely to have lower incomes, were attracted to buffets and cafeterias because of convenience or greater perceived value.

Previous studies found that participants reported not feeling safe from traffic while walking or biking in rural communities (Boehmer et al., 2006; Parks et al., 2003). The presence of fewer, or poorer quality, sidewalks and/or higher traffic speeds on roads are features more often associated with rural, rather than urban areas (Boehmer et al., 2006; Catlin et al., 2003; Giles-Corti et al., 2003; Parks et al., 2003; Wilcox et al., 2000). There are now numerous studies documenting an association between built environment characteristics and obesity or weight status (Papas et al., 2007). To our knowledge, this study is only the second in the United States to document an association between obesity and the perceived physical environment features specifically in rural communities (Boehmer et al., 2006).

Few previous studies have examined whether obesity rates are associated with access to healthy and unhealthy foods and specific types of food establishments, and that limited evidence is mixed (Giskes et al., 2007; Faith et al., 2007). The present study did not find that perceptions of the food environment were related to weight status among rural adults, but previous research was extended by inclusion of measures of frequency of use of specific types of food outlets.

The present findings build on earlier results that use of fast food restaurants may be a risk factor for obesity (Pereira et al. 2005).

Strengths of this study include the large, multi-state sample of rural residents, the nationally tested measures of physical activity environment characteristics, and the use of reliable measures of the eating environment. Limitations include the cross-sectional design, which limits our ability to establish causality. Perceptions may be influenced by unique situational and personality characteristics, so clear interpretations cannot be made with confidence. In addition, BMI was calculated based on self-reported height and weight. Inclusion of objective measures of the physical activity and food environments in rural environments would allow for disentangling objective versus perceived influences. Adults in the overweight category were excluded; this allowed for greater contrast but also limited the applicability of findings to obese and normal-weight adults. Because this study sampled persons in a two-mile radius of walking trails selected because they were built near rural towns, residents of the most isolated areas were not included.

Because research on the built environment and obesity has been mainly limited to urban and suburban populations, future studies should focus on residents of rural areas to determine specific aspects of their neighborhood environment that may decrease obesity risk. In particular, additional studies should examine aspects of the food environment as they relate to obesity. New research should include longitudinal designs that better take into account temporal effects. Also, both perceived and objective measures of the neighborhood environment should be incorporated (Boehmer et al., 2006). Studies in urban and suburban communities show evidence of an interaction between the neighborhood environment and individual-level risk factors (Joshu et al. 2008); this needs to be examined for rural settings.

If present findings are replicated, they can provide guidance for interventions that are relevant for residents of rural areas. Consistent with ecological models of behavior, there was evidence of environmental and individual correlates of weight status. Perceptions of safe street shoulders are likely related to traffic speed and volume, and rural residents may have few other places to walk or bicycle than the shoulders of roads (Boehmer et al., 2006). If confirmed, these findings suggest interventions need to be found to enhance the perception of safety of people who want to walk or bicycle along rural roads. Potential strategies are to widen the shoulders, use signage to identify pedestrian and cycle areas, construct paths separated from the road, and reduce vehicle speed limits. Some policy strategies (e.g., making it illegal to drive too close to cyclists) require minimal funding.

Although perceived access to food outlets with unhealthy food was not directly associated with weight status in the present study, it is clear that healthy foods must be available for people to choose them. One implication of these findings is that simply making healthy foods available is not sufficient to prevent or reduce obesity. It may be necessary to intervene at multiple levels. Options to explore in future studies include providing incentives to increase availability and affordability of healthy foods; working with food outlet owners and managers to reduce the range, convenience, and low cost of unhealthy food items; and changes in state or federal taxation and agricultural policies to reduce the relative price of healthy foods compared to unhealthy foods. Further research is needed to understand the factors that lead rural adults with lower levels of education to more frequently patronize food outlets that appear to facilitate less healthy eating patterns.

In summary, these findings add to a growing evidence base of neighborhood environment correlates of obesity and make a unique contribution regarding the environment-obesity relationship within rural communities. As these associations are clarified, interventions options will become more apparent.

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Table 1

Socio-demographic characteristics of normal weight and obese respondents in Missouri, Arkansas, and Tennessee from July to September 2005

	Total n= 826 N (%)	**Normal Weight[a] n= 451** N (%)	**Obese[b] n= 375** N (%)	**p-value[*]**
Female	662 (80.1)	380 (57.4)	282 (42.6)	= 0.001
Male	164 (19.9)	71 (43.3)	93 (56.7)	
White, non-Hispanic	786 (95.2)	428 (54.5)	358 (45.5)	= 0.706
Non white	40 (4.8)	23 (57.5)	17 (42.5)	
Age				
18-29	66 (8.0)	45 (68.2)	21 (31.8)	<0.001
30-39	113 (13.7)	64 (56.6)	49 (43.4)	
40-49	172 (20.9)	95 (55.2)	77 (44.8)	
50-59	191 (23.2)	78 (40.8)	113 (59.2)	
60-69	115 (14.0)	61 (53.0)	54 (47.0)	
70+	166 (20.2)	105 (63.3)	61 (36.7)	
Education				
Less than high school	103 (12.5)	43 (41.7)	60 (58.3)	<0.001
High school graduate	258 (31.3)	122 (47.3)	136 (52.7)	
Some college	193 (23.4)	108 (56.0)	85 (44.0)	
College graduate	271 (32.8)	177 (65.3)	94 (34.7)	
Annual income				
≥ $25,000	502 (62.4)	300 (59.8)	202 (40.2)	<0.001
< $25,000	303 (37.6)	139 (45.9)	164 (54.1)	
General health status				
Excellent	122 (14.8)	103 (84.4)	19 (15.6)	<0.001
Very good	237 (28.7)	163 (68.8)	74 (31.2)	
Good	238 (28.8)	111 (46.6)	127 (53.4)	
Fair	158 (19.1)	49 (31.0)	109 (69.0)	
Poor	71 (8.6)	25 (35.2)	46 (64.8)	
Meet moderate physical activity recommendations				
Yes	306 (37.3)	200 (65.4)	106 (34.6)	<0.001
No	515 (62.7)	250 (48.5)	265 (51.5)	

[*] chi-square statistics comparing normal weight and obese respondents.

[a] Normal weight is identified as BMI between 18.5 and 24.9 kg/m^2.

[b] Obese is identified as BMI ≥ 30 kg/m^2.

Table 2

Characteristics of the perceived food environments, use of food sources, and perceived activity environments among respondents in Missouri, Arkansas, and Tennessee from July to September 2005

	Total (n=826) %	≥ High School %	< High School %	p-value*
Perceived Food Environment				
Easy to purchase fruits and vegetables	84.1	86.2	83.1	0.161
Easy to purchase low fat foods	86.5	87.7	86.0	0.418
Low fat food are high quality	81.6	83.8	80.6	0.163
Large selection of low fat foods	81.3	82.5	80.8	0.467
Large selection of fruits and vegetables	79.5	83.0	77.8	0.034
Produce is high quality	79.0	81.5	77.7	0.128
Use of Food Sources				
When food shopping, often shops at				
Supermarket	82.8	90.6	79.1	<.001
Wal-Mart	68.5	68.1	68.9	0.799
Small grocery stores	40.1	38.5	40.7	0.469
Farmers' market/fruit or vegetable store	31.6	29.9	32.4	0.362
Convenience store	19.1	11.9	22.6	<.001
Bakery	14.6	17.5	13.2	0.040
When eating out, often eats at				
Sit down restaurant	50.6	65.4	43.5	<.001
Fast food	41.4	42.0	41.1	0.776
Buffets or cafeterias	26.6	18.3	30.7	<.001
Deli	24.9	24.9	24.8	0.956
Convenience store	14.7	7.9	18.0	<.001
Coffee shop	9.4	13.1	7.5	0.002
Bar or tavern	6.2	8.4	5.2	0.027
Perceived Activity Environment				
Community has many places to be active	78.0	78.0	77.9	0.959
Many destinations within walking distance	64.1	62.7	64.9	0.458
Sidewalks are present in community	42.3	42.7	42.2	0.872
Safe shoulders are present in community	39.2	39.4	39.2	0.951
Community is pleasant for physical activity	87.8	91.3	86.1	0.008

* chi-square statistics comparing low education and high education respondents.

Table 3

Associations between obesity and the perceived food and physical activity environments for participants in Missouri, Arkansas, and Tennessee from July to September 2005

	Percentage Often in Obese Persons	**Percentage Often in Normal Wt. Persons**	**OR n=822**	**95% CI**
Sum score of produce and low-fat food non-availability	NA	NA	1.02	1.00-1.05
Often shop at				
Supermarket	80.3	83.4	0.91	0.63-1.32
Wal-Mart	70.1	65.6	1.25	0.92-1.70
Convenience store	19.2	18.4	0.97	0.67-1.39
Small grocery store	43.5	37.7	1.30	0.98-1.74
Bakery	16.0	14.0	1.28	0.86-1.90
Fruit and vegetable store	32.8	31.5	1.07	0.79-1.45
Often eat at				
Restaurant	51.9	50.3	1.24	0.93-1.66
Buffet or cafeteria	**32.8**	**22.0**	**1.51**	**1.09-2.08**
Deli	24.3	24.2	1.00	0.72-1.40
Fast food	**47.5**	**39.0**	**1.38**	**1.04-1.84**
Convenience store	17.9	12.4	1.38	0.92-2.06
Coffee Shop	**6.7**	**12.2**	**0.57**	**0.34-0.96**
Bar or tavern	**3.7**	**8.9**	**0.44**	**0.23-0.84**
Mean score, often eat outside of the home	**NA**	**NA**	**1.46**	**1.02-2.09**
	Percent Strongly Agree in Obese	Percent Strongly Agree in Normal		
There are many places to be active	24.0	28.5	0.88	0.63-1.22
Many destinations are in walking distance	11.5	13.8	1.02	0.72-1.44
Sidewalks are present in the community	20.8	22.8	0.84	0.55-1.29
Safe shoulders are present	7.2	8.0	0.97	0.56-1.66
Community is pleasant for physical activity	**36.0**	**50.0**	**0.57**	**0.43-0.77**
Mean score, lack of access to physically active environment	**NA**	**NA**	**1.37**	**1.07-1.74**

Analyses adjusted for age, education, intervention status, and gender Bold indicates significance at $p<.05$