Urban, Rural, and Regional Variations in Physical Activity

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ABSTRACT: ***Purpose:*** *There is some speculation about geographic differences in physical activity (PA) levels. We examined the prevalence of physical inactivity (PIA) and whether US citizens met the recommended levels of PA across the United States. In addition, the association between PIA/PA and degree of urbanization in the 4 main US regions (Northeast, Midwest, South, and West) was determined.* ***Methods:*** *Participants were 178,161 respondents to the 2000 Behavioral Risk Factor Surveillance System (BRFSS). Data from 49 states and the District of Columbia were included (excluding Alaska). States were categorized by urban status according to the US Department of Agriculture. Physical activity variables were those commonly used in national surveillance systems (PIA = no leisure-time PA; and PA = meeting a PA recommendation).* ***Results:*** *Nationally, PA levels were higher in urban areas than in rural areas; correspondingly, PIA levels were higher in rural areas than in urban areas. Regionally, the urban-rural differences were most striking in the South and were, in fact, often absent in other regions. Demographic factors appeared to modify the association.* ***Conclusion:*** *The association between PA and degree of urbanization is evident and robust in the South but cannot be generalized to all regions of the United States. For the most part, the Midwest and the Northeast do not experience any relationship between PA and urbanization, whereas, in the West, the trend appears to be opposite of that observed in the South.*

National surveys indicate that regional differences exist in physical activity (PA) behavior. For example, data from the 1992 Behavioral Risk Factor Surveillance System (BRFSS) indicate that 32% of adults in the South reported no leisure time physical activity (LTPA) in the past month, whereas only 22% of adults in the West reported no LTPA.[1] Interest in potential differences in prevalence of PA or physical inactivity (PIA) by degree of urbanization is a more recent phenomenon. Data from the 1996 BRFSS indicated that prevalence of PIA (ie, no LTPA) was lowest in the central metropolitan settings (27%) and highest in rural settings (37%), with some variation by region.[2] Other reported research comparing activity levels in urban and rural settings suggests that adults living rurally tend to be less active than adults in urban centers, although results were mixed.[2-6] Four of the 5 studies cited did not consider regional variation, a factor that may be important for directing federal efforts to promote regular PA.

If urban-rural differences exist in PA levels, are the differences consistent across the 4 major regions (South, West, Midwest, and Northeast) of the United States? Perhaps urban-rural differences can be explained by other known determinants of PA. For instance, people living in rural areas are more often of lower socioeconomic status (SES) than people living in urban areas,[7,8] and low SES is associated with lower levels of recommended PA.[1,9] Further, levels of PA vary by

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Table 1. Descriptive Characteristics of the Study Population, by Degree of Urbanization

	Most Rural	Rural	In-Between	Urban	Most Urban	*P*-value (*t* test of χ^2)
Age (mean, SD)	47.0 (26.4)	46.4 (29.1)	46.0 (26.9)	45.0 (29.7)	44.8 (26.6)	<.0001
Sex (% male)	48.9	49.8	50.0	49.7	49.4	.8824
Race/ethnicity						
White (%)	95.6	89.5	83.7	78.1	65.6	<.0001
Black (%)	0.2	3.6	5.3	9.2	12.2	
Hispanic (%)	1.7	4.8	6.1	9.5	17.1	
Other (%)	2.5	2.1	4.8	3.1	5.1	
Education						
<High school	17.1	14.8	11.4	11.4	11.9	<.0001
High school, GED	37.0	37.0	34.3	31.0	26.9	
Some college	21.1	25.9	29.0	28.6	27.2	
College graduate	24.8	22.3	25.3	29.0	34.1	

season.[10-12] Because the seasons present different barriers to PA in the 4 regions of the country, there may be an important intervening factor of an association between PA, region, and urban-rural locality.

This study examined the prevalence of PIA (ie, no LTPA) and the prevalence of meeting the Centers for Disease Control and Prevention/American College of Sports Medicine recommendation for PA in the US by degree of urbanization. We also examined whether the potential association between PA and urbanization differed by geographic region. The robustness of the association, if present, was tested by controlling for the sociodemographic characteristics of age, sex, race/ethnicity, and education. Finally, this study evaluated the association between PA and degree of urbanization by determining whether it differed by sex, race/ethnicity, or season.

Methods

Sample. Participants were respondents to the 2000 BRFSS in 49 states and the District of Columbia (n = 178,161). Alaska was excluded from the analyses because we were not able to determine urban/rural status. Individuals were excluded if information was missing regarding their PA level (n = 1,457), their urbanization status (n = 41,803), or any of the other covariates (age, sex, race/ethnicity, education) used in the statistical models. The final sample size for analysis was 126,824; descriptive characteristic of the sample are displayed in Table 1, by degree of urbanization.

Variables. BRFSS respondents were asked whether they had performed any LTPA over the past month.[13] If they answered "yes," they were asked to describe the type of activity, its frequency, and average duration per session. Moderate-intensity activity was defined as any of the 56 selected activities with a MET value of at least 3, such as calisthenics or dancing, based on the compendium of physical activities.[14] Vigorous-intensity activity was defined as aerobic PA with an assigned MET value of at least 60% of a person's maximum cardio-respiratory capacity as estimated using sex-specific regression equations, as described by the Centers for Disease Control and Prevention.[15] Meeting a PA recommendation was defined as either exercising vigorously for 3 or more times per week for at least 20 minutes per session (based on the American College of Sports Medicine's, ACSM, recommendation for aerobic fitness), or engaging in moderate-intensity activity at least 5 days per week for at least 30 minutes per session (based on the CDC-ACSM recommendation for health).[16] Physical inactivity was defined as reporting no LTPA in the past month.

Respondents' degree of urbanization was defined using the US Department of Agriculture (USDA) Rural-Urban Continuum Codes, which describe counties by degree of urbanization and proximity to metropolitan areas.[17] For analyses, the 10 USDA continuum codes were collapsed into 5 categories as follows: (1) Most rural: areas with a population less than 2,500; (2) Rural: areas with a population of 2,500 to 19,999; (3) In-between: areas with a population of 20,000 to 49,999; (4) Urban: metropolitan areas with a population of 50,000 to 999,999; (5) Most urban: metropolitan areas with a population at least 1 million. The categories were selected to ensure both comparability to previous investigations[2] and adequate cell sizes for analyses.

Four regions were defined to represent the Northeast, Midwest, West, and South, as published in previous national surveys, including the 1996 BRFSS[2] (Table 2). Race/ethnicity was assessed as 1 of 8 categories on the BRFSS and collapsed into 4 categories for these analyses (White, African American, Hispanic, and other). The 4 seasons were defined by Julian months; winter beginning December 1. Additional covariates included age, sex, and education (less than high school, high school graduate or graduate equivalency degree, some college, and college graduate), because education is as an important marker of SES.[18,19]

Statistical Analyses. To account for the complex sampling methods of the BRFSS, SUDAAN statistical

Table 2. Regions of the Country: United States

Northeast	Midwest	South	West
Maine	Ohio	Delaware	Montana
New Hampshire	Indiana	Maryland	Idaho
Vermont	Illinois	Virginia	Wyoming
Massachusetts	Michigan	West Virginia	Colorado
Rhode Island	Wisconsin	North Carolina	New Mexico
Connecticut	Minnesota	South Carolina	Arizona
New York	Iowa	Georgia	Utah
New Jersey	Missouri	Florida	Nevada
Pennsylvania	North Dakota	Kentucky	Washington
	South Dakota	Tennessee	Oregon
	Nebraska	Alabama	California
	Kansas	Mississippi	Hawaii
		Arkansas	(Alaska)
		Louisiana	
		Oklahoma	
		Texas	

software (Research Triangle Institute, Version 8, Research Triangle Park, NC) was used to analyze the data. The Crosstab procedure was used to calculate weighted prevalence estimates of PA and PIA for 2000. The Multilog procedure (ie, logistic regression) was used to test for significant differences in PIA and PA by degree of urbanization. Models that were run included region and the interaction term between region and degree of urbanization (ie, region × urbanization) as potential predictors of the 2 outcomes of interest (PIA and PA). If the interaction term was significant ($P<.05$), stratified analyses were run by region, and weighted prevalence estimates and odds of PA and PIA were calculated by degree of urbanization for the nation both as a whole and by region.

When significant relationships were found between either PIA or PA and degree of urbanization, additional models were run for the 2000 data controlling for known covariates of PA and PIA (ie, age, sex, race/ethnicity, education). Additional logistic models were run to test whether the relation between PA and PIA and degree of urbanization differed in any region by sex, race/ethnicity, education, or season, by including the main effect of each variable, one at a time, and its interaction term with degree of urbanization. We did not test for an interaction with age, or its main effect, as this would have been problematic given the small cell sizes.

Results

Physical Inactivity. In 2000, the prevalence of PIA was highest in the most rural category (33.1%) and lowest in the middle and 2 urban categories (range: 25.7% to 25.9%). The odds of being physically inactive were 43% higher in the most rural compared with the most urban categories (OR = 1.43; 95% CI: 1.23-1.66). A significant interaction was observed between PIA, degree of urbanization, and region of the country (Northeast, Midwest, South, and West; $P<.001$); hence, stratified prevalence estimates were calculated.

In the South, prevalence of PIA was 43.1% in the most rural areas vs 26.7% in the most urban areas (OR = 2.09; 95% CI: 1.63-2.66). In contrast, the prevalence of PIA in the West was highest in the 2 urban categories (24.3% to 24.5%) and lowest in areas categorized as most rural (19.7%; OR = 0.75; 95% CI: 0.50-1.15 for most urban vs most rural; OR = 0.85; 95% CI: 0.76-0.96 for most urban vs most rural). No association was found between PIA and degree of urbanization in the Northeast or West (Table 3). As shown in Table 3, the estimates of PIA among the most urban categories were similar in each region of the country: 24.3% in the West, 26.5% in the Midwest, 26.7% in the South, and 26.7% in the Northeast. In contrast, PIA estimates across the 4 regions differed

Table 3. Prevalence of Meeting a Physical Activity (PA) Recommendation* and Prevalence of Physical Inactivity (PIA) by Degree of Urbanization and by Region of the Country

	Most Rural	Rural	In-Between	Urban	Most Urban
Northeast					
Inactive	26.3%	26.7%	25.9%	24.5%	26.7%
Meeting PA recommendation	29.8%	28.3%	28.7%	30.7%	30.2%
Midwest					
Inactive	28.4%	26.3%	27.0%	24.6%	26.5%
Meeting PA recommendation	27.6%	29.5%	29.5%	29.6%	28.9%
South					
Inactive*	43.1%	37.3%	30.3%	27.5%	26.7%
Meeting PA recommendation	15.4%	23.4%	25.1%	28.7%	28.5%
West					
Inactive	19.7%	21.5%	21.9%	24.5%	24.3%
Meeting PA recommendation	34.4%	32.7%	33.9%	32.7%	31.9%

* Moderate-intensity PA: ≥5 days per week, ≥30 minutes per session of aerobic activity of moderate-intensity (≥3 metabolic equivalents); and/or vigorous-intensity PA: ≥3 days per week, ≥20 minutes per session of aerobic activity of vigorous-intensity (≥60% of maximum capacity).

Table 4. Prevalence of Physical Inactivity (PIA, %) Across Regions of the US by Race/Ethnicity for Rural and Urban Settings

	White		Black		Hispanic	
	Rural	Urban	Rural	Urban	Rural	Urban
Northeast	26.9	22.7	9.6	34.2	20.9	38.0
Midwest	23.4	26.5	14.8	35.3	22.6	39.6
South	38.0	23.5	39.4	32.0	19.2	40.3
West	18.4	20.3	38.9	35.2	28.0	38.7

considerably in the most rural categories: 19.7% in the West, 26.3% in the Northeast, 28.4% in the Midwest, and 43.1% in the South. The association between PIA and urbanization in the South remained after controlling for sociodemographic characteristics (ie, age, sex, race/ethnicity, and education), although the strength of the association was reduced slightly (OR = 1.99; 95% CI: 1.54-2.57). The association between PIA and urbanization was not evident in other regions.

Meeting a PA Recommendation. The prevalence of meeting either the vigorous or the moderate-intensity PA recommendation was lowest in the 2 rural categories (23.8% most rural and 27.7% rural) and highest in the most urban categories (30.1%; OR = 0.73; 95% CI: 0.62-0.85 for rural compared with most urban). As with PIA, a significant interaction was observed between PA, degree of urbanization, and region of the country (Northeast, Midwest, South, and West; $P<.001$). Hence, stratified prevalence estimates of meeting one or both PA recommendations were evaluated (Table 3).

In the South, prevalence of PA was highest for people in the urban (28.7%) and most urban categories (28.5%) and lowest for those in the most rural categories (15.4%). When compared with their urban counterparts, the odds that people residing in the most rural areas met a PA recommendation was 0.46 (95% CI: 0.34-0.62). No association was found between PA and degree of urbanization in the Midwest, Northeast, or West. The association between PA and degree of urbanization in the South remained after controlling for sociodemographic characteristics; the strength of the association was attenuated only slightly (OR = 0.51; 95% CI: 0.37-0.70 for most rural compared with most urban).

Testing for Interactions. Race/ethnicity was an important interaction term of the association between PIA and urbanization in all 4 regions. In the Northeast and Midwest, African Americans and Hispanics in urban localities were much more likely to report no LTPA than were those of the same racial/ethnic group in rural localities (eg, 34% vs 10% for African Americans in the Northeast). In the South, prevalence of PIA was more than twice as high for Hispanics in urban areas as for those residing in rural areas (40% vs 19%). On the other hand, prevalence of PIA was higher for Whites and African Americans in rural areas than in urban areas (38% vs 24%; 39% vs 32%, respectively) in the South (Table 4).

Race/ethnicity also had a differential effect on the association between PA and urbanization in the Northeast and South. In the Northeast, African Americans in rural settings were more likely to meet a PA recommendation than were those in urban settings (63.1% vs 25.0%). In the South, however, African Americans classified as "rural" were less likely to meet the recommendation than were their urban counterparts (14.9% vs 25.0%). Hispanics in the Northeast (34.4% vs 22.4%) and the South (58.4% vs 22.0%) were more likely to meet a PA recommendation if they were from a rural location compared with urban.

The association between degree of urbanization and prevalences of both PIA and PA differed by sex in the Northeast ($P = .002$ for interaction term), but not in other regions. Urban or rural locality made little difference among women (about 27% inactive and 30% active in either location), but degree of urbanization did matter among men (38% rural vs 34% urban for PIA; 26% rural vs 31% urban for PA).

Education modified the association between urbanization and PIA in the West ($P = .002$); the low-education group was less active in the urban areas than in the rural areas (52% for urban vs 36% for rural for PIA among those with low-education; and 15% for urban vs 25% for rural for PA). Virtually no difference in activity levels was found among those with college-level education, whether the category was urban or rural. Season did not modify the association in any region of the country.

Discussion

Using an ecological approach, which considers environmental (eg, degree or urbanization and season) as well as individual factors,[20] this study helps clarify previously published results concerning whether an association exists between PA and urban-rural locality. It appears that the association exists in the South but not in other regions of the country. Prevalence of both PIA and meeting a PA recommendation varied by degree of urbanization in the South; respondents in

southern urban centers reported being more active in their leisure time.

We had hypothesized that seasonal variations across the regions might affect activity levels differently. The studies showing season variation were conducted in the Northeast (Massachusetts)[10,12] and in the upper Midwest (Minnesota)[11] where winters are known to be cold. In the South, on the other hand, winter is moderate, but the summers are hot and humid. The West has temperatures that are more moderate year round, although there are differences from state to state. Our results showed no differences across regions with respect to season, suggesting that perhaps whatever effect winter has in limiting PA (eg, shorter days, busy holiday planning) exists across the nation.

The results are consistent with related ecological work describing the geographic and socioeconomic variation in the onset of decline of coronary heart disease (CHD) mortality in the US for white men[21,22] and women.[23] Physical activity and CHD are inversely related. Areas of the country that experienced the earliest declines in the rate of CHD mortality were metropolitan centers and regions (other than in the South) with the highest levels of income, education, and occupation.[23] Community development progress, particularly structural economic factors, are key to public health.[23] Further corroborating evidence comes from Georgia, where the 1979 crude death rate was nearly 30% higher in rural counties than in urban counties. Mortality rates remained higher in rural areas than in urban areas after adjustment for age and race, although most of the differences were accounted for by Whites.[8] Deaths caused by heart disease (standardized mortality rate, SMR = 1.4) and cerebrovascular disease (SMR = 1.6), along with 5 other causes of the 13 leading causes of death, were higher than expected in rural counties and lower than expected in urban counties.[8]

In the South, both education and race/ethnicity were significantly related to PA and PIA. Statistical control for race/ethnicity reduced the strength of the relationship between PIA and PA and degree of urbanization, but did not completely account for the observed relationships. Race/ethnicity also was an important effect modifier in other regions of the country, where the largest differences in activity rates by urbanization were for African Americans and Hispanics. As an interesting note, in every region, PA levels were higher among Hispanics in rural areas than in urban areas, even though only LTPA was assessed. These data suggest that the degree of urbanization and PA behavior does not have a unidirectional relationship. Research conducted in Canada suggests that residents of rural communities had higher measures of ''readiness'' for PA (based on the transtheoretical model of change) than did residents of suburban or urban communities.[5]

We found that degree of urbanization made more of a difference in PA and PIA rates for men than for women across all ages. In some regions of the country, we found no difference in rates among women. In contrast, a recently published report found that women aged 40 years and older who live in rural settings were more likely to report no LTPA than were their urban counterparts.[3] Among other factors possibly inhibiting LTPA, rural women reported higher crime in their neighborhood compared with urban women.[6]

A recent study by Parks and colleagues demonstrated that correlates of PA across urban rural categories differed depending on income level.[24] The current study adds information to the literature that disputes the generic notion that the prevalence of PIA or PA unidirectionally varies with degree of urbanization. The study, however, is not without limitations. The extent of misclassification of urbanization is not known, given our classification system draws from the 10 codes of the USDA. Furthermore, the continuum codes were based on the 1990 census; new codes are not presently available.

The study was restricted to LTPA according to data available from the BRFSS. Urban-rural differences may exist in occupational activity, household activity, and transportation-related activity, all of which are important components of total PA levels. According to the US Census 2000, there are a few regional variations in occupation that may affect LTPA levels, though these differences are rather small.[25] For example, 11% of the population in the South is employed in ''construction, extraction, and maintenance'' compared with 8% to 9% in the other regions. The highest percentage of ''management, professional, and related occupations'' are held in the Northeast (37% compared with 32% in the South).[25] Availability of certain occupational categories surely differs by urban rural status, for example, ''farming, fishing, forestry'' occur in more rural settings, although they account for only 0.7% of the jobs. The degree to which occupational differences may influence one's LTPA is not well documented.

In conclusion, the association between PA and degree of urbanization is evident and robust in the South but cannot be generalized to all regions of the US. For the most part, the Midwest and the Northeast do not experience any relationship between PA and urbanization, whereas in the West, the trend appears to be opposite of that observed in the South. For the nation as a whole, other factors more closely related to PA/PIA are race/ethnicity, sex, and education. Social

and cultural factors clearly interact with the physical environment (urbanization) and should be carefully considered in evaluating environmental determinants of PA or inactivity.

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