Obesity and Place: Chronic Disease in the 500 Largest U.S. Cities

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Abstract

Objectives. Extant research clearly points to a correlation between place and health, specifically as it pertains to chronic diseases like obesity. The present study examines this relationship among a diverse set of compositional place indicators and obesity rates across census tracts in the 500 largest cities in the United States.

Methods. Using data compiled from the Robert Wood Johnson Foundation 500 Cities project and the Census' American Community Survey, the analyses examined aggregate relationships between sociodemographic, socioeconomic, and housing characteristics of census tracts and age adjusted obesity prevalence rates in over 27,000 census tracts located in the 500 largest cities in the United States.

Results. Multivariate analysis confirms the place-chronic health connection. Regardless of variable groups, deteriorating places with low-income minority populations report more obesity prevalence.

Conclusions. Place matters. The continuing burden of zip code in the United States for disenfranchised populations will likely continue to force policymakers to examine the role that place and place-focused medical care plays in the future health and well-being of U.S. residents.

Introduction

Obesity is a costly, persistent, and serious public health issue that continues to burden the U.S. health system. Nearly 70 percent of the U.S. adult population is considered either overweight or obese; twice and in some cases, three times more than any other chronic disease prevalence (e.g. hypertension, cancer, mental illness) among adults in the U.S.[1,2] Like other chronic diseases in the United States, obesity tends to follow patterns related to characteristics of the places where people reside and is not randomly distributed across these communities.[3-5] Overweight and/or obese persons tend to be concentrated in high-risk communities, that have limited access to healthy foods, open/green space, quality health care, and are often physically, socially, economically, and emotionally isolated in these unhealthy "deserts" throughout large metropolitan areas in the United States.[6-8] This "ecology of disadvantage" has clear health implications for the populations that live in these unhealthy places where a persons' risks to experience considerable physical and mental health problems across the life course are elevated compared to persons living in healthier communities.[9-12]

While place typically has been an important construct in the health conversation, both in the United States and around the world, what has been lacking has been comprehensive, place-specific chronic disease data collected at the micro level (i.e. census block, tract). Most of the health and place conversations have been limited to examining health risks in the context of larger geographic units (i.e. country, state, MSA, county).[3,13,14] In addition, there has been limited work examining chronic disease in micro-level units across the country; typically, analyses are limited to a small number of states or a single region of the country.

In an effort to address these methodological shortcomings, we present a comprehensive examination of the compositional "correlates" of census tracts with age-adjusted prevalence rates

of obesity in the United States' 500 largest cities.[15] These 500 largest cities are dispersed throughout the United States with at least one city in every one of the 50 states and obesity prevalence estimates for nearly 30,000 census tracts. The intent of the paper is to examine patterns of weight status dispersion across these 500 cities while asking the question: What compositional community characteristics are correlated with obesity crude prevalence rates at the census tract level? The pattern is clear. Census tracts in older, more deteriorated cities would have higher rates of age- adjusted prevalence of chronic disease; in particular, being overweight and/or obese.

Why focus on chronic health issues in urban centers? There are several reasons. First, the majority of the U.S. population is concentrated in urbanized cores with over three-quarters of the current population living in the central core and suburban rings of metropolitan areas.[16] Second, expanding urbanization has had dramatic effects on the environment—increasing air, water, and noise pollution, consumption of non-renewable resources, limited green space for sustainable agriculture, exercise/recreation, etc. With these growing planetary health risks, we have witnessed important effects on urban residents who are exposed at significantly higher levels of physical/mental risk compared to residents living in other locations across the metropolitan area. Finally, because the city is an "artificial" constructed space, it can be designed/changed in ways to improve health. Obviously, there are considerable health costs to living in urban areas—these costs tend to be highest among persons living in the urban core where the circumstance of poverty and racial/ethnic status are exacerbated by segregation and racial discrimination. The intersection of poor nutrition/eating habits, poverty, unemployment, deteriorating housing, unemployment, and limited resources has deepened the divide between the haves and have nots and created a health crisis that is clearly detectable based on where people live.

Methods

We conducted a cross-sectional analysis by using data from the 2015 Behavioral Risk Factor Surveillance System (BRFSS), 2015 American Community Survey[17] and the 500 Cities Project. Overall, we compiled/merged data from over 27,000 census tracts that were located in the 500 largest cities in the United States; seven hundred and ninety-four census tracts (2.8%) were removed from the analysis because fewer than fifty residents resided in the census tracts and the prevalence rate was redacted.[15] The project provides data on 497 of the largest American cities and includes data on Burlington, Vermont, Charleston, West Virginia, and Cheyenne, Wyoming to ensure the inclusion of cities from all 50 states. The city population size ranged from 42,417 in Burlington, Vermont to 8,175,133 in New York City, New York. The census tracts range in population with less than 50 (removed from the current analysis) to 28,960 persons. The estimated population includes more than one-third of the total U.S. population in 2010 (103,020,808).

To utilize demographic information archived in the census tract files for data analysis using the 500 cities data, data preprocessing needed to be conducted. In general, the census tract data were used to clip the boundaries of the cities. As a result, each city in the 500 cities project potentially contained multiple segments. In some cases, section of a city could not use the demographic information of the corresponding census tract directly. In the 500 cities project, each section of the city had an estimated value of total population (Pop_{city}), and each census tract had information on the total population (Pop_{tract}). A ratio was derived as $R = Pop_{city} / Pop_{tract}$ where the data in the 500 cities project were joined with census tract data using the same census tract identifier. When the demographic information of the census tract (e.g. population number by age, race, gender, etc.) was used to conduct analysis on the city data of the 500 cities project,

this ratio was applied. When the socioeconomic data of American Community Survey (e.g. household income, poverty rate, etc.) was joined to the city data, this ratio was not applied. This conjoined data represents our initial attempt at examining the co-variation of age adjusted obesity rates and population and community compositional characteristics across census tracts.

Measurement

The primary objective of this paper was to examine age-adjusted obesity prevalence rates across relatively small geographic units in the 500 largest cities in the United States. As such, we examined obesity prevalence as estimated by the 2015 BRFSS among adults 18 years of age and older. The BRFSS, sponsored by the Center for Disease Control and Prevention (CDC), is the premier system of health-related telephone surveys that collect state data from U.S. residents regarding their health risks behaviors, chronic health conditions, and use of preventive services. Established in 1984 in in all 50 states as well as the District of Columbia and three U.S. territories. BRFSS completes more than 400,000 adult interviews annually and the health data that is being used in this paper as the dependent variable was collected in 2015.

Independent variables representing the compositional correlates for the analysis were all obtained from the American Community Survey and other Bureau of Census Population Files.[16,17] The analysis consisted of examining a set of variables that included census tract level population demographics, housing, and socioeconomics. Specifically, we included the following demographic variables in the analysis: percentage of Blacks, percentage of Hispanics, median age of residents, and percent married. In addition, we included the following housing variables in the analysis: median home value of owner-occupied units and median year structure was built. Finally, we included socioeconomic variables in the analysis: Gini index of income inequality[18] and the percentage of residents 25 years of age and over with less than high school education.

The multivariate analysis used SPSSPC 23 and focused on both the impact of variable groupings and the statistical significance ($p < .05$) of individual unstandardized regression coefficients.

Results

Figure 1 presents age adjusted obesity prevalence rates across the 500 largest cities in the United States; average obesity rate in 2015 was 29.8. Clearly, the Eastern and Western parts of the country appear to be very different and we know this to be, in part, a function of both age of place and the predominant concentration of low-income minority populations. Nevertheless, there are some interesting exceptions to that rule. Despite the fact that there are significant concentrations of obesity in Florida, California, New York, and Texas cities, there are a number of cities in those states that, on average, report normal weight; southern California cities appear to report the greatest concentration of normal weight locations. Additionally, the greatest concentrations appear to be on the southern coastal areas of Texas, Louisiana, and Alabama, the eastern coastal regions of New York, New Jersey, and Massachusetts, as well as the Great Lakes region around Wisconsin, Illinois, and Michigan.

[Insert Figure 1 here]

Table 1 presents the means and standard deviations for the variables included in the analysis. On average, these 500 city's residents had a median age of 35. Roughly 20 percent minority concentrations (Hispanic and Black), with 37 percent married among the population 15 years of age and over. On average, housing units were constructed in 1937, with an average home value of $255,000. The Gini index of .42 was slightly lower than the country on average (.45) and on average, sixteen percent of residents in census tracts in the 500 largest cities had less than a high school education.

[Insert Table 1 here]

Table 2 presents the multivariate regression results with age-adjusted obesity prevalence rates regressed on population demographics, housing characteristics, and socioeconomic compositions of census tracts in the 500 largest U.S. cities. The first regression model includes demographic variables including, percent Hispanic and percent Black, and both were positive and statistically significant correlates of obesity prevalence. Additionally, median age and percent married were negative and statistically significant. Places with a lower median age and a greater percentage of married persons reported lower obesity rates compared to places with a higher median age, or more single, divorced, separated and widowed residents.

[Insert Table 2 here]

The second regression model added housing characteristics to the population demographics. For the most part, the model remained intact except median age reversed its direction and was statistically significant and positive suggesting that on average, census tracts with higher median age residents reported higher rates of obesity. The housing variables were significant as a group and increased the explained variation in the model by nearly eight percent. Census tracts that had an older housing stock reported higher rates of obesity. Those tracts with higher median home values were negatively related to obesity rates and statistically significant ($p < .000$).

Finally, the third regression model added socioeconomic composition variables. While increasing the explained variation as a group ($R^2 = .76$), a higher Gini index, and a higher percentage of adults (25 years of age and over) who did not have a high school degree both were positive and statistically significant ($p < .000$) with obesity rates. A higher degree of income inequality asserts an important underlying assumption about the ecology of disadvantage—as the gap between rich and poor increases, so does this growing disadvantage of health and well-being

for low-income, predominantly minority populations. Similar to what other research has found, higher percentages of residents with less than a high school education are positively correlated with higher rates of overweight and obesity weight status.[3,4]

Conclusions

Research continues to find an important link between place characteristics and resident's health. Our research adds to this growing body of literature and makes several important contributions to our understanding of how place is related to chronic diseases like obesity. First, only a few studies have examined multiple community factors and their role in shaping the distribution of chronic disease. The current study examines three groups of demographic, housing, and socioeconomic factors that capture more than any one single dimension of neighborhood composition that other studies have used in the past. Second, the vast majority of previous studies did not examine chronic disease across the entire country but typically focused on smaller units (states, regions, or even single cities). The 500 largest cities data is important to understand the regional distribution of weight status across place. Findings may allow policy to be shaped with a focus on the places that require the most assistance with regards to programming, funds, and interventions. Three, the results of our study lend new support to the role that income inequality and racial and ethnic composition play regarding weight status and obesity. Research suggests that these "effects" are unclear[3] but our results indicate a clear connection between obesity prevalence, income inequality, and racial and ethnic population composition across census tracts in the 500 largest U.S. cities. This finding, in particular, compliments existing research showing that inequality and racial composition have implications not just for the distribution of resources that support healthy behaviors and physical activity[19], but also for the psychosocial stressors experienced throughout daily living.[20] Thus, this study

adds to a growing literature which suggests the structuring of hierarchy in society impacts physiological processes related to weight gain along with other chronic diseases.

Study Limitations

Our study has several limitations. While we controlled for a large number of compositional community characteristics, key variables were likely omitted. Direct measures of unhealthy behaviors and specific measures of the built environment represent two important factors that need further analysis in conjunction with aggregate community composition but were beyond the scope of the current study. Additionally, the BRFSS relies on self-reported height and weight, which has continually been questioned regarding recall accuracy. Finally, our analysis is cross-sectional and only allows us to note the community correlates of obesity reporting across these 500 largest U.S. cities. Despite these and other limitations, this study shows an important role that both household income inequality and racial/ethnic composition play in determining chronic health outcomes like obesity, net of a variety of social and economic neighborhood factors.

Study Implications

There is little doubt that behavior plays a role in the health equation. However, the question from a public policy perspective is how those behaviors might be nudged towards more positive health outcomes—behaviors, after all, are shaped by the environment. This requires a look at the contextual characteristics of place that have been examined in the present study. Given the findings from this study, there is reason to take seriously both the physical factors of place, or the "obesogenic" environment, as well as social factors related to status and hierarchy (i.e. race and inequality). Individuals who feel in control of their lives and do not experience stress related to relative deprivation are more likely to make the behavioral changes needed to

reduce obesity. Governmental policies related to taxes, wages, the social safety net, and education, all have serious implications for the structuring of economic and racial equality that either directly or indirectly impact health outcomes. Policies that promote equality are likely critical to lessening the prevalence of chronic disease such as obesity. [20]

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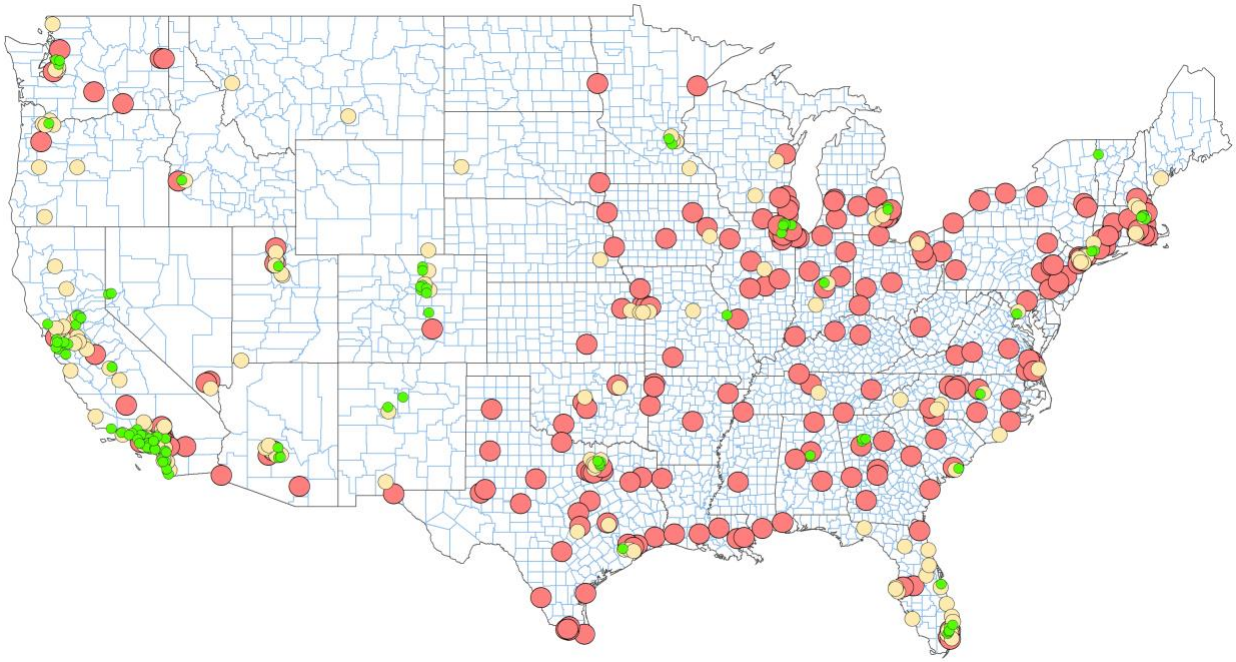

Legend

Normal weight (18.5–24.9 kg/m2)

Overweight (25–29.9 kg/m2)

Obesity (>30 kg/m2)

N

W E

S

0 250 500 1,000 Miles

Table 1. Descriptive Statistics for Study Variables in 500 Largest U.S. Cities, 2015

	Mean	S.D.
Dependent Variable		
Crude Prevalence Obesity Rate	29.76	8.06
Population Demographics		
Median Age	35.43	7.18
Percent Hispanic/Latino	21.80%	24.46
Percent Black	19.87%	27.49
Percent Married	37.84%	15.82
Housing Characteristics		
Median Year Units Built	1966.31	19.18
Median Home Value (Owner-Occupied Housing Units)	$254,889.38	$199,222.58
Socioeconomic Composition		
GINI Index of Inequality (Household Level)	.421	.074
Percent Less than High School	16.44%	14.02

N = Based on 27, 204 Census Tracts

Table 2. Crude Obesity Prevalence Regression Models in 500 Largest U.S. Cities, 2015

Variables	Model 1		Model 2		Model 3		Model 4	
	b	95% CI	b	95% CI	b	95% CI	b	95% CI
Population Demographics								
Median Age	-.06**	-.06 to -.04	.02**	.02 to .04	.04**	.03 to .05	.04**	.04 to .11
% Hispanic/Latino	.10**	.10 to .12	.08**	.08 to .09	.01**	.00 to .01	.02**	.01 to .02
% Black	.20**	.19 to .20	.16**	.16 to .17	.13**	.13 to .14	.14**	.13 to .14
% Married	-.08**	-.08 to -.07	-.04**	-.05 to -.04	-.03**	-.03 to -.04	-.04**	-.04 to -.03
Housing Characteristics								
Median Year Units Built			-.05**	.00 to -.01	-.02**	.00 to -.01	-.06**	.00 to -.01
Median Home Value (Owner-Occupied)			-.01**	.00 to -.01	-.01**	.00 to -.01	-.01**	.00 to -.01
Socioeconomic Characteristics								
GINI Index of Inequality (Household Level)					3.9**	3.2 to 4.7	3.6**	2.9 to 4.3
% < High School					.17**	.17 to .18	.16**	.17 to .18
Moderation (AGE X HOUSING)								
Median Age X Median Years Unit Built							.01**	.00 to .01
Median Age X Median Home Value							.01**	.00 to .01
Constant	28.0	28.8 to 29.6	25.6	27.2 to 28.2	22.2	24.8 to 26	22.4	24.2 to 25
df	4		7		9		11	
Adjusted R^2	.57		.74**		.76***		.77***	

(p < .001*; p < .000**; p < .001*** (Hierarchical F-Test R^2 Change)