The Skinny on Obesity Rates and Fast Food Restaurants in the United States, 2023

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ABSTRACT

The authors examine what, if any, role the number of fast-food restaurants per capita plays in explaining the variation of obesity rates across the United States in 2023. Apart from the presence of seven different popular fast-food chains in America, the analysis employs census regional dummy variables to gauge how obesity rates vary after the number of restaurants per capita has been allowed for. Obesity rates are directly related to the number of Subway, Taco Bell, Burger King, and Wendy's restaurants per capita, while obesity rates are inversely related to the number of Chipotle restaurants per capita. Among census regions, obesity rates are highest in the South and Midwest.

Introduction

Many people have already studied the link between obesity rates and fast-food consumption. In some studies, the primary focus was proximity of some segment of the population to a fast food restaurant. Currie *et al.* [1], for example, examine the obesity rates of children whose schools are within a certain distance of a fast-food restaurant and how their obesity rates vary with this distance. In other studies, the primary focus is on obesity among adults living in a particular state. Anderson *et al.* [2], for example, study the relationship between fast-food consumption and obesity among Michigan adults by race and ethnicity.

We will examine the relationship between fast-food restaurant locations per capita and obesity rates among all adults across 50 states in 2023. The oft-stated claim among statisticians is that "correlation does not imply causation." The regressions in this study will nonetheless enable one to see which one or more of seven popular fast-food restaurant locations per 100,000 of a state's residents tend to move most closely with overall adult obesity rates. We are, however, loathe to blame one franchise more than another, but demonstration that the prevalence of popular fast-food restaurants is not unrelated to obesity rates in all 50 states strikes us as a contribution to this literature.

The Data

In the analysis that follows, the statistics on overall adult obesity rates for the 50 states (updated through September 21, 2023) are from the Centers for Disease Control and Prevention (CDC) [3]. The CDC data comes from the Behavior Risk Factor Surveillance System (BRFSS), a state-based survey conducted by the CDC. These rates show the proportion of adults in each state with a body mass index (BMI) equal to or greater than 30. BMI is the person's weight in kilograms divided by the square of height in meters. The three states in our sample with the highest overall adult obesity rates are West Virginia (41 percent), Louisiana (40.1 percent), and Oklahoma (40 percent); the three states with the lowest obesity rates are Colorado (25 percent), Hawaii (25.9 percent), and Vermont (26.8 percent). Eight of the ten states with the highest obesity rates are all in the South census region. Six of the ten states with the lowest

obesity rates are all in the Northeast. For the 50 states, the mean overall adult obesity rate is 33.95 percent and the standard deviation is 3.86 percent.

For each state, we recorded the number of fast food restaurants per 100,000 people (as of February 26, 2024) for each of seven different fast food chains: Chipotle [4]; McDonald's [5]; Kentucky Fried Chicken (KFC) [6]; Subway [7]; Wendy's [8]; Taco Bell [9]; and
Burger King [10]. For McDonald's, the latest available data were as of November 2021. Population estimates for each state at the beginning of 2024 were obtained from the World Population Review [11].

Methodology

We examine whether the number of restaurant locations per 100,000 people in each state and regional factors influence overall adult obesity rates. This will be done by means of regressions fitted to the cross section of 50 states of the following form:

(1) $$\textit{obesity rate} = \mathrm{a} + \mathrm{b}\ \textit{restaurants per capita} + \sum_{i=1}^{4} c_i R_i$$

where the *obesity rate* is the overall adult obesity rate of each state, *restaurants per capita* is for each of seven different popular fast-food chains (namely, Chipotle, McDonald's, KFC, Subway, Wendy's, Taco Bell, and Burger King) the number of restaurant locations in each state per 100,000 people, and the R_i are four dummy variables employed to capture the census regional pattern of obesity rates that emerges after the number of restaurants per capita has been taken into account.

Since for a variety of economic, climatic, and other reasons some census regions have higher obesity rates than others, we would expect to find regional patterns independent of the prevalence of fast-food restaurants. To capture this regional pattern, a set of four dummy variables R_i was defined for each state so that $R_i = 1$ for all states in census region i; otherwise,
$R_i = 0$. The correspondence of the R_i to census regions was as follows:

R_1 : South (Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia)

R_2 : West (Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming)

R_3 : Northeast (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont)

R_4 : Midwest (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin)

In fitting the regression equations, the average of the coefficients of the R_i was constrained to zero [12]. As a result, positive coefficients on dummy variables correspond to census regions whose obesity rates were above average, and negative coefficients correspond to census regions whose obesity rates were below average after the number of restaurants per capita has been allowed for.

The contribution of the regional pattern to the regression analysis can be measured by a partial R^2, calculated by comparing the total R^2 of the final regression to that of the same regression with the dummy variables omitted. Where R_1^2 is the (unadjusted) total R^2 when the dummy variables are omitted, and R_2^2 the total R^2 including the dummy variables, then the partial R^2 contributed by the dummies is

(2) $$(R_2^2 - R_1^2)/(1 - R_1^2)$$

The partial R^2 can be subject to an F test for significance.

In summary, the R_i show the "effect" of region *after* allowing for differences in the prevalence of restaurants per 100,000 people and should not therefore necessarily correspond to the observed pattern of obesity rates. If they did, it would imply that the prevalence of restaurants has *no* influence at all. That is, the whole point to investigating the pattern of statewide obesity rates is that one would otherwise confuse "South" with disproportionately many fast-food restaurants per capita.

The Results

To permit measurement of variations in the roles played by individual census regions, the set of four dummy variables R_i discussed above was introduced, and the results obtained are summarized in Table 1.

Table 1. Regression of Overall Adult Obesity Rates on the Number of Fast-Food Restaurants per 100,000 People

(A) Including and (B) Excluding Regional Dummies

Fast Food Chain		Regression coefficient on *Constant*	Regression coefficient on *Restaurants per 100,000 people*	R^2
Chipotle				
	(A)	34.873	-1.635	0.651
		(44.62)[1,**]	(-2.07)[*]	
	(B)	35.291	-1.637	0.034
		(30.26)[**]	(-1.30)	
McDonald's				
	(A)	29.649	0.926	0.645
		(13.64)[**]	(1.85)	
	(B)	22.995	2.577	0.288
		(9.08)[**]	(4.40)[**]	
KFC				
	(A)	31.245	1.754	0.646
		(21.07)[**]	(1.90)	
	(B)	28.119	4.352	0.239
		(17.82)[**]	(3.88)[**]	
Subway				
	(A)	28.933	0.678	0.679
		(18.40)[**]	(2.92)[**]	
	(B)	25.282	1.261	0.296
		(12.74)[**]	(4.49)[**]	

Table 1. Regression of Overall Adult Obesity Rates on the Number of Fast Food Restaurants per 100,000 People (Continued)

(A) Including and (B) Excluding Regional Dummies

Fast Food Chain		Regression coefficient on *Constant*	Regression coefficient on *Restaurants per 100,000 people*	R^2
Wendy's				
	(A)	31.678	1.054	0.651
		(25.55)**	(2.06)*	
	(B)	29.382	2.516	0.256
		(24.08)**	(4.07)**	
Taco Bell				
	(A)	30.159	1.482	0.673
		(20.47)**	(2.76)**	
	(B)	27.226	2.838	0.354
		(19.65)**	(5.13)**	
Burger King				
	(A)	30.193	1.484	0.652
		(18.27)**	(2.11)*	
	(B)	25.530	3.707	0.285
		(12.90)**	(4.38)**	

[1]Figures in parentheses are *t*-statistics.
*Significant at better than the 0.05 level. **Significant at better than the 0.01 level.
Sources: *Obesity* rates: https://cdc.gov/obesity/data/prevalence-maps.html;
Chipotle: https://locations.chipotle.com/; *McDonald's* : A. Young. "How Many McDonald's Restaurants Are in Your State?" 25 November 2021. https://247wallst.com/special-report/2021/11/25/states-with-the-most-mcdonalds-restaurants/; *KFC*: https://locations.kfc.com; *Subway*: https://restauranyts.subway.com/united-states; *Wendy's*: https://locations.wendys.com/ united-states; *Taco Bell*: https://locations.tacobell.com; *Burger King*: https://leadsdeposit.com/ list-of-all-burger-king-locations-in-the US/#How_Many_Burger_King_restaurants_are_there_in_the_United_States_in_2023.

For all but one of the seven fast food chains, we find a positive or direct relationship between the number of restaurant locations per capita and statewide overall adult obesity rates. For Subway ($p = 0.005$), Taco Bell ($p = 0.008$), Burger King ($p = 0.040$), and Wendy's ($p = 0.045$), their influence on obesity rates is highly significant at better than the 0.05 level. For McDonald's ($p = 0.071$) and KFC ($p = 0.064$), the relationship is not significantly positive. For Chipotle, however, the larger the number of restaurant locations per capita the *lower* the state's overall adult obesity rate ($p = 0.045$). Mulroy [13] writes that

"when you look at ingredients, Chipotle is comparatively healthier than other to-go options." In particular, Chipotle's "build-your-own" meals enable patrons to eat healthy.

Table 2. Regional Effects: Coefficients of R_i

	R_1: South	R_2: West	R_3: Northeast	R_4: Midwest	Partial R^2 contributed by region
Chipotle 3.429	-2.724	-3.271	2.566	0.64*	
McDonald's	3.082	-2.429	-2.796	2.143	0.50*
KFC	2.915	-2.512	-2.883	2.478	0.54*
Subway 3.264	-2.443	-2.435	1.612	0.54*	
Wendy's 2.847	-2.364	-2.990	2.506	0.53*	
Taco Bell	2.724	-2.729	-1.962	1.967	0.49*
Burger King	3.181	-2.222	-2.938	1.979	0.51*

*F-test significant at better than the 0.01 level with 3,45 degrees of freedom.

Table 2 shows the regional effects, R_i, which summarizes the effect of the distinctiveness of individual census regions vis-à-vis other census regions. The contribution made by the regional dummy variables was significantly different from zero for all seven regressions.

The peculiarities of certain census regions are clearly marked. Taking an overview of various coefficients on the R_i, it is clear that obesity rates are highest in the South and Midwest relative to the West and Northeast. Table 2 suggests that, after the number of fast-food restaurant locations per capita is allowed for, obesity rates are unambiguously highest in the South. Low incomes among many Southerners is part of the explanation. Figures on the percentage of each state's residents living in poverty [14] highlight the differences between the South and the three other census regions. The percentage of people living in poverty in the South as of 2022 (14.31 percent) is discernably higher than it is in the West (11.56 percent, *p*-value on the difference between the two averages = 0.0096), the Midwest

(11.92 percent, $p = 0.0137$), and the Northeast (10.58 percent, $p = 0.0023$). Many people living in the South have limited means of purchasing healthy food. And, when summer temperatures reach triple digits day after day, it is difficult if not dangerous to exercise outdoors.

Concluding Remarks

Fast-food restaurants and obesity have both increased over time. But, are fast food restaurants alone to blame for America's obesity? As researchers have noted, people who consume large amounts of fast foods may have other behaviors that contribute to their obesity. The sheer number of fast-food restaurants does not necessarily establish a causal link between fast food and obesity.

Although the principal factors influencing obesity are as many as the number of Americans who struggle with this disease, our study shows that two factors − the number of fast food restaurants per capita and regional − explain almost two-thirds of the variation in overall adult obesity rates in the United States.

The statistics presented in this paper represent a modest attempt to assess the significance and relative importance of seven different fast food chains on statewide obesity rates. Apart from clear regional differences with obesity rates significantly higher in Southern and Midwestern states relative to states in the Northeast and West, differences emerge by fast food chain. Obesity rates are significantly higher in states with higher per capita numbers of Subway, Taco Bell, Burger King, and Wendy's restaurants, but significantly lower in states with higher per capita numbers of Chipotle restaurants. Why Chipotle bucked the trend is obviously (fast) food for thought.

So far as future research is concerned, one could replace the catch-all regional dummy variables with more explicit state-specific variables for the percentage of people living in poverty, unemployment rates, educational attainment (say, the percentage of a state's residents with a bachelor's degree or higher), and race.

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