CHILDHOOD OBESITY IN THE U.S.: HOW EFFECTIVE ARE SCHOOL PREVENTION PROGRAMS?

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ABSTRACT

This study uses a logistic regression to analyze the 2004-2005 Arkansas Center for Health Improvement body mass index data from four school districts in Arkansas. We conclude that the probability of elementary school children being overweight or at risk of being overweight depends on economic factors, demographics, and food availability.

INTRODUCTION AND OBJECTIVE

Childhood obesity has become a leading public threat in the United States[2] (Centers for Disease Control and Prevention/ National Center for Health Statistics (CDC/NCHS), 2004a, 2004b, and 2006; Institute of Medicine (IOM) 2004; Ogden *et al.* 2006). Studies indicate childhood obesity tends to persist into adulthood, which increases the risk of a multitude of chronic disease health risks, which are costly to individuals and society (Mokdad *et al*., 2000; Finkelstein, Fiebelkorn, and Wand, 2004). Furthermore, the onset of obesity in children and adolescents tends to persist throughout their adulthood. If the increasing trend in childhood obesity continues, then today's young people may become the first generation in U.S. history with lower life expectancy than their parents (Arkansas Center for Health Improvement (ACHI), 2006).

With the gene pool remaining relatively stable, factors such as change in eating habits and sedentary lifestyles are considered to be responsible for much of the increase in the obesity epidemic (Yanovski and Yanovski, 1999). Food availability is critical for the decision to purchase food. High-calorie foods, such as food away from home, have assumed a main role in the U.S. food supply, because they are good-tasting, cheap and convenient to consume (Drenowski and Levine, 2003; Chou, Grossman, and Saffer, 2002). Interestingly, rich and poor allocate the same amount of spending on food away from home (Atkinson, 2005). The low cost and the convenience of energy-dense foods may play a role in the observed association between economic deprivation and obesity (Drenowski and Specter, 2004; Darmon, Ferguson, and

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[2] Overweight and obesity is categorized by the Body Mass Index (BMI), which is determined by the formula: weight (in kilograms)/height^2 (in meters). Among adults, overweight is classified by a BMI between 25.0 and 29.9, while a BMI greater than or equal to 30.0 defines obesity (CDC, 2004a). Overweight in children is typically not referred to as "obesity", though these terms will be used interchangeably in this proposal. Overweight in children is defined as a body mass index that surpasses the 95th percentile of a fixed distribution for a child's age and gender (CDC, 2004b). Because the current child population is too heavy, current weight classification guidelines (percentiles) are based on pre-1980 population references (Kantor).

Briend, 2003; Leibtag and Kaufman, 2003). Chou, Grossman, and Saffer, (2002 and 2004) determined that another significant factor contributing to the increased demand for food away from home is the fact that the per-capita number of fast food restaurants doubled between 1972 and 1997, which reduces the search and travel time. However, Sturm and Datar (2005) could not establish a significant relationship between the distribution density of restaurants and the increase in obesity, indicating a need for additional research on this topic.

Another issue with regard to food availability that may contribute to childhood obesity is the participation in one or more of the food assistance programs. The U.S. Department of Agriculture/Food and Nutrition Service (USDA/FNS) provides meals, snacks, or individual foods to children and National School Lunch Program (NSLP) serves free lunches to approximately 60% of U.S. school children across socio-economic status, race and geographic boundaries each day (USDA/FNS, 2005; Devaney, Gordon, and Burghardt, 1993, Whitmore, 2004). School lunch programs affect school children by serving them about one-third of their total daily calories. Recently, the USDA sponsored an expert panel to review the relationship between poverty, food program participation and obesity. The panel determined that several studies relate child participation in the NSLP to height, and/or weight status (e.g. Mei *et al.*, 1998; Jones *et al.*, 2003). However, published research provides inconsistent evidence regarding the relationship between participation in this food assistance program and weight gain (e.g. Gordon, Devaney, and Burghardt, 1995; Wolfe *et al.*, 1994; Melnik *et al.*, 1998; Jones *et al.*, 2003). Thus, there is need to establish a relationship between participation in the NSLP and childhood obesity.

Although the increasing trend in childhood obesity prevails nationwide, it is of greater concern in most southern U.S. states where obesity rates have consistently ranked above the national average. About 38% of Arkansas' children are overweight or at risk for overweight (Arkansas Center for Health Improvement (ACHI), 2006). A national study recently ranked Arkansas as the seventh unhealthiest state in the United States due to its high levels of obesity, inactivity and smoking (Segal, 2006). In order to combat childhood obesity in public schools and communities, the state passed legislation in 2003 to create a Child Health Advisory Committee (Act 1220 of 2003 Arkansas Legislature). One of the requirements of Act 1220 is the confidential reporting of each student's body mass index (BMI) to his or her parents (ACHI, 2006). The Arkansas Center for Health Improvement (ACHI) is responsible for implementing the data collection and reporting the aggregated results.

Given that the ACHI BMI data has become recently available to the public, economic research on the success of this initiative has begun. Previous studies on the effectiveness of the ACHI and other childhood obesity prevention programs have shown mixed results. On one hand, it has been determined that since 2003, the number of obese kids has leveled off, which researchers see as a positive sign (Wadas-Willingham, 2007). On the other hand, some lawmakers question whether it should be the role of schools to monitor students' weight or whether the BMI report cards may hurt children's self-esteem[3] (CNN, 2007; Kantor, 2007). Thus, there is a need to determine whether and to what extent a relationship between demographic characteristics, food availability, and body weight among children exists.

The objective of this study is to investigate how the probability of a child being overweight or at risk of being overweight is affected by (1) school demographic characteristics, (2) student demographic information, and (3) food availability. Using data from the 2004-2005 ACHI BMI assessment, the proposed research estimates the relationship between food

[3] This latter view may have been what led the recently elected Governor of Arkansas, Mike Beebe, to support regulations that weaken the practice of reporting children's BMI to parents. Arkansas' pending regulations will require biennial BMI reports instead of annual (Associated Press (AP), 2007).

availability and childhood overweight while controlling for city and school characteristics. The availability of this information will provide help considering design, development and improvement of strategies, programs and information for weight maintenance as well as weight reduction.

MODEL, DATA AND PROCEDURES

THEORY

In the logit model, the dependent variable Y_i is discrete and binary (also called a Bernoulli random variable) with possible outcomes $Y_i = 1$ to indicate the event in which child *i* is considered overweight or at risk of being overweight (BMI≥95th percentile) and $Y_i = 0$ otherwise. The event in which $Y_i = 1$ occurs with a probability of p_i, while $Y_i = 0$ with a probability of $1 - p_i$. The probability mass function for Y_i for the data sampling process is $f(Y_i) = p_i^{y_i}(1 - p_i)^{1-y_i}$ with $\mathrm{E}\left[Y_i\right] = p_i$ and $\mathrm{var}(Y_i) = p_i(1 - p_i)$. Assuming that the individual decisions are independent, the log-likelihood function based on the observations for *n* individuals can be written as $\ln L(\boldsymbol{\beta};\boldsymbol{y}) = \sum_{i=1}^{n}\left[y_i \ln\left(p_i\right) + \left(1 - y_i\right)\ln\left(1 - p_i\right)\right]$ (Mittelhammer, Judge, and Miller, 2000). Thus in the logit model, $\ln\left(p_i / 1 - p_i\right) = \boldsymbol{x}_i^{'}\boldsymbol{\beta}$, where $\boldsymbol{x}_i$ is a vector of independent variables for the i^{th} individual and $\boldsymbol{\beta}$ is a vector of parameters. The left-hand side expression is the logarithm of the odds ratio, also referred to as log-odds. A positive (negative) coefficient in the logit analysis means that higher values of the corresponding explanatory variables are linked to an increase (decrease) in the likelihood of being overweight or the risk of being overweight.

Maximum likelihood estimation of the logit model yields an estimator that is consistent, asymptotically efficient and asymptotically normal (Allison, 1999).

The slope of the logistic curve, i.e. the effect of a change in one of the explanatory variables on the probability of event $Y_i = 1$ is $\partial p_i / \partial x_{ik} = \beta_k p_i (1 - p_i)$, where x_{ik} is the value of the k^{th} variable for the i^{th} individual. The advantages of using a logit analysis, as indicated by Allison (1999), are: (i) simple interpretation of the coefficients, (ii) desirable sampling properties, most notably, disproportionate stratified random sampling of the dependent variable does not bias the parameter estimates, and (iii) the ability to generalize the model to allow for several unordered categories for the dependent variable.

DATA

We focus on the school districts of four geographically, demographically, and economically distinct areas in Arkansas: Springdale, Fayetteville, Pine Bluff, and Jonesboro. Springdale and Fayetteville are located in northwest Arkansas and are part of what is called the Northwest Arkansas Metro, Pine Bluff lies in central Arkansas, and Jonesboro is located in northeast Arkansas in an area denoted as the Arkansas' Delta. Although Arkansas is mostly rural and ranks as the 3rd poorest U.S. state, these four regions are quite diverse with regard to income and ethnicity. For example, in 2007, Fayetteville ranked number eight in terms of best places for business and career in the U.S. (Badenhausen, 2007).

We focus on the ACHI BMI database of the 2004-2005 school year, given that it is the sample with the least missing values for the four school districts considered in our study (ACHI, 2005). A total of 35 elementary schools are in the sample. Table 1 shows the total number of students and the number of sampled students in each of the four school districts. As parents are able to opt out their children from participation in the BMI assessment, the average number of sampled students is 87% of the total number of enrolled students in a school. The lowest participation rate is 65% in Forrest Park School and the highest participation rate is 95% in Thirty Four School. Both of these schools are located in Pine Bluff. All elementary schools in Fayetteville and Springdale offer grades K-5, while the schools in Pine Bluff and Jonesboro offer varying grade levels.

Due to government recommendations advising against the disclosure of sensitive health information, whenever small numbers of children are involved, they are reported as missing observations in the data set. In the 2004-2005 data, two types of information were omitted: the number of students in each grade by gender (74 grouped observations corresponding to 2,107 students) and the percentage of students who were at risk of being or were overweight (20 grouped observations corresponding to about 441 students). In most cases, either one type of information was missing or the other, but five schools contained grouped observations that contained neither data. In all cases, we chose to fill in the missing observations. For missing observations for students in grades K through 4, the number of students in each grade for the 2004-2005 school year was computed according to the distribution of the students for the following grade in year 2005-2006. For grade 5, the number of students was computed as the difference between the total number of students in each school by gender and the sum of the students in grades K-4. Lakeside Elementary School and Cheney Elementary School, both in the Pine Bluff School District, did not report student participation by grade and gender for neither of the school years. In this case, for the 2004-2005 school year, we equally divided the total number of students by gender among all grades. Table 2 shows the descriptive statistics of the variables considered in the study.

The dependent variable in this study consists of the percentage of students that were overweight or at risk of being overweight by school, grade and gender. Because ACHI does not make individual student data available, student data were reported clustered into their respective grades. Whenever this information was missing for a gender or for a school, we replaced the missing observation with a proportion such that the weighted average of the proportions by gender matched the reported weighted average for the gender. Although our procedure is not infallible, it allowed us to not lose any other information.

Table 2 shows that 51% of the students per school were male. Furthermore, the majority of the sampled students attend Kindergarten or Grade 1, with 18.7% and 17.2% percent of all sampled students, respectively. Most of the sampled students are enrolled in the Springdale school district with 43.32%. Jonesboro school district has the least enrollment with only 14.07% of all sampled students.

Ethnicity has an important impact on childhood obesity. Previous research has shown that the prevalence of obesity is disproportionately high among children from ethnic minority groups, especially Black or African-American and Hispanic children (e.g. Flegal *et al*. 2002; Galuska *et al*. 1996; Kumanyika and Grier 2006). The Springdale school district contains a high percentage of Hispanic students, while in Pine Bluff, the majority of the students are Black or African-American. The majority of the Jonesboro students are White Non-Hispanic.

We also investigated several variables expressing various city demographics, such as per-capita income, population per square mile, poverty and unemployment levels (U.S. Department of Labor/ Bureau of Labor Statistics (DOL/BLS), 2004; U.S. Census Bureau, 2000, 2005). Previous studies have found that the highest rates of obesity occur among population groups with low income levels (Cutler, Glaeser, and Shapiro, 2003; Chou, Grossman, and Saffer, 2004;

Gortmaker, *et al.* 1993; Galobardes, Morabia, and Bernstein, 2000; Sobol and Stunkard, 1989; Jeffery and French, 1996; Jeffery, French, and Spry, 1991; Stunkard, 1996; Wang, 2001). Being employed increases income, which may increase the parents' ability to buy healthier food which is typically higher-priced or live in more affluent areas with more opportunities to exercise. Thus, we expect a higher probability of a child being overweight or at risk of being overweight in the presence of low-income level per capita, high poverty level, and high unemployment level. The lowest income, and highest unemployment and poverty rates were observed in Pine Bluff, with $14,637, 7.7% and 25.5%, respectively. Jonesboro is the least densely populated city with only 721 people per square mile.

Table 2 shows five different variables related to food availability, i.e. the percentages of students enrolled in the National School Lunch Program (NSLP) who receive free or reduced lunches, and the numbers of grocery stores, convenience stores, and fast food restaurants (U.S. Department of Education- National Center for Education Statistics (USDE/NCES) 2005; GoogleMaps, 2007, YellowPages.com, 2007). Our data shows that on average more than half of the student population of the four school districts participates in the free lunch program and about eight percent participate in the reduced lunch program.

In this study, we collect the number of fast food stores, grocery stores, and convenience stores in Fayetteville, Springdale, Pine Bluff, and Jonesboro from GoogleMaps (2007) and YelllowPages.com (2007). We used the ratio of grocery stores to fast food restaurants as an independent variable. Chou, Grossman, and Saffer (2004) defined fast-food restaurants as refreshments places that primarily sell limited lines of refreshments and prepared food items. Examples for these establishments are restaurants that prepare pizza, chicken, or hamburgers for consumption at the premise and take-home consumption. As Table 2 shows, the average numbers of grocery stores, convenience stores, and fast food restaurants per region are 17, 29, and 36 respectively. While Springdale has the most grocery stores, Jonesboro shows more convenience stores and fast food restaurants than the other three regions. We expect that with higher food availability, the probability of childhood overweight increases.

EMPIRICAL RESULTS

Using a logit model, this study directly estimates the impact of demographic characteristics of the respective geographic areas and schools, and food availability on the probability of a child being overweight or at risk of being overweight. The model was estimated using maximum likelihood by implementing the Newton-Raphson algorithm available in SAS® proc logistic. Several variables were correlated with each other and were dropped from the final model. For example, density of grocery stores, convenience stores, and fast food restaurants were all correlated with average income per capita. Thus, we included the ratio of grocery stores to fast food restaurants but we dropped density of convenience stores.

The means of the variables used in the logit analysis are reported in Table 3; the results of the logit model can be found in Table 4. The only variable that is not statistically significant is participation in the free lunch program (PFLP); however, the parameter estimate indicates it has a positive impact on being overweight or at risk of being overweight. The estimate for participation in the reduced lunch program (PRLP) is significant and positive, indicating that schools with higher student participation in this program have higher incidence of overweight students or students at risk of being overweight. Because these two variables are expressed as percentages that are complementary to each other and to non-participation in the programs, the interpretation of the odds-ratio is not as straight-forward as with binary or continuous variables.

One cannot look at it as change in the odds given a one-unit increase in PRLP, since this variable cannot increase by one, that is 100%, *ceteris paribus*. When PRLP increases by a small amount that is less than one, non-participation is the program must decrease by the same amount, holding PFLP constant. Thus we computed the effect of an increase in PRLP by evaluating the change in $p_i/(1-p_i)$ at the mean of the explanatory variables. Our computations indicate that an increase by 5% in participation in the reduced school lunch program would increase the odds-ratio that kids would be overweight or at risk for overweight by 10.69%; note that we are controlling for differences in income by school district.

The odds that elementary school females are overweight are 11.6% lower than males. As expected, income has a negative relationship on the probability of overweight or being at risk for overweight: for each additional $1,000 of income per capita, the odds of a child being overweight or at risk for overweight decrease by 41.7%. The parameter estimate for the ratio of grocery stores to fast food restaurants was statistically significant but its sign indicated that a one-unit increase in the ratio decreases the odds of overweight or the risk for overweight by nearly 100%.

The probability of overweight or being at risk for overweight is highly correlated with grade, which is a near-perfect proxy for age. By the time children enter 5th grade, the odds that they are overweight or at risk for overweight are 49.4% higher than the odds faced by kindergartners. The largest increase in the odds of being overweight occurs between kindergarten and 1st grade: the odds that kids in 1st grade are overweight or at risk for overweight are19.3% higher than the odds of kindergartners. Another steep increase in the odds can be found between 4th and 5th grades with 11.1%.

The final set of explanatory variables that we investigated is ethnicity. Because the population of American Indians and Alaskans was so minute with less than one student for every two schools, we grouped these two ethnicities with Whites. The parameter estimates are individually statistically significant at the 5% level but not at the 1% level. The signs of the estimates indicate that Asians and African Americans are less likely to be overweight or at risk for overweight than Whites. Hispanics have a higher probability of being overweight or at risk for overweight. For these variables the interpretation of the odds ratio poses the same problem as the interpretation of PRLP that we discussed above. Thus we computed the change in the odds-ratio manually and evaluated it at the means of the explanatory variables. An increase of 5 % in the Asian population at the expense of Whites would decrease the odds-ratio by 2.95%, similarly an increase of 5% in the African-American population at the expense of Whites would decrease the odds ratio by 2.21%. An increase of 5% in the Hispanic population at the expense of Whites would increase the odds-ratio by 2.19%.

DISCUSSION, CONCLUSIONS, AND LIMITATIONS

A variety of factors influence childhood obesity. These factors range from economic elements, such as income, to demographic characteristics, lifestyle factors and food availability. The special interest of this study was to explain the effects of demographic characteristics and food availability by city and school on childhood overweight in four school districts in Arkansas.

Regarding the demographic characteristics, our results indicate that age, gender and ethnicity play important roles with regard to the probability of elementary school children being overweight or being at risk for overweight. As the children become older, the probability of being overweight or being at risk for overweight increases. Hence, a promising way to control overweight in elementary school children would be to monitor activity levels, food consumption, and behavior toward food between kindergarteners and 1st graders. Our results do not support evidence found in prior studies that a higher prevalence of African-Americans are at risk for overweight or are more overweight than Whites. The difference may be due to the age of the children considered in our study. It is possible that African-American children engage in different activities than White children, such as playing street basketball instead of videogames or that there may be genetic or cultural differences between the two groups that delay the onset of weight increases in African-Americans until later in their life.

Other important factors are participation in the reduced lunch program at school, income per capita, and food choices in terms of grocery stores and fast food restaurants. Children that participate in the reduced lunch program are more likely to be overweight or at risk for overweight. Higher income per capita decreases the probability of being overweight or at risk for overweight as does an increase in the number of grocery stores and fast food restaurants. We had expected a positive sign for the estimate of the ratio of grocery stores to fast food restaurants. Thus, this finding contradicts our initial assumption that food availability would increase chances of overweight. One possible explanation for the negative sign is that a larger number of grocery stores and restaurants increases the variety of food choices. Thus, if a family has a wider selection of food choices, their children may be at lower odds for overweight or at risk for overweight. We consulted the current nutrition information of kid's meals of several fast food restaurants and found nutritional variations among the choices. According to each company's website, we found that kid's meals contain 554 calories at Wendy's, between 360 and 710 calories at McDonalds', and a kid's meal at Taco Bell ranges between 594 and 654 calories

(McDonalds.com, 2007; TacoBell.com, 2007; Wendys.com, 2006).[4] However these nutritional values may have changed over time, given we used BMI data from the school year 2004-2005.

There are several limitations to this study. Since ACHI did not collect information on each child's economic situation and ethnicity, we used school or city data as proxies. The predictive power of our model could be increased if the data had been at the individual level instead of clustered. Furthermore, the method of counting fast food restaurants and grocery stores from the 2007 editions of GoogleMaps and YellowPages.com could serve only as rough approximation of the number of these food establishments in 2004, given that this market is quite dynamic with constant new additions and closings. Another limitation is that because school children are not assigned to schools randomly and participation in the ACHI BMI study is voluntary, two types of sample selection bias may occur, which may result in biased logit parameter estimates. Future research will correct for these sample selection biases.

The findings of this study suggest several areas for further investigation, such as (i) the effect of changes in food availability and demographic characteristics on childhood obesity using panel data, (ii) the reason for the increase in the probability of overweight or at risk for overweight during the transition of children from kindergarten to 1st grade, (iii) the impact of ethnicity with regard to overweight over time, and (iv) the effect of the reduced lunch program on the likelihood of a child being overweight or at risk for overweight.

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4 Complete nutrition lists of U.S. fast food restaurants is available from calorie-count.com (2007).

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APPENDIX: Tables

Table 1. Number of Enrolled and Sampled Students by School (Source: ACHI 2005, USDE/NCES, 2005)

School District	Grades	School Name	Response rate (%)	Number of total students enrolled		Number of sampled students	
				Male	Female	Male	Female
		Elmdale	91.77	330	314	305	286
		George	83.73	325	302	270	255
		Harp	89.42	376	333	338	296
		Jones	87.52	263	258	231	225
		Lee	89.01	243	221	221	192
Springdale	K-5	Parsons Hills	85.94	316	317	268	276
		Smith	88.10	374	374	341	318
		Tyson	85.74	265	275	237	226
		Walker	89.81	282	287	257	254
		Westwood	86.26	319	278	279	236
		Young	83.26	361	314	309	253
		Asbell	88.38	200	213	179	186
		Butterfield	67.45	192	192	136	123
		Happy Hollow	86.36	166	186	144	160
Fayetteville	K-5	Holcomb	88.66	289	516	249	267
		Leverett	78.55	156	249	117	132
		Root	90.15	241	216	212	200
		Vandergriff	91.01	295	306	271	276
		Washington	94.04	174	145	165	135
	4-6[5]	Belair	89.39	194	164	167	153
		Broadmoor	96.26	193	155	189	146
	K-3	Forrest Park	64.82	183	178	114	120
		Greenville	72.14	117	145	82	107
		Indiana	84.51	156	141	124	127
Pine Bluff	K-5	Lakeside	87.55	139	134	129	110
	4-6[4]	Oak Park	94.25	184	216	172	205
		Sam Taylor	90.56	106	74	90	73
	K-3	Southwood	89.09	141	134	124	121
	4-6[4]	Thirty Four	97.23	136	153	131	150
	K-3	Cheney	92.78	98	82	90	77
	1-5	Hillcrest	89.79	212	209	187	191
	K	Kindergarten	86.75	217	183	193	154
Jonesboro		Philadelphia	83.91	243	223	198	193
	1-5	South	86.16	226	222	201	185
		West	78.90	240	215	185	174

[5] We did not include 6th grade students in the study.

Table 2. Descriptive Statistics of Variables Investigated in the Study (N=13,051) (Source: ACHI, 2005; USDE/NCES, 2005; BLS, 2004, DOL/BLS, 2004; U.S. Census Bureau, 2000, 2005; GoogleMaps, 2007, YellowPages.com™, 2007)

Variable	Definition	Mean (Std. Dev.)
Overweight measure		
Overweight	% of students that are overweight or at risk of being overweight (latent variable)	36.67 (0.12)
School Demographics		
Male	% of male students per school	51.08 (3.31)
Female	% of female students per school	48.92 (3.31
Kindergarten	% of students that attend Kindergarten	18.70
Grade 1	% of sampled students that attend grade 1	17.16
Grade 2	% of sampled students that attend grade 2	17.05
Grade 3	% of sampled students that attend grade 3	15.76
Grade 4	% of sampled students that attend grade 4	15.63
Grade 5	% of sampled students that attend grade 5	15.70
Springdale	% of students enrolled in the Springdale school district	43.32
Fayetteville	% of students enrolled in the Fayetteville school district	22.00
Pine Bluff	% of students enrolled in the Pine Bluff school district	20.71
Jonesboro	% of students enrolled in the Jonesboro school district	14.07
White	% of White Non-Hispanic students per school	43.95 (31.56)
Black or African-American	% of Black or African-American students per school	37.51 (41.32)
Hispanic	% of Hispanic students per school	14.55 (18.43)
Asian	% of Asian students per school	3.55 (4.87)
Other race	% of American Indians or Alaskans per school	0.44 (0.61)
City Demographics		
Income	Income per capita in $1,000s	16.992 (1.6412)
Population	Population per square mile	1,129 (407.5)
Poverty	% of population below poverty level in 1999	18.8 (5.4)
Unemployment	% of unemployment in 2004	5.1 (2.0)
Food availability		
Free lunch	% of students enrolled in free lunch program	52.13 (21.64)
Reduced lunch	% of students enrolled in reduced lunch program	8.11 (2.71)
Grocery	Number of grocery stores per city	17 (2.65)
Convenience	Number of convenience stores per city	39 (3.77)
Fast food	Number of fast food restaurants per city	26 (10.11)

Table 3. Descriptive Statistics of Variables Used in the Logistic Regression Analysis (N=13,051) (Source: ACHI, 2005; USDE/NCES, 2005; BLS, 2004, DOL/BLS, 2004; U.S. Census Bureau, 2000, 2005; GoogleMaps, 2007, YellowPages.com™, 2007)

Variable		Mean	Std Dev	Minimum	Maximum
PFLP	% Eligible for free lunch program	0.47496	1.32262	0.05324	0.84069
PRLP	% Eligible for reduced lunch program	0.08437	0.16558	0.02496	0.12591
PAS	% Asian students	0.0451	0.32712	0	0.2575
PBL	% Black or African-American students	0.24882	2.16185	0.00148	0.99237
PHIS	% Hispanic students	0.18639	1.17571	0	0.74856
GSFFR	$\left(\frac{\text{Number of grocery stores}}{\text{Number of fast food restaurants}}\right)$	0.78659	1.60191	0.38462	1.13333
SEXF	Female student (Dummy variable)	0.48781	3.07433	0	1
TIPC	Income per capita in $1,000s	16.9292	7.57394	14.637	18.311
G1	1^{st} Grade (Dummy variable)	0.17158	2.31883	0	1
G2	2^{nd} Grade (Dummy variable)	0.17054	2.31321	0	1
G3	3^{rd} Grade (Dummy variable)	0.15759	2.24095	0	1
G4	4^{th} Grade (Dummy variable)	0.15625	2.23321	0	1
G5	5^{th} Grade (Dummy variable)	0.15705	2.23783	0	1

Table 4. SAS Proc Logistic MLEs of Coefficients of Model with Dependent Variable Overweight or Risk for Overweight in Elementary School-Aged Children

Parameter		Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq	Odds-Ratio Estimates: Point Estimate	Odds-Ratio Estimates: 95%Wald Confidence Intervals	
Intercept		9.5652	2.418	15.6486	<.0001			
PFLP	% Eligible for free lunch program	0.3804	0.2945	1.6677	0.1966	1.463	0.821	2.606
PRLP	% Eligible for reduced lunch program	3.3814	0.8361	16.3579	<.0001	29.413	5.713	151.423
PAS	% Asian students	-1.0431	0.4717	4.8905	0.027	0.352	0.14	0.888
PBL	% Black or African-American students	-0.7747	0.3152	6.0424	0.014	0.461	0.248	0.855
PHIS	% Hispanic students	0.7398	0.3557	4.327	0.0375	2.096	1.044	4.208
GSFFR	$\left(\frac{\text{Number of grocery stores}}{\text{Number of fast food restaurants}}\right)$	-1.8976	0.4327	19.2286	<.0001	0.15	0.064	0.35
SEXF	Female student (Dummy variable)	-0.1231	0.0366	11.2877	0.0008	0.884	0.823	0.95
IPC	Income per capita in $1,000s	-0.5401	0.1205	20.0996	<.0001	0.583	0.460	0.738
G1	1^{st} Grade (Dummy variable)	0.1768	0.0625	8.0118	0.0046	1.193	1.056	1.349
G2	2^{nd} Grade (Dummy variable)	0.2106	0.0624	11.3841	0.0007	1.234	1.092	1.395
G3	3^{rd} Grade (Dummy variable)	0.2708	0.0634	18.2224	<.0001	1.311	1.158	1.484
G4	4^{th} Grade (Dummy variable)	0.3245	0.0639	25.7972	<.0001	1.383	1.221	1.568
G5	5^{th} Grade (Dummy variable)	0.4014	0.0637	39.7252	<.0001	1.494	1.319	1.693

Note: Algorithm used was Newton-Raphson, Likelihood Ratio: 225.2303 ((Pr > χ^2)<0.0001), Score: 222.5975 ((Pr> χ^2)<0.0001)