Spring 5-5-2022

The Associations Between Overweight/Obesity Among Children and Select Social and Economic Predictors

Lauren A. Powell

THE ASSOCIATIONS BETWEEN OVERWEIGHT/OBESITY AMONG CHILDREN AND SELECTED SOCIAL AND ECONOMIC PREDICTORS

by
Lauren A. Powell
B.S., UNIVERSITY OF FLORIDA

A Capstone Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment
of the
Requirements for the Degree

MASTER OF PUBLIC HEALTH

Under the Direction of Ruiyan Luo, Ph.D. & Harry J Heiman, MD, MPH

ATLANTA, GEORGIA,
30303

APPROVAL PAGE

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by
Lauren A. Powell

Approved by:

Ruiyan Luo, Ph.D.
Committee Chair

Harry J Heiman, MD, MPH
Committee Member

June 7th, 2022

Acknowledgments

I would like to thank my committee chair Dr. Luo and committee member Dr. Heiman who provided me with persistent teaching and mentorship in the completion of this capstone. I would also like to recognize my aunt and uncle Ann-Marie and Chris for their constant love, direction, and advice. Most importantly I want to thank my parents, Michael and Jacqueline for their unwavering love, care, guidance, encouragement and support of my endeavors.

Author's Statement Page

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Lauren Asha Powell,

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CHAPTER I

INTRODUCTION

1.1. Background

The prevalence of childhood overweight and obesity in the United States has increased dramatically in recent decades, rising from 5 percent in 1978 to 18.5 percent in 2016 (Robert Wood Johnson Foundation, 2019). With the continuing epidemic of obesity among American children, agencies like the Centers for Disease Control and Prevention (CDC) are interested in interventions and policy approaches to both prevent and address this important public health issue.

Factors like community walkability, fast food exposure, and access to healthy foods are related to the social and economic status as well as the race and ethnicity of a family. Low income families often live in communities where these factors associated with childhood obesity are more concentrated. Processed, high-calorie foods that are high in sugar and unhealthy fats are more common in low-income areas and are often the only options that a poor family can afford (Cooksey-Stowers et al., 2017). Family economic status exists in a complex relationship with a number of other factors associated with childhood obesity, including race (as a reflection of structural racism) and geographic location.

Exploring the association between social and economic variables and childhood obesity will be helpful in informing interventions and policies aimed at reducing both racial and ethnic health disparities and those experienced by low-income populations.

1.2. Purpose of the study

The purpose of this study is to explore the association between certain social and economic factors and childhood obesity and overweight. Analyzing this relationship could help to shape more effective and targeted interventions for at-risk children. Thus, this study aims to assess:

- The prevalence of overweight/obesity among children based on social and economic status
- The odds of overweight/obesity among children based on specific predictors of youth overweight/obesity like race, income, fast-food exposure, and enrollment in free/reduced lunch programs

1.3. Research Questions

1. What is the prevalence of childhood overweight/obesity based on certain markers for social and economic status?
2. Do certain social and economic factors increase the odds of a child being overweight/obese?

CHAPTER II

REVIEW OF THE LITERATURE

This research paper will explore the associations between certain social and economic factors and overweight and obesity in children. Factors related to social and economic status like family income/poverty status, race, and enrollment in free/reduced lunch programs have been associated with these adverse outcomes.

2.1. Defining Overweight/Obesity in Children

Childhood obesity is a serious epidemic in the United States due to its profound effects on not only children and their families, but the future implications for society as a whole. One in three American children are either overweight or obese (Kumar, 2017). While the prevalence of overweight and obesity has remained about the same since 2008, this still equates to a tripling of the rate in the past three decades (Harvard School of Public Health, 2016). Obesity prevalence rates differ by age; rates are 13.4% among 2- to 5-year-olds, 20.3% among 6- to 11-year-olds, and 21.2% among 12- to 19-year-olds (Centers for Disease Control and Prevention, 2021). There are also significant differences in the prevalence of obesity among children of different racial and ethnic groups; prevalence is 25.6% among Hispanic children, 24.2% among non-Hispanic Black children, 16.1% among non-Hispanic White children, and 8.7% among non-Hispanic Asian children. Prevalence in low-income (18.9%) and middle-income (19.9%) groups were nearly double the rates of the highest income group (10.9%) (Centers for Disease Control and Prevention, 2021).

Overweight and obese children often continue to struggle with weight as they mature into adulthood, and are at increased risk for developing other comorbid diseases (Sahoo et al., 2015). These diseases that are increasingly common in children, like type 2 diabetes, sleep apnea, and high blood pressure, used to affect adults almost exclusively and are associated with increasing prevalence of obesity. What's worse, interventions rooted in diet improvement and exercise have had only limited effects on weight loss in children (Kumar, 2017). Bariatric surgery has been effective for children with most severe obesity but is backed by little long-term efficacy data. These outcomes both worsen the quality of life for affected children, and burden the taxpayer due to increased healthcare costs. Childhood obesity in the U.S. costs an estimated $14.3 billion per year (Hammon, 2010). Current rates of obesity all predict increased future costs, with estimated future costs of $45 billion as these children age into adults (Hammon, 2010).

In addition, there are marked psychosocial consequences associated with childhood obesity and overweight. A 2016 systematic review by Rankin et al. assessed 53 papers related to markers of psychological distress and disease. They found that children who were overweight or obese were significantly more likely to experience ADHD, anxiety, depression, lower self-esteem, and eating disorders (Rankin, et al., 2016). They also found that maladaptive behaviors and problems with peers increased with increasing weight, especially at young ages (4-5 years old). This is likely driven by increased bullying and stigma experienced by overweight and obese children. These outcomes related to performance and interpersonal relationships are especially troubling because of how important school performance and social involvement are for future success in school (Liu, et al., 2017).

Obesity is defined differently in children than in adults.

BMI Category – Children/Adolescents (BMDBMIC)--- was created for children and adolescents aged 2 to 19 years at examination. Cutoff criteria are based on the Centers for Disease Control and Prevention's (CDC) growth chart, "BMI-for-age charts, 2 to 20 years, by sex and age (NCHS, 2021)." Age in months at examination was used to match age in months from BMI growth chart data, separately for males and females. There are four categories: Underweight (BMI < 5th percentile), Normal weight (BMI 5th to < 85th percentiles), Overweight (BMI 85th to < 95th percentiles), Obese (BMI ≥ 95th percentile) (NCHS, 2021).

2.2. Race, Family Income, and Weight Status

Low household income is a significant risk factor for adverse weight outcomes (Min et al., 2018). When formulating interventions, focusing on economic status also targets other health disparities because of its association with other health outcomes. Family economic status exists in a complex context that is affected by race, and geographic location. Analyzing the effect of income on childhood obesity would help to craft interventions that also serve low-income racial minorities and residents of rural and urban locations.

The association between income and weight outcomes has been clearly defined. Children from poorer families are consistently at higher risk of being overweight or obese. A large 2019 meta-analysis of national survey data found that high- and middle-income children had 32% and 22% less risk of being obese compared to the lowest income children, and this difference was significant (Weaver et al., 2019).

A study by Eagle et al. (2012) assessed BMI data for over 100,000 children in Massachusetts. They found that as income decreased, behaviors related overweight/obesity increased. Neighborhood environments associated with lower income communities lead to differences in eating behaviors (consumption of fast food and sugary beverages), physical activity, screen time, and health literacy. Particularly troubling is that while the rate of childhood obesity has increased sharply for all American children in the past decades, the increase is two to three times greater for those in low income households, and racial/ethnic minorities are disproportionately represented in the nation's lowest income groups (Ogden et al., 2010).

According to data from the United States Census Bureau, Black and Hispanic households have disproportionately lower incomes compared to white households (United States Census Bureau, 2019). Rogers et al. conducted a study in 2015 assessing the relationship between overweight/obesity, race, and economic status. They included the interaction between income and race, noting that other studies had not done so. In a multivariate model including income, race, and an interaction variable between the two, they found that income had a strong predictive relationship with adverse weight outcomes in children ($p<.0001$). While overweight/obesity was higher among African American and Hispanic students, race and race*income were not significant in the model (Rogers et al., 2015). This finding indicates that income has a larger effect than race, but does not explore why racial and ethnic minority communities are over-represented among low-income populations.

The relationship between race and income is due to overarching societal factors. For example, individuals who do not graduate college also make lower incomes on average than graduates, and have worse disease prevalence rates (Williams et. al., 2019). Black and Hispanic individuals are also less likely to graduate college – but this is not due to any factors inherent to race; the socioeconomic context in which they live due to structural racism places them at increased risk.

Min et al. (2018) conducted a large longitudinal study using nationally representative data over an 8-year period. They examined overweight/obesity risk, differences in related health behaviors, and BMI trajectory. They included race and ethnicity, family dynamics and structure, mother's employment status, and an interaction factor between race and SES. They found that children in low SES households were more likely to be racial and ethnic minorities, be in single-parent homes, have parents with low levels of educational attainment, and have unemployed mothers (Min et al., 2018). This study was robust, including income factors and family dynamics in their research methodology. These studies were extremely effective in including race in their analysis. The prevalence of adverse health outcomes, including overweight and obesity, were consistently higher with lower family SES and increased steadily over time.

2.3 Neighborhood-Level Factors and Fast Food Consumption

Low-income families are more likely to live in environments featuring increased crime, compromised food quality, and poor infrastructure, neighborhood-level factors which have been associated with a higher odds of obesity (Lee et al., 2019). These neighborhoods are less walkable, reducing opportunities for physical activity and energy expenditure, contributing to increased risk for weight gain. These neighborhoods are also more likely to have a larger proportion of Black and Hispanic residents, which adds to racial and ethnic health disparities.

Neighborhood contexts can also translate into biologic stress, which can also contribute to a child's weight status (Theall et al., 2019). In a 2019 cross-sectional study, Theall et al.

looked at local crime and its relationship to stress as well as obesity in New Orleans neighborhoods. Children were matched based on their neighborhood violence levels as well as exposure to Hurricane Katrina, which brought in a unique perspective into disaster recovery and long-term health implications. Researchers found that for each crime in a child's neighborhood, BMI and cellular aging (a stress marker) increased (Theall et al., 2019).

More directly, low-income neighborhoods are likely to have barriers to access to healthy foods, and overexposure to unhealthy options. A 2017 meta-analysis that included 87 studies across 16 countries found that there is a positive relationship between fast food restaurant (FFR) exposure and consumption in children (Jia et al., 2019). The relationship between FFR and other weight-related behaviors and outcomes, however, is mixed. This analysis found that associations between FFR exposure and overweight/obesity, and behavioral indicators like dietary quality and eating frequency were unclear or insignificant. It may be difficult to flesh out a direct relationship between fast food and weight due to overlapping environmental and economic factors. For example, fast food restaurants are a defining feature of food swamps and are associated with food deserts (marked by poor access to fresh, healthy foods). A 2017 study by Cooksey-Stowers et al. found that food swamps, reflecting higher FFR exposure, were more predictive of obesity than food deserts (Cooksey-Stowers et al., 2017).

2.4 Free/Reduced Lunch and Weight Status

The free and reduced lunch program was introduced to improve childhood nutrition outcomes. Families are qualified based on yearly federal poverty guidelines (USDA, n.d.). School meal nutrition standards continue to improve, and are regularly evaluated (Food Research & Action Center, 2017). There has been much criticism of the state of school lunches in the United

States in general, especially concerning the most vulnerable children who do not have other options (Schanzenbach, 2009). This 2009 study by Schanzenbach used data from the Early Childhood Longitudinal Study – Kindergarten Cohort (ECLS-K), which followed children from kindergarten to eighth grade. It collected data about their obesity, overweight and underweight status and their school lunch participation status. They found that children who ate school lunches were more likely to become overweight/obese. They also found a more pronounced effect when these children were income-eligible for reduced-price lunches. That said, family income is clearly associated with reduced price lunch eligibility, which could play a role in risk.

On the other hand, according to the Food Research & Action Center (2017), free lunches actually reduce obesity and poor health outcomes. Obesity is reduced by an estimated 17% in children receiving the benefit. Further, a 2020 study by Kenney et al. tested whether improvements in school lunch with the 2010 Healthy, Hunger-Free Kids Act had an impact on childhood obesity. While they found no significant association, they found that obesity risk declined for children in poverty and would have been 47% higher without these improved school lunches (Kenney et al., 2020). These conflicting findings indicate a lack of consensus in the literature surrounding the impact of school lunches, likely because of how closely tied this program and income are.

CHAPTER III

METHODS AND PROCEDURES

3.1. Study design

Data for this research was obtained from the National Health and Nutrition Examination Survey (NHANES), a publicly available dataset. NHANES is a large survey, gathering data through interviews and physical examinations from a country-wide representative sample of 5000 people. Study questionnaires are done in individual homes and further exams are conducted in mobile examination trucks. The data are collected in a two-year cycle, and structured into five sections: demographics, dietary, examination, laboratory, and questionnaire files. Each of these sections includes several individual components, some of which will be used in this analysis. This analysis will evaluate the associations between certain social (race, gender, age) and economic (income, lunch program enrollment, fast food exposure) factors and childhood obesity using the 2017-2020 NHANES datasets (Centers for Disease Control and Prevention, 2022). Further information about the sampling plan and study protocol are available at the National Center for Health Statistics (NCHS) website (NCHS, 2021).

The Statistical Analysis System (SAS) software version 9.4 was used to analyze data.

3.2. Inclusion Criteria and Study Population

As stated previously, the study was restricted to child participants of the 2017-2020 NHANES. Only those aged 4-19 years old with values for the following variables: age, race/ethnicity, BMI category, lunch price, fast food consumption, and family income were eligible for this study.

Exclusion criteria included those who fell out of the specified age range of 4-19 or had missing values for any of the variables. From 2017-2020 NHANES data, 2,006 individuals met all the criteria and were included in the analysis.

3.3. Measures

The primary outcome for this capstone is the combined measure of overweight and obesity status in children. For overweight and obesity, the CDC BMI categories for children will be used: Underweight (BMI < 5th percentile), Normal weight (BMI 5th to < 85th percentiles), Overweight (BMI 85th to < 95th percentiles), Obese (BMI ≥ 95th percentile). For simplicity, I used 'obese/overweight' (BMI ≥ 85^{th} percentile) and 'not obese/overweight' (BMI < 85^{th} percentile) to create two categories in the analysis for weight status.

For annual family income, I used the NHANES family monthly poverty level index (INDFMMPI). The index is grouped into three categories (i.e., INDFMMPI ≤ 1.30, 1.30 < INDFMMPI ≤ 1.85, INDFMMPI >1.85). These categories represent commonly used percentages of the federal poverty level (FPL) (i.e., 130 percent FPL and 185 percent FPL), used by federal programs in determining eligibility. I coded these three levels as low-, middle-, and high-income categories.

Race and ethnicity were defined based on NHANES grouping: Mexican American, Other Hispanic, non-Hispanic white, non-Hispanic Black, and an 'other' race category, including multi-race. Sex groupings were male and female. For free/reduced lunch status, I used the NHANES groupings: Free price, Reduced price, Full price, Refused, Do not know. I only used reduced and full price in the analysis. For age, I used the following ranges: 4-9, 10-14, and 15-19 years. Fast food consumption ranged from 0-21 meals consumed in the past 7 days. I grouped this variable into no meals, 1-2 meals, and 3+ meals.

3.5. Statistical Analysis

Datasets were pulled from the publicly available NHANES data into SAS Studio, and merged by Respondent sequence number, creating one dataset that included all youth meeting all the inclusion criteria.

I compared sociodemographic characteristics for the descriptive statistics by obese/overweight status. Bivariate and multivariate logistic regression were conducted to determine the association between youth weight status and several risk factors. Multivariate logistic regression model includes race, family income to poverty ratio, gender, age, lunch price, fast-food consumption, the interaction between race and lunch price, and the interaction between race and fast-food consumption. Results are presented using both tables and figures. I considered p-values less than .05 as statistically significant.

CHAPTER IV

RESULTS

4.1. Demographic and Environmental Factors

The study sample consisted of 2,066 participants (822 overweight/obese children and 1,184 who were neither). The mean age of overweight/obese children was 11 (sd=3.6), the majority (81.2%) of whom were under the age of 15. The mean age of children who were not overweight/obese was 10.44 (sd=3.9), most (80.7%) of whom were under the age of 15.

The distribution of racial and ethnic makeup between the groups was significantly different (p=.0002), especially for Mexican and Other/Multirace groups. Mexican children represented 21.3% in the obese/overweight group compared to being only 13.6% in the group that was not overweight/obese. Other/multirace children, on the other hand, represented a smaller portion of the Overweight/Obese group (13.5%) relative to the group that was not overweight/obese (18.67%). Both groups included similar proportions of males and females.

The income breakdowns were similar between both groups (p=.0511). That said, it is important to note that the overall income variable skews relatively low compared to the general U.S. population, so in the larger context, NHANES participants are more likely to be low-income. About 70% of the sample was in the very lowest income bracket. This makes income less generalizable to the national population.

For lunch price, a larger proportion of the overweight/obese group received free lunch than the non-overweight/obese group (70.19% vs 65.29%). One the other end, students eating full price lunch were more represented in the non-obese group (27.45% vs 21.42%). For fast food consumption in past week, there was not a significant difference between groups, with the vast majority (about 88% in both groups) consuming less than 3. These descriptive statistics are shown in Table 1.

4.2. Analysis

The result of bivariate analysis is shown in Table 2. In studying the marginal association by logistic regression models, Black, Hispanic-Mexican, and Hispanic-Other have increased odds of overweight and obesity (OR=1.2, 1.8, and 1.3, respectively) compared to White. Among these, only the Mexican odds were found to be significant (CI= 1.339-2.436). Other/multirace on the other hand was associated with a decreased odds compared to Whites (OR= 0.7, 95% CI = 0.455 - 1.059), but this was also not significant. There was no difference in odds of overweight/obesity between females vs males (OR=0.921 CI= 0.748-1.133). There was no also no significant difference in overweight/obesity based on age.

Lowest and middle income were associated with 25% and 39% increased odds of overweight/obesity compared to the highest income group, respectively. However, these associations were not statistically significant.

Children in the free lunch price program had 53% increased odds of overweight/obesity compared to the reference group, full price (OR = 1.53, CI = 1.099 - 2.127) and this difference was significant. Children in the reduced lunch price program had 67% increased odds of overweight/obesity compared to the reference group, full price (OR = 1.67, CI = 1.018-2.729), and this association reached significance. Compared to no fast food meals in the last week, children eating 1-2 fast food meals had an increased odds of overweight/obese weight status of (OR = 1.342, CI =0.808 - 2.23). Children who ate 3 or more fast food meals in the last week also had an increased odds of overweight/obesity than those who ate 0 meals (OR = 1.806, CI =0.677-2.334). However, neither fast food association was statistically significant.

Initially, a multivariate model was fitted with the following predictors: age, sex, income, race, lunch status, fast-food exposure, income*lunch price, income*race, income*fast-food, race*lunch price, and race*fast-food exposure. The three interaction variables involving income (income*lunch price, income*race, income*fast-food) were insignificant. A likelihood ratio test was conducted to assess the difference between a model including them and a smaller one which did not. There was no significant difference between the larger and smaller model (p=0.14) so these three variables were removed in favor of the smaller model.

The final model included the following predictors: age, sex, income, race, lunch status, fast-food exposure, race*lunch price, and race*fast-food exposure. The result of multivariate analysis is shown in Table 3. Free and reduced lunch status was associated with a significant 68% and 140% increased odds of overweight or obesity for non-Hispanic white after controlling for all other predictors (OR=1.68, CI: 1.168-2.425; OR=2.4, CI: 1.199-4.823). When compared to the highest income group, neither low or middle income groups reached significance in the model. No significant associations between weight and predictors race, age, sex, or fast food were found after controlling for other predictors.

Due to the associations between race and lunch price, and race and fast-food exposure, two interaction variables were present in the final model (race*lunch price and race*fast-food exposure). Both reached significance, with race*lunch price having a p value of <.0001 and race*fast-food exposure also having a p-value of <.0001. More specifically, the effect of free lunch was significantly lower in Black than in white (beta(se) = -0.74(0.37)), and the effect of reduced lunch was significant lower in Other Hispanic than in white (beta(se) = -0.74(0.37)).. For race*fast food, the interaction between Other/Multirace and 3+ meals (beta(se) = 1.35 (0.59)) was significant, indicating a significant higher effect of 3+ meals for overweight/obesity in Other/Multirace than in White.

CHAPTER V

DISCUSSION

5.1. Discussion of Research Questions

As a result of the analysis, differences were observed between not obese/overweight and obese/overweight groups by the characteristics of interest, even though findings were not significant. This study shows that the associations between overweight/obesity and social and economic factors are difficult to pinpoint, and in this case, were mostly statistically insignificant. This does not necessarily mean that they were unimportant; they may be meaningful differences but did not reach significance due to other factors. For example, significant interactions between race and fast food consumption were found during multivariate analysis, even though fast food alone was not. Sometimes an analysis will simply not have the statistical power to say whether those differences observed were not due to chance alone.

This may be because there is a baseline difference between NHANES respondents and non-respondents. Based on the descriptive statistics, I hypothesized that NHANES participants may be, on average, less healthy and at a lower social and economic status. This is not a novel thought about this survey.

A 2020 CDC study by Fakhouri et al. detailed the impact that steadily decreasing response rates have had on the survey. They studied the 2017-2018 NHANES sample specifically, one of the years that was used for this capstone (Fakhouri et. Al., 2020). They found that NHANES respondents were lower income and less educated compared to a representative sample from previous cycles. While weighting adjustments were made and used in the analysis, it is possible that this baseline bias was still present. It is obvious that a more representative sample would have improved clarity into the environmental and social inequities that fuel childhood obesity.

5.2 Limitations

Due to the highly complex and closely woven relationships between the social and economic predictors evaluated in the study, it is difficult to reach statistically significant conclusions. Due to the cross-sectional nature of the study, it is not possible to draw conclusions about causation.

Missing data levels were high; for the weight variable alone, 68% of the participants were missing a value, and thus excluded. This reduced sample size made study results less representative of the NHANES study and the U.S. population in general. The income variable for this study was skewed heavily to the left due to NHANES groupings, with a disproportionate amount of data involving children with a low family income, even in those grouped in the 'highest income' category, making it difficult to differentiate outcomes between income strata. In contrast, income groupings in related studies better fit national data and results were more conclusive because of it. There may be other confounding variables that this study did not include, like other nutrition markers and family factors like health history and levels of educational attainment. For example, one study found that children with a parent who had only a high school diploma or less were 80% more likely to be overweight or obese compared with children of parents with higher education (Vinciguerra et al., 2019). It is also possible that the analytical plan was not appropriate for this kind of data, and more advanced analytical techniques were needed to provide the structural context to the research question, like multi-level modeling.

5.3. Conclusions and recommendations

Overall, the findings of this study showed that low-income children are more likely to be overweight/obese, and certain neighborhood-level risk factors are also associated with overweight/obesity, though the associations were not significant. In the absence of a truly experimental study, which is unethical, it is difficult to make conclusions about causation, and when certain factors are highly associated with each other, even correlation can be muddled. Participation in free/reduced price lunch requires low income levels to qualify, and fast-food consumption is also tied to the food choices a family can afford. There is a lack of consensus on the individual impact of each of these variables, a pattern found with other social and economic variables included both in this study and other research in the field.

Addressing risk factors disproportionately impacting families with lower socioeconomic status is crucial in the fight against childhood overweight and obesity. Current interventions mostly target individual behaviors, like increasing exercise for overweight children using step counters, or logging food to share with practitioners for weight loss. However, overweight and obesity in childhood are clearly contextual, associated with social and economic environments, and prevention is ideal, even as the intricacies are difficult to tease out.

This study reinforces the need for childhood interventions aimed at obesity and overweight to target these contextual factors. Since the predictors of childhood overweight and obesity are tightly intertwined, and often not well understood, this capstone can help to inform further research into this field. This study proposes bigger programs targeting health disparities at the neighborhood level, not at the child or family level.

Appendix A: Tables

Table 1. Summary Characteristics of Study Population

Participant Characteristics	Overweight/Obese (n=832)	Not Overweight/Obese (n=1184)	P-value
Socio-demographic characteristics			
Age, mean (SD) years	11 (3.6)	10.44 (3.9)	<.0001
Age, years n (%)			0.0288
4-9 years	302 (36.73)	545 (46.03)	
10-14 years	369 (43.68)	406 (34.3)	
15-19 years	161 (19.58)	233 (19.68)	
Sex, n (%)			0.9765
Male	409 (49.76)	635 (53.63)	
Female	413 (50.24)	549 (46.37)	
Race, n (%)			0.0002
Mexican American	175 (21.29)	161 (13.6)	
Other Hispanic	86 (10.46)	112 (9.46)	
White	221 (26.89)	335 (28.29)	
Black	229 (27.86)	355 (29.98)	
Other/Multirace	111 (13.5)	221 (18.67)	
Income, n (%)			0.0511
Low Income	393 (47.81)	549 (46.37)	
Middle Income	128 (15.57)	176 (14.86)	
High Income	263 (32)	427 (36.06)	
Lunch Cost Status, n (%)			0.0434
Free	577 (70.19)	773 (65.29)	
Reduced price	65 (7.91)	82 (6.93)	
Full price	176 (21.41)	325 (27.45)	
Number of Fast Food Meals in Last Week, n (%)			0.7334
0 meals	89 (8.36)	154(9.86)	
1-2 meals	636 (59.72)	897 (57.43)	
3+ meals	96 (9.01)	132 (8.45)	

***Refused/Didn't know responses removed from Income, Lunch Cost, and Fast food Meals in table**

Table 2: Bivariate analysis of overweight/obesity regressed on various social and economic factors

Predictive Factors	Odds Ratio	95% Confidence Interval
Age		
4-9 years vs 15-19 years	0.6	0.13-2.795
10-14 years vs 15-19 years	1.04	0.223-4.898
Sex		
Female vs Male	0.921	0.748-1.133
Race		
Mexican vs. non-Hispanic white	1.81	1.339 - 2.436
Other Hispanic vs. non-Hispanic white	1.26	0.751 - 2.099
Black vs. non-Hispanic white	1.21	0.888 - 1.643
Other/Multirace vs. non-Hispanic white	0.69	0.455 - 1.059
Income		
Low Income vs high income	1.25	0.978 - 1.588
Middle Income vs high income	1.39	1.036 - 1.869
Lunch Cost Status		
Free Lunch vs full-price lunch	1.53	1.099 - 2.127
Reduced Price vs full-price lunch	1.67	1.018 - 2.729
Number of Fast Food Meals in Last Week		
1-2 meals vs 0	1.34	0.808 - 2.230
3+ meals vs 0	1.26	0.677 – 2.334

Table 3: Multivariate model of overweight/obesity controlling for various social and economic factors

Predictive Factors	Odds Ratio	95% Confidence Interval	Beta (Standard Error)	P-value
Age				0.0801
4-9 years vs 15-19 years	1.03	0.996-1.065	0.0319 (0.0261)	
10-14 years vs 15-19 years	0.97	0.71-3.45	0.0295 (0.0169)	
Sex				0.649
Female vs Male	1.05	0.854-1.288	0.0478 (0.1049)	
Race				0.394
Mexican vs. non-Hispanic white	1.88	0.561-6.286	0.6299 (0.6165)	
Other Hispanic vs. non-Hispanic white	0.93	0.258-3.376	-0.0692 (0.656)	
Black vs. non-Hispanic white	1.17	0.251-5.4	0.1532 (0.7825)	
Other/Multirace vs. non-Hispanic white	0.77	0.32-1.867	-0.2577 (0.4501)	
Income				0.508
Low Income vs high income	0.920	0.757-1.136	-0.0753 (0.1036)	
Middle Income vs high income	1.100	0.772-1.568	0.0955 (0.1807)	
Lunch Cost Status				0.03699
Free Lunch vs full-price lunch	1.68	1.168-2.425	0.5206 (0.1863)	
Reduced Price vs full-price lunch	2.4	1.199-4.823	0.8773 (0.3552)	
Number of Fast Food Meals in Last Week				0.2092
1-2 vs 0	1.13	0.498-2.577	0.1245 (0.4194)	
More than 3 vs 0	0.64	0.241-1.7	-0.4462 (0.4985)	

Table 3: Multivariate model of overweight/obesity controlling for various social and economic factors, continued with interaction variables

Interaction Variable	Odds Ratio	95% Confidence Interval	Beta (Standard Error)	P-value
Race*Lunch Price				<.0001
Free Lunch*Mexican American	-	-	-0.2275 (0.3086)	0.4609
Free Lunch *Other Hispanic	-	-	-0.5688 (0.3496)	0.1037
Free Lunch *Black	-	-	-0.7358 (0.3705)	0.047
Free Lunch *Other/Multirace	-	-	-0.00813 (0.3672)	0.9823
Reduced Price*Mexican American	-	-	-0.8537 (0.6486)	0.1881
Reduced Price*Other Hispanic	-	-	-1.8068 (0.5826)	0.0019
Reduced Price*Black	-	-	0.015 (0.5527)	0.9784
Reduced Price*Other/Multirace	-	-	-0.5647 (0.756)	0.4551
Race*Fast Food				<.0001
Mexican American*1-2 meals	-	-	0.0144 (0.5469)	0.979
Mexican American*3+ meals	-	-	0.5075 (0.6966)	0.4663
Other Hispanic*1-2 meals	-	-	0.8461 (0.6287)	0.1784
Other Hispanic*3+ meals	-	-	0.5958 (0.7343)	0.4171
Black*1-2 meals	-	-	0.316 (0.5809)	0.5864
Black*3+ meals	-	-	1.1016 (0.7161)	0.124
Other/Multirace*1-2 meals	-	-	-0.3161 (0.5127)	0.5376
Other/Multirace*3+ meals	-	-	1.3523 (0.5913)	0.0222

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