**Childhood Obesity in the United States 1971-2016**

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**Abstract**

Childhood obesity has been a growing epidemic for the past five decades, bringing large amounts of concern for the physical and mental consequences of obesity in adolescence. Several studies seek to understand the reasons for the rise of obesity rates, and why different minority groups have higher obesity rates than others. The data set being investigated here involves the obesity rates in children starting in 1971, with the most recent results being reported for 2016, controlling for gender and race. It was collected from the *National Health and Nutrition Examination Survey* conducted by The National Center for Health Statistics. The surveys show that over the past 45 years, childhood obesity rates have tripled. Changes in dietary options, high levels of sugar, and less access to physical activity and sports all play a role in the health changes of American children. The obesity epidemic has hit Black and Hispanic children disproportionately, which highlights that change on a structural level needs to occur to help children of all races gain knowledge about healthy habits and have access to healthy food and a variety of easily available physical activity options. Examination of the data shows that the rise in obesity has been statistically significant and that it remains a growing problem.

*Keywords:* childhood obesity, racial disparities, schools and obesity

**Childhood Obesity in the United States 1971-2016**

Childhood obesity affects roughly 19% of children today and results in both physical and mental health struggles (Weinstock, 2017). The objective of examining data of obesity rates is to analyze how the childhood obesity rate is a growing problem and examine how the rates of obesity are different based on sex and race. It is important to know how obesity rates are changing over time to determine if solutions are having an effect, or if the problem continues to grow. The data is intended to track the rates of obesity in children over time, looking at differences in sex as well as race. This information can be used to see how obesity rates have changed over time and what sexes and races are higher risk groups for obesity. Additionally, it can be used to support investigations into different historical changes in children’s environments, such as school environment changes and how children spend their free time, which may result in weight differences. Childhood obesity can lead to a variety of negative physical and mental health struggles, which are likely to continue into adulthood, so it is vitally important to encourage healthy eating and movement programs for children (Weinstock, 2017).

The *National Health and Nutrition Examination* surveys show the percentage of children who were obese in America from 1971 through 2016, taken from a sample of approximately 5,000 completed annual surveys issued out randomly among the United States population. The surveys gather information about demographics of the survey group as well as health and nutrition information to help track health trends throughout the United States (US). The survey has changed over time, gathering more relevant data as newer versions of it have been created. In early stages of the survey, prior to 2011, they did not specifically track Asian as a racial option. There were also gaps from 1981-1987 and 1995-1998 where surveys were not conducted, and the surveys went over longer periods of time from 1971-1974, 1976-1980, and 1988-1994. Starting in 1999, the survey methods became more standardized and consistent. The Division of Health and Nutrition Surveys within the United States Center for Disease control (CDC) conducts the surveys and combines interviews, physical examinations, and laboratory test results into publicly available data (The National Center for Health Statistics, 1971-2018). The specific data being examined is a subset of the total surveys, focusing on children aged 2-19 and obesity rates.

*Obesity, High-Calorie Food Intake, and Academic Achievement Trends Among U.S. School Children* examined data, focusing on the *National Health and Nutrition Examination Survey* from 1976-1980 and 2003-2006, to determine how obesity rates have changed over time for children. The article cites that obesity rates nearly tripled according to the studies (Li & O’Connell, 2012). The authors examine possible causes and the effects of childhood obesity on educational achievement. They established that children who frequently consumed fast food had lower mathematical and reading scores, but that soda consumption did not significantly affect academic achievement. Being overweight without other risk factors also did not negatively impact academic achievement. This study demonstrated that there is a significant difference in obesity rate and that some parts of diet have a correlation to academic performance.

One of the potential causes of obesity rates increasing for children was examined by Anderson and Butcher. They claim that “observers have begun to question the role played by schools, pointing in particular to declines in physical education and increases in the availability of soft drinks and snack foods” (2006). The article goes on to look at the profitability of vending machines in schools, which leads to schools introducing more unhealthy snacks into the school environment. Additionally, the increased pressure of schools to produce adequate test results may be causing electives to be cut in favor of focus on standardized tests. The study found that in schools that made junk food available, there is an increase in the body mass index (BMI) for students, particularly if the student had an overweight parent (Anderson & Butcher, 2006). This research showed that schools do have a level of culpability for increasing the BMI of their students by providing unhealthy food options and limiting elective choices, including physical education.

**Limitations and strengths**

The key limitation to the analysis is that this was not performed as a time-series analysis. The survey has also changed over time. The data prior to 1999 is less complete but is important in providing insight over time. The accuracy of the data must be considered, with new technologies and ability to record and save data existing on a more accurate and comprehensive scale in the more recent surveys. Information on race had fewer options prior to 2011, so the data is categorized differently before and after 2011, with some data potentially being excluded. There is also a factor of a sample size of around 5,000 children every two years, which compared to the larger population may not provide an accurate sample of different ethnicities and locations, which may affect results. The sample population is randomized and is a significant size but could still have skewed results depending on the sample size characteristics. The data of BMI and obesity rates based on BMI is standardized over the study, so it allows a strong comparison of data between the 1970’s and present day, which is valuable in demonstrating how the rates have changed. Having demographic data helps to highlight that the greatest contributors to childhood obesity are not variables such as sex, but variables such as race and changes once children enter school. This highlights areas where change needs to be made to make the most impact on children’s health.

**Method**

**Procedure**

The obesity rate data is based on the percentage of obese children in each year, separated by sex, age groups, and race. Graphs were created in Microsoft Excel to highlight the differences in obesity rates in the different categorical groups over time increments of two years. During years that the data was not collected, it has been left blank. The average obesity rate was calculated for each variable over the time frame studied as well as the standard deviation to highlight how much the obesity rate has varied over time, with a higher standard of deviation showing a higher variability.

**Variables**

Shown in (1), obesity rates are affected by variables including race, age, and sex.

*Obesity (Y|N)*

(1)

where Obesity is the variable of interest;

ɛ is the error factor associated with each regression coefficient.

The variable that provides the largest differences of results for childhood obesity rates is race. The four categories for race are Black, Hispanic, White, and Asian. There are many reasons why race takes on such a large role in obesity rates, and Davis goes into detail about the different causes in *Racial Disparities in Childhood Obesity: Causes, Consequences, and Solutions*. The three main categories are outlined as school-based causes, neighborhood-based causes, and family-based causes (Davis, 2011). School-based causes include the National School Lunch Program, which is accessed by Black and Hispanic children more than White and Asian students. “A government study found that eighty-five percent of elementary schools and eighty-seven percent of secondary schools exceeded the requirements for saturated fat” (Davis, 2011, p. 324). The lunches being provided to the low-income students who rely on them the most are not balanced meals. Anderson and Butcher cite the rise of vending machines in schools as an additional source of building unhealthy eating habits, referencing that schools that are lower income can use the income from these treats to supplement their budget (2006). In addition to unhealthy food options, schools have decreased their requirements for physical education. “One study found that schools with a high minority population reported offering significantly fewer minutes of P.E. class per week as compared to schools with a high white population” (Davis, 2011, p. 326). In addition to the lack of healthy options at school, “Food availability varies greatly between neighborhoods along both socioeconomic and racial lines” (Davis, 2011, p. 328). Minority children generally have more media exposure than White children, which means more access to advertisements (Davis, 2011, p. 329). Children are a very vulnerable group for advertising, and they are a group that is targeted by marketers because of it. Many advertisements for children are for food or candy, so viewing more of these is likely to influence children to want the food or candy being advertised. There are many reasons why race is affecting obesity rates, leading unhealthy consumption habits to be learned and reinforced in Black and Hispanic children as they grow at a much higher rate than White or Asian children.

The second variable is age, which has three categories: Age 2-5, Age 6-11, and Age 12-19. The largest jump in obesity rate is between the age 2 to 5 category and the age 6 to 11 category. There are a few differences between the two categories—young children may be naturally more active and pickier compared to older kids. For children entering elementary school around age 5-6, their days are often scheduled to include more time being sedentary. Pressure on schools to have higher test scores means kids are sitting and studying instead of having recess and physical education (Anderson & Butcher, 2006). The food offered in school is also referenced when looking at the differences in obesity rate between different races and is a factor for the rising rate of obesity in school children overall. In older children, the ability to buy snacks from vending machines and the lack of any break times such as recess to be outside could also contribute to the building of habits that lead to obesity. As children get older, parents may take less of a role in helping them making decisions. “Research has confirmed that parental oversight of consumption habits can decrease a child’s likelihood of becoming overweight or obese” (Allen, 2011, p. 329). As children make their own choices about what to consume, they can be susceptible to their environment, particularly if they do not have parental guidance.

The last factor examined is sex, which has a less impactful difference on the rates of childhood obesity, but still provides meaningful information, particularly when it is evaluated at in combination with adult obesity rates by sex. One key difference is in activity levels. “Overweight boys were significantly less active than those who were non-overweight. However, no significant differences were found between overweight and non-overweight girls” (Sharma & Ickes, 2008, p. 42). Boys and girls may have similar rates of obesity as children, but they are impacted by different factors. The higher rates for obesity in boys can be associated partially with the lower amounts of exercise being offered to children in schools. Boys who struggled socially were more likely to be less active and overweight (Sharma & Ickes, 2008). For girls, there is a correlation between socioeconomic status and obesity, which is more pronounced in minorities (Hiatt et al., 2007). Although the rates are not drastically different between boys and girls with obesity, it is important to examine in order to understand that different environmental factors may be impacting boys and girls in different ways.

**Results**

**Characteristics of Table 1**

In Table 1, the characteristics of the sample population of 5,386 children age 2-19 from the 2015-2016 *National Health and Nutrition Examination* survey are shown by race.

**Table 1**

*Characteristics of 5,386 Survey Respondents by Classification*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Population N (%)**  **(N=5386)** | **Race: Black n (%) (n=1211)** | **Race: Hispanic n (%)**  **(n=1837)** | **Race: White**  **n (%)**  **(n=1745)** | **Race: Asian**  **n (%)**  **(n=593)** | ***p* value** |
| Sex  Male (1)  Female (2) | 2,741 (50.9%)  2645 (49.1%) | 609 (50.3%)  602 (49.7%) | 934 (50.8%)  903 (49.2%) | 891 (51.1%)  854 (48.9%) | 307 (51.8%)  286 (48.2%) | <.0001 |
| Age  Age 2-5 (1)  Age 6-11 (2)  Age 12-19 (3) | 1,161 (21.6%)  1,803 (33.5%)  2,422 (44.9%) | 261 (21.6%)  401 (33.1%)  549 (45.3%) | 423 (23.0%)  636 (34.6%)  778 (42.4%) | 350 (20.1%)  569 (32.6%)  826 (47.3%) | 127 (21.4%)  197 (33.2%)  269 (45.4%) | <.0001 |

The sample is distributed with 1,211 Black, 1,837 Hispanic, 1,745 White, and 593 Asian respondents. The distribution of male and female respondents does not vary from the population by a large margin, with the largest difference in Asian respondents with 51.8% male and 48.2% female compared with the population distribution of 50.9% male and 49.1% female. The variable of Age has more variation across Race. The sample population has 21.6% age 2-5, with the Hispanic respondents having a proportionately higher number of respondents of Age 2-5 (23.0%) than the population and White respondents having a lower distribution (20.1%). Similarly, there is a higher distribution of age 6-11 with more Hispanic respondents (34.6%) than White respondents (32.6%) as compared to the population (33.5%). This trend reverses in the Age 12-19 group, with Hispanic respondents having a lower proportion at 42.4% vs. White respondents at 47.3% (and the population at 44.9%). The Asian and Black respondents are close to the population distribution for all Ages. A statistically significant association exists between these variables and race at an α level of .05 (*p* <.0001).

**Regression Analysis**

In order to decide if obesity rates have changed over time, one can examine the null hypothesis of (there is no change over time in obesity rates) while , with the alternative hypothesis being that there is a change in obesity rates over time. Figure 1 is a visual representation of the obesity rate in children (y%) plotted in relation to the number of years since 1971 (x), when the surveys began.

**Figure 1**

*Childhood Obesity Rates*

The table for the ANOVA for simple linear regression is below in Table 2, examining how the overall childhood obesity rate has changed over time, based on x being the number of years since 1971 when the studies began, and y being the childhood obesity rate (%).

**Table 2**

*ANOVA Table for Simple Linear Regression of Childhood Obesity Rate 1971-2016*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source of Variation** | **df** | **Sum of Squares** | **Mean Square** | ***f*** |
| Regression | 1 | 226.07 | 226.07 | 273.69 |
| Error | 10 | 8.26 | 0.83 |  |
| Total | 11 | 234.33 |  |  |

The *f*-value of 273.69 would yield a *p*-value of approximately 0, so it would be rejected at any level of significance, meaning that we would reject the null hypothesis that the obesity rate is unchanged and accept that . The equation for the linear regression model is shown in (2).

(2)

The equation (2) describes a positive correlation between years since 1971 and the obesity rate in children with . The coefficient of determination for this model is , so 96.47% of the variation in obesity rate over time would be represented in the linear regression model, making the model a very accurate fit for the data.

**Comparing Variables**

The overall childhood obesity rate from 1971-2016 is shown in Figure 2.

**Figure 2**

*Percentage of Childhood Obesity 1971-2016*

*Note.* Data from *National Health and Nutrition Examination Survey* (The National Center for Health Statistics, 1971-2018)

The average percentage of obese children is 11.9% with a standard deviation of 5.0. Having such a large standard deviation shows that there has been a large variance in the obesity rate over the 45 years being studied. The first and last values of 5.2% in 1971-1974 and 18.5% in 2015-2016 show a rise of 13.3% for the overall obesity rate. The rate has more than tripled.

When looking at sex as a factor in obesity rate in children, Figure 3 shows that there is a small difference in obesity rates in boys and girls.

**Figure 3**

*Percentage of Childhood Obesity by Sex 1971-2016*

*Note.* Data from *National Health and Nutrition Examination Survey* (The National Center for Health Statistics, 1971-2018). This maximum vertical axis of this graph is 25% for viewing purposes.

Rates for boys are slightly higher with an average of 12.3% vs girls at 11.6%. The standard deviation is similar as well, with boys having slightly more variation in the data with σ=5.3 and σ=4.7 for girls. The overall difference in obesity rate for boys is 13.8% and 12.7% for girls.

Looking deeper into the obesity rates for girls and boys, Figures 4 and 5 examine the obesity rates in girls and boys age 2-5, 6-11, and 12-19.

**Figure 4**

*Female Obesity Rates by Age Group*

*Note.* Data from *National Health and Nutrition Examination Survey* (The National Center for Health Statistics, 1971-2018). This maximum vertical axis of this graph is 25% for viewing purposes.

**Figure 5**

*Male Obesity Rates by Age Group*

*Note.* Data from *National Health and Nutrition Examination Survey* (The National Center for Health Statistics, 1971-2018). This maximum vertical axis of this graph is 25% for viewing purposes.

The average rate of obesity in children 2-5 is 8.6% with σ=2.7. In children age 6-11 the average is 12.0% with σ=5. For the oldest group, children ages 12-19, the average is 12.7% with σ=5.8. This information shows that the rates for obesity are higher in school-age children, with larger increases over time. The same breakdown of age groups for boys is shown in Figure 5. The rates for boys are very similar. Boys age 2-5 have an average of 8.3% vs. 8.6% for girls with σ=3.5 and σ=2.7 for girls. There is a similar jump for ages 6-11 and 12-19 compared to the younger group for boys, with the average for ages 6-11 being 13.4% and for ages 12-19 being 13.3%. Compared to the rates for girls, they are slightly higher.

The largest differences in obesity rates in children are shown in Figure 7, Obesity Rates in Children by Race from 1999-2016.

**Figure 6**

*Obesity Rates in Children by Race 1999-2016*

*Note.* Data from *National Health and Nutrition Examination Survey* (The National Center for Health Statistics, 1971-2018). This maximum vertical axis of this graph is 25% for viewing purposes. Data for race was not recorded prior to 1999 and obesity rate in Asian children was not available prior to 2011.

The average rate of obesity in Black children is 20.3%, which is similar to the rate of obesity in Hispanic children of 21.3%. Comparatively, White children have an average obesity rate of 14.2% and the average for Asian children is 9.4%. The data that includes information on race was not available prior to the 1999 surveys, so the variance is much lower than when there is data for the full 45 years. Regardless, the data is still powerful in showing that there is a component of obesity rates that leads to more Hispanic and Black children being obese.

When examining the outcomes of childhood obesity, it is important to observe how obesity rates continue into adulthood. The data in Figure 6: Obesity Rate in Children vs. Adults, by Sex 1987-2018 shows that adult obesity rates are double those of children.

**Figure 7**

*Obesity Rate in Children vs. Adults, by Sex 1987-2018*

*Note.* Data from *National Health and Nutrition Examination Survey* (The National Center for Health Statistics, 1971-2018). Data for adults is not available prior to 1987, so data and averages are based on the 1987-2018 data. This maximum vertical axis of this graph is 50% for viewing purposes.

Interestingly, in children the male obesity rate is higher, while in adulthood, the female obesity rate is higher. This may be changing, as the adult male obesity rate is higher than the adult female obesity rate. The obesity rate for men is still lower at 29.8% vs 33.4%, but men have a higher standard of deviation at σ=7.4 and women σ=5.9, showing that the rate has risen at a higher rate. The rate has risen 22.8% in men and 16.5% in women since 1987. The data begins in 1987 for adults and since 1987 the rates in children and adults have doubled.

**Discussion**

**Conclusion**

It is undeniable that obesity rates have increased at a rapid rate for children and adults alike. The *National Health and Nutrition Examination Survey* provides data demonstrating the rise in childhood obesity from 5.2% in 1971 to 18.5% in 2016. “Today’s children are growing up in an environment filled with fast food, sugary beverages, heavily processed food, a barrage of advertisements, a paucity of opportunities for exercise, and media images of impossible slimness and muscularity” (Hiatt et al., 2007). Children are exposed to many unhealthy dietary and lifestyle options without education about the long-term consequences and are often preyed upon by companies seeking to sell products to a vulnerable population. The higher rates for obesity in boys can be associated partially with the lower amounts of exercise being offered to children in schools. Boys who struggled socially were more likely to be less active and overweight (Sharma & Ickes, 2008). Socioeconomic factors are a larger factor for girls than for boys, especially among minorities (Hiatt et al., 2007).

Table 2 shows that the high value of the test statistic (*f =* 273.69) would yield a *p*-value of approximately 0. At any level of significance, the null hypothesis of is rejected, meaning that there is a statistically significant amount of change in the obesity rate in children over time. This was demonstrated in the simple linear regression model (2), with 96.47% of the variation in the data explained by the model. Based on the model, obesity rates will likely continue to rise unless there are changes to combat the current trends.

The children affected most by these trends are minority children. Being Black or Hispanic means a child has a higher likelihood of being obese. The factors that cause obesity are tied strongly to minority status and any solutions need to be particularly impactful for those groups. Focusing on healthy options at school and home as well as limiting advertisements that target children can make great impacts in children’s health. Substantial change needs to begin from a young age, particularly when kids are starting school and obesity rates start rising. Combatting obesity can mean improved school performance and self-esteem as well as much lower risks of serious health issues such as diabetes and heart disease and other health issues that have been on the rise. As awareness rises, hopefully education and structural change within schools and homes will as well, resulting in a healthier future for our youth regardless of minority status.

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