**Data Activity: Educator Materials**

**Title**

Obesity - An Epidemic with Unexpected Causes, Consequences, and Complexity

**Overview**

In this activity, students will explore the interaction of obesity and socioeconomic status. The background reading material will demonstrate that obesity is a complex disease with several contributing factors and no easy solution. Further, students will be introduced to the idea that obesity is a disease that leads to numerous other diseases. Students will populate data tables with figures from a curated version of the CDC’s Nutrition, Physical Activity, and Obesity - Behavioral Risk Factor Surveillance System dataset. From these data tables, students will generate graphs to visualize the relationships between education level/income level/race-ethnicity and obesity for a single US state of their choosing. Students will use their graphs to answer questions and will share their results with two or more students to compare patterns among states. Students can then engage in a classwide discussion to consider why levels of obesity are variable among states and how socioeconomic status correlates with obesity. This could lead to an advanced project/activity where students investigate policy efforts in different states to determine if those efforts have assisted with reducing obesity levels. There is a dataset with this policy information available for all U.S. states from 2001 - 2017 at this site:

<https://chronicdata.cdc.gov/Nutrition-Physical-Activity-and-Obesity/CDC-Nutrition-Physical-Activity-and-Obesity-Legisl/nxst-x9p4>

**Key Concepts**

* Obesity can lead to comorbid diseases including cardiovascular diseases (heart disease, high blood pressure, stroke, etc.), cancer (breast, colon, liver, etc.), respiratory diseases (asthma, pulmonary embolism, etc.), and type II diabetes mellitus.
* Obesity is a complex disease with at least four contributing factors: dietary intake, physical activity levels, genetics, environmental factors (socioeconomic status and others).
* Obesity is especially common in low-income communities that have limited access to fresh and high quality foods (food deserts) or have an abundance of fast food and convenience food options in lieu of healthy alternatives (food swamps).

**Student Learning Targets**

* Students should be able to list different factors that contribute to obesity.
* Students should be able to define BMI and discuss the limitations associated with this measure of health and obesity.
* Students should be able to define comorbidities, list comorbidities associated with obesity, and find datasets that provide data relating comorbidities and obesity.
* Students should be able to define food desert & food swamp and explain why food swamp is likely a more accurate representation of the reality faced by individuals in lower SES groups.
* Students should be able to create a data table, and graph the information in the table, to demonstrate the relationship between various metrics of socioeconomic status and obesity.
* Students should be able to note patterns that emerge in their, as well as other students’ data, when comparing graphs between states.

**Prior Knowledge**

Before beginning this activity it is anticipated that students would recognize obesity as an

unhealthy condition that can lead to further health challenges. It is anticipated that

students will assume obesity is primarily caused by choices, such as poor diet and lack of physical activity, and therefore that obesity is under one’s immediate control. A consideration of

socioeconomic status and food environment, in relation to obesity, will be used to demonstrate the complexity of the obesity problem and that often obesity is out of one’s immediate control. Finally, students will be expected to have a basic understanding of descriptive statistics & sample size, have basic skills in google sheets, and basic skills in graphing and interpreting data when considering trends in data over time. Example data charts, graphs, and instructional video links (for sorting and graphing in Google Sheets) are included in the provided materials.

**Background**

Obesity is a challenging medical condition that can lead to numerous other conditions called comorbidities. A number of factors may contribute to the development of obesity, including diet & physical activity levels, genetics, and environmental factors (socioeconomic status as well as exposure to endocrine-disrupting chemicals). Obesity is studied in an effort to provide a better quality of life for obese individuals by preventing the development of comorbid diseases that further challenge the healthcare and life quality of the individual.

**Teaching Tips**

* Consider having students watch *The Obesity Epidemic*:(<https://www.youtube.com/watch?v=vCORDl4bqDE&feature=youtu.be>; 7:13, CDC background segment on obesity) prior to completing the background reading and activity.
* This activity relies on the use of internet searches and use of the Google DRIVE suite. Computers with internet access will be required.
* Students can either work independently or in small groups of 2-3 students. Eventually the students will share their results with other students or groups to evaluate multiple graphs and attempt to discern patterns.
* This activity requires students to sort data in a large dataset, to extract relevant information for placement into a data table, and to graph the information from the data table.
* Background reading should be completed prior to attempting the graphing exercises. A short classwide conversation related to the background reading could highlight multiple points (below) and should plant the idea in students’ minds that obesity is not always related to lifestyle decisions or under one’s immediate control.
  + obesity is a complex disease
  + obesity can lead to other diseases
  + obesity is related to socioeconomic status
* Working in small groups may facilitate movement through the activity if students have varying levels of experience and comfort with navigating a dataset and or graphing data.
* Concepts to reinforce:
  + Prior to this activity, students will likely assume that diet and exercise are the sole contributing factors to the development of obesity. Evaluation of the dataset should reveal that socioeconomic status is correlated with obesity. During small group or class-wide discussions it should be noted that low socioeconomic status is not an obvious choice and therefore the development of obesity is often beyond one’s immediate control.
  + Additionally, students may incorrectly assume that obese individuals have made poor decisions regarding their own health choices or that they are not ‘trying’ to control their weight. With the short introduction to food deserts and food swamps they may begin to see the reality that other individuals face.
* The CDC has multiple datasets that focus on obesity. One in particular examines policy efforts to help control obesity through systemic changes meant to educate individuals on food quality and food choices. Evaluation of this dataset with a consideration of when legislative policy was passed (or failed to pass) would provide an extension activity to overlay on top of the obesity dataset utilized in this activity. The years do not align perfectly; However, the policy dataset could be curated to have overlap with the current dataset from 2011 - 2017.

**Answer Key**

**Activity 1 - Understanding Obesity (7 questions):**

Use the Center for Disease Control and Prevention’s resources on obesity to learn how obesity is defined and categorized.

<https://www.cdc.gov/obesity/adult/defining.html>

Based on the CDC website answer the following questions:

1. What two factors are used to determine Body Mass Index (BMI)?

* + Body weight in kilograms
  + Height in meters
  + BMI is therefore: kg/m2

2. What are the limitations of using BMI to predict obesity in various groups? Why do you envision BMI is used despite the known shortcomings?

* + BMI has two major limitations:
    1. BMI does not differentiate between fat and muscle. Therefore, individuals with high levels of muscle mass, such as certain athletes, can be classified as overweight or obese based solely on BMI measurements.
    2. BMI was originally developed using data from white males and is therefore less applicable to studies involving females or non-white males.
  + Though the use of BMI has limitations it should be noted that BMI is generally considered as one data point among many. For example, what is the individual's level of muscle mass (i.e. athletes)? Have there been changes in weight over time? Is there a family history of excess weight or obesity?

3. BMI measurements are an indirect measure of body fat. Write a statement about why BMI is considered useful even though it does not directly measure fat.

* + Variable responses expected. Answer should include statements about BMI being used as a screening tool and that BMI correlates well with adverse health outcomes that are predicted with more direct measures of body fat level.

4. What categories do BMI values place an individual into?

* + BMI of less than 18.5 = underweight range
  + BMI of 18.5 to < 25 = within the normal range
  + BMI of 25.0 to < 30 = within the overweight range
  + BMI of > 30.0 or higher = within the obese range; note that obesity can be further subdivided in three classes. The highest class is class 3, severe or extreme obesity.

5. Follow the link provided on the resource website to the *Adult Obesity Causes and Consequences* site (panel at top left).

* + List three contributing factors to obesity that an individual may have control over:
    1. Physical activity
    2. Diet
    3. Medication use
  + Next list three contributing factors to obesity that an individual likely does not have control over:
    1. Quality or amount of education
    2. Food marketing
    3. Diet
  + Do contributing factors in your lists overlap?
    1. This will depend on what items students have added to their lists. However, diet or related issues may be present in both.
  + Compare your responses with another student and discuss why the factors that contribute to obesity make it particularly challenging to manage.
    1. Students should recognize that medication and food marketing or promotion are challenging issues that can work against people as they attempt to manage their weight, make healthy choices, etc.

6. Recall the comorbidities that are linked to obesity. Use the Google DataSet search tool (<https://datasetsearch.research.google.com/>) to find databases related to one of the comorbidities and obesity.

* + Are there few or many databases for comorbidities and obesity?
    1. For each of the comorbidities and obesity there are 100+ datasets available for review.
  + Are there government databases, such as the CDC or NIH (National Institutes of Health), for comorbidities and obesity?
    1. Yes, also datasets are available from international sources and scientific journals.

7. At the bottom of the *Adult Obesity Causes and Consequences* site review the information related to economic, societal and military implications provided. Based on this information:

* + What challenges, related to obesity, do you envision we might face as a country during your lifetime?
    1. Obesity can have an economic impact on health care
    2. Diagnostic and treatment services as well as increased sickness, lost productivity, disability and premature death contribute to this economic impact.
  + Does this information surprise you?
    1. Variable responses. Students will likely be surprised that an individual’s poor health status can have such far reaching implications on the economy.

**Activity 2 - Sorting the data (14 steps/questions)**

There are numerous data sets available from the CDC. You will be working with a specific dataset that provides information related to obesity and characteristics such as education level, income level, and race/ethnicity. This dataset is based on telephone interviews where individuals respond to a scripted set of questions. Although this data set was built from responses to numerous questions, the data you will be considering relates to one specific area, ‘Percent of adults aged 18 years and older who have obesity.’

Data are provided for all U.S. states for the years 2011 and 2018.

**Directions for sorting and organizing the Nutrition, Physical Activity, and Obesity - Behavioral Risk Factor Surveillance System Dataset**

**Follow the steps below to obtain the dataset and place it in your Google DRIVE:**

1. Download the curated dataset from the HHMI website.

2. Save the curated dataset to the Google DRIVE and open the file using Google SHEETS.

**Follow this link (**[**https://www.youtube.com/watch?v=QoZnJQLEywo&t=216s**](https://www.youtube.com/watch?v=QoZnJQLEywo&t=216s)**) to learn how to sort the dataset. Next, complete the following tasks:**

3. Open the dataset and Insert a new tab by clicking on the plus sign at the bottom left.

4. Rename your new tab by double clicking on the tab name and inserting your state name

5. Go back to the initial tab, given below, and scroll to locate your state data. (Nutrition\_\_Physical\_Activity\_\_and\_Obesity\_-\_Behavioral\_Risk\_Factor\_Surveillance\_System)

6. Highlight all rows that include your state’s data; for most states this will be ~56 rows (28 for the 2011 data and 28 for the 2018 data).

7. Copy the data from 2011 to 2018 for your state of choice (ctrl - C) and paste the data into your tab by clicking in cell A1 and hitting ‘ctrl-V’

8. Evaluate your data and note that it is not organized beyond the second column which designates year.

9. Highlight the first row in your tab and right click to choose ‘insert 1 above.’ This will insert a row above your state’s data.

10. Go back to the initial tab and copy the first row by highlighting it and hitting ctrl - C. Next, paste the column labels in your tab’s row 1 by highlighting the row and hitting ctrl-V.

11. Below your final row, in ~row 58, highlight the row and fill with a color using the inkwell tool. This serves as a visual separation between the unsorted data (above) and the sorted data that will be generated (below) the colored row.

12. In the first cell below your colored row, A59 in this example, type in a formula to sort by column 1. Does your data look different when comparing to the unsorted data above the colored row?

13. Add more sorting commands to your formula so that the data are sorted by rows 1, 7, 8, 9, 10, and 11. Does your data look different when comparing to the unsorted data above the colored row?

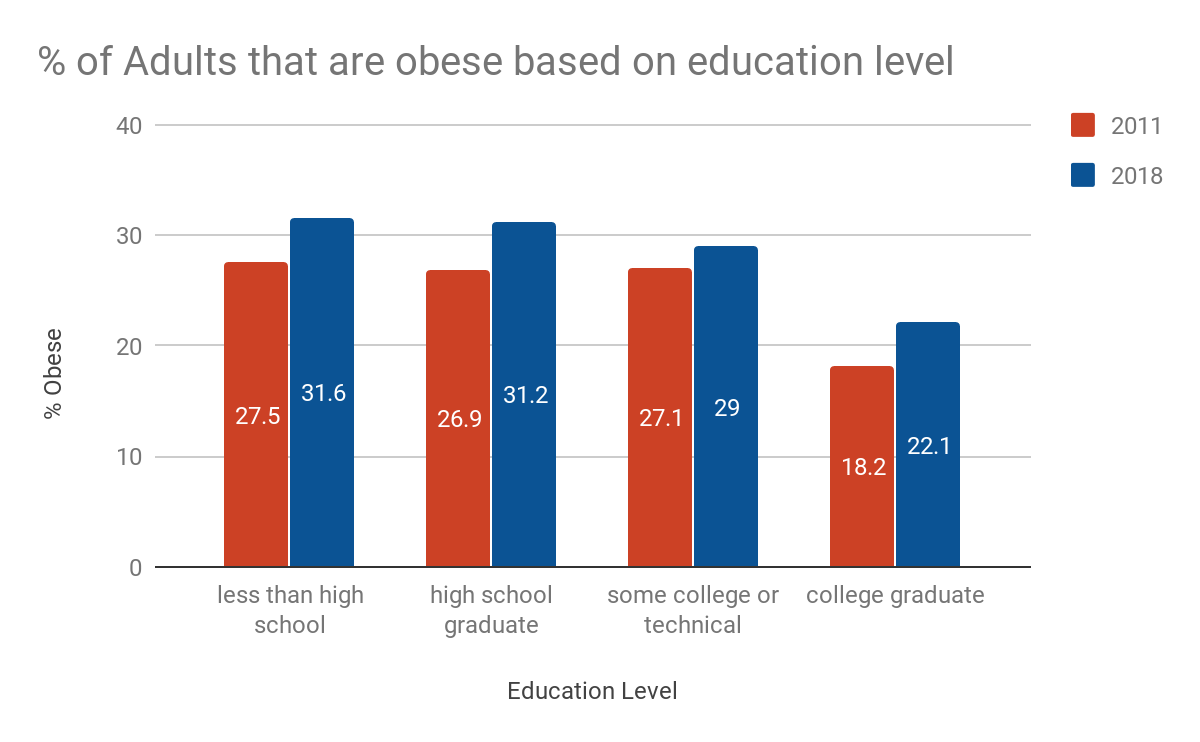
14. Study your data and note that the information to fill in the data tables below should now be readily accessible. See the example for New York state below.

**Activity 3 - Analyzing the Data Table and Graphs (11 questions)**

Using the sorted dataset generated in Activity2, choose a state and sort the data to allow for graphing and comparison of graphs between states. Example data for New York state is provided below. Students will view this data then follow the example to generate data for a state of their choice.

**Percent of adults that are 18 years old or older who have obesity: Education Level**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| State and region of U.S.  New York, Northeast | less than high school | high school graduate | some college or technical | college graduate |
| 2011 | 27.5 | 26.9 | 27.1 | 18.2 |
| 2018 | 31.6 | 31.2 | 29 | 22.1 |



**Analysis of Data Table and Graph for Obesity and Education level:**

1. Is there an apparent relationship between obesity and education level? Explain.

* Yes; with lower education levels there is a greater percentage of obese adults. With higher education levels there is a lower percentage of obese adults.

2. Does obesity prevalence among those with different education levels differ between years?

* + Which education levels tend to fare the best, regardless of year? Higher education levels
  + Which education levels tend to fare the worst, regardless of year? Lower education levels

3. Compare your graph with one from another region of the U.S. and discuss with your classmate the trends you notice.

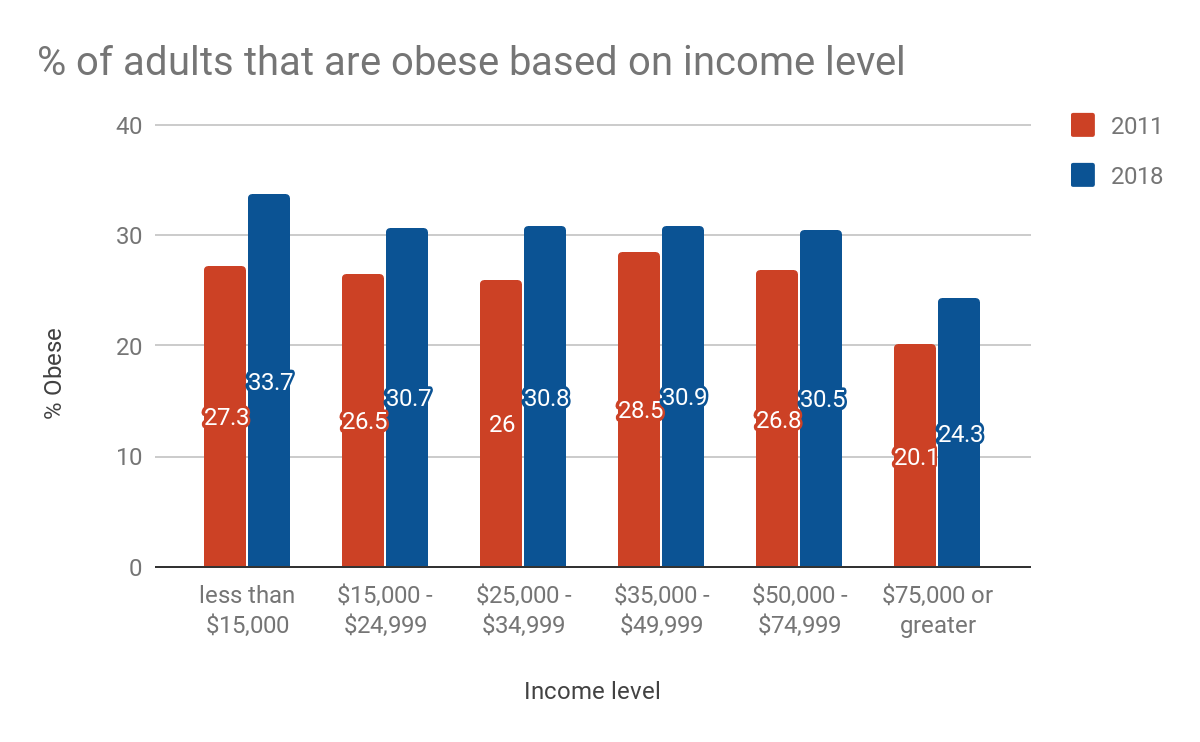
* + The southeastern and midwestern U.S. tend to have higher obesity levels when compared to the northeast and the west. This pattern holds true when considering the correlation between education level and obesity.

4. Write a statement to demonstrate your understanding of the relationship between education level and obesity.

* + This prompt is provided so students must begin to make the connection between socioeconomic status (which is impacted by education level) and obesity.

**Percent of adults that are 18 years old or older who have obesity: Income Level**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| State and region of U.S.  New York, Northeast | less than $15,000 | $15,000 - $24,999 | $25,000 - $34,999 | $35,000 - $49,999 | $50,000 - $74,999 | $75,000 or greater |
| 2011 | 27.3 | 26.5 | 26 | 28.5 | 26.8 | 20.1 |
| 2018 | 33.7 | 30.7 | 30.8 | 30.9 | 30.5 | 24.3 |



**Analysis of Data Table and Graph for Obesity and Income level:**

5. Does obesity prevalence among those with different income levels differ between years? Explain.

* + The trends noted for income level are not as obvious as for education level. With New York state there is a clear reduction in obesity levels with incomes >$75,000 and a trend toward higher obesity levels at the lowest income levels, regardless of year.

6. Compare your graph with one from another region of the U.S. and discuss with your classmate the trends you notice.

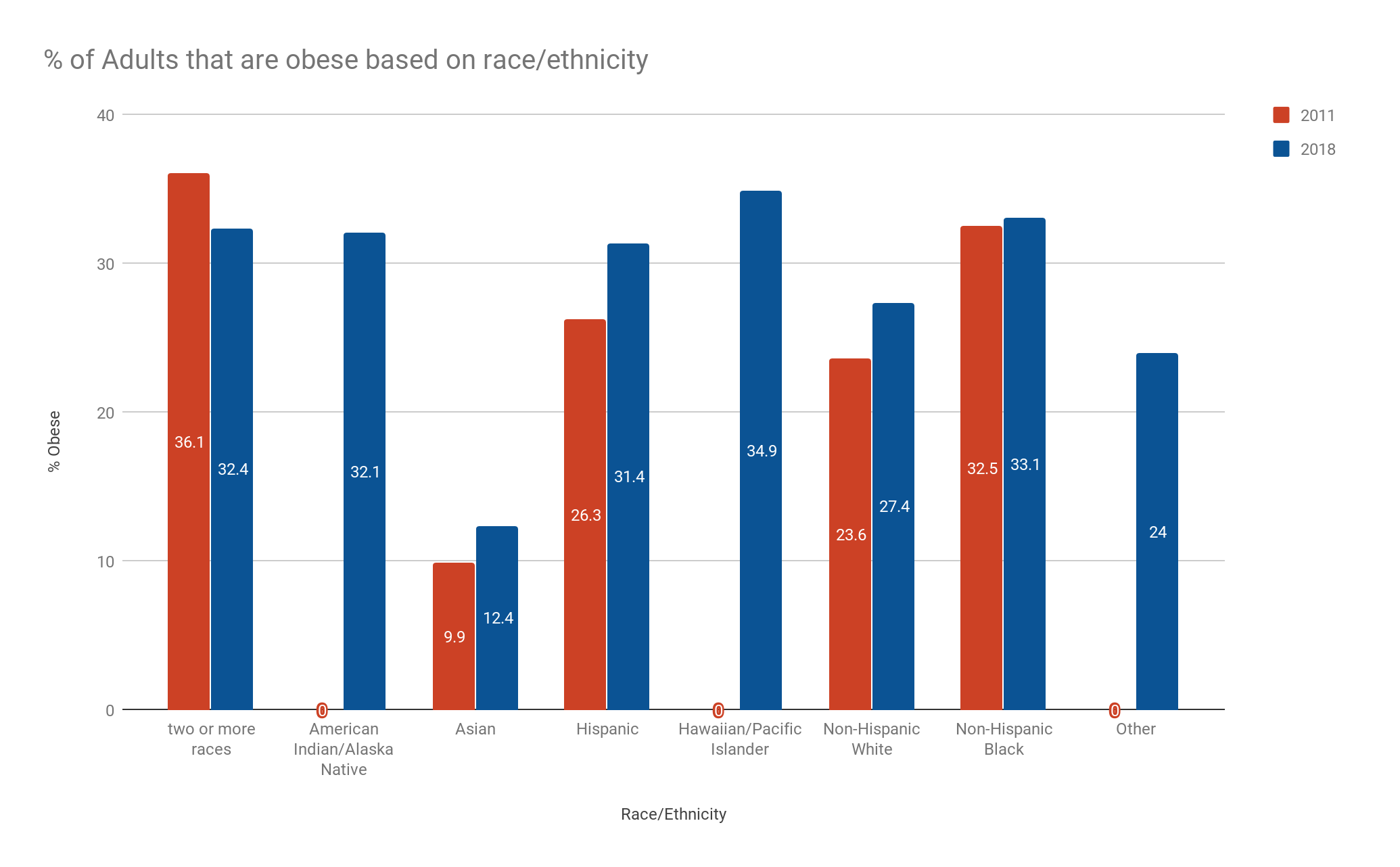
* + As indicated above, the southeast and the midwest tend to have higher obesity levels when compared to the northeast and the west. This pattern may hold true when considering the correlation between income level and obesity depending on the states that are compared.

7. Write a statement to demonstrate your understanding of the relationship between income level and obesity.

* + This prompt is provided so students must continue to make the connection between socioeconomic status (which is impacted by income level) and obesity. A non-exhaustive list of possible points students might make includes the following:
    1. Lower SES individuals may work multiple low paying jobs and have less time for food preparation.
    2. Lower SES individuals may have less money to spend on physical activity, such as running shoes or gym memberships.

**Percent of adults that are 18 years old or older who have obesity: Race/Ethnicity**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| State and region of U.S.  New York, Northeast | two or more races | American Indian/Alaska Native | Asian | Hispanic | Hawaiian/Pacific Islander | Non-Hispanic White | Non-Hispanic Black | Other |
| 2011 | 36.1 | 0 | 9.9 | 26.3 | 0 | 23.6 | 32.5 | 0 |
| 2018 | 32.4 | 32.1 | 12.4 | 31.4 | 34.9 | 27.4 | 33.1 | 24 |



8. Is there a trend for obesity based on Race/Ethnicity? Explain.

* + This data is less clean than other metrics from the dataset. For example, the 2011 data for New York state has 0 respondents in the following categories: Hawaiian/Pacific Islander, American Indian/Alaska Native, and Other. However, there are respondents from each of these categories in 2018.
  + The trend in New York state is that White/Non-Hispanic and Asian individuals tend to have lower obesity levels compared to Black/Non-Hispanics and Hispanics.

9. Do some groups appear to higher or lower obesity levels between years?

* + Which groups have lower obesity levels in each year? White/Non-Hispanics, Asians
  + Which groups have lower obesity levels in each year? Black/Non-Hispanics, Hispanics

10. Compare your graph with one from another region of the U.S. and discuss with your classmate the trends you notice.

* + As indicated above, the southeast and the midwest tend to have higher obesity levels when compared to the northeast and the west. This pattern generally holds true when considering the correlation between race/ethnicity and obesity.

11. Evaluate the three graphs side by side.

* + Based on your evaluation of two states does it appear that different regions of the country have variable levels of obesity between 2011-2018 when education level is considered?
    1. As we have seen before there is variability in obesity levels based on region of the country. This relationship should be reasonably obvious from the graphs.
  + Based on your evaluation of two states does it appear that different regions of the country have variable levels of obesity between 2011-2018 when income level is considered?
    1. As noted before there is variability in obesity levels based on region of the country. This relationship is more obvious in some states than others. However, the highest income levels tend to have lower obesity levels than the lowest income levels; it is the intermediate income levels that do not always follow a direct trend line between the lowest and highest.
  + Based on your evaluation of two states does it appear that different regions of the country have variable levels of obesity between 2011-2018 when race/ethnicity is considered?
    1. As noted before there is variability in obesity levels based on region of the country. This relationship is often noted between states with White/Non-Hispanics and Asians having lower levels of obesity compared to Black/Non-Hispanics and Hispanics. It may be further noted that these relationships may be maintained within a state and exacerbated when comparing states in the southeast or midwest to states in the northeast and west.

**References**

Boulmetis, Maria. “Making a Simple Bar Graph in Google Sheets,” YouTube, April 23, 2018. https://www.youtube.com/watch?v=-x\_mBMkB9KQ&feature=youtu.be.

Oaktree, Prolific. “Google Sheets - How to Use the SORT Function - YouTube.” YouTube, August 6, 2020. https://www.youtube.com/watch?v=QoZnJQLEywo&t=216s.

“The Obesity Epidemic,” YouTube, Centers for Disease Control and Prevention. Accessed August 7, 2020. https://www.youtube.com/watch?v=vCORDl4bqDE&feature=youtu.be.

“Overweight & Obesity,” Defining Adult Overweight and Obesity, Centers for Disease Control and Prevention, June 30, 2020. https://www.cdc.gov/obesity/adult/defining.html.

**Credits**

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