

**FINAL PROJECT**



**Course:** Design Decision Support System

CIS-530-06003

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**Date of Submission: August 9, 2023**

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# Introduction

Obesity has become a pressing global health challenge, affecting a significant proportion of the adult population, and giving rise to numerous health-related complications. As obesity rates continue to rise, understanding the key factors that contribute to its prevalence among adults across diverse demographic groups and geographic locations is vital for developing effective interventions to address this public health concern. In this report, we aim to explore the factors influencing obesity rates among adults using data from the Behavioral Risk Factor Surveillance System (BRFSS) and discuss how this information can be utilized to design impactful strategies for obesity prevention and management.

## Background

Obesity is characterized by the accumulation of excess body fat, and it has emerged as a complex and multifactorial health issue affecting millions of adults worldwide. Its detrimental impact on health is well-documented, as obesity is associated with an increased risk of chronic diseases, including cardiovascular diseases, type 2 diabetes, certain cancers, and musculoskeletal disorders, among others. Additionally, obesity poses economic challenges due to the heightened demand for healthcare resources and decreased workforce productivity.

The Behavioral Risk Factor Surveillance System (BRFSS) is a valuable database that provides comprehensive information on adult's diet, physical activity, and weight status. Managed by the Centers for Disease Control and Prevention (CDC), specifically the National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition, Physical Activity, and Obesity (DNPAO), the BRFSS data is instrumental in assessing the prevalence of obesity and related factors at both the national and state levels.

## Research Question

The primary research question guiding this report is: “*What are the key factors influencing obesity rates among adults across different demographic groups and geographic locations based on the data from the Behavioral Risk Factor Surveillance System, and how can this information be utilized to develop effective interventions for obesity prevention and management?”*

To address this question, we will analyze the extensive dataset from the BRFSS, which contains 88.6K rows and 33 columns of information. The dataset includes data on various parameters, such as year, location, data source, class, topic, question, data value unit, data value type, data value, confidence intervals, sample size, and other demographic attributes (age, education, gender, income, and race/ethnicity).

The purpose of this report is to provide a comprehensive analysis of the factors influencing obesity rates among adults, drawing insights from the rich BRFSS dataset. By examining the data across different demographic groups and geographic locations, we aim to identify the determinants that contribute significantly to obesity prevalence. Understanding these factors will enable us to devise targeted and evidence-based interventions that can effectively tackle the obesity epidemic.

# Data Analysis

## Summary of the Dataset

The dataset used for this analysis includes relevant information from the Behavioral Risk Factor Surveillance System (BRFSS) to investigate factors influencing obesity rates among adults. The dataset contains data for years starting from 2017, focusing on three main categories of questions:

* Consumed Fruits and Vegetables
* Participated in Physical Activity
* Suffered from Obesity

These categories summarize nine specific questions related to the percentage of adults in various health-related classifications. The dataset comprises the following nine questions:

1. Percent of adults aged 18 years and older who have an overweight classification.
2. Percent of adults aged 18 years and older who have obesity.
3. Percent of adults who achieve at least 150 minutes a week of moderate-intensity aerobic physical activity or 75 minutes a week of vigorous-intensity aerobic activity (or an equivalent combination)
4. Percent of adults who achieve at least 150 minutes a week of moderate-intensity aerobic physical activity or 75 minutes a week of vigorous-intensity aerobic physical activity and engage in muscle-strengthening activities on 2 or more days a week.
5. Percent of adults who achieve at least 300 minutes a week of moderate-intensity aerobic physical activity or 150 minutes a week of vigorous-intensity aerobic activity (or an equivalent combination)
6. Percent of adults who engage in muscle-strengthening activities on 2 or more days a week.
7. Percent of adults who engage in leisure-time physical activity.
8. Percent of adults who report consuming fruit less than one time daily.
9. Percent of adults who report consuming vegetables less than one time daily.

## Data Cleaning

Before commencing the analysis, the dataset was cleaned to focus on the relevant information and remove unnecessary columns. The following steps were taken for data cleaning:

**Column Selection**

The columns that were retained for analysis are given below with details. The other columns were removed as they were not relevant for visualization purposes.

|  |  |
| --- | --- |
| **Field Name** | **Detals** |
| YearStart | The starting year for the data collection. |
| YearEnd | The ending year for the data collection. |
| LocationAbbr | Abbreviation for the geographic location. |
| LocationDesc | Description of the geographic location. |
| Class | The class to which the question belongs (Obesity, Physical Activity, or Consumed Fruits and Vegetables). |
| Topic | The topic related to the class. |
| Question | The specific question asked in the survey. |
| Question Summary | A summary linking the question to one of the three categories (Consumed Fruits and Vegetables, Participated in Physical Activity, or Suffered from Obesity). |
| Data\_Value | The percentage value for the corresponding question. |
| Data\_Value\_Alt | An alternative data value (if available). |
| Low\_Confidence\_Limit | The lower bound of the confidence interval for the data value. |
| High\_Confidence\_Limit | The upper bound of the confidence interval for the data value. |
| Sample\_Size | The size of the sample for the data value. |
| Age(years) | Age group to which the data value pertains. |
| Education | Education level of the respondents. |
| Gender | Gender of the respondents. |
| Income | Income level of the respondents. |
| Race/Ethnicity | Race/Ethnicity of the respondents. |
| GeoLocation | Latitude and longitude of the location. |
| ClassID | ID for the class. |
| TopicID | ID for the topic. |
| LocationID | ID for the location. |
| StratificationCategory1 | Categorical stratification for the question. |
| Stratification1 | Further stratification for the question. |
| StratificationCategoryId1 | ID for the stratification category. |
| StratificationID1 | ID for the stratification. |

**Year Filtering**

Data before the year 2017 was removed from the dataset to focus on the period where all three factors (obesity rate, fruit and vegetable consumption rate, and physical activity rate) were available.

**Question Summary**

A new column named "Question Summary" was created to categorize the nine specific questions into the three broader categories (Consumed Fruits and Vegetables, Participated in Physical Activity, and Suffered from Obesity).

**Plan for Analysis**

* Race-Based Comparison - Average Percentage of Data Values Change in different ethnic groups.
* Income-Based Comparison - Average Percentage of Data Values Change in different Income groups.
* Gender-Based Comparison - Average Percentage of Data Values Change in male and female.
* Age-Based Comparison - Average Percentage of Data Values Change in different age groups.
* Location-Based Comparison - Average Percentage of Data Values Change in different states of USA.
* Education-Based Comparison - Average Percentage of Data Values Change in different education level groups.
* Time-based Comparison - Average Percentage of Data Values Change Over Time from 2017 to 2021.

Additionally, we can use color-coded visualizations to further explore how specific factors influence obesity rates. For example, we can use color gradients or heatmaps to show how the percentage change varies based on the interaction between race, education, gender, income, and other demographic variables.

# DSS Construction

## Race-Based Comparison

A screenshot of a graph

Description automatically generated

In this visualization, a stacked column chart effectively compares the average percentage changes in obesity rates and related factors across distinct race/ethnicity groups. Each column represents a race/ethnicity category, and the segments within the column represent the three broader question summaries: "Consumed Fruits and Vegetables," "Participated in Physical Activity," and "Suffered from Obesity." The color distinction within each segment signifies the different question summaries. Utilizing this chart type allows for clear comprehension of how various races/ethnicities differ in their responses to health-related questions. By applying the question summary as a color encoding, we easily distinguish the distribution of factors influencing obesity rates within each racial group. The filter excluding null values ensures a focused view, highlighting relevant data.

## Income-Based Comparison

A screenshot of a computer

Description automatically generated

The highlight table format is suitable for comparing average percentage changes in obesity rates and factors concerning income levels. Rows correspond to different income brackets, while columns feature question summaries. This table type excels at presenting detailed data in a even layout, highlighting high and low values. Coloring by average data value enhances visual clarity, making disparities evident across income groups. By filtering out null values for income, the visualization focuses solely on relevant income data, enhancing precision.

## Gender-Based Comparison

A screenshot of a graph

Description automatically generated

A side-by-side bar chart effectively illustrates how gender impacts obesity rates and related factors. The x-axis features gender categories, while the y-axis displays the average data value. The left three columns represent Female and the right three columns represents Male in this chart. The distinct bars for each gender group provide direct comparison of responses to health-related questions. By applying color to the question summaries, we convey key information at a glance, while the filter excluding null values for gender ensures a meaningful and targeted depiction of the data.

## Age-Based Comparison

A screenshot of a computer

Description automatically generated

The horizontal bar chart presents a comprehensive view of how different age groups influence obesity rates and related factors. The x-axis shows the average data value, while the y-axis combines question summary and age. Utilizing this chart type facilitates easy comparison across age groups and question summaries. Employing color for question summary differentiation and applying a filter to exclude null values for age contribute to a focused and insightful visualization.

## Location-Based Comparison

A map of the united states

Description automatically generated

Using a symbol map for location-based comparison offers a three-dimensional understanding of obesity rates and related factors. Latitude and longitude represent locations, and the color of symbols signifies average data values. This visualization excels at revealing geographic disparities in obesity prevalence. By employing location abbreviation as labels and details, we enhance the map's informativeness. The question summary filter ensures that only relevant data ('Suffered in Obesity') contributes to the visualization's clarity.

## Education-Based Comparison

A screenshot of a computer

Description automatically generated

Similar to the race-based comparison, this stacked column chart provides insights into how education levels impact obesity rates and related factors. The x-axis represents different education categories, while the segments within each column represent the question summaries. Employing this chart type assists in recognizing trends among diverse education levels. The color variation conveys the distribution of responses within each education group, contributing to an understanding of how educational attainment influences health behaviors. Using question summary color encoding and null value filtering ensures the visualization remains informative and focused.

## Time-based Comparison

A screenshot of a graph

Description automatically generated

The line chart effectively portrays how obesity rates and related factors change over time. The x-axis depicts the years, while the y-axis represents the average data value. Using a line chart allows for easy identification of trends and patterns over the years. Applying color to question summaries and labeling average data values enhances comprehension. This visualization serves as a sequential tracker of health-related trends, aiding decision-making for interventions.

By employing these diverse visualization techniques and configurations, we have developed a comprehensive Decision Support System that empowers us to explore and understand obesity rates and factors impacting different demographics and locations. Each visualization type serves a specific purpose, contributing to a holistic understanding of the data and enabling data-driven decision-making for obesity prevention and management strategies.

## Obesity Insights Explorer: Income, Education, and Location Analysis

A screenshot of a computer

Description automatically generated

In creating this dashboard, our objective is to uncover the intricate relationship between obesity rates and key socio-economic factors: income and education. By incorporating a map filter, we have empowered users to pinpoint a specific location of interest. This feature is pivotal as it enables users to observe how obesity rates correlate with income and education at a granular level. By filtering the map, users can instantly visualize how obesity prevalence varies across different income levels and education categories within the selected location. This exploration can reveal disparities and trends, allowing us to identify regions with higher or lower obesity rates relative to income and education. Such insights will be instrumental in shaping targeted interventions and policy decisions tailored to the unique socio-economic characteristics of specific regions.

## Health Demographics Dashboard: Age, Location, and Gender Trends

A screenshot of a computer

Description automatically generated

This dashboard is designed to provide a holistic view of how age, location, and gender intersect with health outcomes, specifically focusing on obesity rates. With the map filter functionality, users can zoom in on a particular location, examining how age groups and genders within that area contribute to obesity trends. By interacting with the map filter, users can uncover age-specific and gender-specific patterns in obesity prevalence. This insight can offer a deeper understanding of how local demographics influence health behaviors and obesity outcomes. The map filter acts as a window into regional distinctions, aiding in the identification of areas where certain age groups or genders are particularly susceptible to obesity. This dashboard empowers us to develop strategies that cater to the unique health needs of specific populations, leading to more targeted and effective interventions.

In both dashboards, the map filter serves as a gateway to localized insights, allowing us to extract valuable information that directly addresses our research question. The ability to narrow down data by location enhances the relevance and applicability of the generated insights, supporting evidence-based decision-making for obesity prevention and management strategies across diverse demographics.

# DSS Results

## Result of Worksheet

**Race-Based Comparison**

By analyzing the race-based comparison, it becomes evident that Asian individuals exhibit the lowest obesity rate at 22.15%, contrasting with Hawaiian individuals who have the highest obesity rate of 36.82%. Interestingly, Asians also surpass other ethnic groups in physical activity and fruit and vegetable consumption rates which exceed the obesity rate. In contrast, most other race groups display lower physical activity and fruit or vegetable consumption rates compared to their respective obesity rates. This suggests varying health behaviors across ethnic demographics, contributing to obesity disparities.

**Income-Based Comparison**

The income-based analysis highlights interesting patterns. Obesity rates appear to rise with increasing income until the range of $15,000 to $75,000, where it then declines for higher income levels. Additionally, a counterintuitive trend emerges, indicating that fruit and vegetable consumption decreases as income levels rise. These findings prompt exploration into the underlying factors influencing dietary choices and obesity across income brackets. Again, physical activity remained constrained from 29% to 31% and did not vary much between the income groups.

**Gender-Based Comparison**

Examining gender-based differences, males demonstrate a higher obesity rate compared to females. Moreover, male respondents also show a higher fruit and vegetable consumption rate. These gender-driven differences in obesity and dietary patterns necessitate a closer look at factors contributing to the divergence in health behaviors. Physical Activity rate remained almost same among the two groups.

**Age-Based Comparison**

The age-based comparison exposes a visible trend which is, as age groups progress, obesity rates tend to increase until age 55 and older, where a decline is observed. In contrast, Fruit and vegetable consumption decreases as age increases. Notably, the youngest and oldest age groups display the highest physical activity rates, while the intermediate age groups show relatively consistent physical activity levels. These findings underscore the role of age in shaping health behaviors and obesity prevalence.

**Location-Based Comparison**

Analyzing location-based differences, Mississippi stands out with the highest obesity rate among U.S. states, contrasting with Colorado, which displays the lowest rate. This geographical divergence suggests that local factors play a significant role in influencing obesity rates and related health behaviors.

**Education-Based Comparison**

Exploring education-based trends, an unexpected finding emerges which is college graduates show a lower obesity rate than those with an education level of less than high school. Also, fruit and vegetable consumption rates are lower among college graduates in comparison to other groups. This complex relationship between education, obesity, and dietary choices underscores the nuanced influences of education on health behaviors. However physical activity among these groups does not vary at a high rate.

**Time-based Comparison**

The time-based analysis reveals that from 2017 to 2021, the average obesity rate increased by approximately 1%. Correspondingly, fruit and vegetable consumption also experienced a gradual increase over the five years. In contrast, physical activity witnessed a decline from 31.35% to 25.42%. These temporal trends provide insights into evolving health behaviors and potential contributing factors.

Our DSS-generated insights unveil complex patterns within obesity rates, dietary habits, and physical activity across different demographic groups and locations. These findings serve as a foundation for targeted interventions and evidence-based strategies aimed at mitigating obesity and promoting healthier lifestyles.

## Result of Dashboard

**Obesity Insights Explorer: Income, Education, and Location Analysis**

A screenshot of a computer

Description automatically generated

The "Obesity Insights Explorer" dashboard with map filters yields valuable insights. For example, here we selected the state Texas in the location-based comparison, we can see all the Income-based comparison and Education based comparison of Texas.

**Health Demographics Dashboard: Age, Location, and Gender Trends**

A screenshot of a computer

Description automatically generated

The "Health Demographics Dashboard" unveils age, location, and gender dynamics using map filters. For example, if we select the state Arkansas in the Location-based Comparison map, we can see all the relevant data of Gender-based Comparison and Aged-based Comparison of Arkansas.

In both dashboards, the map filter has proven to be a crucial tool in extracting localized insights, enhancing the precision and applicability of the generated results. These findings provide actionable information for crafting evidence-based interventions that account for the intricate interactions between demographic factors and obesity rates.

# Conclusion

Utilizing Information for Effective Interventions:

* The authorities should consider adapting interventions to address disparities in obesity rates among racial, ethnic, gender, and income groups. They should design culturally sensitive and gender-specific interventions to tackle unique challenges faced by each demographic.
* They can also develop educational campaigns to raise awareness about the relationship between education and health behaviors. They should address misconceptions and encourage informed choices across education levels.
* The authority should implement income-sensitive interventions considering the contradictory relationship between income, obesity rates, and dietary habits. They can promote affordable healthy food options and physical activity in different income brackets.
* Interventions can be designed considering age-specific trends. For instance, targeting physical activity campaigns towards younger and older age groups. Also promoting the importance of physical activity to all age groups.
* They can adapt interventions based on location-specific challenges. For example, they can collaborate with local communities and authorities to implement contextually relevant strategies for a specific location.
* By monitoring the upward trend in obesity rates and decreasing physical activity, the authority should focus on developing sustainable programs to reverse these trends over time with the help of specialized people in these field and implementing the overall recommendations.

By leveraging these findings, we can formulate evidence-based interventions that address the diverse factors influencing obesity rates. A universal approach that acknowledges demographic and regional variations will be essential to effectively prevent and manage obesity, promoting healthier lifestyles and well-being.

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