Implementation and Design of an Interactive Article for Food Insecurity through Data Visualizations

What food insecurity is, its long-lasting effects, and its contributing factors.

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INTRODUCTION

The universal and basic need for food is not always a reality for some individuals and communities. Food insecurity stems from a lack of food availability, limited food access, and irresponsible food utilization. Food access refers to having available nutritious and affordable food. When there is a lack of food access, the state of food insecurity rises. Nutrition and affordability are the two major components of food accessibility. Even if food is affordable, it may not be nutritious enough to ensure a balanced diet. For example, food deserts occur when those in low-income and urban areas are further than 1 mile from a grocery store. While fast-food and convenience stores may be available and affordable, they lack fresh produce, are highly processed, and often contain too much sodium or sugar to be a sustainable food source. On the other hand, even if within proximity to a grocery store or market, the prices could be too high for an individual to purchase enough food. Within America, this is a prevalent issue among many households as it affects millions. The motivation for our engaging interactive article is to build a narrative that raises awareness and educates others on the harsh realities of food insecurity, its long-lasting effects, and its contributing factors.

RELATED WORK

Research surrounding food insecurity has been completed through the lens of various topics of interest. Through health and race, we learned more about the current and future effects of food insecurity.

The most notable research we discovered surrounding the health focus is compiled by The National Center for Biotechnology Information in the National Library of Medicine. One significant research was completed by Janice Ke *MSc* and Elizabeth Lee Ford-Jones *MD* specifically on food insecurity in Canada for children.[1] Through chronic diseases, negative impacts on mental health, and early onset obesity and diabetes, food insecurity has very adverse effects on health. The research also covers why current food access solutions are not effective. At the root, combating poverty was key, but for immediate solutions, food banks still fail to provide nutrient-dense food. Given the research focused on children, a key solution lies in the food provided by the schools. This research inspired us to focus on the long-lasting health effects as well as explore specific groups that are experiencing food insecurity.

Additionally, since this research was completed in Canada, we wanted to shift the focus to the United States. Another key research work we discovered was from the Northwestern Institute for Policy Research by Abigail Pitts. This research details how race factors into rising rates of food insecurity.[2] The key finding showcased that Hispanic and Black households deal with food insecurity much more than White households. Using this, we were motivated to investigate how race specifically overlaps with food insecurity. Other related research already existing in the space provided context and motivations for potential features of our article. Our article is not necessarily looking to perform additional research but is utilizing existing data to create an engaging and interactive narrative.

While there is much more research completed for food insecurity, an interactive article such as this project is not popularized yet, however interactive articles for other topics are. Ultimately combining the previously completed research with new data insights in an engaging format is the goal.

METHODS

Our work aims to utilize data visualization techniques and best practices for design to create an informative and interactive article. The interactive article asks what food insecurity is, its long-lasting effects, and its contributing factors. Census data was collected from various US government agencies and Feeding America.

For the foundation of our work, we used the d3 template repository that was given to us by the professor. We cleaned our data and selected the data useful for us using Python and Pandas. Due to the nature of the large datasets this involved removing columns from the original

dataset that we did not plan to use. Also, many of the variables in the dataset were counts, so for those variables, we replaced NULL with 0 and manually recalculated the proportions.

For the map visualization, the original dataset was organized by census tracts, which would have led to an extraordinarily cluttered map as there are a lot of census tracts and each one is small in area so it would be hard to tell the different census tracts apart and most individuals do not know what census tract, they are in. In the cleaning process, we grouped all the census tracts by which county they are in, summed up the counts, and manually calculated the percentages. Also, the data did not contain geojson data for each county, so we found a geojson dataset of the US counties and joined the datasets together by the Federal Information Processing Systems (FIPS) code for each county.

Our visualizations were created using the d3 library, and we used HTML and CSS for the front-end of our project.

RESULTS

The resulting product of our work was a final interactive article. It contained a narrative and visualizations in the form of graphs and interactive features. Multiple data sets were used to create these visualizations.

Food Insecurity Across America

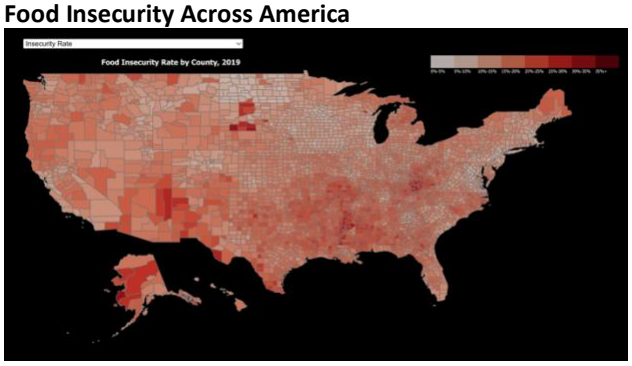

Figure 1: Map of the United States by county indicating severity of food insecurity.

To produce the maps, we used data from Feeding America [3] and USDA. [4] These choropleth map visualizations showcase three maps of the United States by county. Counties are smaller than states and typically comprised of several cities. The first map, as seen in Figure 1, indicates the rate of food insecurity within the county. The insecurity rate is determined by the number of individuals experiencing food insecurity divided by the total number of individuals within the county. The darker red the county is, the higher the rate of food insecurity. The purpose of this visualization is to indicate how widespread food insecurity is across America. Across all counties, food insecurity is prevalent which further validates food insecurity as an issue.

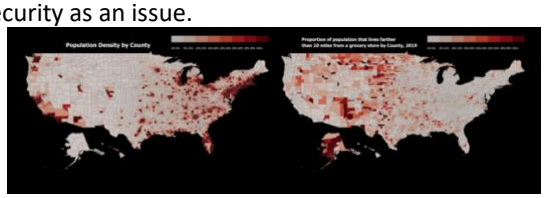

Figure 2: Comparison Maps of the United States by county indicating population density and proportion of population living further than 10 miles from a grocery store.

For the second map, we provided the population densities of each county as seen in Figure 2. For the third map, we provided the proportion of those living more than 10 miles from a grocery store, which can be classified as those living in a food desert as seen in Figure 2. The takeaway from these supplemental maps is to demonstrate the widespread trend that counties with lower population densities have higher rates of food insecurity and are more likely to live in food deserts.

Long-Lasting Effects

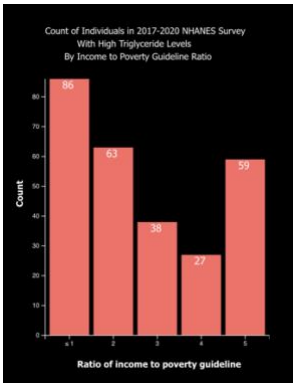

Figure 3: Bar graph indicating how the ratio of an individual's income to poverty guidelines correlates to triglyceride levels.

To produce the bar graph, we used data from the CDC. [5] Essentially the further from poverty, the more likely the lower the high triglyceride levels, as seen in Figure 3. More importantly, the long-lasting effects of high levels could lead to obesity, diabetes, and cardiovascular disease. While food insecurity may be perceived as a temporary issue, its long-lasting effects can lead to poor long-term health and shorter life spans.

Contributing Factors

The following correlation visualizations are all produced with data from the US Census [6].

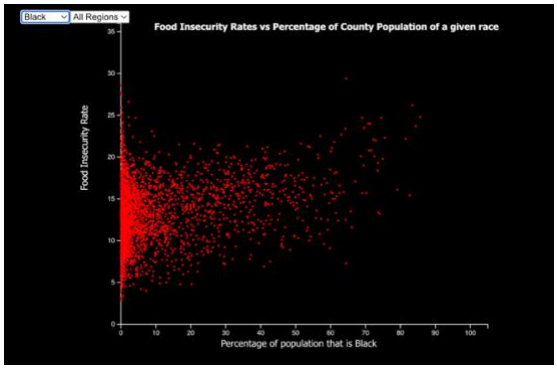

Figure 4: Scatterplot of percentage of population of a given race, Black, versus their respective food insecurity rates.

Correlation with Race: To examine the correlation of race and food insecurity, we compared the proportion of a given race within a county's population with the population's food insecurity rate. By comparing different groups, the scatterplots indicate trends that showcase that populations with higher proportions of Whites and Asians have decreasing food insecurity rates and for all other races such as Black, Hispanic, and Native American, as the proportion of the population increased, the food insecurity rates increased. This feature allows the reader to explore how race correlates to food insecurity.

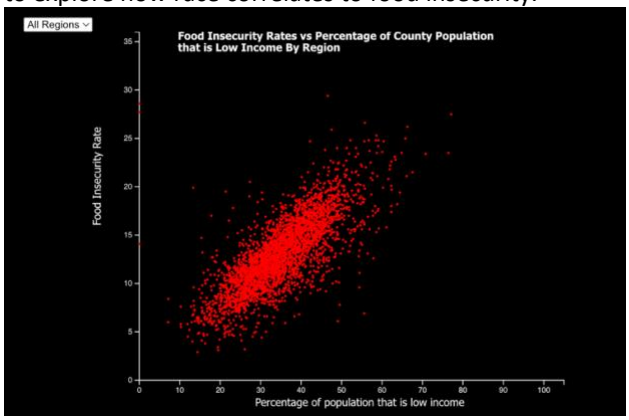

Figure 5: Scatterplot of percentage of population that is low income, versus their respective food insecurity rates.

Correlation with Income: To examine the correlation of income and food insecurity, we compared the proportion of low-income individuals within a region with the population's food insecurity rate. The reader can explore different region's food insecurity rates and see the trends that as the proportion of low-income individuals decreases, the rate of food insecurity decreases. The scatterplot indicates the positive correlation between income and food insecurity.

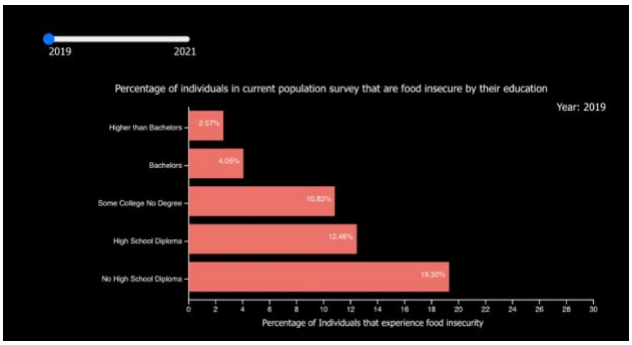

Figure 6: Bar Graph of percentage of individuals that experience food insecurity by education levels.

Correlation with Education: To examine the correlation of education and food insecurity, we compared the rate of food insecurity with the level of education. Starting from no high school diploma up until more than a bachelor's degree, there appears to be an inverse relationship between the two such that as education increases, food insecurity decreases. We also provide a slider which the reader can see the change over time.

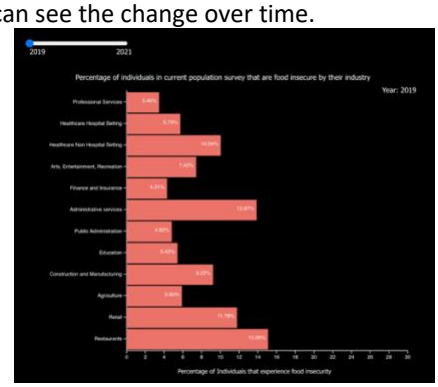

Figure 7: Bar Graph of percentage of individuals that experience food insecurity by occupation categories.

Correlation with Occupation: To examine the correlation of occupation and food insecurity with the level of education, we had multiple occupation categories with their respective food insecurity rates. As the level of job tends to require higher education and receive salary income rather than shift-based income, the food insecurity level decreases. We also provide a slider which the reader can see the change over time.

Quantifying Statements with Pictograms

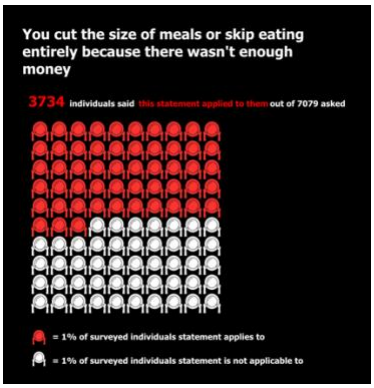

Figure 8: Pictogram displaying the percentage of individuals that the statement, "You cut the size of meals or skip eating entirely because there wasn't enough money" applies to.

The pictogram visualizations were produced with data from the US Census. [7] Our final visualizations are a series of pictograms demonstrating the percentage of individuals that resonate with the given statement surrounding food insecurity. The pictogram consists of hands holding an empty plate, and those that are red signify those that the statement applies to. Many of the statements involve limiting food intake, feeling anxious and worried about food, or other insecurities surrounding food, and seeing how many individuals it applies to quantifies the importance of addressing this issue. Also, the statements seem simple and sometimes taken for granted, but the reality of the statements is true for many Americans.

DISCUSSION

Our work, an interactive article, serves to engage the audience in a narrative that educates and justifies the harsh realities of food insecurity. Providing context, gravitas, and depth to the problem can lead the audience to act on their own and be more insightful. Our article is formatted by guiding the audience through the big questions. What is food insecurity? Who is affected? What are the long-lasting effects? What are the systemic factors and how do they contribute to overall food insecurity? As an audience, they are naturally curious themselves, and by answering these questions with interactive visualizations and a compelling narrative, the audience can educate themselves and others. When storytelling, words make up the bulk of the message, but by integrating our visualizations, we present the information for the audience to discover trends and connections on their own. It makes the narrative more meaningful. Rather than solely being told the facts, you are drawn to click, drag, type, and observe the article dynamically. If the audience is compelled, they too can act and take their insights to make meaningful changes in creating solutions for food insecurity. Moving forward, creating more articles and media in this engaging manner can lead to higher levels of motivation and inspiration in generating solutions. Feeling the reality of the issue can lead to more change.

ACCESSIBILITY

Our final application is a simple scrolling webpage article. When designing the format of the application, we emphasized on having a clear structure of information, along with being intentional with our color. Using a monochrome palette with red, white, and black, the users can distinct the red headers and highlighted information against the black bodies of text. To make the visualizations accessible, we included alternative descriptions that described the visualizations. Given time and knowledge constraints, we attempted to make our article as accessible as possible, however we understand there is more that can be done to make it more accessible.

FUTURE WORK

An expansion of our current work is certainly possible and recommended. In terms of refinement, edits to the visualization and narrative themselves are welcomed. There are multiple data sets and ways the narrative could be built to be more educative. Providing context into what food insecurity was standard. However, there are the two supplemental sections on long-lasting effects and contributing factors could be extended.

When we explored long-lasting effects, we focused primarily on health implications. Looking to the future, we could explore beyond an individual's health. Some topics could include analyzing systemic socioeconomic status, economic policies, and legislations, as well as food sourcing and supply chain decision making. These analyses could provide interesting insights into the governmental and corporate long-term effects.

Another factor to expand more deeply on could be looking into more contributing factors. We explored many topics like race, income, geography, education, and occupation; however, we didn't investigate age, gender, ideologies, political preferences, or other factors. Primarily the limitations for these were access to data, but in the future, if data corresponding food insecurity and these factors were made available, it would be a logical next step.

Separate from the extensions to the content, the article itself has potential future work. We created the article as a website, meant to be read and scrolled through, but we could implement better techniques to increase the interactivity and level of engagement with the content. Implementing more user input can allow users to enjoy a personalized experience. Currently, we use a variety of techniques, but it would be interesting to add an audio portion of an anecdote of someone sharing what it was

like to experience food insecurity could help really contextualize the article.

Additionally, this style of interactive article, could be extended to other important topics that may be less known or more understandable with visualizations. For example, other topics on food access like what food deserts are or agricultural changes. While this the work only analyzes food insecurity within America, and it can be extended to other countries. This could help see the broader effects of how a countries demographics or food supply affects food insecurity.

Overall, the extensions of our work are vast in many regards, however with each extension, it seems reasonable to limit to only one or two extensions because these topics are meant for basic understanding, education, and awareness, having too many extensions could lead to vague understanding and information overload.

ACKNOWLEDGMENTS

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