MACS 40700 - Data Visualization

Final Project: Obesity in Mexico

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INTRODUCTION

Obesity-related diseases have been a heavy burden for the public health system in Mexico, and Mexico has been one of the most obese country around the world. According to OECD, one third of Mexicans who are older than 15 years suffer from different degrees of obesity, and the obesity rate among mexican children is the highest around the world. Consequently, obesity-related diseases have become a critical public health concern in the country. In 2016, 9.4% of the population in Mexico suffered from diabetes – an increase of more than 2% points from 2006, one in four Mexicans suffer from high blood pressure, and around 100,000 Mexicans die every year due to cardiovascular diseases.

Sugar Sweetened Beverages (SSB), carbonated liquids that include sodas and fruit drinks, is recognized by international organizations and Mexican agencies as a major contributor to obesity. The World Health Organization suggest that one of the main strategies to prevent chronic diseases is to find "ways to reduce the intake of sugars-sweetened drinks […] "[1]. The Instituto Nacional de Salud Pública (National Institute of Public Health) states "scientific evidence is conclusive: sugary drinks cause harm to health"[2].

The goal of this visualization is to generate a tool that contributes to increase awareness of the risk of developing obesity and to promote healthy habits among the Mexican population. We expect to do so by providing information about the prevalence of this problem in Mexico. Allowing users to understand if they are at risk of obesity allows us to focus on providing information on the prevalence of habits that affects the risk of developing obesity. In addition, we also explore mexican population's perceptions about the consumption of SSBs, which is one of the main drivers of obesity in the country. We developed an interactive dashboard that combines a set of visualizations with the information we want to share with the user. Through the development of our visualizations, we focused on making the visualizations appealing to the user and easy to interpret. We also focused on making the dashboard easy to navigate, since this will increase the chances that the user will get engaged in exploring the information included in the dashboard.

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[1] World Health Organization. Diet, nutrition and chronic diseases.

[2] National Institute of Public Health, Mexico. Research shows negative effects of sugar sweetened beverages.

METHODS

We use a flexdashboard to display a set of interactive visualizations presenting Body Mass Index (BMI) data on obesity and habits that impact the risk of obesity in Mexico. We use data from the Mexican National Health Survey (ENSANUT). All our visualization were coded in R. Next, we describe each of the visualizations included in the flexdashboard.

BMI by Age and Gender :

The *BMI by Age and Gender* plots the average Body Mass Index (BMI) by age and gender. The goal of this dynamic visualization is to offer users an idea of the severity of obesity issue in Mexico while also ensuring the interactivity with readers which enables readers to compare their BMI to the average level through entering the basic information necessary for the BMI calculation.

The visualization is achieved through R Shiny and presented as a part of the final project in the platform of flex dashboard. Based on what we have completed on the topic of *Obesity in Mexico* in the previous project of Visualization Experiment and Interactive Visualization, we made a few changes and improved the presentation in six major ways: ample and well-structured layout and components, multi-measurement used to calculate user's BMI, step-by-step instructions, user's summary statistics of a higher precision, more complete legends, and vivid background images.

Layout and Components: First, in order to enable readers to process the information easier and faster, instead of having the three tabset panels Visualization, Profile, and About in the original piece, we reproduce the presentation with charts stacked vertically within a column and sized to fill available browser height. The first chart is the Shiny App – it includes the user interface part where information needs to be input, and one tabset panel of dynamic plot and one summary panel of a user's statistics. User can scroll when any additional vertical space is needed here. The second chart provides users with a step-by-step instruction of how to input their information on the user interface panel. The advantage of displaying these components in by dividing the flexdashboard into columns and rows is that as much useful information as possible is presented to users in one page and users can identify and filter the information faster compared to clicking on different tabset panels.

Two Calculation Measures: Compared to the old version that only has the measurement unit of metric with weight in kilograms (kg) and height in meters (m), the plot has been improved with the standard measurement with weight in pounds (lbs) and height in feet (ft). This provides users

with more flexibility: more than one measurement option are provided to enter height and weight information based on users' preference.

Instruction: On the left-bottom side of the dashboard, instruction of how to use and interpret the plot is provided: first it tells readers that the goal of entering their information is to provide them with their calculated BMI and it can be used to compare them to the average BMI by age and gender. Meanwhile, four detailed steps of instruction would help users to use the plot if needed. In addition, A note that reminds readers that if they have trouble reading the three dots of different colors, further information is provided on the right side - one legend of *How to Read* that helps readers to understand what each point of different colors stands for and how they relate to each other.

Legends: The legend of the plot has been improved to facilitate the understanding of the plot. Based on the peer evaluation we received from our classmates, we realize that in the old version, our prime goal of enabling users to compare their BMI with the average level was hindered by the original legend (Graph 1, Exhibit), which was plotted in Excel. The new legend (Graph 2, Exhibit) on the right-bottom of the dashboard was achieved completely in ggplot2, other than the marks of each dot, we add two dashed line – one in green and connects the self-portrait BMI and calculated BMI based on the information entered by the user, and another one that connects the calculated BMI with the average BMI by the same age range and gender. Meanwhile, for each dashed line, there is an interpretation of how to read each line. This is also mentioned in Your Profile panel to further explain that the user should takes these two lines to see how much he/she wrongly estimated him/herself and how much his/her calculated BMI departs from the average level. Besides, we remind users that none of the line represents the actual difference, but the relative relationship between three dots. Since both yellow and green dashed line represents some relationship with the black dot (average BMI), in order to facilitate the understand when two lines overlap, we use curves to connect instead of straight lines. An example is provided in the index (Graph 3, Exhibit).

*Summary Statistics:*A minor change we made here is that we no long provide users with how much they wrongly estimate their BMI. Because the BMI of their self-perceived body type is calculated by taking the median of the body-type group and providing the difference of subtracting the calculated BMI from the perceived one is not precise and might mislead user. Rather, in order to keep the truthfulness of this visualization, we only inform user if he/she wrongly estimate their BMI or not, depending on if their real body type based on calculated BMI matches their self-portrait body type. In addition, as described above detailed instruction of how to read the yellow and the green dashed lines are offered too.

Background Images: The background images of each body type by two genders are embedded in the plot. We replace the images of female with four more vivid presentation of body types which helps readers to better capture their plausible body types if their BMI falls in one of the four BMI ranges.

Sugar Sweetened Beverages:

This Shiny app provides information about the most common answers to question about perceptions on consumption of Sugar Sweetened Beverages (SSB). Bar plots allow the display of information in a clear and simple way and the visualization is easy to interpret. A separate plot is constructed respectively for each question to avoid potential misinterpretation issues. Regarding the design of the app, we use panels to display each plot. This allows all the information to be included on the screen, without requiring the user to scroll down. Interactivity allows the user to select the age range for which information will be displayed. We include information for three questions from the Mexican National Health Survey ENSANUT: "How often do you drink sweetened beverages?", "How capable do you feel about consuming one or fewer glasses of Sugar-Sweetened Beverages per week?", and "Which of the following benefits of eating healthy do you consider more important?".

Interactive Maps:

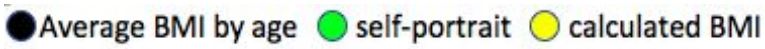
We use maps to display information about health habits and body mass index at the state level. The maps were constructed using the Leaflet library in R. We present information for each state, since the data we use is representative at the state level. Information can be accessed by clicking at a marker located in the capital of each state. The interactivity of the maps allows to include more information in the visualization without making it hard to read. In addition, interactivity can help the user engage more with the information provided in the visualization. Another advantage of these visualizations is that they allow the user to search for particular geographical trends in health habits. Our dashboard contains two maps. One of the maps provides information on the prevalent habits of the Mexican population per state. Each popup provides information on three habits categories for each state: regular consumption of sweetened beverages, regular consumption of fruits and regular physical activity (exercise). A second map shows the average body mass index (BMI) at each stare.

CONCLUSION

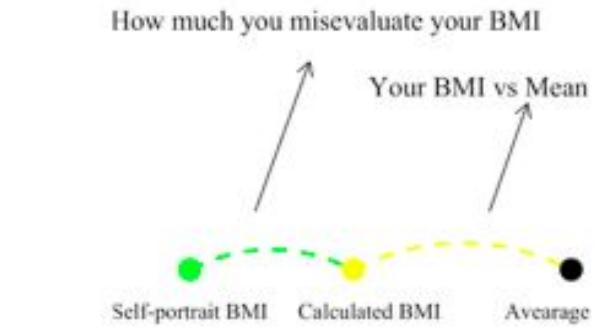
As the two authors of the final visualization, Lucia and Jessica we consider this work truthful and comprehensive, functional, beautiful, and enlightening. We have been working on reflecting the truthfulness of the original data set, which is reliably obtained from ENSANUT. All three visualizations provide an accurate and factual depiction of the topic of Obesity and Sugar Consumption. We worked on complete information of all 32 states and age ranging from 0 to 100 year-old. In addition, the formulas used to calculate BMI at individual level are available in two different measurement units. It is functional in the sense that it not only allows readers to understand the trend of average BMI by age group, but also enables the positioning and comparison between users' BMI and the average level. Meanwhile, the Sugary Beverages Consumption illustrates the high frequency of consuming sugar while also highlighting the benefits of less sugar ingestion. Three visualization are also beautiful and eye-catchy: embedding background pictures of plausible body types provide straightforward and interesting illustration of how one might look like if his/her BMI is falling in that range. Compared to a summary statistics table, dashed curves used to link three dots also provide a more fun way of conveying how self-portrait differentiates from the real body BMI and how much one is (less) healthier than the country's average level. Maps gives a geospatial sense and allows users to locate the state where he/she wants to learn more about. The work is insightful because if highlights the severity of obesity in Mexico and is able to emphasize the importance for the government and policy makers to implement a program/ policy to get obesity under better control and prevent it. The attention of coming up with a more effective way to tackle this epidemic is solidly drawn by this visualization.

Exhibit

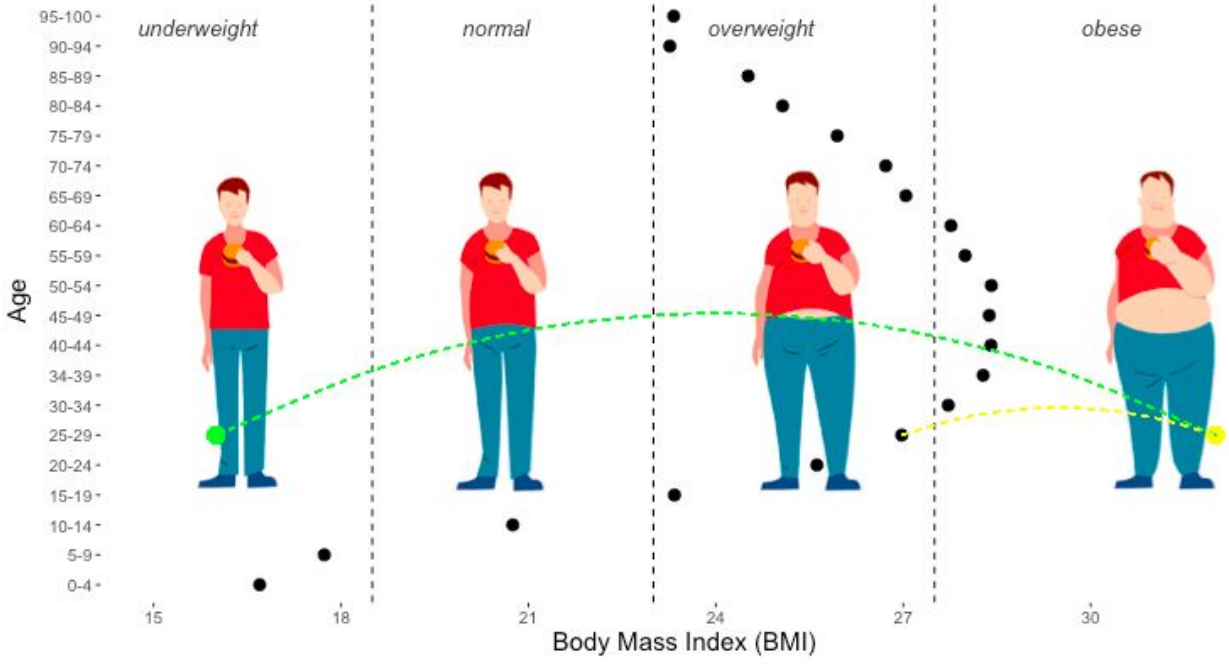
Graph 1



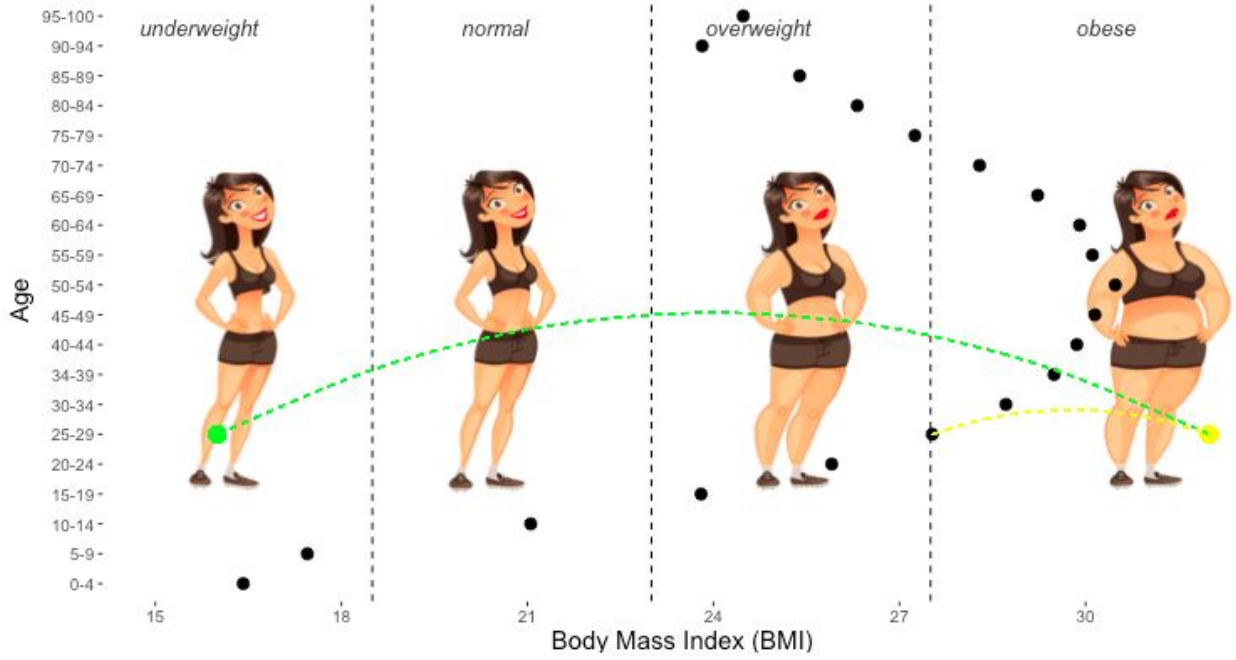
Graph 2



Graph 3



Graph 4


underweight
normal
overweight
obese
Age
95-100
90-94
85-89
80-84
75-79
70-74
65-69
60-64
55-59
50-54
45-49
40-44
34-39
30-34
25-29
20-24
15-19
10-14
5-9
0-4
15
18
21
24
27
30
Body Mass Index (BMI)