

Nutritional Facts

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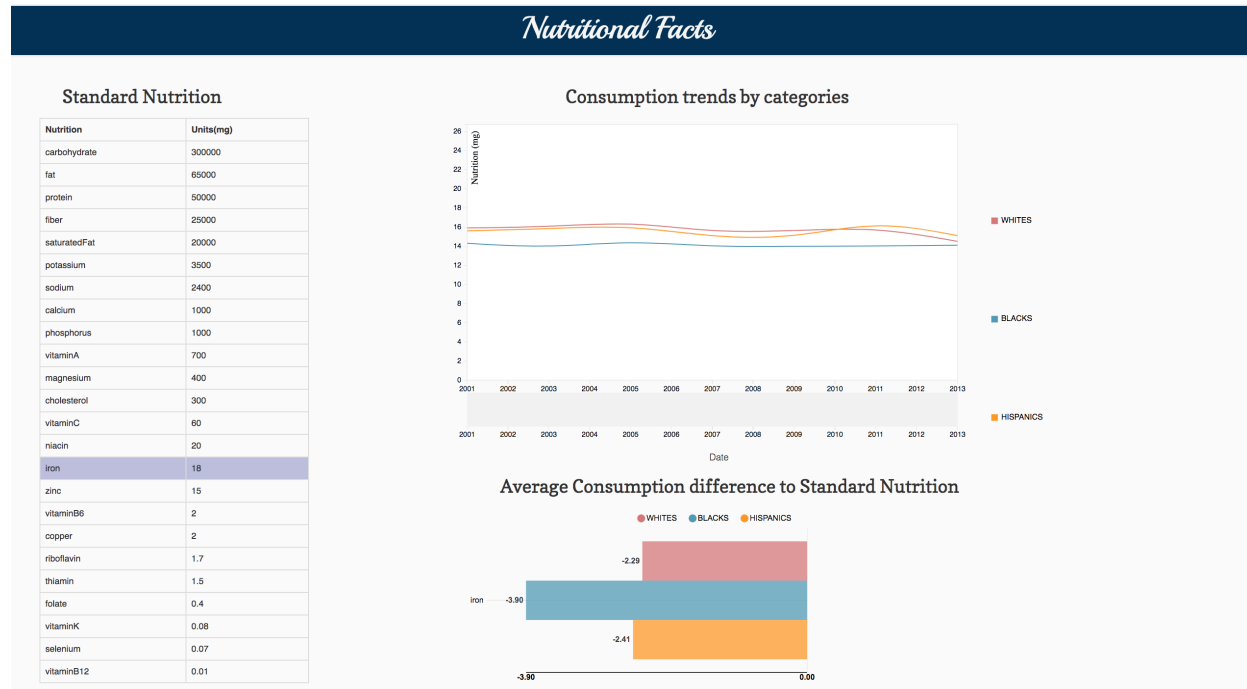


Fig. 1. Nutrition Chart

Abstract—abstract: Daily nutrition is a definite measure for everyone to compare the levels of nutrition intake. Amidst comparison to the daily standard values, there are certain nutrients which become deficient based on the food intake. Taking this into consideration, we developed a web-based visualization which is likely to show the standards and intake measures over the years by considering three different races. Substantially, we also show the key differences in the intake levels of various nutrients and the deficiencies as well. Having analyzed and identified the understanding of deficient nutrition, it is quite important to overcome the deficiency. Thus, we also present sufficient information visually where proper nutrition can be formulated through consumption of fruits. The purpose of this project to understand the Grey areas of nutrition standards and deficiencies. Also, derive a definite way to fill the nutritional gap.

1 INTRODUCTION

Visualizations help to analyze and understand patterns in a limited amount of time. In general, one needs to deal with huge data to derive absolute insight of the tasks. In this paper, we aimed to analyze Nutrition intake of Hispanics(HIS), Non-Hispanic Blacks(NHB), Non-Hispanic Whites(NHW) by analyzing food consumption patterns. We want to compare the Nutrition intake to the Nutrients prescribed in the standard 2000 calorie diet and find out if there are any deficiency in Nutrients due to the food consumption habits. At the same time, we want to analyze how fruits can contribute to the nutrients which are deficient. The visualizations are developed using D3.js, NVD3.js, JQuery, CSS for styling. Here are the questions that can be answered

through the visualization.

1. Do the Non-Hispanic Blacks, Non-Hispanic Whites, Hispanics have deficiencies in the Nutrition intake due to food consumption habits?
2. What are the Nutrients which are deficient in the three races?
3. What is the average deficiency at each Nutrient across three races?
4. Can fruits contribute to fulfill the Nutrition deficiencies?
5. What is the Nutrition value of different fruits and how much fruits can contribute to fill the nutrition deficiency?

Analyzing the data related to Nutrition consumption provides ways to answer the research questions. The data derived through analyses of all the three charts in Fig 1 was used to obtain information regarding the nutrients which are deficient across the three races. Through the analyses of Parallel coordinate chart(Fig 6) and Horizontal bar chart(Fig 7) we can understand the contribution of fruits to the nutrients which are deficient. Visuals which we included to answer the research questions

are:

1. Table to represent the Standard Nutrition.
2. Line chart to represent the average nutrition consumption patterns for the past 13 years(2001-13) across Non-Hispanic Blacks, Non-Hispanic Whites, Hispanics.
3. Horizontal bar chart to show nutrients which are consumed above and below the recommended levels of prescription across different races.
4. Vertical bar chart to show the average percentage deficiency of nutrients.
5. Parallel coordinates chart to show the standard nutrition of fruits per 100 grams.
6. Horizontal bar chart to show the contribution of fruits to the nutrients which are deficient.

2 RELATED WORK

The article [4] referred discusses the big picture on Nutrition quality, health status by considering different age groups, income levels, different races in the US. The article claimed that by the end of 1995 many Americans were having calcium deficiency. Our analysis support that Americans are still having a deficiency in Calcium. In this article, we are concentrating particularly on Non-Hispanic Blacks, Non-Hispanic Whites, Hispanics and analyzed the Nutritional deficiency in these races. On top of it, this article tries to analyze how fruits can contribute to fulfill the nutrition deficiency.

3 DATA

The data is available at United States Department of Agriculture(USDA) at what we eat in America (WWEIA) [3] database and food composition database [1]. The data which is in its raw format was modified as per requirements into CSV, JSON, TSV and consumed by the respective JavaScript libraries to create Visualizations. At WWEIA we obtained data required to show Nutrition consumption patterns. The data was modified into attributes like Year and different Nutrition labels like carbohydrates, protein. The data required for charts like Horizontal bar chart(Fig 4) to show nutrition consumption difference by category and Vertical bar chart(Fig 5) to show the average percentage deficiency of nutrients was derived from this data. Food consumption database provides a search tool to look for fruits based on Nutrition. The data obtained was modified into attributes like Fruit, different Nutrition labels to support parallel coordinate chart(Fig 6). The data required for the Horizontal bar chart(Fig 7) to show the contribution of fruits to the deficient nutrients was derived from this data.

4 VISUALIZATION

The Visualizations for the Nutritional facts has 6 charts divided into two categories: First categories include a Table, Line chart, Vertical bar chart, Horizontal chart used to represent Nutritional deficiency. Second categories include Parallel coordinated chart, Horizontal bar charts used to provide information about how fruits contribute to nutritional deficiency. As stated earlier the main purpose of this Visualization is to analyze the Nutritional deficiency across Hispanics, Non-Hispanic Blacks, Non-Hispanic Whites for a period of 13 years(2001-13).

From the first category visualizations, the Nutrients in the table(Fig 2) has impact on the Line chart(Fig 3) and Horizontal bar chart(Fig 4). By selecting the row in the table, for example, the row which has carbohydrates data, the information in the Line chart and Horizontal bar chart will be modified. The line chart provides information about the Nutritional intake of carbohydrates by races like Hispanics, Non-Hispanic Blacks, Non-Hispanic Whites. The Horizontal bar chart helps to analyze if the Nutrients consumed are above and below the recommended level by comparing average intake of 13 years with standard values in the table. Since the data can be expressed across positive and negative scale, it is easy to analyze if the Nutrients are deficient or consumed in excess. The Vertical bar charts concentrates on the nutrients which are deficient and provides information about deficiency in percentages.

The second category visualizations are designed to understand how the fruits can contribute to Nutrients which are deficient. By clicking

over fruits in the table(Fig 6) the parallel coordinate charts highlights the line which indicates the amount of Nutrients present per 100 grams. By clicking on fruits in the table the Horizontal bar chart(Fig 7) updates and provides information about the contribution of fruits to the nutrients which are deficient.

4.1 Design Decisions

The visualization was designed to analyze Nutrition deficiency and to show how fruits can contribute to nutrition deficiency. For better understanding, we could divide the charts into two categories. One category to represent the Nutrition deficiency and the second to represent how fruits can contribute to the nutrients we observed as deficient through the first category charts.

4.2 Table

Standard Nutrition	
Nutrition	Units(mg)
carbohydrate	300000
fat	65000
protein	50000
fiber	25000
saturatedFat	20000
potassium	3500
sodium	2400
calcium	1000
phosphorus	1000
vitaminA	700
magnesium	400
cholesterol	300
vitaminC	60
niacin	20
iron	18
zinc	15
vitaminB6	2
copper	2
riboflavin	1.7
thiamin	1.5
folate	0.4
vitaminK	0.08
selenium	0.07
vitaminB12	0.01

Fig. 2. Standard Nutrition Table.

To represent the Nutrition deficiency through first category charts we used four different charts. The table was preferred to represent the 26 standard nutrients and its values. The data is expressed in milligrams. By Representing the data in milligrams in the table we can easily understand the difference in recommend levels of different nutrients.

In the initial design, we were confused if we need to consider different units of Vitamins since they were of a small scale, but the National Institute of health [2] provides conversion factors from one unit to other with the aim to compare among different nutrients which supports our design decision.

4.3 Line chart

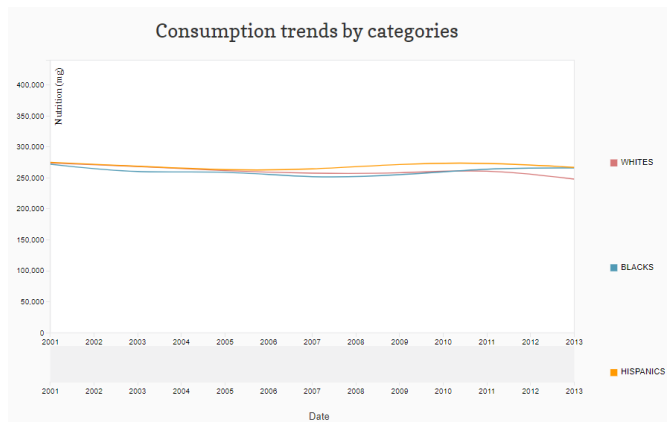


Fig. 3. Nutrition consumption trends.

Line chart was used to represent nutrition consumption patterns for the period of 13 years(2001-13) for three distinct categories Hispanics, Non-Hispanic Blacks, Non-Hispanic Whites. X-axis defines the Year and Y axis was scaled in milligrams. Since line chart is best used to observe the change in patterns across distinct categories we selected Line chart for the design. The Line chart was interlinked with Table(Fig 2) and the data in line chart represents nutrition consumption trends based on the selected nutrient. For uniformity, the data is represented in milligrams. In this way, the data can be comparable with standard values in the table. Since Y scale adjusts automatically with the variation of data, it is easy to observe all the nutrients patterns through the design selection. Brushing helps the user to analyze the trends for a particulate time interval in the data.

4.4 Horizontal bar chart with positive and negative scales

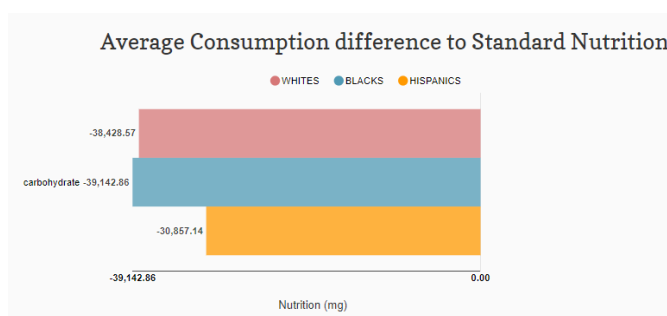


Fig. 4. Average consumption difference to standard nutrition .

The Horizontal bar chart was used to analyze if the nutrients consumed are above or below the recommended level by comparing average intake of 13 years with standard values in the table. The average intake was calculated across three distinct categories and color coding was used to represent each category. The color coding used is in sync with coding schema used in the line chart(Fig 2) to represent races. By scaling axes in the horizontal bar chart, it is possible to represent data in positive and negative scale which was a requirement for our design. The data in the chart varies with the selection of nutrients in the table providing a way to analyze if each nutrient is consumed above or below the standard levels by different races. In the initial design, the

x-axis was scaled in percentages. We changed the scale to milligrams since expressing the deficiency of each nutrient in milligrams would be more useful to the user since the standard labeling across different food products follows the conventions of milligrams or grams.

4.5 Vertical bar chart

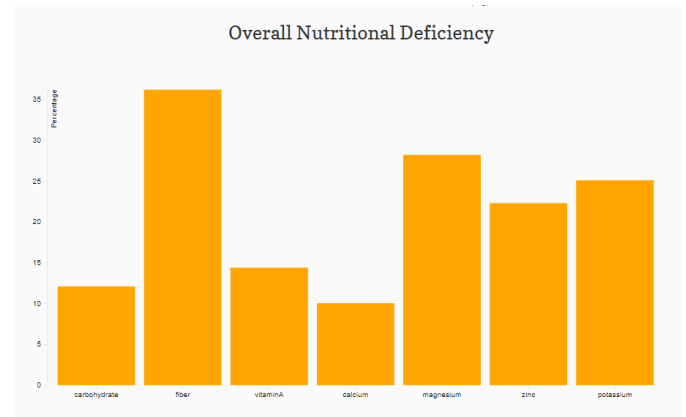


Fig. 5. Overall nutrition deficiency .

The vertical bar chart represents data related to nutrients which are deficient by combining nutrition intake across all the races. Initially, the data was scaled to milligrams, but the visualization was unable to pass required information due to huge variations of data and scaling in percentages by comparing to the standard values was observed as the best way to pass the required information on deficiencies. The tool tip was considered as the effective way to pass the information to the user and was used in the visualization. Single color coding channel was used to maintain uniformity.

4.6 Parallel Coordinates chart

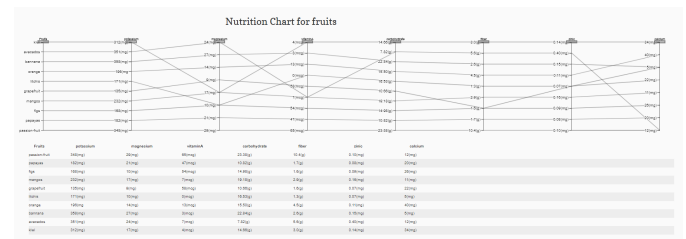


Fig. 6. Nutrition charts for fruits.

The parallel coordinate chart is used to represent the Standard Nutrition information for fruits. Here we are concentrating on nutrients which are deficient. The table along with parallel coordinate chart provides the best form of representing nutrition information as per design decision. Parallel coordinate charts provide ways to represent data in different units and at the same time allows the user to compare similar attributes. By brushing through the pillars in the chart we can filter data in the table and concentrate on the nutrients which are above certain level. By hovering over rows in the table the data related to fruit will be highlighted in the parallel coordinate chart.

4.7 Horizontal bar chart

The horizontal bar chart is used to present the contribution of fruits to the Nutrients which are deficient. By clicking on the Fruits from the table in the parallel coordinate chart(Fig 6) the data in the horizontal bar chart updates automatically. The Bars represent nutrients which are deficient and by hovering over the bar after selecting the fruit we can understand how much percentage the selected fruit can contribute to the nutrients which are deficient

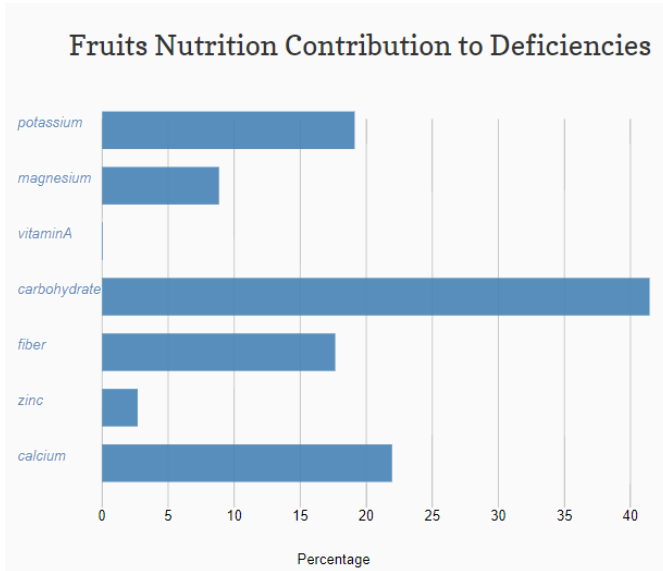


Fig. 7. Fruits Nutrition Contribution .

5 ANALYSIS

We analyze the nutritional fact system using the what/why/how framework, defined by Munzner. This framework can be used for visualizing any form of data.

5.1 WHAT: Data

The datasets used across the system where in .csv, .tsv and .json format and was a two-dimensional table. There are 2 major datasets used in this system one which contains the information about nutrition intake of Whites, Blacks, and Hispanics over a period of 13years (2001-13) and the other dataset contains the information about the nutritions in fruits. The dataset used here has static information. The attributes in one of the data sets are type (Whites/Blacks/Hispanic), year, and their respective 26 nutrients consumption values. And in the other data set the attributes are the type of fruit and the contribution of that fruit in 7 deficient nutrients.

5.2 WHAT: Derived Data

We used aggregation to get the required data for the visualization though the attributes were quantitative. We calculated/derived few values for the visualizations like horizontal and vertical bar charts. Average deficiency for each nutrition in each race, the deviation from the standard value for each race in each nutrition, average deficiency across all the races, percentage of nutrition contributed by each fruit to the nutrition deficiencies values are the derived attributes used across the system.

5.3 WHY: Tasks

This system helps people to answer questions like Do the Non-Hispanic Blacks, Non-Hispanic Whites, Hispanics have deficiencies in the Nutrition intake due to food consumption habits, what are the Nutrients which are deficient across all the races, can fruits contribute to fulfill the deficiencies, what is the Nutrition value of different fruits and how much can fruits contribute to fulfill the nutrition deficiency? All these can be obtained by letting the user interact with the system by hovering or selecting the required data set from the tables that represent the standard nutrition and in few visualizations like multi-line chart and parallel coordinate chart which helps users to perform comparison operations with the attributes across various data sets.

5.4 HOW: Encode

We used color coding to represent the data for different races like Non-Hispanic Blacks, Non-Hispanic Whites, Hispanics in the multi

line chart(Fig 3) which represents the trends of nutrition consumption over a period of 13 years. And the same color coding is maintained in the horizontal bar chart(Fig 4) with positive negative scales which represents the deviation value from the standard value for each race in each nutrition. This helps the user to compare and analyze the information represented in the visualizations. Users are also given the option to select the nutrition/fruit from the tables and brush feature in multi line chart and parallel coordinate chart helps the user to compare only the required information. In our system we used tables, multi line chart, horizontal bar chart with positive negative scales, vertical bar chart, parallel coordinate bar chart, normal horizontal bar chart.

5.5 HOW: Manipulate

Manipulate In the table for the standard nutrition user can select the nutrition and the respective data for the different races is updated in the multi line chart(Fig 3) and the horizontal bar chart(Fig 4) with positive negative scales. User can also use the brush effect in the multi line chart to get the trends in different races for the required duration. By hovering over the bar charts the value of the respective attribute is displayed. In the table for the fruits and its nutrition values user can select any fruit and the horizontal bar chart(Fig 7) will be updated with the data which represents the percentage coverage of different nutrients by that fruit. User can also use the brush effect in the parallel line chart(Fig 6) to compare or filter the fruits for the required fields.

System	Nutritional Facts
What: Data	.csv format (2-dimensional data)
Why: Task	Identify and compare, trend, and distribution
How: Encode	Multiline chart
How: Manipulate	Brush, select

Table 1. What/Why/How framework for Multi-line chart

System	Nutritional Facts
What: Data	.json format (2-dimensional data)
What: Derived	the deviation value from the standard value for each race in each nutrition
Why: Task	Identify and compare
How: Encode	Horizontal bar chart with positive negative scales
How: Manipulate	Hover

Table 2. What/Why/How framework for Horizontal bar chart with positive, negative scales

System	Nutritional Facts
What: Data	.tsv format (2-dimensional data)
What: Derived	average deficiency across all the races
Why: Task	Identify
How: Encode	Vertical bar chart
How: Manipulate	Hover

Table 3. What/Why/How framework for Vertical bar chart

System	Nutritional Facts
What: Data	.csv format (2-dimensional data)
Why: Task	Identify and compare, trend, and distribution
How: Encode	Parallel coordinate chart
How: Manipulate	Brush, select

Table 4. What/Why/How framework for Parallel coordinate chart

System	Nutritional Facts
What: Data	.tsv format (2-dimensional data)
What: Derived	Percentage of nutrition contributed by each fruit to the nutrition deficiency's
Why: Task	Identify
How: Encode	Horizontal bar chart
How: Manipulate	Hover

Table 5. What/Why/How framework for Horizontal bar chart

6 INSIGHTS OR CASE STUDY

Through the related work, we observed that around 1995 USDA observed there is a deficiency of calcium among US citizen. By analyzing the nutrition intake pattern from 2001 to 2013 we observed that still there is a deficiency of calcium by 10(percent). Along with calcium deficiency of nutrition consumption was observed across carbohydrates, fibers, Vitamin A, magnesium, zinc, potassium. After analyzing the nutritional information of fruits, we observed at most one fruit can contribute to the nutrient which is deficient by fifty percent. We observed Vitamin A deficiency cannot be filled by consuming fruits. Fruits can be considered as the best source to fill the fiber deficiency since passion-fruit per 100 grams can alone cover the fiber deficiency.

7 CONCLUSIONS

Through this visualization we analyzed Nutrition consumption patterns cross three different races and at the same time we narrowed down the Nutrients which are deficient. Through the derived data from Fig 2, Fig 3, Fig 4 we observed the nutrients which are deficient in the three races through Fig 5. We considered fruits as a factor to fill the nutritional deficiency and observed how fruits can contribute to compensate the deficiency through Fig 6 and Fig 7.

8 FINAL THOUGHTS

We learned D3.js and NVD3.js through the visualizations. we performed the unit test as a user to check if the Visualization would make any sense and made the changes accordingly. The course work and the learning materials helped us along the process as it broke down the project into small chunks which helped us to design the flow of the project

REFERENCES

- [1] Food composition database. <https://ndb.nal.usda.gov/ndb/foods/>.
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- [4] Usda nutrition report. <https://www.ars.usda.gov/ARSEUserFiles/80400530/pdf/tronm.pdf>.