

International Journal of **Health Sciences** (IJHS)

**Addressing Health Disparities using Social Determinants of Health:
A Descriptive Analytics Approach**



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Addressing Health Disparities using Social Determinants of Health: A Descriptive Analytics Approach

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Accepted: 17th Feb 2024 Received in Revised Form: 3rd Mar 2024 Published: 19th Mar 2024

Abstract

Purpose: This paper explores Social Determinants of Health (SDOH) data and its implications using descriptive data analytics. The analysis aims to help healthcare organizations understand the trends and impact on the industry and develop strategies to resolve disparities and eventually reduce healthcare costs.

Methodology: This paper uses descriptive data analytics to analyze Social Determinants of Health (SDOH) data and its implications. The study focuses on the Centers for Disease Control and Prevention's (CDC) five critical areas of SDOH: healthcare quality and access, education quality and access, economic stability, social and economic context, and built and neighborhood environment.

Findings: Health equity remains a significant challenge in the world and the United States, with persistent inequalities and injustice among different populations. Failure to address health equity issues could lead to social problems, including violent crimes, alcohol, and substance abuse, and potentially a global pandemic, which could significantly impact healthcare systems and increase costs. According to a report published by Deloitte, inequities in the United States cost more than 300 billion dollars in 2022. If not addressed, they could account for more than a trillion dollars in annual spending by 2040. Social Determinants of Health (SDOH) are critical in providing health equity and reducing disparities.

Unique Contribution to Theory, Practice, and Policy: Understanding the implications and trends of SDOH data is crucial in developing targeted strategies to achieve health equity for all. Healthcare organizations can use this analysis's findings to establish policies and practices that address social determinants of health and reduce disparities. This, in turn, will help improve overall health outcomes and reduce healthcare costs.

Keywords: *Healthcare, Health Quality, Infectious Disease, Substance Abuse, Alcohol Abuse, Health Disparities, Data Analytics, Descriptive Analytics.*

I INTRODUCTION

SDOH plays a vital role in resolving health inequities, which will eventually help improve health outcomes and reduce healthcare costs [12]. SDOH can directly impact healthcare costs, with inequalities in access to healthcare, education, and economic and social context leading to increased healthcare utilization and costs. People with lower income and education could have a higher prevalence of chronic diseases, leading to higher healthcare utilization and costs. Due to the inequity in healthcare access, people's timely treatments could be delayed, resulting in more complex health outcomes, and eventually increasing the healthcare costs. Hence, it is very critical to address the SDOH to reduce healthcare care costs while improving the health outcomes of the communities.



Figure 1: Social Determinants of Health [2]

Based on the reports published by the White House, SDOH can account for close to 50% of the health outcomes in communities at the county level [3]. In this Economic Stability, Social and community factors and education impact health outcomes most. Based on the statistical report published by the National Institute of Health, out of the Population with chronic conditions, nearly 36.71% had insecurity with housing, while 31% had experienced insecurity with food [4]. According to the United States Department of Agriculture, with the increase of insecurity in food access, the prevalence of Chronic conditions like hypertension, diabetes, Arthritis, Asthma, and COPD increased [5].

II METHODOLOGY:

We will use descriptive statistical techniques to explore SDOH data and its impacts. Descriptive Analytics is a type of data analysis that analyzes historical data and identifies trends, patterns, and relationships within the datasets. It provides a statistical summary of the data not only for numeric but also for the categorical dataset. Descriptive statistics describe the dataset's features like

dispersion, shape, distribution, mean, median, and mode. Descriptive data analytics helps summarize large sets of complex data into simple presentable measures, which end users can easily consume for decision-making. In a nutshell, descriptive analytics' primary goal is to tell what happened in the past and how it will impact the present.

This paper will primarily focus on using data visualizations to analyze the data to identify trends, relationships, and patterns. For data analysis, we will use SDOH data from the AHRQ's (Agency for Healthcare Research and Quality), which contains the county-level social determinants of health (SDOH) measures from the American Community Survey and five years of data from the entire United States [8]. We will explore various data visualization elements, some of which are below.

A. Charts: These are visual representations of numerical or categorical data in an organized manner for

easy end-user consumption. There are various charts available for specific reasons. Below are some of the commonly used charts with definitions.

- **Pie Chart:** A circular statistical graphical representation illustrates the numeric proportions of a given data set by dividing into different slices.
- **Area Chart:** It is a visual representation of quantitative data. This uses line charts and areas to represent the information about the data.
- **Gauge Chart:** Also known as dial charts or speedometer charts, use a needle to show information as a reading on a dial.
- **Gantt Chart:** It is a bar chart commonly used to visually represent the dependencies between activities at any time. It is commonly used in project management.
- **Bubble Chart:** It is an extension of the scatter plot, which represents the relationship in three-dimensional ways.
- **Column Chart:** It visually represents data in vertical or horizontal rectangular proportions, representing the values.

B. Graphs: These are visual representations of numerical data showing the relationship between the numeric variables. They are specific types of charts. Graphs primarily focus on raw data and show trends over time. Below are some of the commonly used Graphs with definitions.

- **Line Graphs:** It visually represents information changing over time.
- **Histogram:** It is a graphical representation of data in rectangles, which should show the frequency distribution of the variable.
- **Scatter Graph:** Also known as a Scatter plot, a graph typically uses two coordinates to represent the values of two variables from the data set.

- **Exponential Graphs:** It is a graphical representation of a curve representing the exponential function. An exponential curve starts as a horizontal line and either increases or decreases slowly by transforming into a curved line.

C. Tables: They represent data in the raw format split into columns and rows. They organized the data in a structured way, which helped the end users to see the results quickly. There are three different types of tables used in Business intelligence. Below are the details.

- **Vertical Table:** Usually has all the headers in the first row, with each column representing unique data attributes in the table.
- **Horizontal Table:** Usually has all the headers in the first column, with a row representing a unique data attribute in the table.
- **Cross Table:** This combines horizontal and vertical tables, representing dimensions in the first row and first column and related metrics within the table's cross-section.

D. Infographics: An infographic is a collection or combination of images and data visualization elements like charts, graphs, or maps with texts to provide an overview of the data, an easy and powerful way to communicate to the end users [7].

E. Maps: It is a visualization used to analyze geographically related data and combine them to visualize in a Map. There are many types of maps to visualize geospatial data. Below are some commonly used maps with definitions [6].

- **Point Maps:** A map primarily used to display related to a specific location or individual points on the maps. This is usually used to display hospitals, stores, locations of earthquakes, or specific places of interest.
- **Proportional symbol map:** It is an extension of Point maps where quantitative data can be represented relating to a specific location. For example, hospitals with ER admission rates, earthquakes with magnitudes
- **Choropleth map:** This is one of the most used types of maps. The maps are separated by areas using the county or CBSA (Core Based Statistical Area) and then filled with different colors or shared to represent the proportion of data, variables, or data groups.
- **Flow maps (path maps):** Also known as path maps, are types of specialized line maps. It usually connects paths across a map to visualize where some things traveled over time. They are used to follow bird or animal migrations, flight paths, storm paths, trade paths, or even vehicle traffic.
- **Spider maps (origin-destination maps):** Is a type of flow map with some variations. This shows how an origin location and one or more destination locations interact.

We have used the bubble chart to represent the prevalence of SDOH in % by categories combined for all the states in America. Racial or Ethnic Status, Poverty, Housing Cost, Aged population, and no internet connections are the top 5 SDOH categories.

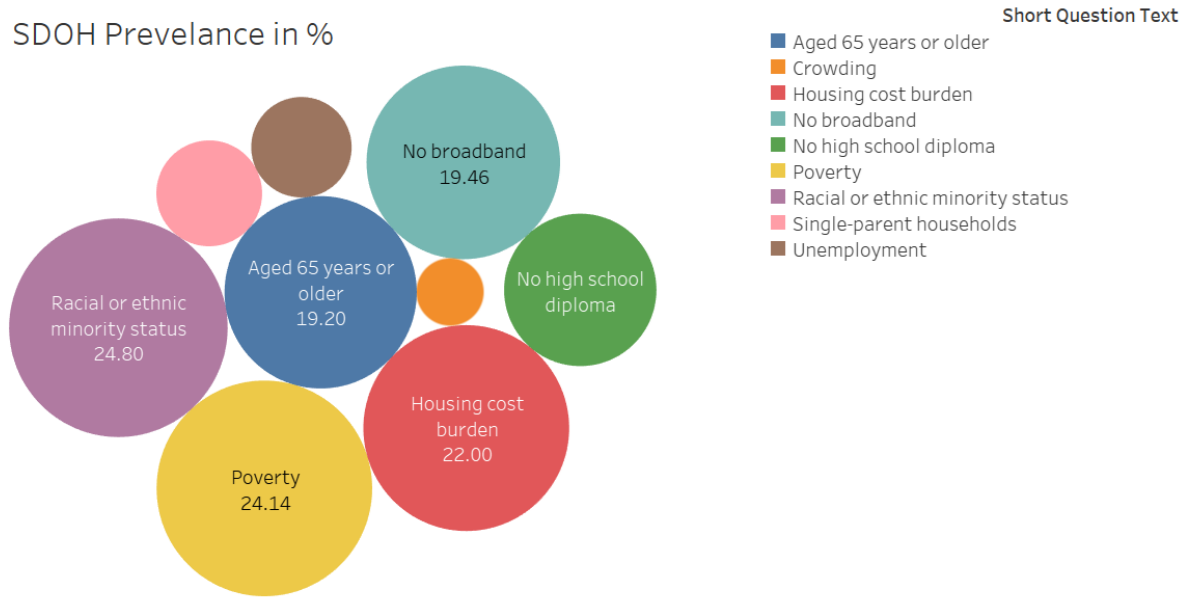
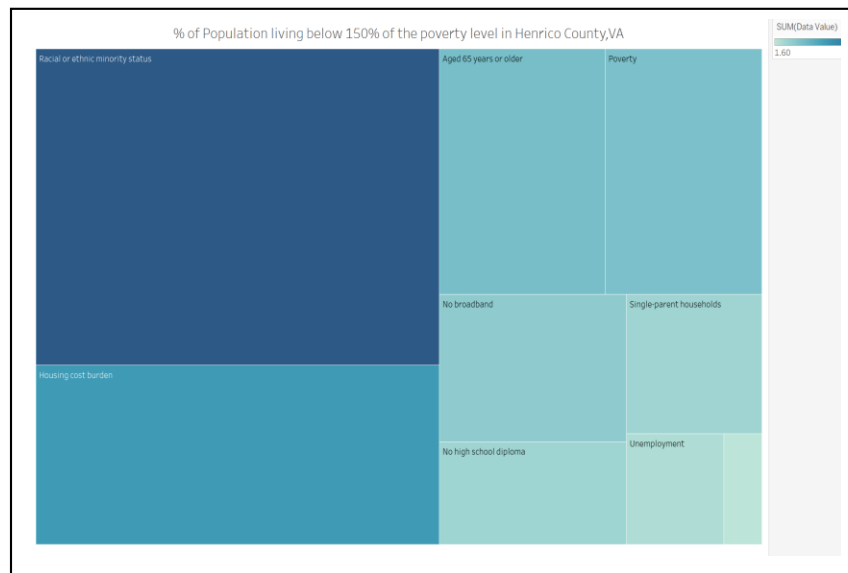


Figure 2: SDOH Prevalence in %



We are using Treemaps to visualize the SDOH data for the Henrico County, Virginia State, population living 150% below the poverty level. Treemaps represent the data using nested rectangles to display the relative size of the category or subcategory. The biggest rectangle represents the highest category values; in this case, it is Racial or ethnic minority status. The smallest rectangle represents the lower category values, that being unemployment.

Figure 3: % of the Population living below 150% of the poverty level.

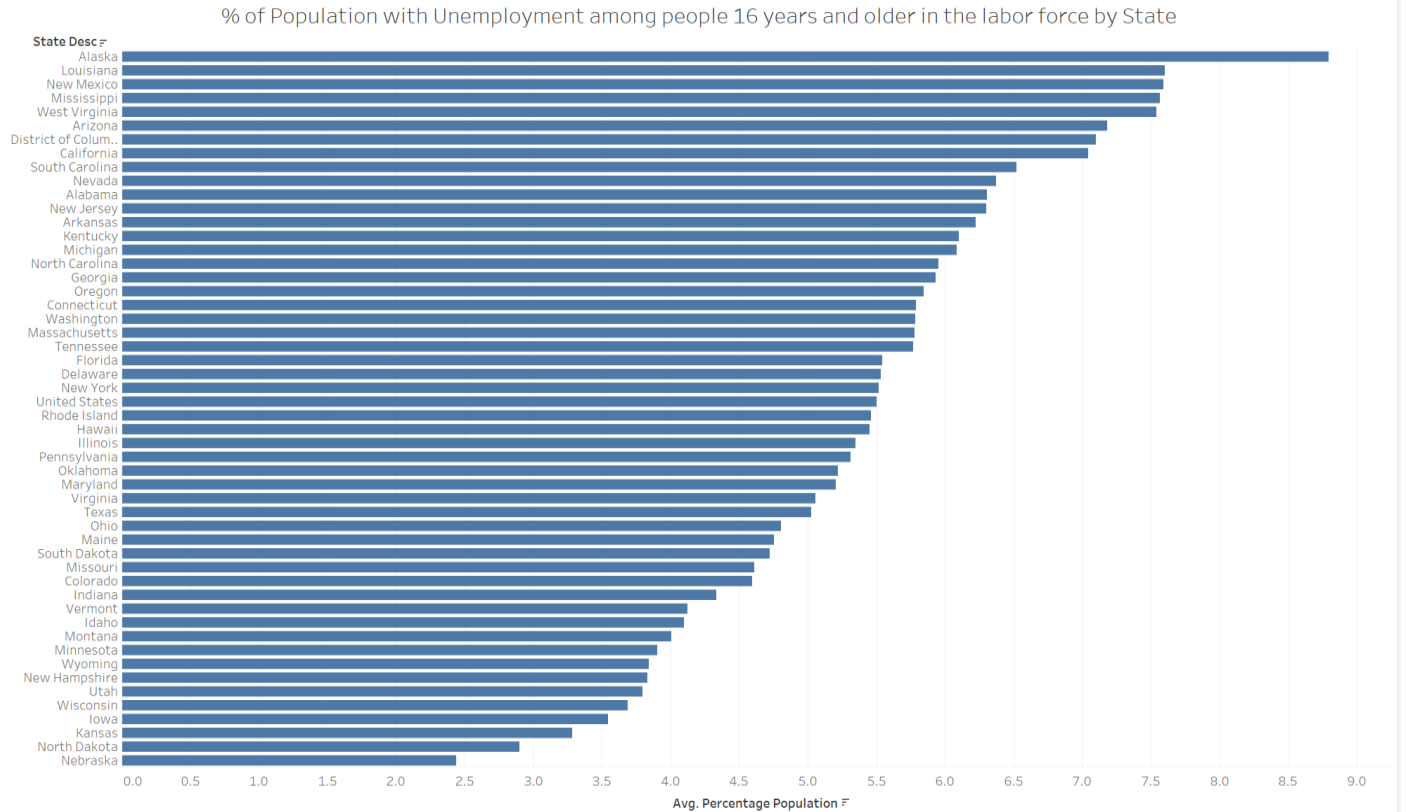


Figure 4: % of the Population with unemployment among people 16 years and older

In the above Visualization, we use the horizontal bar graphs to represent the SDOH category, % of the population with unemployment by state. The highest percentage by state sorts the graph. Using this data, we can conclude that Alaska has the highest unemployment issues, contributing to the SDOH. In contrast, Nebraska has unemployment as the least contributing factor for SDOH compared to all other states in America.

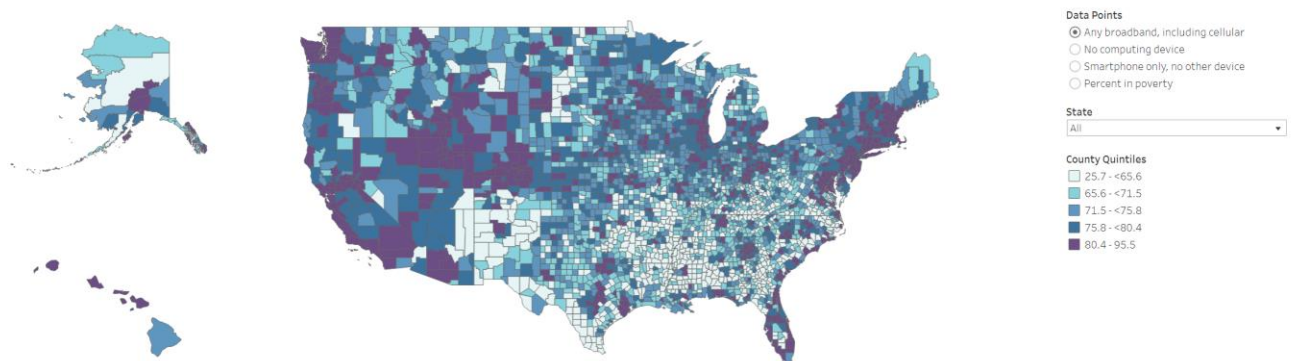


Figure 5: Broadband/Cellular Internet Access across the USA [11]

The above map provides the county-level details of the households with internet access through broadband or a cellular network. In this digital age, Internet access is critical, as most healthcare activities like booking appointments, telemedicine, Live Health Online, and accessing test results have moved to digital. The Internet has become a necessity with the onset of covid 19 pandemic. Using the above data, we can see which population has the least internet access, represented by a lighter color.

III. FINDINGS:

Descriptive data analytics has broad applications across various organizations. Below are some of the use cases:

A. Financial Reporting in the Banking and Finance Industry

Financial reporting is critical in the Banking and financial industry as it shares the financial data with the internal and external stakeholders. Internal financial reports are either built as financial or CFO dashboards consisting of various KPIs metrics, different visualizations, and infographics [10]. These dashboards identify trends, understand the cash flow, budget, and forecasting, and improve operational efficiency. In summary, financial reports are critical for the success and sustainability of an organization.

B. Reports in the Hospitality Industry

The findings of this study agree with previous literature regarding the importance of data visualization in the healthcare industry. According to Lee et al. [13], data visualization enables hospitality professionals to display complex data sets in a simple and easy-to-understand format, enabling them to make data-driven business decisions. Similarly, Kim et al. [14] found that data visualization can help hospitality businesses optimize their marketing strategy by identifying trends and patterns in customer behavior and preferences. Xiang et al. [15] also observed that data analytics can help the hospitality industry identify operational inefficiencies and optimize their processes, resulting in cost savings and improved profitability.

C. Reporting in Energy Sector

The findings of this study agree with previous literature regarding the importance of data visualization in the healthcare industry. According to the study by Viegas et al. [16], data visualization is an effective tool for analyzing and displaying complex energy data, identifying inefficiencies, and making data-driven decisions. Similarly, the study by Zhang et al. [17] found that visualizing energy consumption patterns can help identify areas that require improvement, leading to energy savings and improved operational efficiencies. Moreover, the study conducted by Li et al. [18] also supports the importance of data visualization in the energy industry, stating that it enables energy managers to identify patterns and trends in energy consumption, track energy savings, and optimize energy usage. Therefore, visualizing energy data can be an effective way to

identify areas for improvement and make informed decisions to optimize energy consumption patterns and ultimately reduce energy costs.

D. Identify high-risk populations and the development of targeted interventions for them:

Data Analytics plays a critical role in utilizing the SDOH data to identify the high-risk Population and using the visualizations with top contributing SDOH factors for a given location. Utilizing this data, the Healthcare system can analyze the Population at risk of developing chronic conditions and plan for targeted intervention to address the specific needs of this Population. For instance, providing healthy food options for poverty and food insecurity populations can help lower the risk of chronic diseases like Diabetes and Heart problems.

E. Trends and patterns identification of SDOH issues over time:

Various studies have shown that data visualization can effectively analyze trends and patterns in healthcare data. A study conducted by Doker et al. [19] found that line charts were particularly effective in visualizing trends in healthcare data. Similarly, a study by Lurie et al. [20] found that data visualization helped identify patterns in healthcare data related to social determinants of health. The findings from the text agree with previous studies. Data visualization can help healthcare organizations identify trends and patterns in social determinants of health factors like poverty, education, housing cost burdens, and unemployment, which can help them prioritize and focus on addressing these issues more effectively.

F. Enhance Patient Outcome:

A growing body of literature supports the idea that SDOH data can be combined with clinical data to identify populations at risk of developing chronic conditions [21][22]. For instance, a study by Berkowitz et al. found that food insecurity was associated with an increased risk of hospitalization and emergency service use [23]. Similarly, a study by Gottlieb et al. found that social needs were associated with a higher likelihood of missed appointments and medication non-compliance [24]. Regarding the use of visualizations to identify relationships between SDOH data and clinical data, Krieger et al. found that heat maps were effective in identifying areas of high disease burden and social disadvantage [25]. Booske et al. found that scatter plots and line charts were effective in identifying relationships between poverty and health outcomes [26]. Overall, the findings in the provided text agree with previous studies that suggest SDOH data can be used to identify populations at risk of developing chronic conditions and that visualizations are effective in identifying relationships between SDOH data and health outcomes.

G. Reduce Healthcare Costs:

The findings presented in the text are consistent with previous literature that has identified social determinants of health (SDOH) as significant risk factors for high healthcare resource utilization and costs [26]. Studies have shown that individuals living in poverty, experiencing food insecurity, lacking education, and facing housing problems are at higher risk for developing chronic

conditions and requiring high levels of healthcare services [27][28]. Moreover, previous literature has suggested that addressing SDOH can improve health outcomes and reduce healthcare costs [29][30]. Therefore, healthcare organizations need to utilize descriptive data analysis to understand the trends and patterns of SDOH in their patient populations and develop targeted strategies and interventions to address these issues [31].

V RECOMMENDATION:

Based on the findings from the analysis of Social Determinants of Health (SDOH) data, healthcare organizations should establish policies and practices that address social determinants of health to reduce disparities and improve overall health outcomes. The study highlights the need for targeted strategies to achieve health equity for all, focusing on the Centers for Disease Control and Prevention's (CDC) five critical areas of SDOH. Healthcare organizations should prioritize improving healthcare quality and access, education quality and access, economic stability, social and economic context, and built and neighborhood environment. By addressing these critical areas, healthcare organizations can help reduce healthcare costs, promote social justice, and prevent social problems such as violent crimes, alcohol, and substance abuse. Healthcare organizations must work collaboratively with policymakers, community-based organizations, and other stakeholders to develop effective strategies that address social determinants of health and reduce health disparities.

VI CONCLUSION:

In conclusion, Data Analytics is a vital tool for addressing health disparities and understanding the Social determinants of health that contribute to them. By analyzing the data on some of the significant SDOHs like poverty, education, food insecurity, housing cost burden, and transportation, we can identify some patterns, trends, or gaps that can be leveraged by the healthcare organization for interventions. Data visualization can help us identify the risky population, the major contributors to the risk, and what interventions are adequate to mitigate such risks. Reducing the risks also helps us reduce healthcare costs. Ultimately, we can build equitable and just healthcare systems with the collaborative use of data analytics and SDOH data.

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