WHITEPAPER

How can healthcare orgs leverage public datasets and AI to understand member's health?

INTRODUCTION

The social determinants of health (SDOH) are the non-medical factors that influence health outcomes. They are the conditions in which people are born, grow, work, live, and age, and the broader set of forces and systems shaping the needs of daily life. These include economic policies and strategies, development agendas, social norms, social policies, and political systems. SDOH affects roughly 70% of health outcomes. [1]

SDOH include:

Figure 1: Social Determinants of Health

While 95 per cent of U.S. health expenditures go toward medical care, most experts have long agreed that medical services have a limited impact on health and well-being.[2] So, healthcare organizations are looking for ways to improve members health and save costs by addressing needs beyond medical alone. As care shifts from situational to value-based care, whole-person health becomes paramount. To achieve this goal, understanding the community of the members/patients and the challenges they face in these communities is critical.

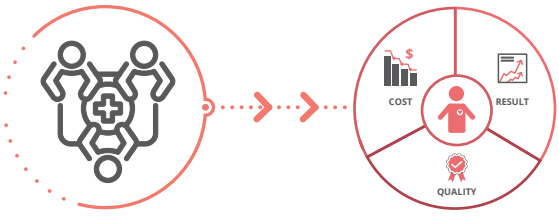

Figure 2

In the U.S., multiple government and non-government organizations collect data and compile indicators at the county and/or zip code level that can be leveraged to understand the communities. In this paper, we will explore two such indicators:

Figure 3

We will explore how organizations can use these two indicators to know more about communities and the potential health conditions of people who live in these communities.

Social Indicators

Social Vulnerability Index (SVI) [3]

Social vulnerability refers to the potential adverse effects on communities caused by external stresses on human health. Such stresses include natural or human-caused disasters or disease outbreaks. SVI ranks counties based on how vulnerable the population living in those counties is during such events. Reducing social vulnerability can reduce both human suffering and economic loss. SVI ranges from 0 (least vulnerable) to 1 (most vulnerable).

Retail Food Environment Index (RFEI) [4]

RFEI is a ratio of the total number of grocery stores vendors in a county compared to fast-food restaurants and convenience stores. RFEI ranges from 0 (poor food environment) to 10 (best food environment).

Here are the key health related measures used for the analysis:

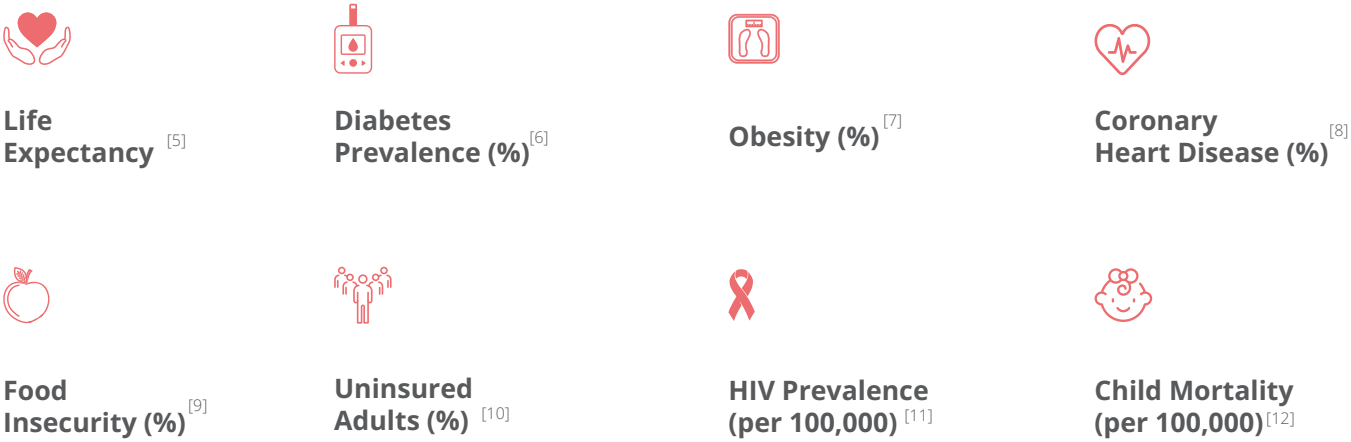

Figure 4

Except for life expectancy, for all other measures, lower values correspond to better health. For life expectancy, higher values correspond to better health.

METHODOLOGY

To analyze and identify the relationship between SVI, RFEI and health-related indicators in counties:

- Extensive exploratory data analysis was performed, and visualizations such as box plots and heat maps were created.
- Pearson's correlation was calculated between SVI and each indicator to evaluate the linear relationship between them. The same was repeated for RFEI. A relationship is linear when a change in one variable is associated with a proportional change in the other variable.
- K-means clustering (an unsupervised AI algorithm) was applied to cluster the counties into groups. The value of K was selected based on the elbow method.

OBSERVATIONS

Social Vulnerability Index (SVI)

Figure 5 below shows Pearson's correlation between SVI and health indicators at the county level. As you can see, there is a significant positive association between SVI and all the indicators. This implies that people living in counties with higher SVI are at higher risk of health-related issues.

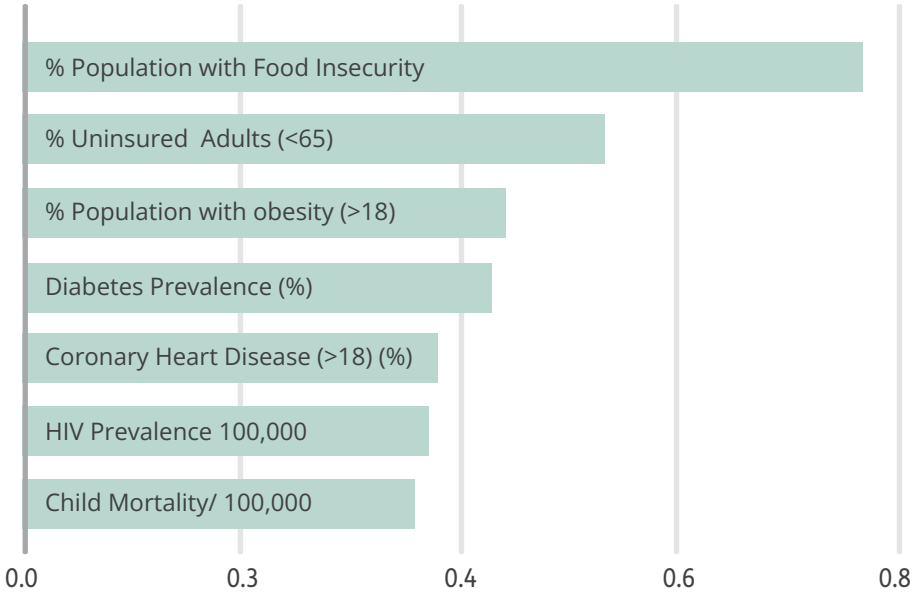

Figure 5: Pearson's correlation of community health related metrics with SVI

Extending the analysis, we used K-means clustering algorithm and clustered US counties into three clusters based on varying SVI and created a heat map as shown below.

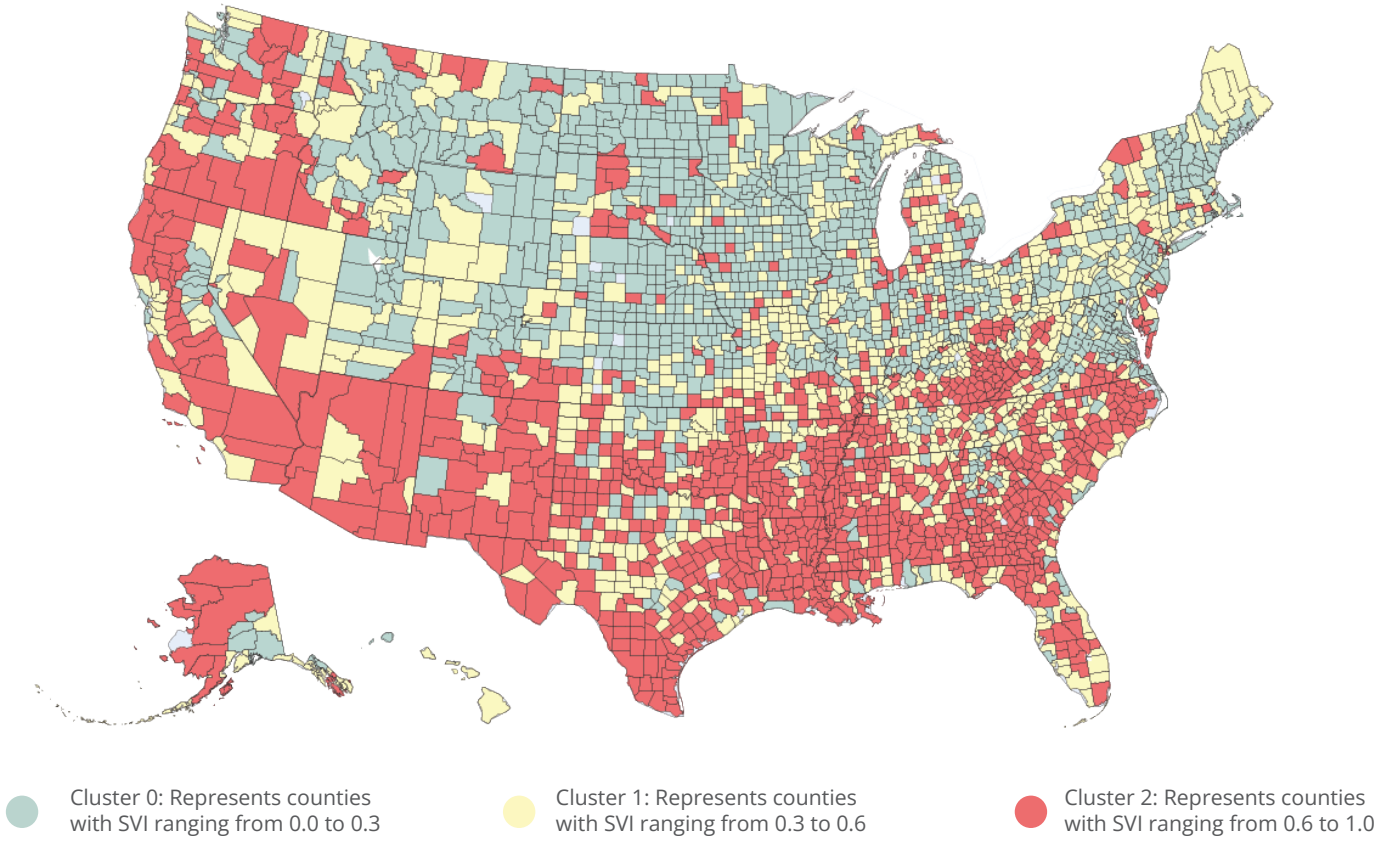

Figure 6: Heat map of counties based on SVI

Below are box plots between SVI clusters and health related indicators. The median, 25th, and 75th percentile values increase for all the health-related indicators as we move from cluster 0 (low SVI) to cluster 2 (high SVI).

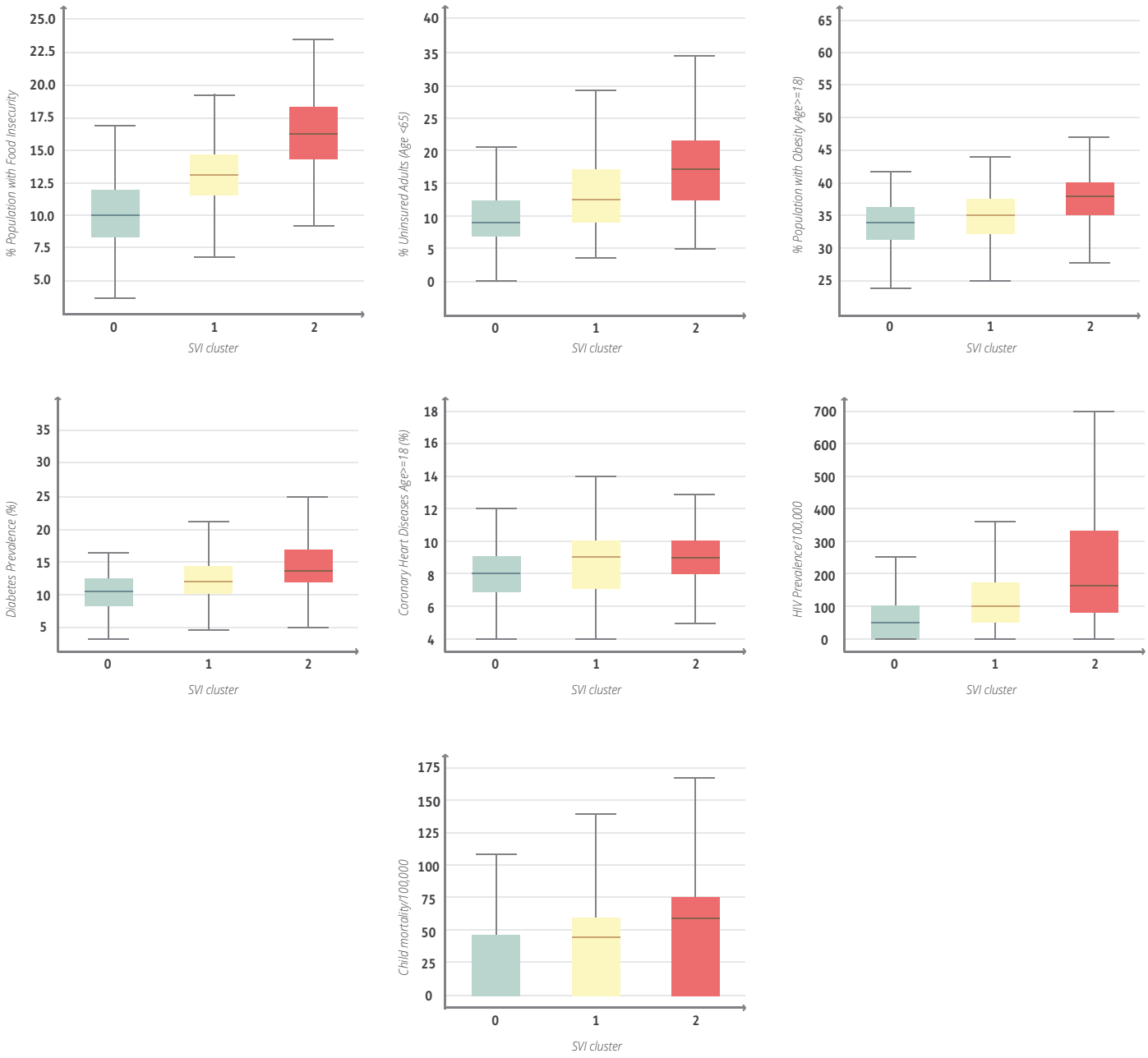

Figure 7: Box plots of health indicators across clusters of SVI

Key Insights

Average child mortality more than doubles from cluster 0 to cluster 2

Average HIV prevalence increases threefold as we move from cluster 0 to cluster 2

Average diabetes prevalence increases by 32% as we move from cluster 0 to cluster 2

The above analysis demonstrates that people living in counties with higher SVI have higher chances of experiencing health-related issues than those living in counties with lower SVI.

OBSERVATIONS

Retail Food Environment Index (RFEI)

If a county is assigned a low RFEI score, it indicates a lower concentration of healthy food outlets and higher concentration of fast-food centers and convenience stores in that county. People living in counties with low RFEI are more likely to eat unhealthy food and at a higher risk of food-related health issues. The reverse is true for people living in counties with higher RFEI values.

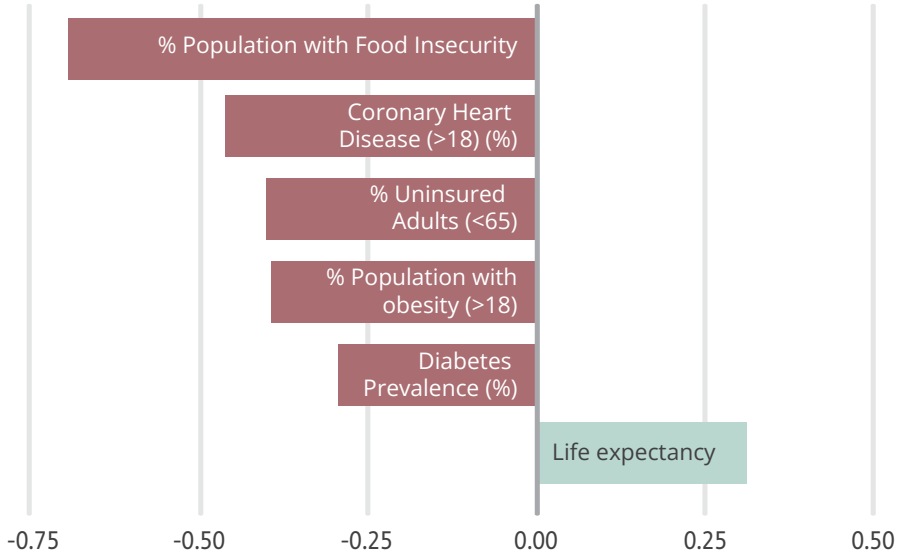

Figure 8: Pearson's correlation of community health related metrics with RFEI

Figure 8 above shows Pearson's correlation between RFEI and health-related indicators at the county level. As you can see, there is a significant negative correlation between RFEI and all the indicators, suggesting that people living in counties with high RFEI have a potentially lower incidence of food-related health issues.

Extending the analysis, we used K-means clustering algorithm and clustered US counties into three clusters based on varying RFEI and created a heat map as shown below.

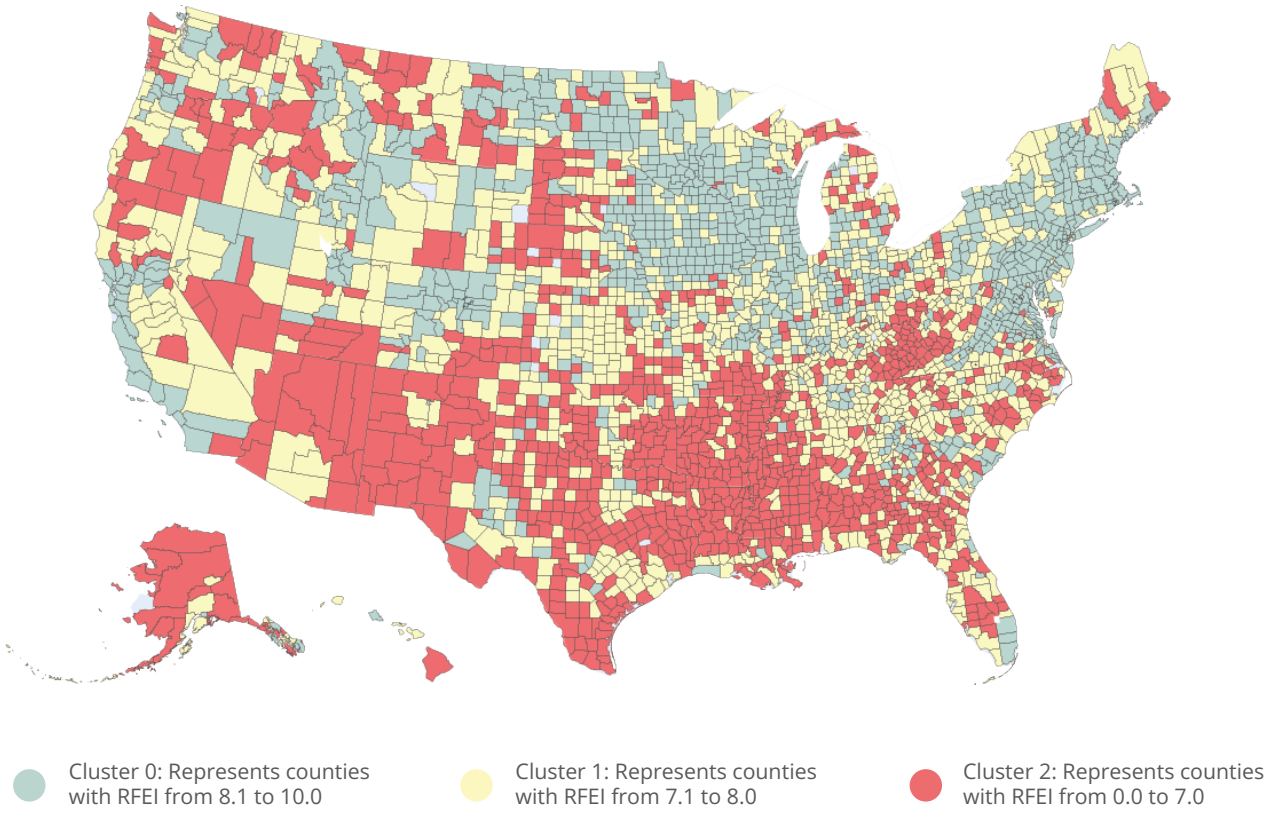

Figure 9: Heat map of counties based on RFEI

Below are box plots between RFEI clusters and health related indicators. From these box plots, we see clear trend across clusters. The median and 25th and 75th percentile values are increasing (worsening) for all health-related indicators except for life expectancy (decreasing which means worsening) as we move from cluster 0 (high RFEI) to cluster 2 (low RFEI).

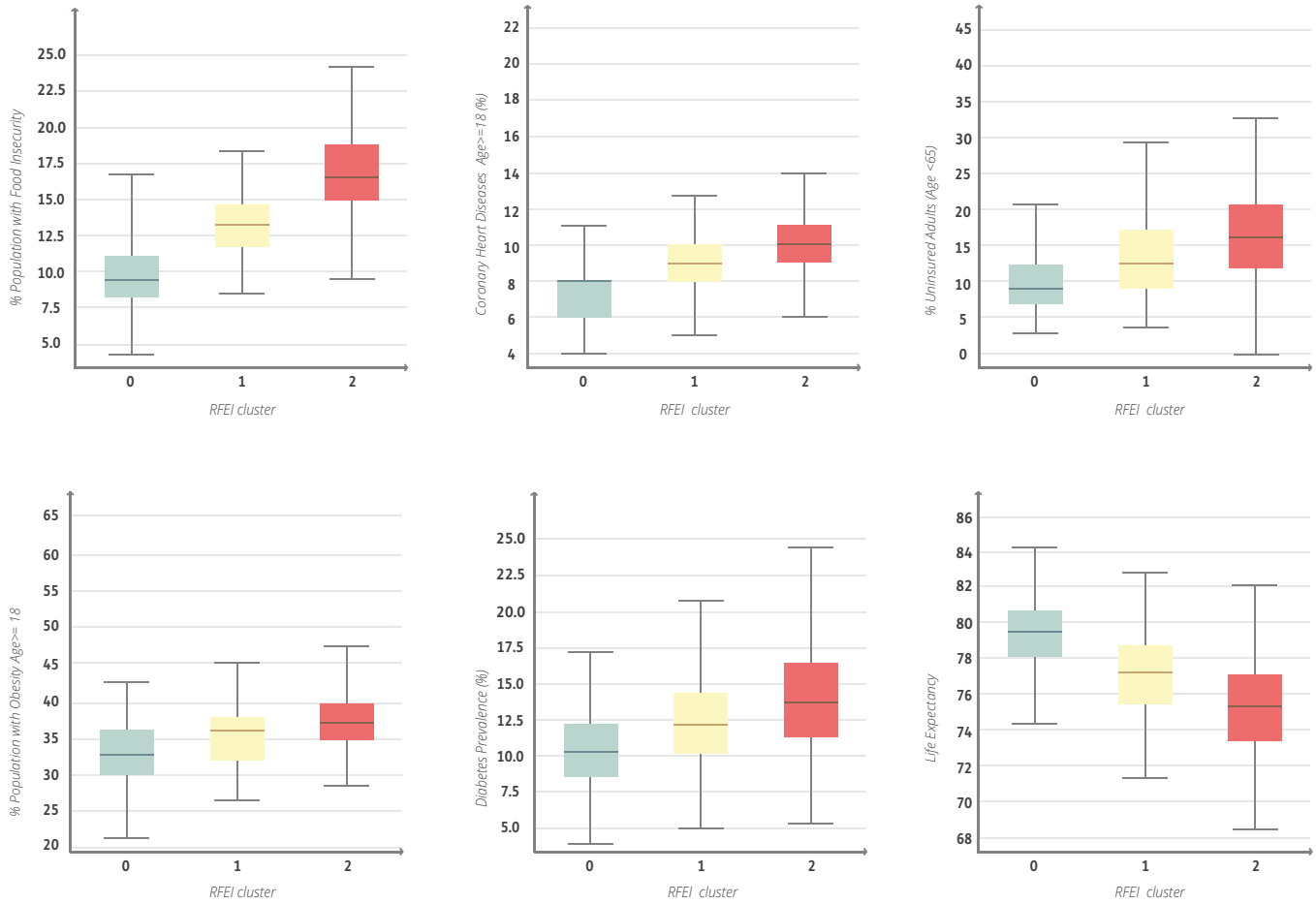

Figure 10: Box plots of health outcomes across clusters of RFEI

Key Insights

Average food insecurity increases by 75% as we move from cluster 0 to cluster 2

Average coronary heart diseases among adults increase by 31% as we move from cluster 0 to cluster 2

Average uninsured adults increase by 67% as we move from cluster 0 to cluster 2

The above analysis demonstrates that people living in counties with lower RFEI have higher chances of experiencing health-related issues than those living in counties with higher RFEI.

CONCLUSION

While the healthcare organizations want to use public and third-party datasets to aid in their strategy, they are usually unable to derive actionable insights from it.

This research demonstrates how various stakeholders in the healthcare industry can leverage public datasets and use them to solve complex use cases. Below listed are a few examples:

- Organizations can create programs and interventions best suited to specific geography. For example, a player operating in a county with low RFEI can make plans to tackle the high rate of obesity and coronary heart diseases in that area. They can deploy resources (capital/staff) in the regions that need them the most.
- Screening every member/patient of an organization is capital intensive and time-consuming. Organizations can use this research to select screenings for specific geographies and members.
- Organizations can decide which markets/geographies to expand their operations into and what to expect.

While the above research is based on publicly available datasets, Fractal can customize and expand the research based on specific organization's needs, membership's/ patient's characteristics, and geographies in which an organization operates. Fractal brings experts in healthcare, AI, Engineering, and Design to innovate on behalf of the organization and solve complex business problems at scale.

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