

EXPLORING HIGH BLOOD PRESSURE PROCLIVITY

PRACTICAL LAB #4



Lindsay Chu

April 7, 2021

OBJECTIVE: Identify the at-risk individuals and co-morbidities (related ailments) associated with high blood pressure by segmenting a health dataset of 15,420 records.

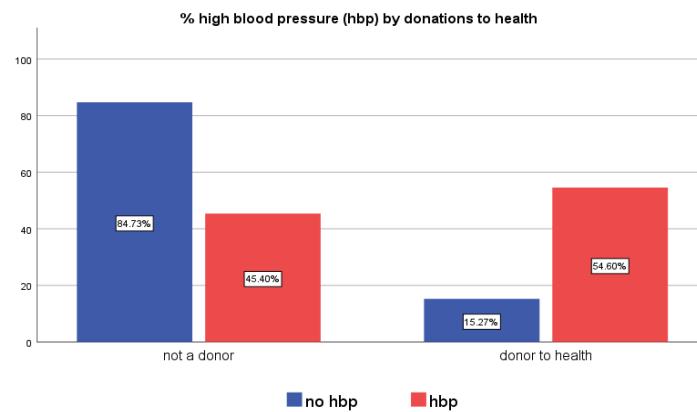
- **Why high blood pressure?** This condition not only runs in my family, but across the US. Nearly half of the population experiences hypertension (defined by the CDC as blood pressure $\geq 130/80$ mm Hg) and heart-related conditions are among the country's leading causes of death. By analyzing a diverse array of demographic data, I hoped to uncover some unexpected social factors that may influence or are associated with this incredibly common health risk.

PROCEDURE:

To better understand HBP and non-HBP profiles, I created a Factor Tree diagram. This method was interesting to analyze, because I could observe high blood pressure and its interactions, or branches into different social factors.

FINDINGS:

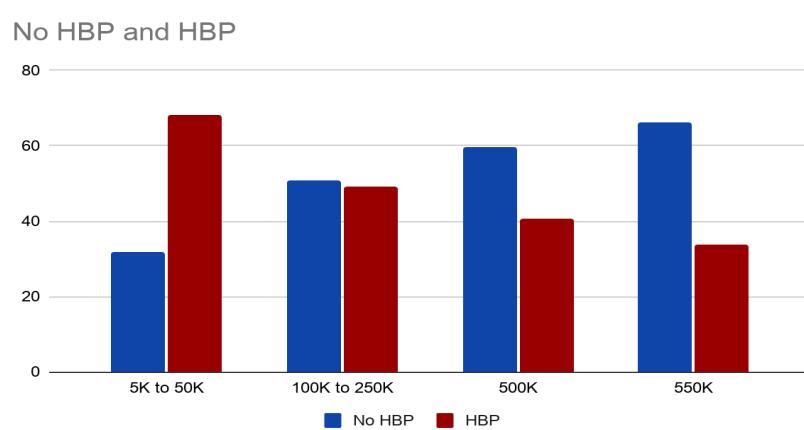
Health donors: Just as discussed in Practical Lab #2, my factor tree analysis affirmed that people without high blood pressure generally did not donate to health causes. Maybe people can only empathize if they have also suffered, because it appears people don't tend to take action unless they or people they know are directly affected.



Interestingly, within the non-donating group, there was an association with **osteoporosis**, a bone-weakening condition. Of those with osteoporosis, **62% also have high blood pressure**. This was the first comorbidity I encountered, and after doing some research, I found that these two ailments are commonly found in older patients, especially women. High blood pressure can cause the body to urinate excess calcium and compensate for the loss by pulling calcium from the bones, thereby weakening them.

Within the donors, there was a nearly perfect split between no high blood pressure and high blood pressure respondents. People may feel emotionally driven to donate because they or their loved ones have ailments, or perhaps they are perfectly healthy and believe in supporting medical R&D. That being said, financial means to donate is likely a key factor, as **net worth was the first variable to interact with the donating group**.

At the **lowest net worth bracket**, the tendency to have high blood pressure was higher than the expected 46% of total health donors.



Socioeconomic factors could explain this observation; people with lower net worths might accumulate stress from working long-hours and providing for large families. They may also eat cheap, high-sodium diets that increase the risk for or aggravate high blood pressure. The second bracket, 100K to 250K, interacted with the characteristic of **owning a motorcycle**. My findings for this variable mirrored those of my previous Practical Lab, where **68% of those with motorcycles also had high blood pressure**. I wondered if other lifestyle factors, such as drinking or staying physically active, influenced this statistic. Maybe, for some cases, motorcycle ownership was unrelated and the hypertension was genetic.

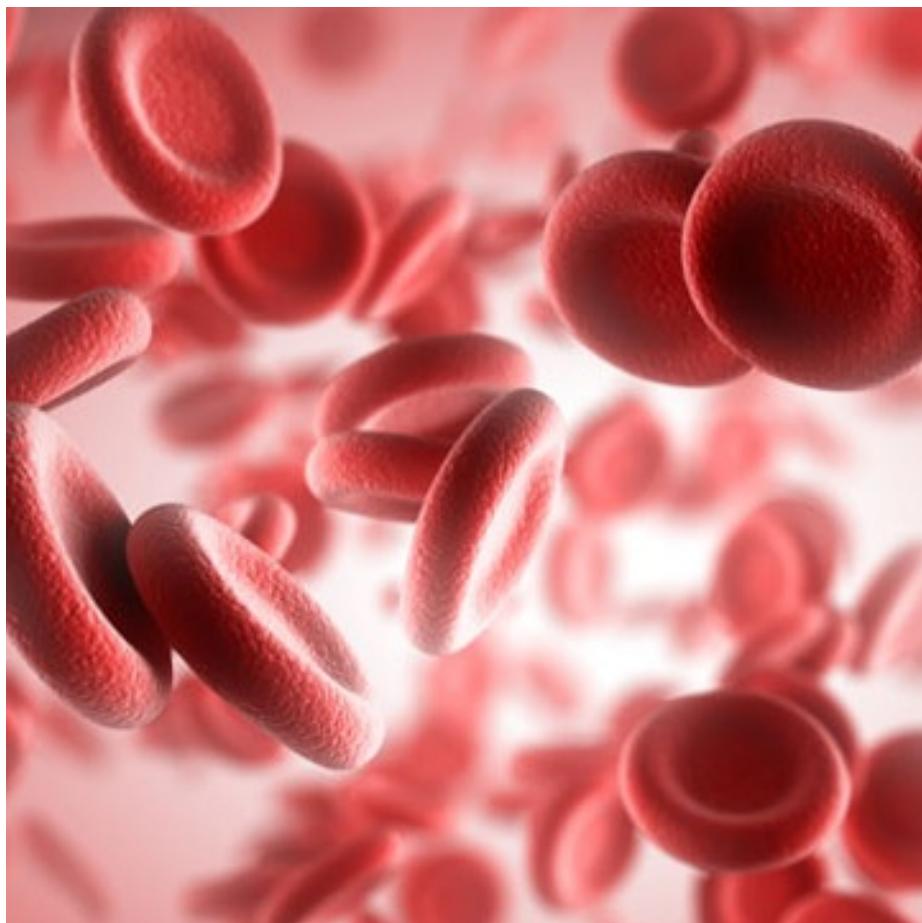
As net worth increased, the tendency for high blood pressure decreased. Those with higher incomes most likely have health insurance and annual checkups to monitor their health. Also, the 500K and 550K net worth categories were associated with the variable, **investing in stocks**. I figured this made sense, as wealthy people enjoy discussing and participating in the stock market. For both net worths, the non-investing groups had ~70% without high blood pressure, whereas the investor groups had less than 50%. The risks of losing investments could create stressors that increase blood pressure levels, or perhaps the investors are older individuals who have hypertension from lifestyle factors, genetics, etc.

CLOSING:

- **Comorbidities:** Based on my analysis, osteoporosis and high blood pressure can occur together, and usually during the aging process. I initially ran analyses with other ailments to examine more comorbidities, but found myself most interested in the current tree diagram because it contains more demographical data. However, I may return to the older outputs to better understand if people with other ailments are at risk for HBP as well.
- **Who else is at risk?** While the groups who own motorcycles, invest in stocks, and donate to health all demonstrate higher than expected values for high blood pressure, it cannot be concluded that these lifestyle choices are the cause. There could be other genetic and environmental factors at play. Nevertheless, I appreciated the insights I gathered from my segmentation methods, and I look forward to exploring more about high blood pressure.

EXPLAINING HEALTH CONDITION PROCLIVITY

PRACTICAL LAB #5



Lindsay Chu

April 24, 2021

PURPOSE:

Good healthcare is an essential aspect of society, but incredibly expensive and difficult to acquire in the US.

Based on a growing interest in understanding the social determinants of health (SDOH) for high blood pressure, I aimed to create a proclivity model to help predict those with or at risk for this very common ailment.

PROCEDURE:

First, I identified a set of intuitive variables to help predict high blood pressure:

a) Ailments

- **Osteoporosis** is a comorbidity I found in my previous lab. If blood is calcium-deficient from high blood pressure, the body may pull the mineral from the bones, possibly weakening them and causing osteoporosis.
- **Obese** individuals require the circulatory system to work extra hard to pump blood through the body, which strains the arteries and increases blood pressure. High-sodium diets can also aggravate **cholesterol** levels.
- **Asthma** can overwork the lungs and heart, increasing blood pressure.
- **Insomnia** and **arthritis** can also create stressors that increase high blood pressure.
- I also wanted to see how **low birth weight** could also factor into high blood pressure in adulthood.

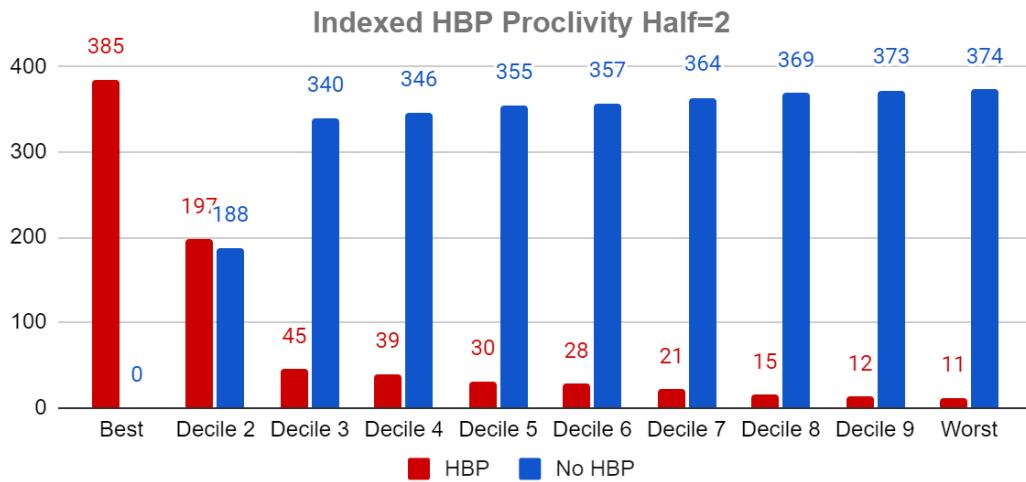
b) Lifestyle factors

- **Marriage** - In lab 2, I found that married people are more likely to experience HBP than single people.
- **Household size** and **buying a new car** - Having large homes and/or families could be associated with more financial responsibilities and stressors that worsen blood pressure.
- **RV ownership** - I considered the idea that constant traveling could be linked to a relatively unhealthy lifestyle (such as touring on the road) or create stress that aggravates HBP (perhaps the RV includes a large number of people to take care of).

After creating a model with the 12 variables, I applied it to a randomized sample (half=1) of the dataset and made sure every person in the sample fell into one of ten different deciles, or ranks.

I wanted to ensure a good distinction between those who suffered from HBP and those who did not, before applying my same model to an independent sample, labeled as half=2 in the dataset.

The results of my proclivity model, transferred from one sample to another, are shown below:

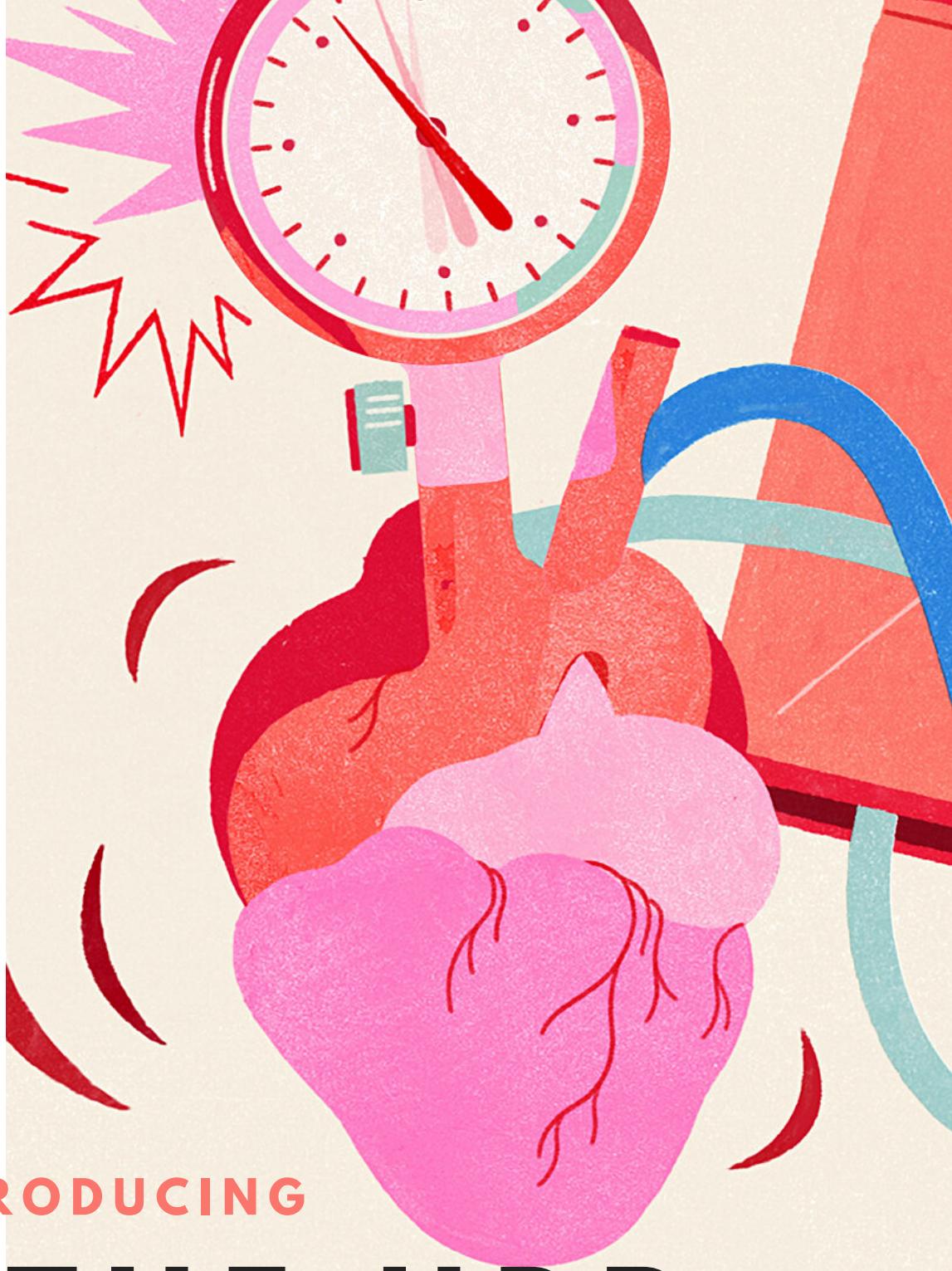


Based on the visual representation, the proclivity model at its best can capture a high number of individuals with high blood pressure, which explains why those with the ailment decrease across the deciles. Conversely, the number of non-HBP members increases dramatically because the model has supposedly identified most, if not all, with the ailment at deciles 1 and 2. Therefore, I believe the proclivity model is a good predictor of high blood pressure.

POSSIBLE APPLICATIONS FOR THE MODEL:

My proclivity model affirms from previous labs how certain lifestyle factors can aggravate high-blood pressure or put people at risk. Perhaps patients with large or growing families, difficult marriages, or other potential stressors could be recommended to use blood pressure monitors at home and document their blood pressure levels periodically.

The comorbidities are more commonly associated with high blood pressure and therefore more likely to be brought up by health care providers, but this model could help illustrate the interactions among the ailments, especially with Lab 4's factor tree.



INTRODUCING

THE HBP HELPER

PREPARED BY
LINDSAY CHU

MKT372

A NEW PRODUCT FOR FINDING AND TREATING
INDIVIDUALS AT RISK OF **HYPERTENSION**



THE CURRENT HEALTHCARE INDUSTRY

As the US population continues growing, so has the importance of a good health infrastructure. However, despite our scientific advancements, medical care access is highly expensive and inequitable; it is unfortunately viewed as a privilege rather than a right.

This is incredibly concerning, especially as health experts are discovering that certain lifestyle factors may influence one's tendency of becoming sick. While these **social determinants of health (SDOH)** are not as easy to analyze as one's body composition or genetics, they could be the key towards **proactively treating people to prevent health complications or deaths**.

MY PRODUCT OFFERING

After months of analyzing and visualizing US healthcare data, I have developed a **visual rubric (via proclivity model) for identifying individuals at risk of high blood pressure (HBP)**.

By studying and modeling an incredibly common condition, I hope that my product can:

- help medical professionals find and provide services to those at-risk and
- serve as a framework for predicting other ailments.

SOME HBP STATISTICS¹

108M

Americans have high blood pressure (roughly 1/2 of the entire US population). Only 1/4 of this group has it under control.

>400K

US deaths per year

\$49B

in annual costs

High blood pressure also puts individuals at risk of heart disease and stroke, two leading causes of death in the US.

These are costs related to HBP medications, services, and lost productivity from premature deaths.

1. Health Topics - High Blood Pressure . 3 Mar. 2021, www.cdc.gov/policy/polaris/healthtopics/highbloodpressure/index.html#:~:text=Economic%20Burden,of%20productivity%20from%20premature%20death.

HOW IT WORKS

My product provides a "criteria" for who might be at risk of hypertension, based on a US health dataset of over 15,000 records.

Here are the ailments and lifestyle characteristics that may determine likelihood of hypertension:

ASSOCIATED AILMENTS



- osteoporosis
- obesity
- high cholesterol
- asthma
- insomnia
- arthritis

Hypertension can be caused by unbalanced diets (especially those high in sodium) and worsened by conditions like asthma and arthritis, which can stress or overwork certain body functions.

LIFESTYLE FACTORS



- marriage
- large households
- net worth between \$5-50K
- household income <= \$35,000
- investing in stocks
- owning a motorcycle and/or RV

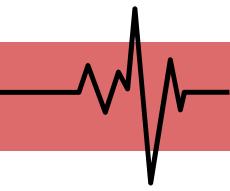
People with lower net worths or income are more likely to develop hypertension than those at higher levels. This trend may be attributed to hours working, inexpensive (and possibly unhealthy) diets, etc.

Supporting spouses and/or larger families, both financially and emotionally, can also strain physical and mental health.

If you identify with any of the above, please consider seeking treatment for hypertension.

To develop the criteria listed above, I created a high blood pressure variable in my dataset and studied its relationships with various factors (please see Appendix for more details).

If more than 50% of people in a factor group also had high blood pressure, I added it to my product as a potential risk.



A VALUABLE RESOURCE

BENEFITS

WIDELY APPLICABLE

High blood pressure is a very common ailment in the US. By using this prediction model, we could find countless people at-risk, help monitor their blood pressures, and prevent deaths.

COST SAVINGS

According to the CDC, high blood pressure costs the US about \$49B annually. If we can treat people for high blood pressure, or dissuade them from associated lifestyle factors as a preventative measure, we may reduce these costs.

MORE RESEARCH OPPORTUNITIES

If this product can identify those susceptible to hypertension, we can continue developing similar proclivity models for other ailments, and support the healthcare industry's notion that social determinants of health are critical in understanding our society's well-being.

APPLICATIONS



Medical Check-Ups

Primary care physicians could use the product to evaluate if their patients meet the HBP-risk criteria and then provide recommendations, such as scheduling periodic high blood pressure check-ups or requiring blood pressure monitors at home.



Consultation Services

Some social determinants of hypertension, such as difficult marriages or insomnia, may require individuals to attend therapy sessions or special clinics. Therapists could use this product gauge their clients' stress levels, check blood pressure levels, and/or redirect them to other treatment options.



APPENDIX

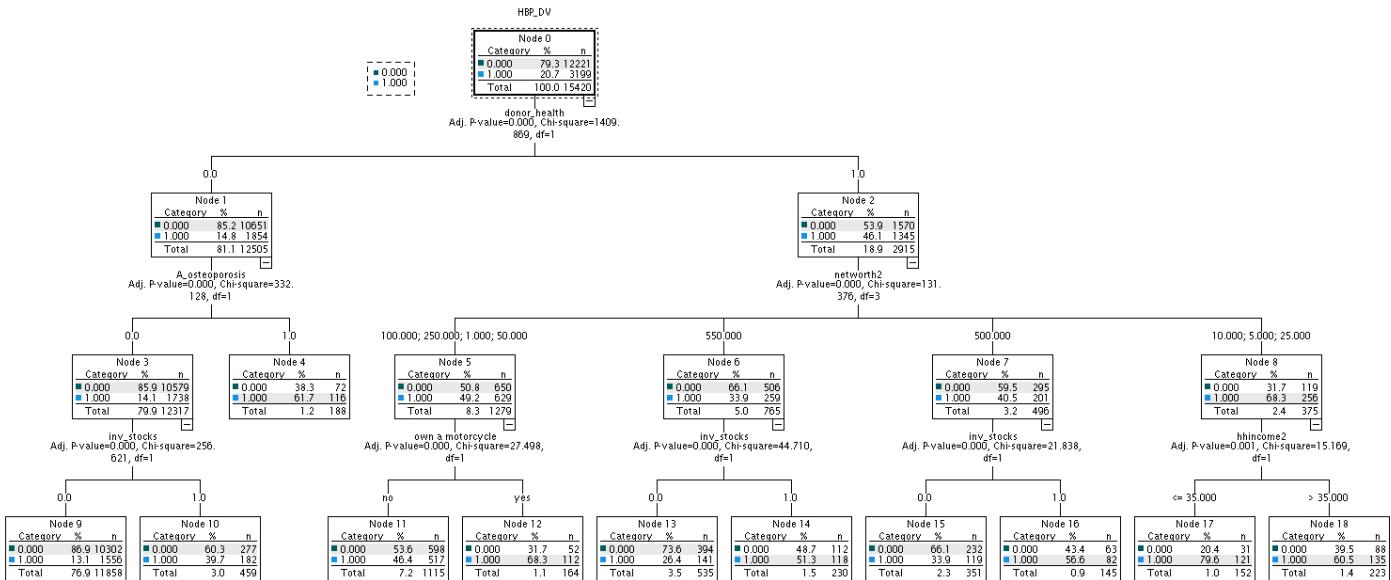
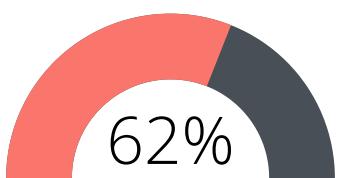


Figure 1: Factor Tree for High Blood Pressure

Description: A diagram explaining the relationships between high blood pressure and variables like: comorbidities (ailments that are found alongside HBP), demographics, and lifestyle factors.

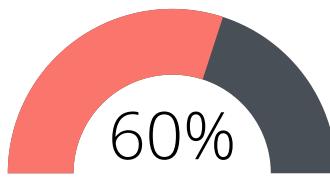
Purpose: Find the ideal variables for creating a model applicable to a generalized random sample and capable of predicting hypertension. These variables are listed on page 3.

Key Findings:



individuals with osteoporosis also have high blood pressure.

HBP-related calcium deficiencies can weaken bones and cause osteoporosis.



individuals who invest in stocks also have HBP.

This percentage is *about double* that of the total percentage of HBP-individuals in middle to upper income levels.



people with income <= \$35K experience hypertension.

Coupled with the fact that lower income brackets are more prone to having this condition, it is evident that socioeconomic factors are key to locating at-risk population.

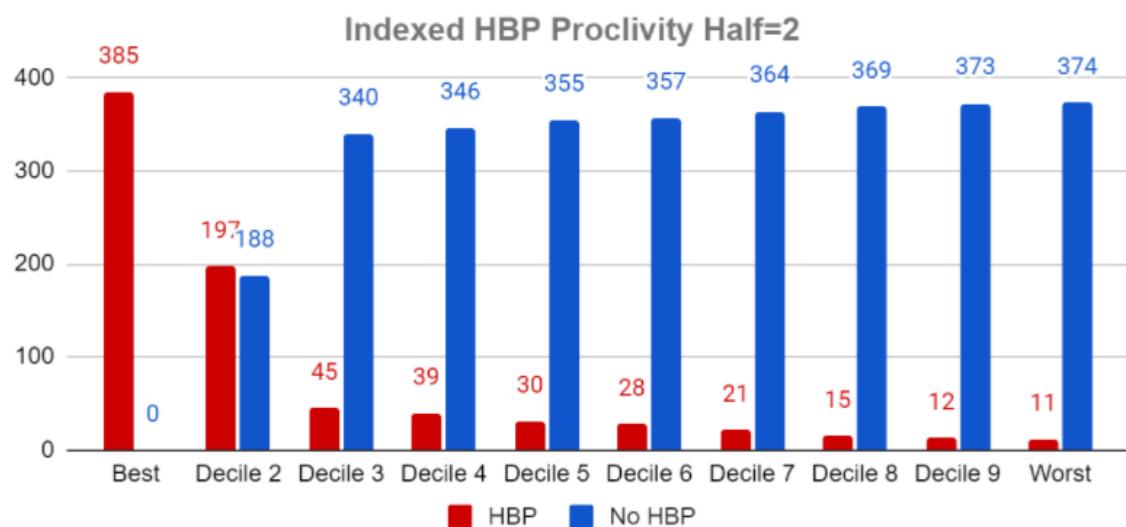


Figure 2: Index for Applying HBP Prediction to an Independent Sample

Description: This chart explains how my proclivity model applies to an independent group of people. I used my variables from Figure 1 to create a stepwise linear regression for predicting hypertension, then applied it to my dataset records (divided into ten deciles, or ranks).

Based on the visual representation, the model at its best can capture a high number of individuals with high blood pressure, which explains why those with the ailment decrease across the deciles. Conversely, the number of non-HBP members increases dramatically because the model has supposedly identified most, if not all, with the ailment at deciles 1 and 2. With these two trends, I believe my proclivity model is a good predictor of high blood pressure.