Metabolic Syndrome

Analysis and Predictive Modeling

Cameron Peace

What is Metabolic Syndrome?

Metabolic syndrome is a **group of conditions that together raise your risk of coronary heart disease, diabetes, stroke,** and other serious health problems.

What is a syndrome? How does it differ from a disease?

"A group of signs and symptoms that occur together and characterize a particular abnormality or condition"

-Merriam Webster

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"A syndrome is a recognizable complex of symptoms and physical findings which indicate a specific condition for which a direct cause is not necessarily understood. "

-Diagnoses, Syndromes, and Diseases: A Knowledge Representation Problem

Franz Calvo, MD,1 Bryant T Karras, MD,1,2 Richard Phillips, MD,1 Ann Marie Kimball, MD,1,2 and Fred Wolf, PhD1

What defines Metabolic Syndrome?

The National Institutes of Health guidelines define metabolic syndrome as having **three or more of the following traits**, including traits for which you may be taking medication to control:

- **Large waist**
  - at least 35 inches for women and 40 inches for men
- **High triglyceride level**
  - 150 mg/dL or greater
- **Reduced "good" or HDL cholesterol**
  - Less than 40 mg/dL for men or less than 50 mg/dL for women
- **Increased blood pressure**
  - 130/85 or higher
- **Elevated fasting blood sugar**
  - 100 mg/dL or higher

-National Institutes of Health

What data were used?

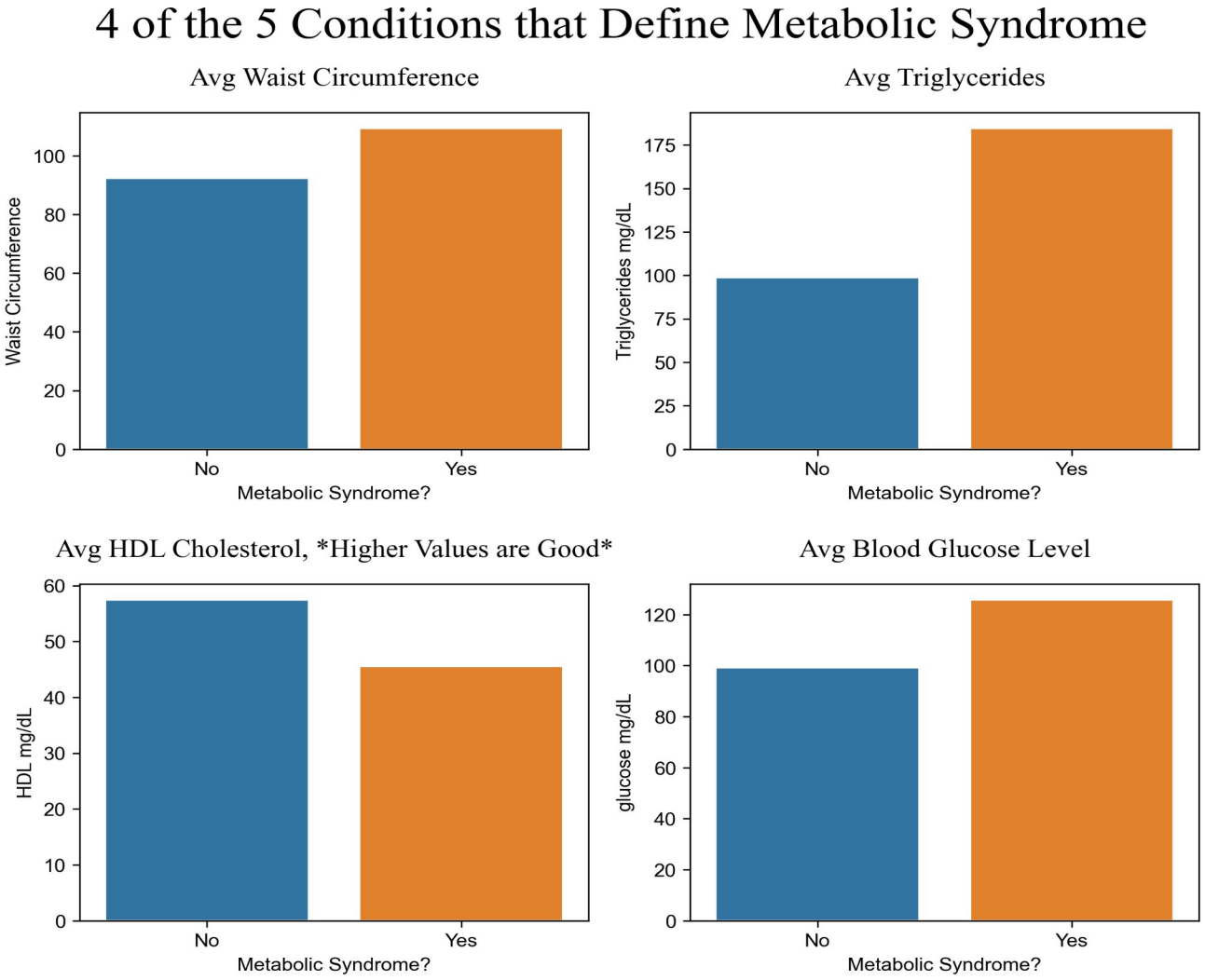
The dataset for analysis came from the The National Health and Nutrition Examination Survey (NHANES)

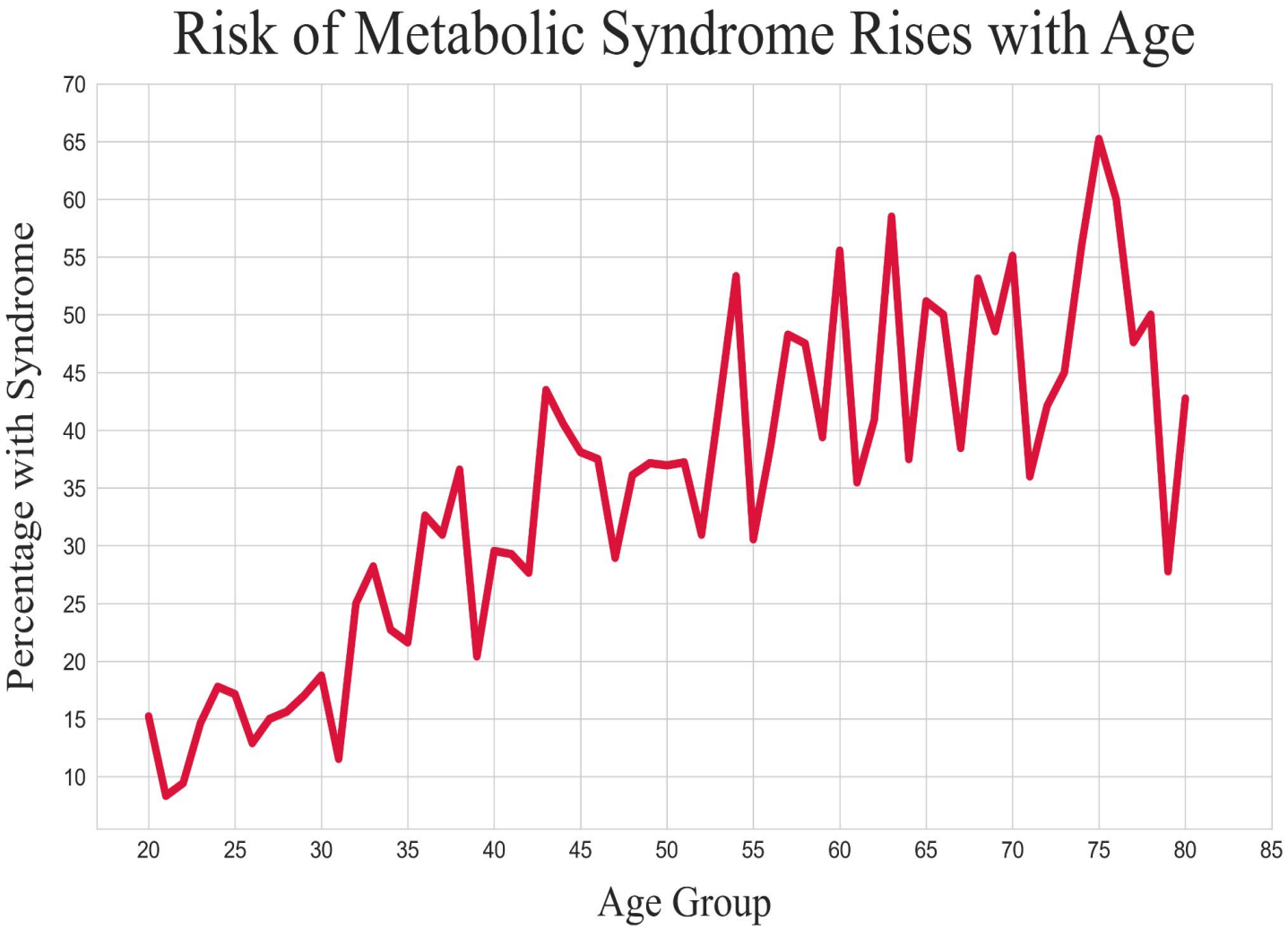
NHANES is a major program of the National Center for Health Statistics (NCHS). NCHS is part of the Centers for Disease Control and Prevention (CDC) and has the responsibility for producing vital and health statistics for the Nation.

This dataset is very small: 2,401 entries (patients)

Which defining features of metabolic syndrome are present in the data?

We are missing data on blood pressure





The data may exhibit "survivorship" bias

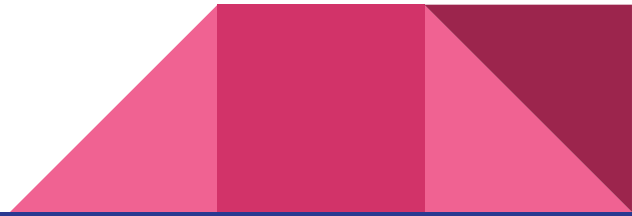
Who might benefit from a predictive model?

- Hospitals and other healthcare organizations could deploy the model directly to diagnose patients with metabolic syndrome outright or simply flag their risk level.
- Companies that develop healthcare software could incorporate the model into a suite of diagnostic tools

How does the model perform?

- The model was 89% accurate at predicting a diagnosis for metabolic syndrome given the data available.
- However, it was only able to correctly label positive diagnoses 82% of the time.

In other words, 89% of the time the model correctly predicted a positive or negative diagnosis of metabolic syndrome, but 18% of the time it missed a positive diagnosis and labeled it as negative.



Model Limitations

- Because a diagnosis of metabolic syndrome involves the presence of 3 or more well defined quantitative measurements above certain thresholds, a predictive model is really only useful in cases where data is missing or unavailable.
- Most of the metrics that define metabolic syndrome are routinely collected in the average visit for preventative care, so scenarios where deploying and maintaining a predictive model is preferable over data collection may be unlikely.
- The accuracy of the current model is currently too low to be effective. It would likely lead to lack of trust by users.
- The dataset used for modeling was very small and also unbalanced, the model would need much more testing on additional data to validate its efficacy.

Recommendations

- In my opinion this is a case where predictive modeling is unnecessary.
- Simpler, filter based screening software could be deployed that would be cheaper, faster, and much easier to maintain. It could even provide warning “levels”, based on what ranges the appropriate patient metrics fall within.
- If there is a use case where predictive modeling is needed, I would recommend collecting much more data, better quality data, and broader data (i.e. more patient features/attributes). This may allow for developing a more accurate model.