

Predicting Health Risk: Blood Pressure Analysis & Web App Development

By Jugal





Problem statement:

- Hypertension affects affects 1 in 3 adults worldwide([WHO, 2023](#))
- Often underdiagnosed, yet a leading cause of heart disease and stroke(Known as “Silent killer”)
- Early detection using data can help target interventions
- Goal: Predict high-risk individuals using health data



Objective:



Analyze health dataset for patterns related to blood pressure



Building a predictive ML model



Deploy it as a simple web application for user interaction



Incorporate feature engineering to boost model performance



Data Overview

Source: National Health and Nutrition Examination Survey(CDC,

<https://www.cdc.gov/nchs/nhanes/continuousnhanes/default.aspx?Cycle=2017-2020>)

Key features:

- Demographics: Age, Gender, Ethnicity
- Physical measurements: BMI, Waist-Hip Ratio, Blood Pressure
- Socioeconomic factors: Education level, Income
- Health behaviors: Smoking status, Physical activity

Target variable Hypertension status ($BP \geq 130/80$ mmHg)



Data Insights

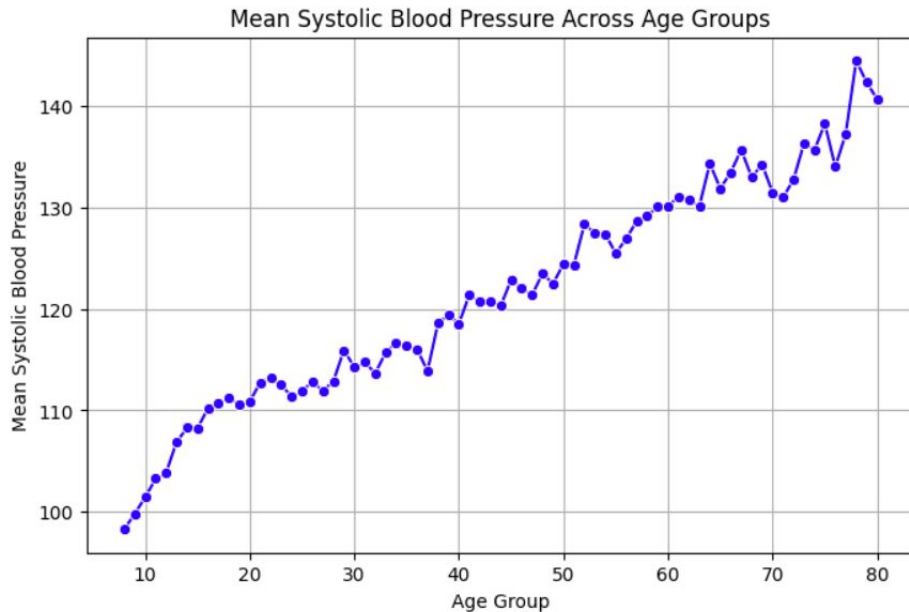
Key Findings from Exploratory Analysis

- Strong positive correlation between age and blood pressure
- Men show slightly higher average systolic pressure than women
- Significant variations across ethnic groups with highest prevalence in Black community
- Inverse relationship between education level and hypertension risk

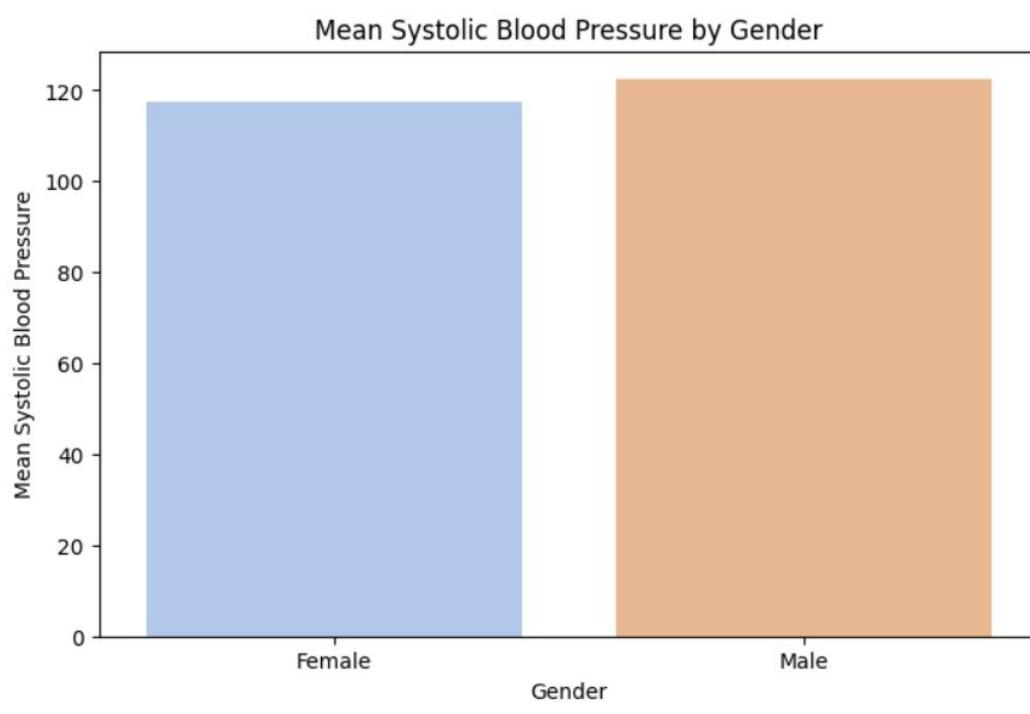


Factors Affecting Blood Pressure:

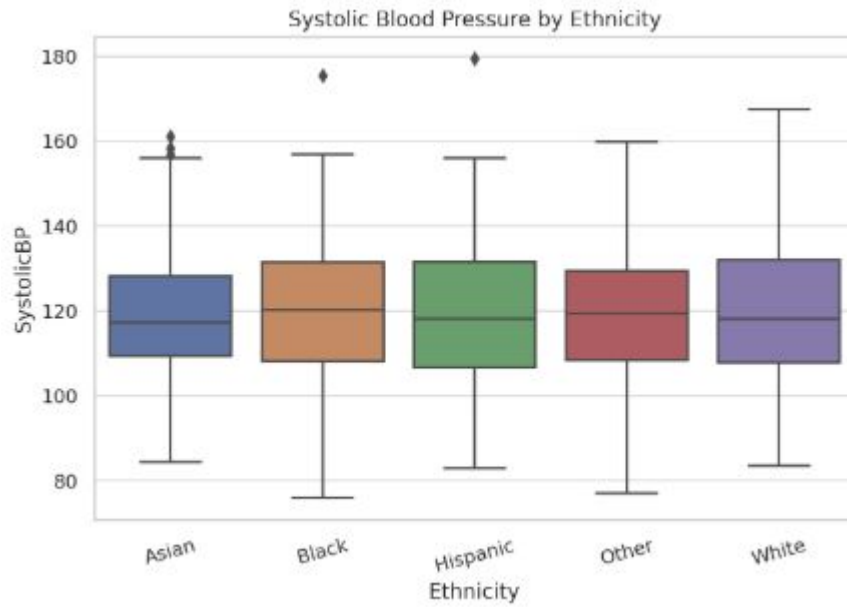
- **Age:** As people age, their blood pressure tends to rise.



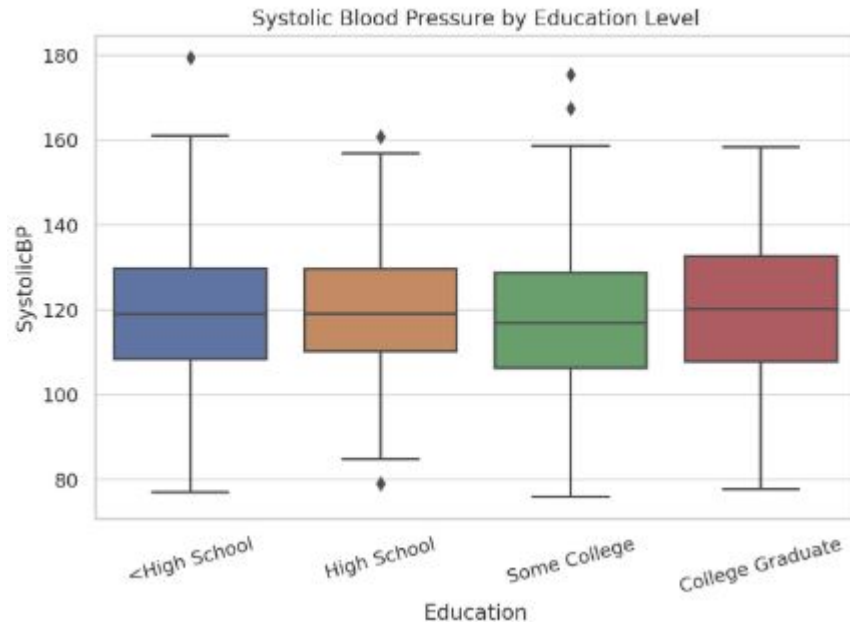
- **Gender:** Men and women may experience different risk levels.



- **Ethnicity:** Certain ethnic groups may be more prone to hypertension.



- **Education: Socio-economic status might also play a role.**





Feature Engineering

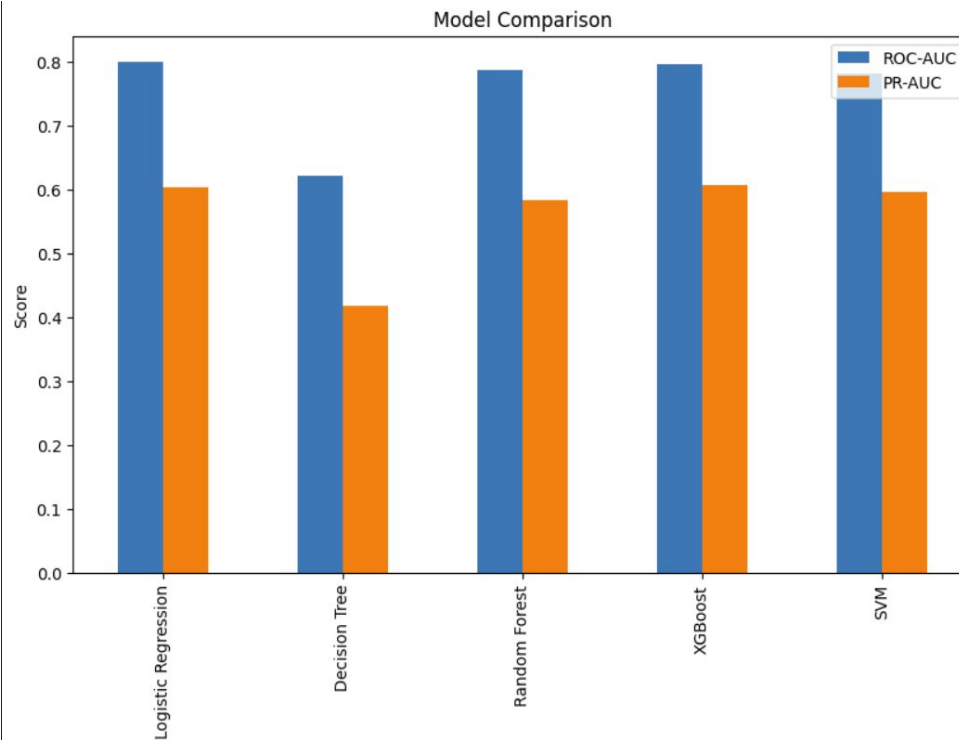
Enhancing Model Performance

- Created BMI from height and weight measurements
- Calculated Waist-to-Hip Ratio as indicator of central obesity
- Developed interaction features:
 - BMI \times Age: Captures compounding effect of weight and aging



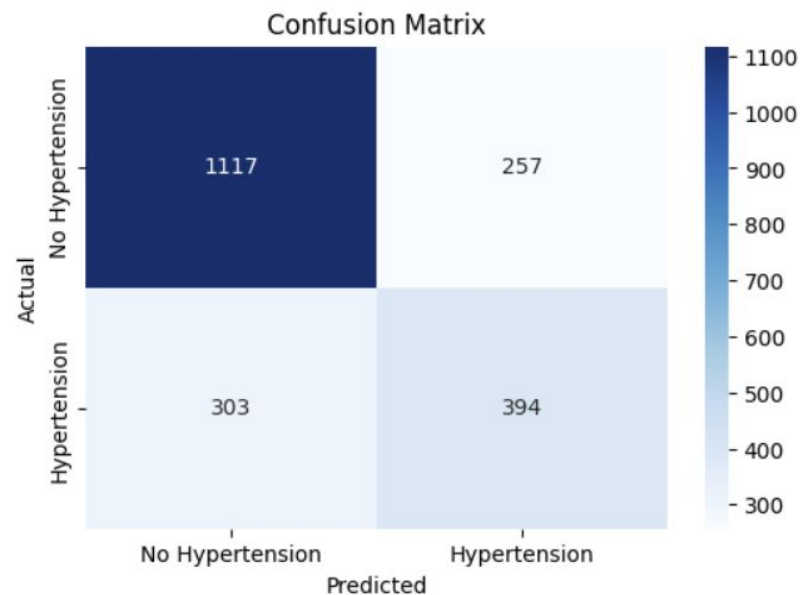
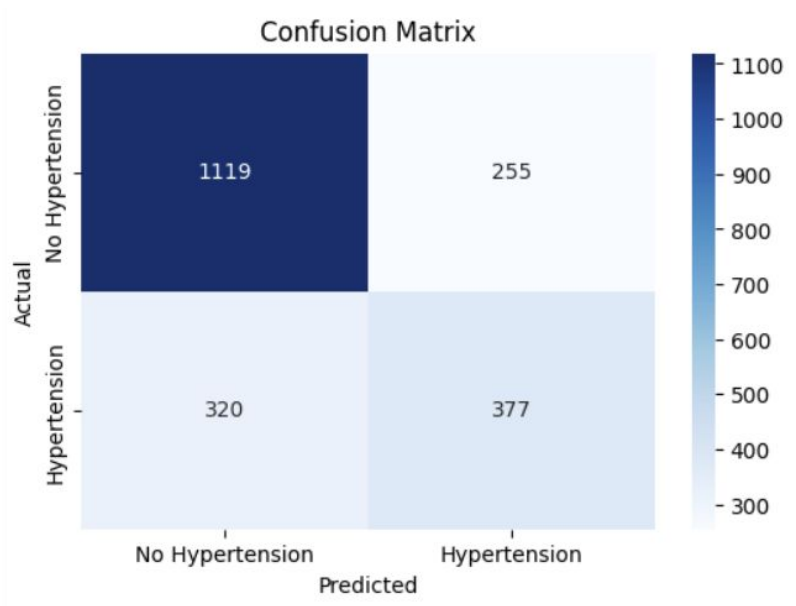
Machine learning model

1. Linear regression
2. Decision Tree
3. RandomForest
4. XGBoost
5. SVM





Hyperparameter tuning(For SVM)





Web application

To make the prediction accessible, I developed a **Flask-based web app** that allows users to input their health data and get a risk prediction.

The screenshot displays a web application titled "Hypertension Predictor". The interface features a blue header bar with the title on the left and navigation links "Home" and "About" on the right. The main content area is light gray and contains a central white form titled "Hypertension Risk Assessment". This form has a blue header and six input fields arranged in two columns: "Age (years)", "Weight (kg)", "Height (cm)", "Waist Circumference (cm)", "Hip Circumference (cm)", and "Arm Circumference (cm)". Below these fields is a blue button labeled "Predict Hypertension Risk". The footer of the page is light gray and contains the copyright notice "© 2025 Hypertension Predictor".

Hypertension Predictor

Home About

Hypertension Risk Assessment

Age (years)

Weight (kg)

Height (cm)

Waist Circumference (cm)

Hip Circumference (cm)

Arm Circumference (cm)

Predict Hypertension Risk

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Key Features of the Web App

- **Input Form:** Users can input age, gender, height, weight, waist circumference, etc.
- **Prediction Results:** Users receive a prediction and risk level (Low & High).
- **Visual Feedback:** Displays a **risk level** with color-coded indicators (e.g., red for high risk, yellow for medium, green for low risk).

Prediction Results

No Hypertension Risk Detected

Risk Level: Low

13.17%

Probability: 13.17%

Your Measurements:

Age:	25.0 years	Waist Circumference:	75.0 cm
Weight:	65.0 kg	Hip Circumference:	90.0 cm
Height:	175.0 cm	Arm Circumference:	28.0 cm
BMI:	21.22 kg/m ²	Waist-Hip Ratio:	0.83

Important Medical Disclaimer

This prediction is intended for informational purposes only and is not a substitute for professional medical advice, diagnosis, or treatment.

The results provided by this tool should not be interpreted as a medical diagnosis. Hypertension (high blood pressure) requires proper medical evaluation by qualified healthcare professionals.

Prediction Results

Hypertension Risk Detected

Risk Level: Medium

63.06%

Probability: 63.06%

Your Measurements:

Age:	55.0 years	Waist Circumference:	110.0 cm
Weight:	92.0 kg	Hip Circumference:	105.0 cm
Height:	165.0 cm	Arm Circumference:	35.0 cm
BMI:	33.79 kg/m ²	Waist-Hip Ratio:	1.05

Next Steps:

- Consult with a healthcare provider for a proper diagnosis
- Consider lifestyle modifications such as diet and exercise
- Monitor your blood pressure regularly



Live Demo



Challenges & Solutions

- **Challenges:**

- Handling missing or incomplete data for some users.
- Ensuring accurate model predictions across different demographics.
- Deployment and ensuring the app is user-friendly.

- **Solutions:**

- Used preprocessing techniques like **imputation** and **scaling**.
- Cross-validation was used to ensure robustness and generalization.
- Developed a Flask web app for user interaction (currently run locally)



Future Improvement

- **Potential Improvements:**

- Cloud deployment on Render-Heroku for public access
- Expanding model to include more factors, like lifestyle data (diet, exercise).
- Expanding model to include additional health variables (Cholesterol, glucose)
- Develop mobile application for wider accessibility
- Integrating real-time health monitoring data (e.g., from wearables) to update predictions.

- **Impact:** I believe this project has the potential to help individuals assess their health risks easily and take preventive measures.



Q&A