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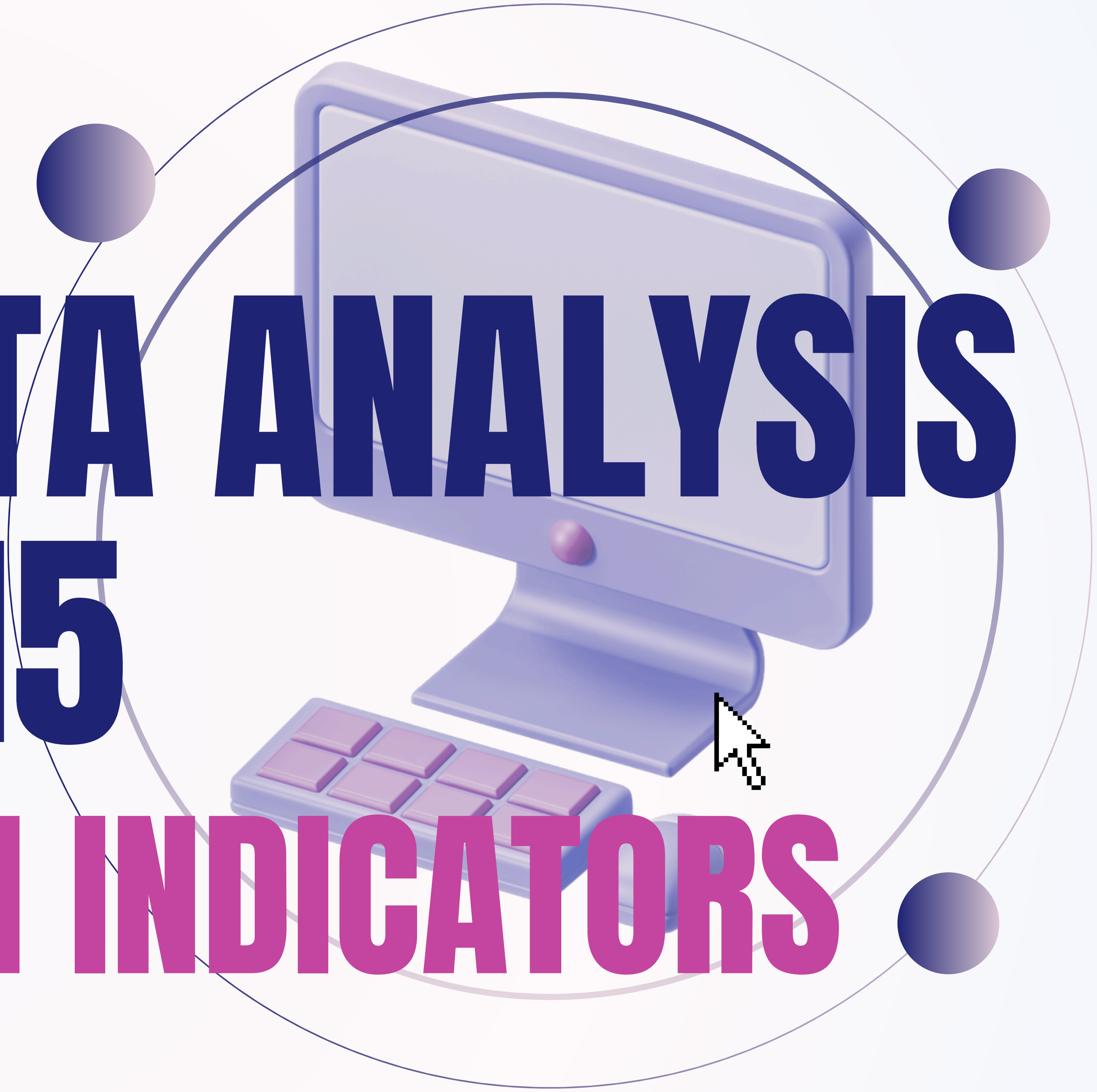
Statistics Laboratories Unit Course

Professor Luís M. Silva

EXPLORATORY DATA ANALYSIS OF THE BRFSS 2015

HEART DISEASE HEALTH INDICATORS DATASET



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SUMMARY

1

INTRODUCTION

2

OBJECTIVES

3

DATA SET LOADING AND UNDERSTANDING

4

DATA AND GRAPHICAL ANALYSIS

5

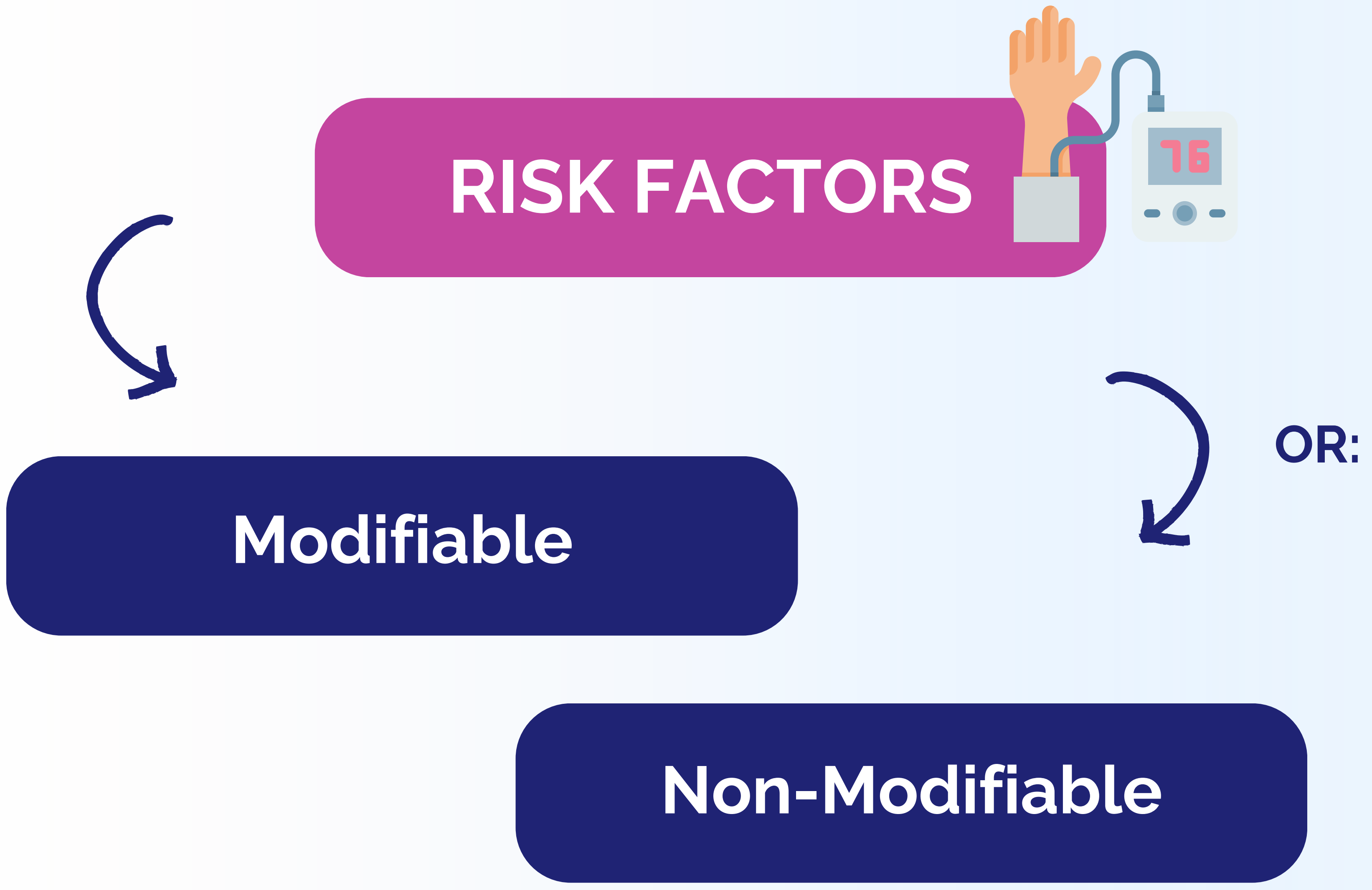
KEY POINTS

INTRODUCTION

Cardiovascular disease (CVD) encompasses a range of conditions affecting the heart and blood vessels, including high blood pressure, atherosclerosis, heart failure, strokes, arrhythmias, and valvular heart disease.

WORLD HEALTH ORGANIZATION (WHO):

Leading cause of death globally, claiming approximately 17.9 million lives annually.


RISK FACTORS

OR:

Modifiable

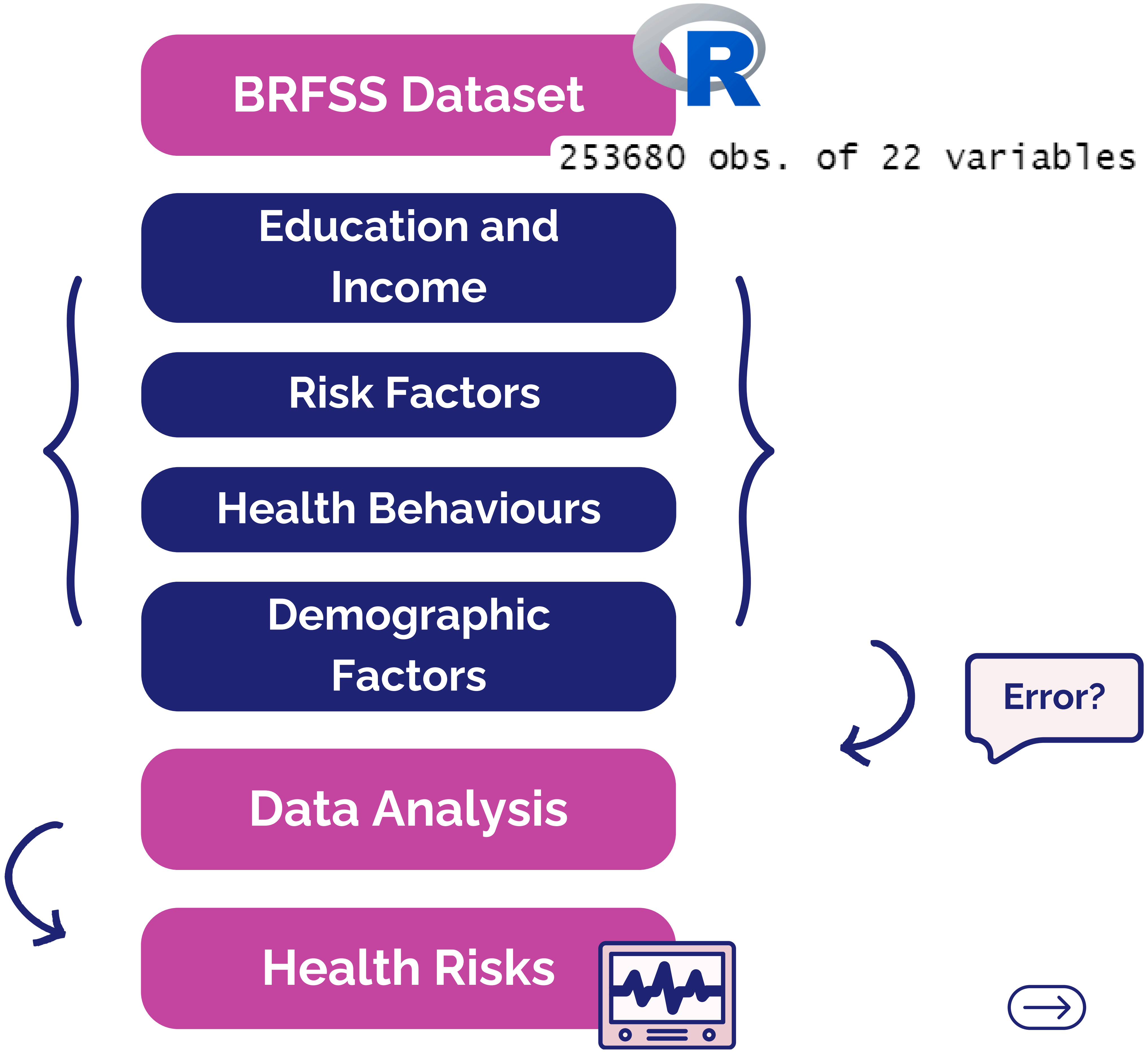
Non-Modifiable

Heart disease risk factors include uncontrollable elements (**age, sex, genetics**) and modifiable ones (**diet, smoking, stress**), where managing the latter can lower CVD risk.

BEHAVIOURAL RISK FACTOR SURVEILLANCE SYSTEM

BRFSS™
Behavioral Risk Factor Surveillance System

The BRFSS is a **U.S. health survey** that **collects state-level data** on citizens' behaviours and conditions. That precious information **can be used to assess various diseases' risk**, such as heart disease risk.



BRFSS Dataset

```
253680 obs. of 22 variables
```

Education and Income

Risk Factors

Health Behaviours

Demographic Factors

Error?

Data Analysis

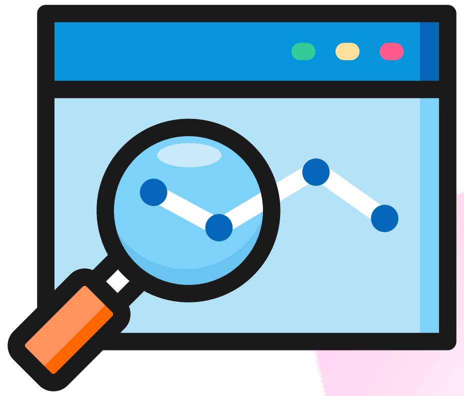
Health Risks

OBJECTIVES

- Analysis of **Indirect** and **Direct Risk Factors** in Cardiovascular Disease
- Exploration of **Health Patterns** and **Behaviours** Related to Cardiovascular Risk
- Assess **potential associations** that the factors under study might imply **in relation to CVDs**
- Development of **Predictive Models** for Cardiovascular Disease
- Discussion and Proposals for **Preventative Strategies**

Age, sex, income and education

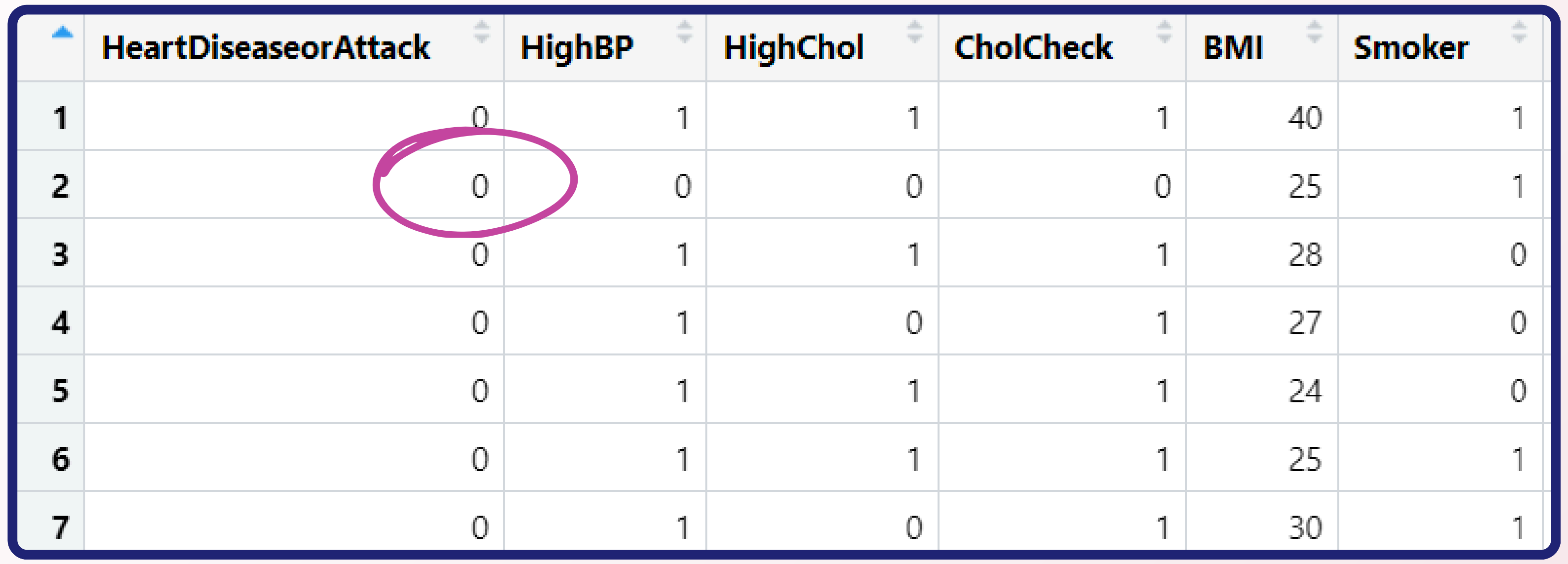
Hypertension, cholesterol levels, diabetes, smoking and physical inactivity (...)



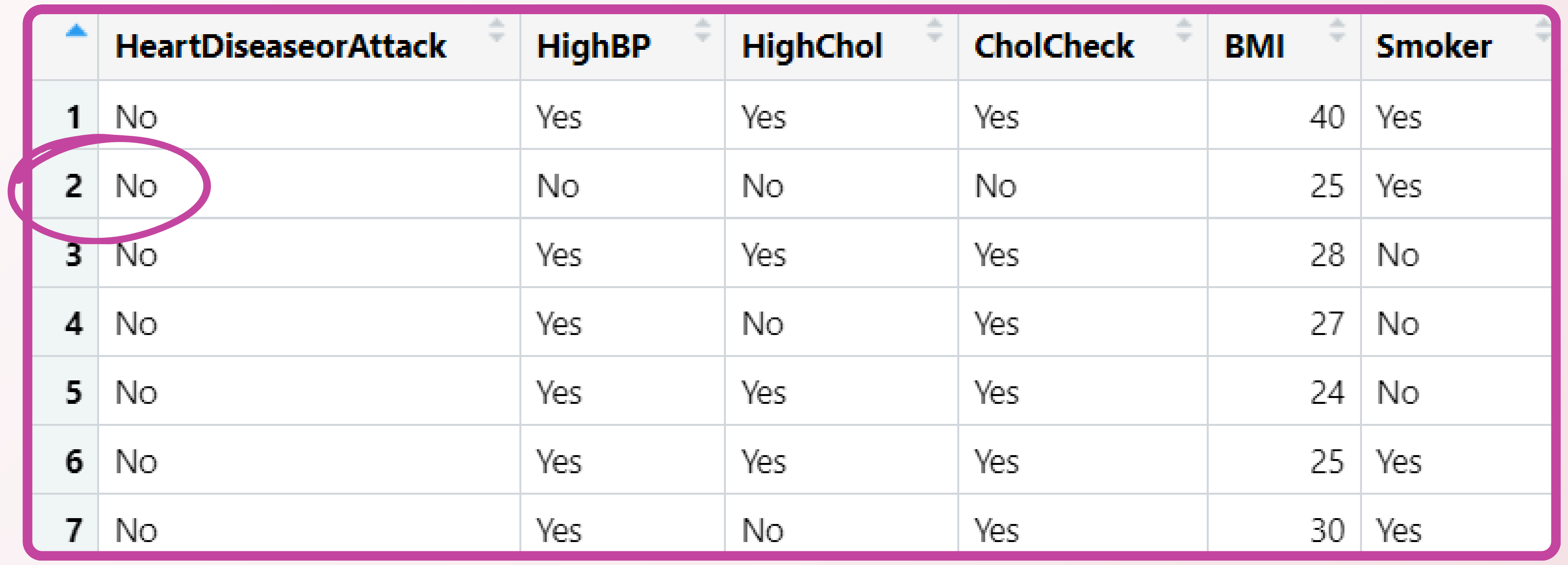
DATA SET LOADING AND UNDERSTANDING

The data, provided in **CSV format**, was imported into R as a **data frame**. Each column is **numeric**, with most responses categorised as **binary variables**.

Data processing converted numeric columns to **factors** for accurate interpretation. The final dataset includes **253,680 records** and **22 columns**, reflecting the sample size and responses.



	HeartDiseaseorAttack	HighBP	HighChol	CholCheck	BMI	Smoker
1	0	1	1	1	40	1
2	0	0	0	0	25	1
3	0	1	1	1	28	0
4	0	1	0	1	27	0
5	0	1	1	1	24	0
6	0	1	1	1	25	1
7	0	1	0	1	30	1



	HeartDiseaseorAttack	HighBP	HighChol	CholCheck	BMI	Smoker
1	No	Yes	Yes	Yes	40	Yes
2	No	No	No	No	25	Yes
3	No	Yes	Yes	Yes	28	No
4	No	Yes	No	Yes	27	No
5	No	Yes	Yes	Yes	24	No
6	No	Yes	Yes	Yes	25	Yes
7	No	Yes	No	Yes	30	Yes

DATA ANALYSIS

To assess data distribution, patterns, correlations, and potential anomalies.

Variables were briefly compared to factors, using **multivariate charts** in ggplot2.

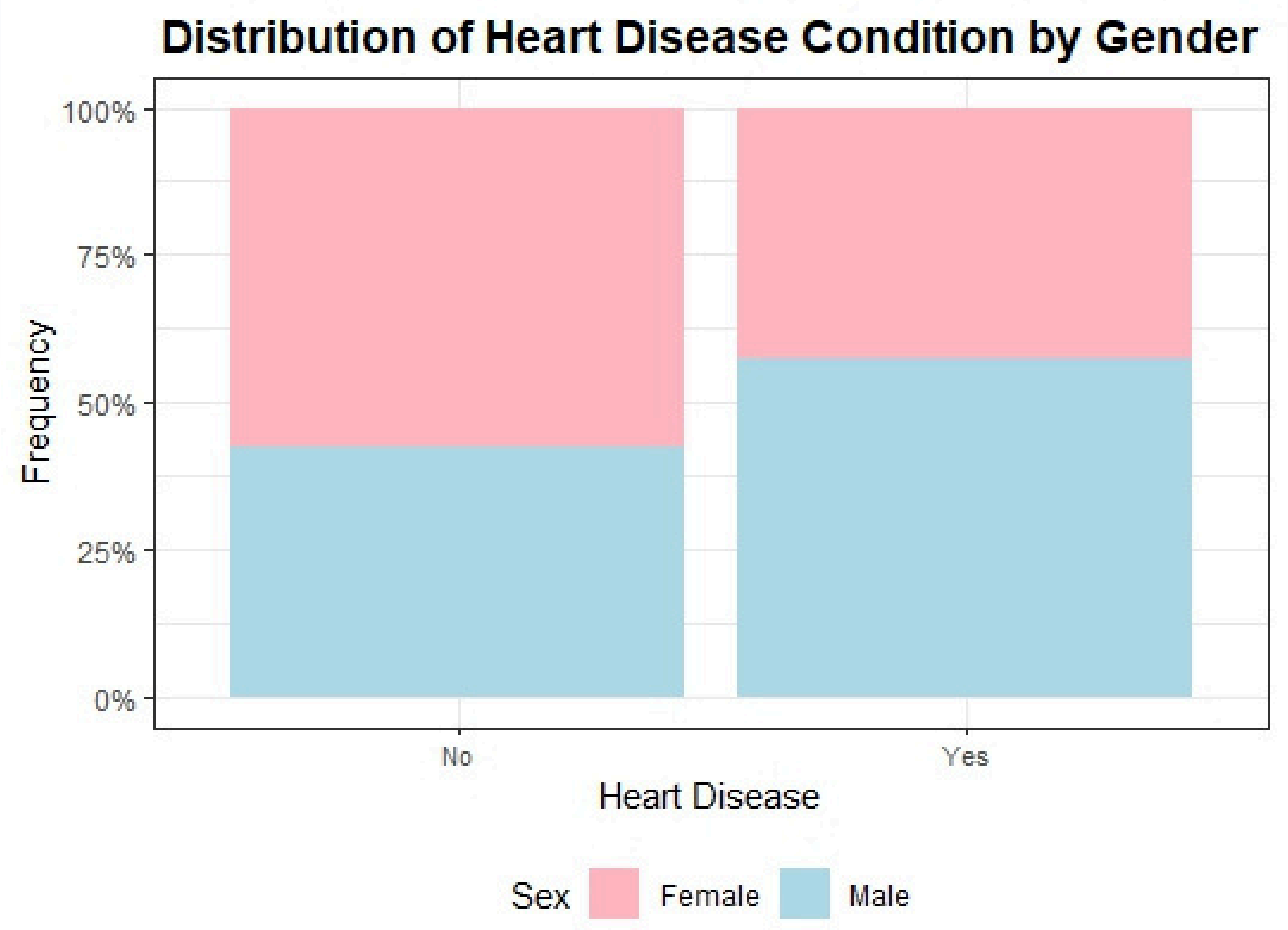
Binomial logistic regression was employed to predict heart disease risk from survey responses, producing **probability rankings** for each individual's likelihood of cardiovascular disease.

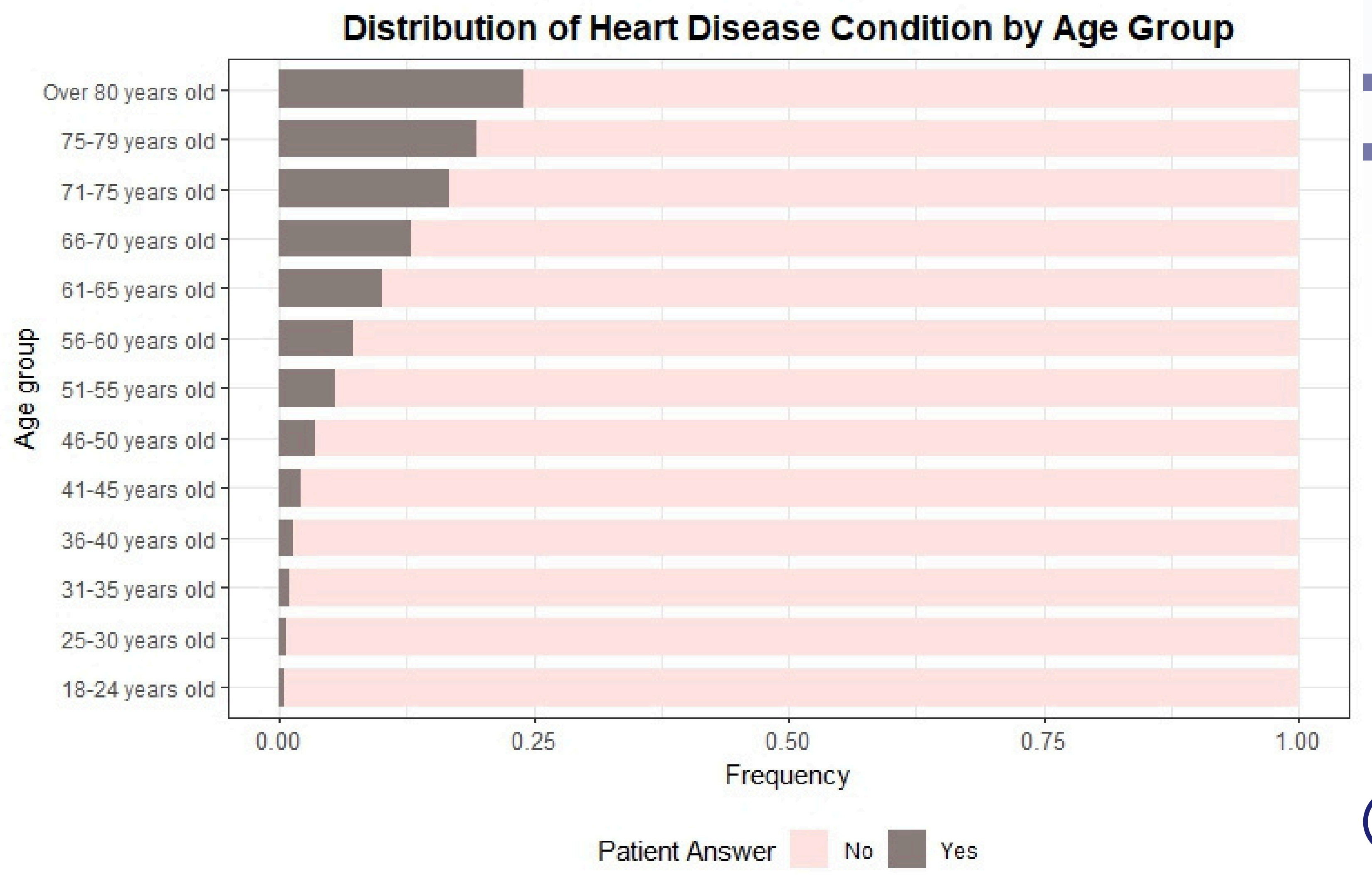
The dataset was split into a **70% training set** and a **30% test set** for robust model validation.

Model fit was assessed using a **likelihood ratio test**.
Chi-squared ANOVA test rejected the null hypothesis.

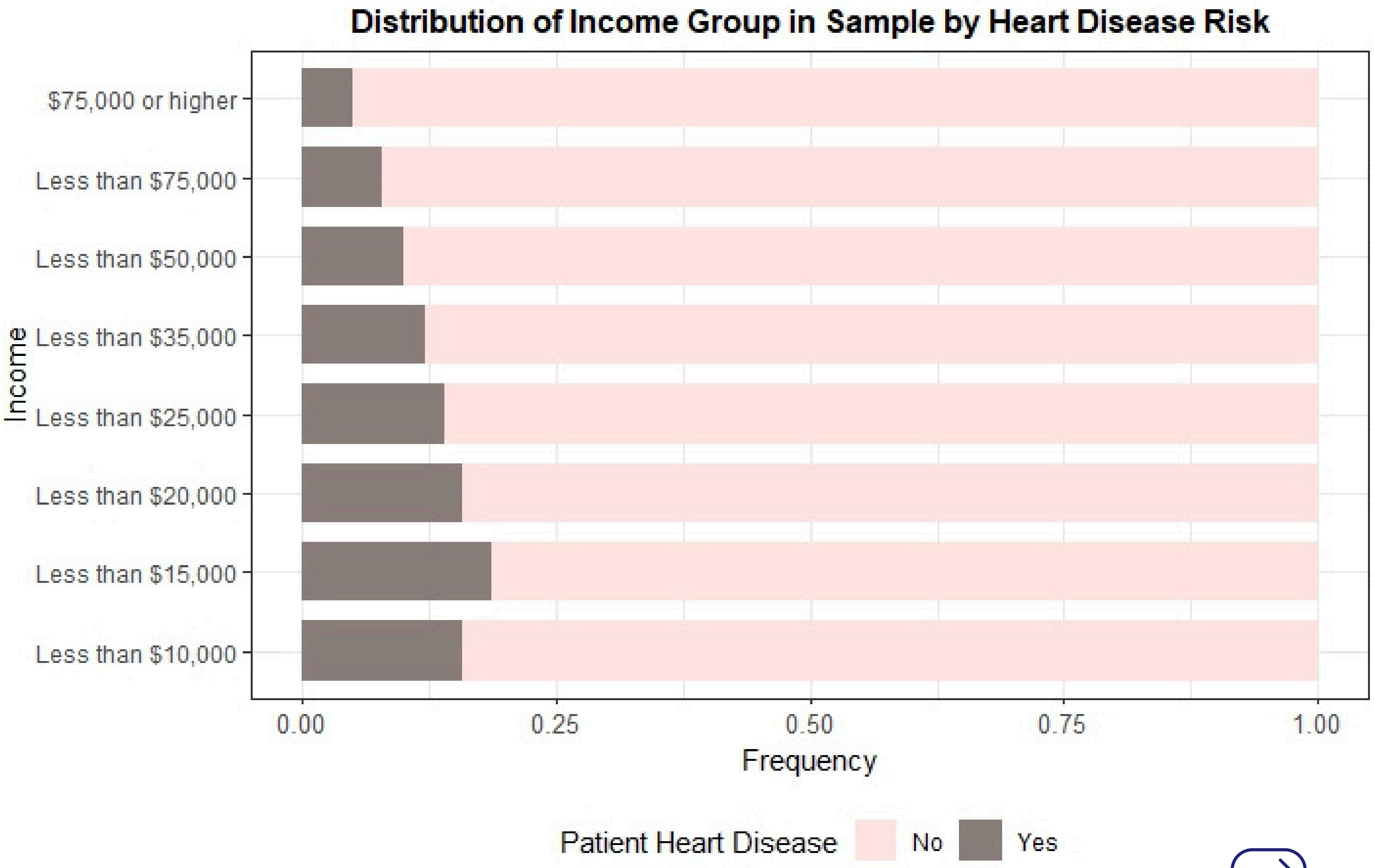
GRAPHICAL ANALYSIS

Age and **gender** are key factors in analysing the **prevalence of cardiovascular disease**.

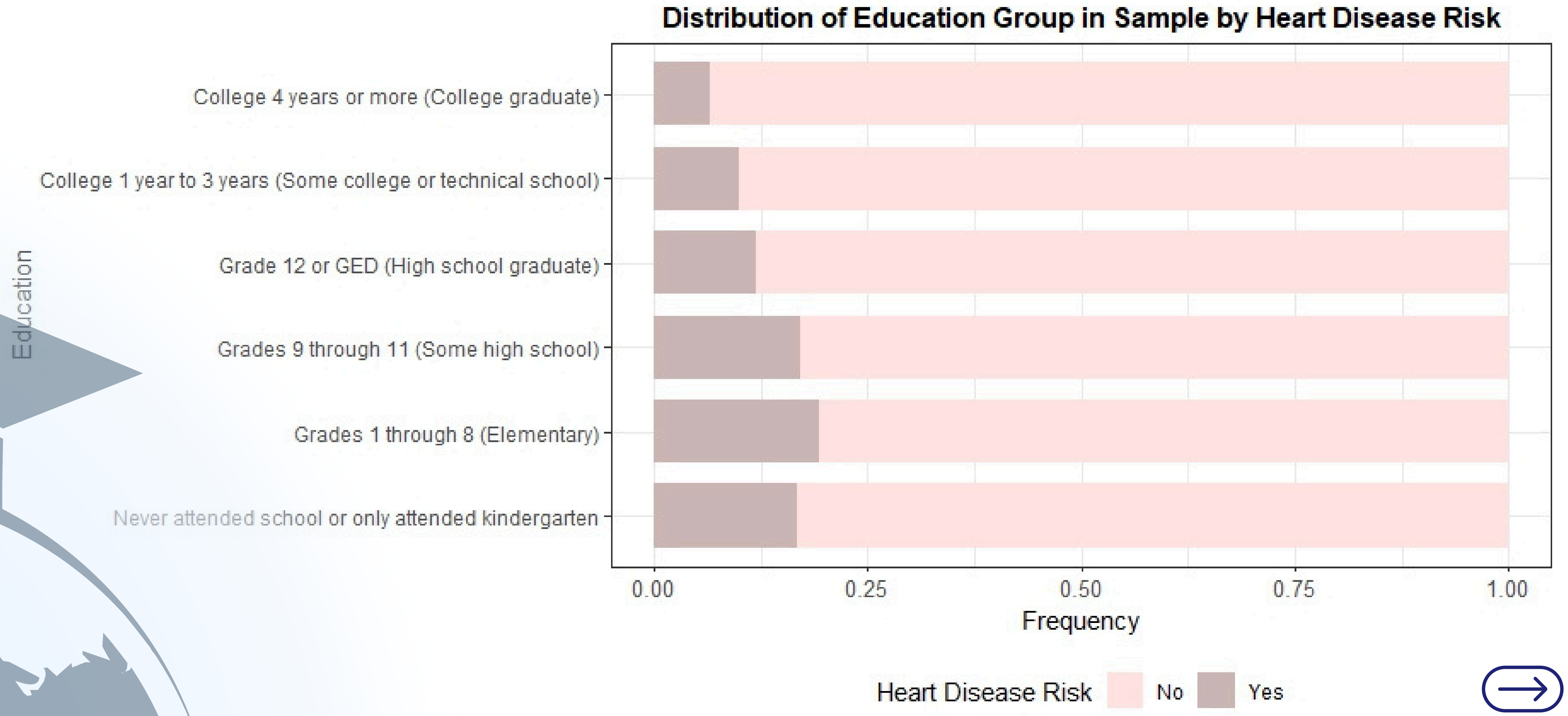




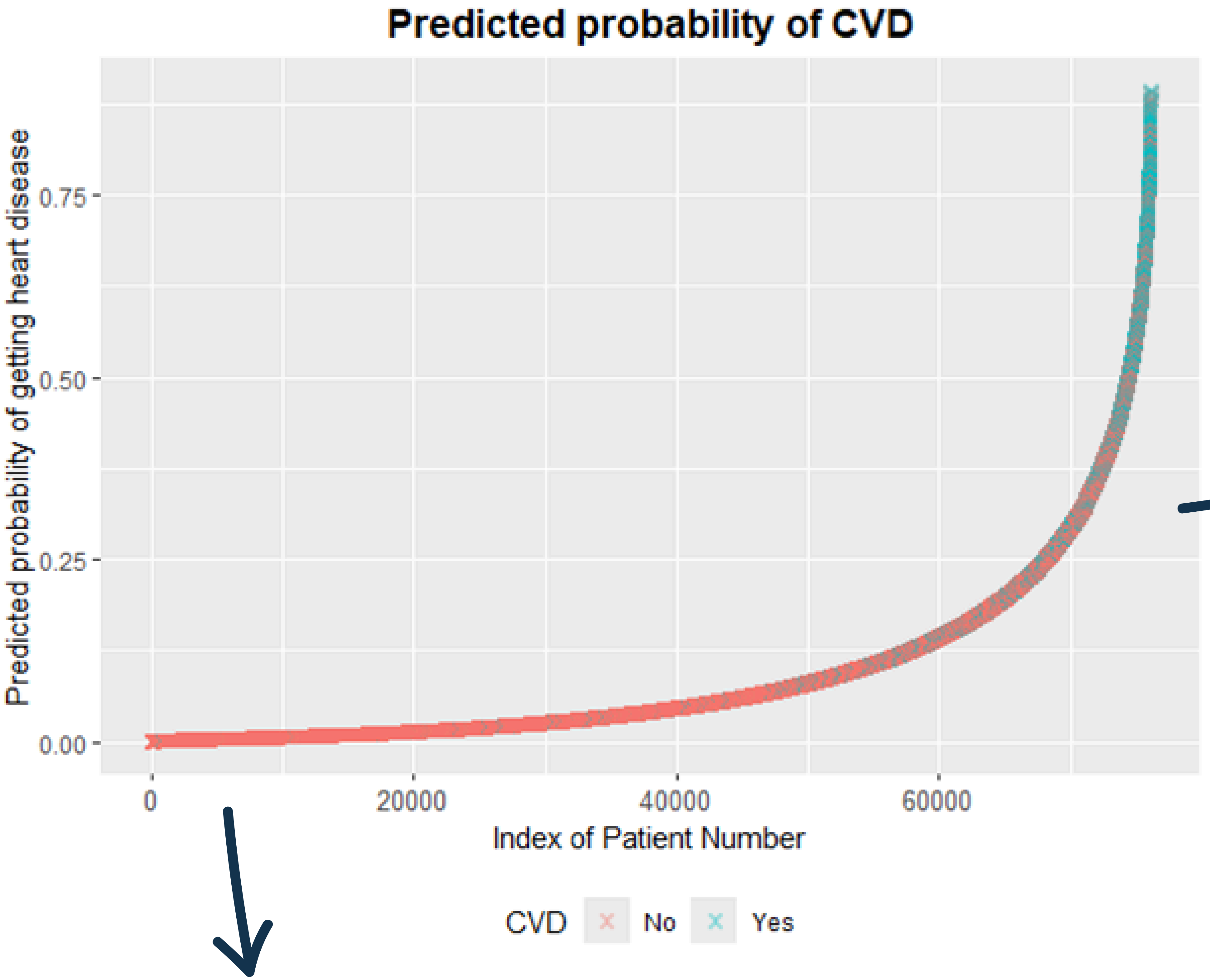
This graphic suggests that **more income** might have some association with **better access to health care and preventive services**, healthier lifestyle choices **versus lower income.**



Individuals with **higher education levels** are more likely to engage in **preventive healthcare practices**, including **regular check-ups** and **early detection screenings** for cardiovascular conditions.



Distribution of Education Group in Sample by Heart Disease Risk



High probability - positive diagnosis for CVD

False negatives?

Low specificity (0.1256):
the test correctly identifies only a small proportion of cases that do not actually have the disease

Low negative predictive value (0.5416):
just over half of individuals with a predicted negative result are actually disease-free

Low probability - negative diagnosis for CVD

KEY POINTS:

- The **Behavioural Risk Factor Surveillance System** (BRFSS) is a respectable tool for **analysis of the relationship between various lifestyle factors** and **the likelihood of developing heart diseases**.

- In our Exploratory Data Analysis (EDA), we conclude that **education** and **income** are modifiable risk factors that can be correlated with Cardiovascular Heart Disease (CVD) alongside the unmodifiable risk factors **gender** and **age**.

- We were able to **predict the probability of heart disease** in patients having into account their answers to the questionnaire, allowing to **develop predictive heart disease models**.