

**The Relationship Between Heart Disease, Age, Gender, and Fasting Blood  
Sugar**

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## **The Relationship Between Heart Disease, Age, Gender, and Fasting Blood Sugar**

### **Introduction**

In 2022, the leading cause of death in the United States was heart disease, with “699,659 deaths” [3]. The study aims to predict heart disease with risk factors such as age, sex, and fasting blood glucose. By knowing one is at a greater risk of heart disease, early interventions can be used to mitigate future risks. The risk factors for cardiovascular disease include: “high blood pressure, high blood cholesterol, smoking, obesity, diabetes, and physical inactivity as well as other valuable information on the effects of related factors such as blood triglyceride and high density lipoprotein (HDL) cholesterol levels, age, gender, and psychosocial issues” [1]. The link between diabetes and heart disease has been quite established in the scientific literature. According to Park et al. [2], “Impaired fasting glucose (IFG), defined by the American Diabetes Association as having a fasting plasma glucose level of 100–125 mg/dL (5.6–7.0 mmol/L) or a 2-h value on the oral glucose tolerance test of 140–199 mg/dL (7.8–11.1 mmol/L) was associated with CVD risk in several studies”. Some of these risk factors can be avoided, like smoking and physical inactivity. However, factors such as sex and age are unavoidable. It is expected that as age increases, heart disease risk also increases. In addition, we expect increased fasting blood sugar levels to be associated with heart disease. We do not anticipate a significant relationship between gender and heart disease. The relationship between risk and fasting blood sugar will also be assessed. The interaction between gender and fasting glucose is hypothesized to be moderated by age.

### **Design**

Information was collected on 918 participants through the Cleveland Clinic. The data contains 14 attributes including age, sex, type of chest pain, resting blood pressure, cholesterol, fasting blood sugar, resting ECG, maximum heart rate, exercise angina, and more. Heart disease was labeled as 0 or 1, 0 being <50% diameter narrowing and 1 being

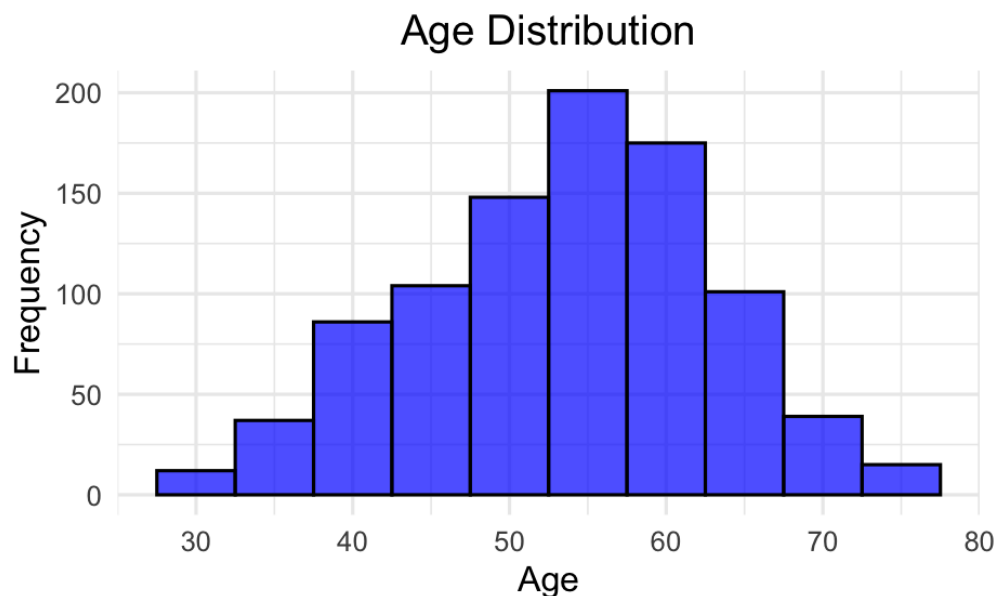
>50%.

## Methods

The database was found on Kaggle and collected through the Cleveland Clinic. The data was previously cleaned and missing data was removed. Exploratory data analysis was conducted to determine which predictors might be most associated with heart disease. The relationship of heart disease with age, sex, and fasting blood sugar will be analyzed. These variables were chosen based on bi-variate relationships with heart disease, and their consistency with preexisting literature. The outcome variable is balanced, thus no weights will be applied. 55% of participants had heart disease, while 45% did not.

## Results

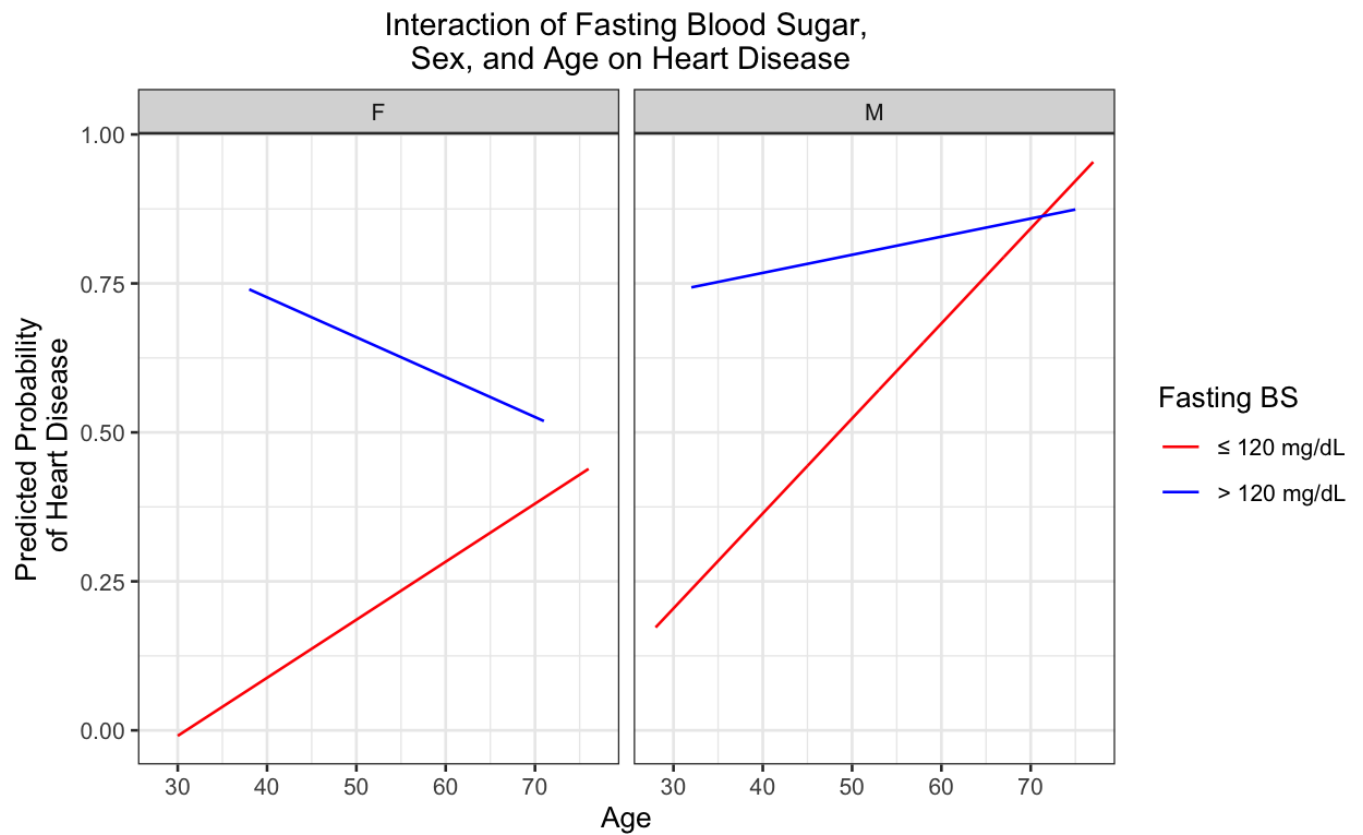
The mean age of participants was 53, with the youngest being 28 and the oldest being 77. There were more men than women with over 78% identifying as male. Fasting blood sugar was coded as 0 and 1, 1 being for those > 120 mg/dl. 21.4% of participants had fasting blood sugar above 120 mg/dl.



**Figure 1**

*Distribution of Age*

A regression analysis was conducted to determine if there is a statistically significant relationship between gender and fasting blood glucose, moderated by age. Regression analyses were also conducted with each predictor. The relationship between age and heart disease was statistically significant:  $b = .01, F(1, 916) = 79.16, p = < .001$ . For every year increase in age, the predicted probability of heart disease increases by 0.01. Sex also had a statistically significant relationship with heart disease:  $b = .37, F(1, 916) = 94.25, p = < .001$ . Males were associated with a 0.37 higher predicted probability of developing heart disease, as opposed to females. Fasting blood sugar also had a statistically significant relationship with heart disease:  $b = .31, F(1, 916) = 70.48, p = < .001$ . A fasting blood sugar level over 120 mg/dl was associated with a 0.31 increase in the predicted probability of heart disease compared to normal blood sugar levels. There was no statistically significant interaction between fasting blood sugar and sex moderated by age:  $b = 0, F(7, 910) = 34.65, p = .78$ . While controlling for fasting blood sugar, sex, and their interaction, age was significantly associated with heart disease.

**Figure 2***Interaction Model*

```
m4 <- lm(heart_disease ~ fasting_bs * sex * age, d)
summary(m4)

##
## Call:
## lm(formula = heart_disease ~ fasting_bs * sex * age, data = d)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.9060 -0.3799  0.1624  0.3491  0.9800
##
```

```
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -0.301376   0.188467  -1.599   0.11015
## fasting_bs     1.295934   0.687232   1.886   0.05965 .
## sexM           0.027708   0.217419   0.127   0.89862
## age            0.009739   0.003574   2.725   0.00655 **
## fasting_bs:sexM -0.376146   0.729784  -0.515   0.60638
## fasting_bs:age  -0.016436   0.012111  -1.357   0.17507
## sexM:age        0.006203   0.004108   1.510   0.13142
## fasting_bs:sexM:age 0.003534   0.012862   0.275   0.78358
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.4437 on 910 degrees of freedom
## Multiple R-squared:  0.2104, Adjusted R-squared:  0.2044
## F-statistic: 34.65 on 7 and 910 DF,  p-value: < 2.2e-16
```

## Discussion

The finding that age increases the probability of heart disease supports Hajar [1], “The risk of developing CAD increases with age, and includes age >45 years in men and >55 years in women”. However, age and sex did not have a significant interaction effect on the probability of heart disease. In the future, more data should be collected on females to ensure a balanced situation of sexes. Our findings also support Ritchey et al. [3], as men are at a higher risk than women, “Around half of cardiovascular events among men and almost one-third of events among women occur before age 65”. Addressing the gender imbalance would help to replicate these findings in the future, as well as more people over age 65. The findings on fasting blood sugar support those of Park et al. [2], where a fasting

glucose of “100 mg/dl” increased the risk for heart disease. Participants were split into groups based on whether or not their fasting blood sugar was more or less than 120 mg/dl. If the cut-off was reduced to 100 mg/dl, the relationship between fasting blood sugar and heart disease risk is expected to be even more significant. Our findings suggest that increasing age, men, and a fasting blood sugar over 120 mg/dl are all associated with risk for heart disease. Awareness of one’s increased risk for heart disease can increase longevity while mitigating the burden on the United States healthcare system.

### References

- [1] Rachel Hajar. “Risk Factors for Coronary Artery Disease: Historical Perspectives”. In: *Heart Views* 18.3 (2017), pp. 109–114. DOI: ["https://doi.org/10.4103/HEARTVIEWS.HEARTVIEWS\\_106\\_17"](https://doi.org/10.4103/HEARTVIEWS.HEARTVIEWS_106_17).
- [2] C. Park et al. “Fasting glucose level and the risk of incident atherosclerotic cardiovascular diseases”. In: *Diabetes Care* 36.7 (2013), pp. 1988–1993. DOI: [10.2337/dc12-1577](https://doi.org/10.2337/dc12-1577).
- [3] M. D. Ritchey et al. “US trends in premature heart disease mortality over the past 50 years: Where do we go from here?” In: *Trends in Cardiovascular Medicine* 30.6 (2020), pp. 364–374. DOI: [10.1016/j.tcm.2019.09.005](https://doi.org/10.1016/j.tcm.2019.09.005).