Exploring the Impact of Lifestyle Factors on the Development and Progression of Heart Disease

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Abstract

This project aims to study the impact of lifestyle factors, including smoking, physical activity, diet and alcohol drinking, on the onset and progression of heart disease. The study be based on the UCI Heart Disease Dataset, which contains comprehensive clinical and demographic information on patients with suspected heart disease. Data analysis and statistical methods will be used to explore the associations between lifestyle habits and heart disease outcomes in the parts of "Data" and " Methods and Data Analysis". The project seeks to provide valuable insights into how these daily factors that influence the risk and pathway of heart diseases. The findings will contribute to the existing body of knowledge on cardiovascular health and inform the development of targeted interventions . By better understanding the role of lifestyle factors in heart disease, this research aims to improve cardiovascular health outcomes and reduce the overall heart diseases at a population level.

1 Introduction

Heart disease remains a significant public health concern globally, accounting for a substantial burden of morbidity and mortality. Lifestyle factors, such as smoking, physical activity, diet, and alcohol consumption, have long been recognized as key modifiable risk factors that can significantly influence the development and progression of heart disease. Understanding the impact of these lifestyle factors on cardiovascular health is crucial for effective prevention and management strategies. The purpose of this project is to investigate the interplay between lifestyle factors and the presence or severity of heart diseases, using the Heart Disease Dataset from the UCI Machine Learning Repository which is a website that i found from my searchings about the most helpful dataset providers to find suitable datasets for researchs. After my investigations for finding a good dataset, I chose the Heart Disease Dataset that has 303 observations with a set of 14 clinical and demographic variables including categorical (sex, chest pain type (cp), fasting blood sugar > 120 mg/dl (fbs), resting electrocardiographic results (restecg), exercise induced angina (exang), slope of the peak exercise ST segment (slope), number of major vessels colored by fluoroscopy (ca), thalassemia

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(thal), target), discrete numeric (maximum heart rate achieved (thalach)) and continous numeric (age, resting blood pressure (trestbps, in mm Hg), serum cholesterol (chol, in mg/dl), ST depression induced by exercise relative to rest (oldpeak)) variables. After chosing the dataset, i pursued on looking for articles related to heart diseases and i saw that how specific lifestyle behaviours contribute to the risk and progression of cardiovascular heart problems. So at last, i designed my question as "What is the impact of lifestyle factors (such as smoking, physical activity, diet, and alcohol consumption) on the development and progression of heart disease?". Then, i just focused more specifically on the articles related to my research question for the project.

1.1 Literature Review

The impact of lifestyle choices on the development and progression of heart disease has been the subject of numerous researchs. This literature review focuses on examining the findings from selected studies on smoking, physical activity, diet and alcohol consumption in association with cardiovascular health outcomes. One of the studies focused on the impact of smoking and smoking cessation on cardiovascular events and mortality in older adults. The results showed a clear connection between smoking and increased cardiovascular risk, while smoking cessation was associated with a reduced risk of cardiovascular events and mortality (Mons et al., 2015). With regard to physical activity, Carnethon (2009) examined how much physical exercise is enough to benefit cardiovascular health. The evidence suggests that moderate-intensity aerobic activity of at least 150 minutes per week provides major cardiovascular benefits. The role of diet in the prevention of heart disease was undertaken by Bechthold et al. (2019) by the systematic research and dose-response meta-analysis that focused on food groups and their association with coronary heart disease, stroke and heart failure. They found that higher intakes of fruits, vegetables, whole grains, and nuts were associated with a lower risk of these cardiovascular consequences. In relation to alcohol consumption, Larsson et al. (2020) conducted a Mendelian randomisation study to investigate the link between alcohol consumption and cardiovascular disease. This report provides evidence of a causal relationship between higher alcohol consumption and increased risk of stroke and peripheral arterial disease. But the results also showed that genetically predicted alcohol consumption was not significantly associated with cardiovascular disease, suggesting that the associations observed in previous studies may be confounded by other factors. Overall, the results of these studies support the importance of a healthy lifestyle, including smoking cessation, regular physical activity, a balanced diet and moderate alcohol consumption, in the prevention and management of heart disease. Future research should continue to explore the long-term effects of lifestyle elements on heart disease, delve into the mechanisms underlying these relationships, and investigate strategies to promote behaviour change and maintain healthy lifestyle habits.

2 Data

The dataset used in this study is the UCI Heart Disease Dataset, a publicly available dataset that has 303 observations and 14 variables, curated specifically for heart disease researchs. The dataset consists of comprehensive clinical and demographic information on patients suspected of having heart disease. Before conducting the analysis, a number of operations were performed on the raw data. First, a thorough examination of the dataset was carried out to ensure data quality and integrity. It was found that a subset of five observations had insufficient data, making them unsuitable for analysis. These observations were therefore excluded from the dataset. Summary statistics were calculated to provide an overview of the dataset. Descriptive statistics, including measures such as mean, median, standard deviation and range, were calculated for relevant variables associated with lifestyle determinants, heart disease indicators and other relevant covariables. These summary statistics give an indication of the central tendencies, variability and distributions of the data set, aiding subsequent analysis and interpretation of the results.

Table 1: Summary Statistics

	Mean	Std.Dev	Min	Median	Max
age	54.54	9.05	29.00	56.00	77.00
ca	0.68	0.94	0.00	0.00	3.00
chol	247.35	52.00	126.00	243.00	564.00
cp	3.16	0.96	1.00	3.00	4.00
exang	0.33	0.47	0.00	0.00	1.00
fbs	0.14	0.35	0.00	0.00	1.00
oldpeak	8.80	11.07	0.00	4.00	62.00
restecg	1.00	0.99	0.00	1.00	2.00
sex	0.68	0.47	0.00	1.00	1.00
target	0.95	1.23	0.00	0.00	4.00
thal	4.73	1.94	3.00	3.00	7.00
thalach	149.60	22.94	71.00	153.00	202.00
trestbps	131.69	17.76	94.00	130.00	200.00

3 Methods and Data Analysis

The figure 1 below, indicates that older individuals tend to have higher resting blood pressure, possibly due to age-related changes in blood vessels, lower levels of physical activity. Additionally, alcohol has been shown to increase blood pressure acutely, nad excessive alcohol consumption can lead to sustained elevations in blood pressure over time.

The figure 2 below, suggests that individuals with heart disease (0 = no, 1, 2, 3, 4 = yes and the levels of it) tend to have higher fasting blood sugar levels, specifically represented as if the level is higher than 120 mg/dl, 1 = true; 0 = false, which can be attributed to

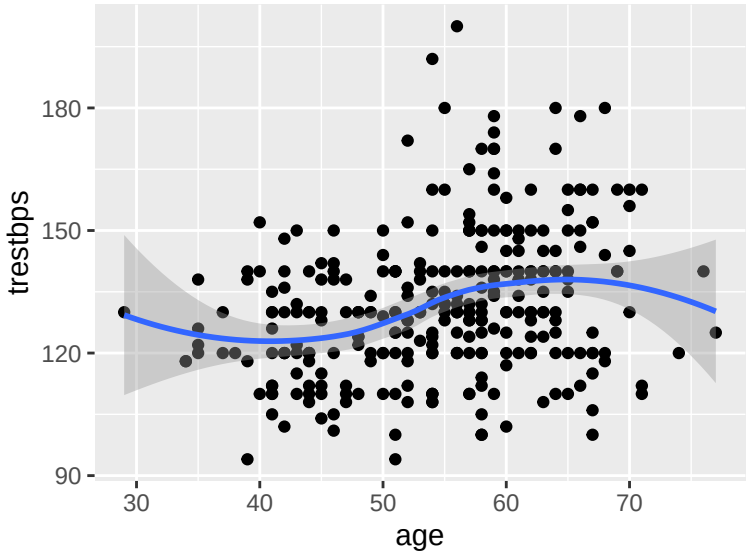

Figure 1: Age and Trestbps

factors such as smoking and poor diet with other determinants. Nicotine can increase blood sugar levels by stimulating the release of stress hormones, such as cortisol and epinephrine, which raise blood glucose levels. A diet high in refined carbohydrates, sugary beverages, and processed foods can contribute to higher blood sugar levels as well. These dietary choices can lead to insulin resistance, impaired glucose tolerance, and ultimately higher fasting blood sugar levels.

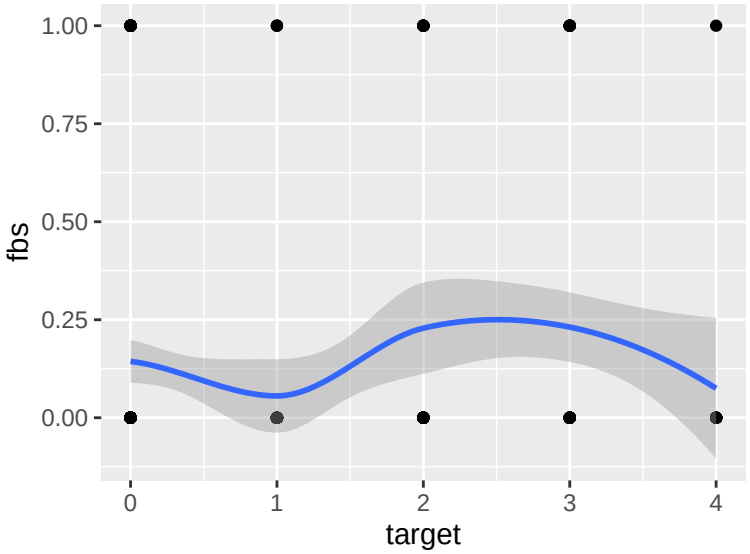

Figure 2: Target and Fbs

4 Conclusion

In this study, we examined the impact of lifestyle factors such as smoking, physical activity, diet and alcohol consumption on the development and progression of heart disease. Our analysis of the UCI Heart Disease Dataset gave us valuable insights into the relationship between these factors and their influence on heart disease. While our study provides valuable informations, it is important to acknowledge its limitations. The analysis was based on the UCI Heart Disease Dataset, which may have inherent biases and limitations. In addition, our study focused on a specific set of lifestyle factors, and other variables such as genetics, socioeconomic status and stress were not included. Future research should aim to address these gaps and adopt a more comprehensive approach to explore the multifaceted nature of heart disease. In conclusion, the findings support the importance of smoking cessation, regular physical activity, a healthy diet and moderate alcohol consumption in reducing the risk of heart disease. These findings can inform public health initiatives, policy decisions and individualised approaches to cardiovascular health management. Further research and collaborative efforts are needed to improve our understanding and develop targeted interventions to effectively combat cardiovascular heart disease.

5 References

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