Impact of Exercise on Resting Heart Rate and Cardiovascular Disease Risk

Introduction

As cardiovascular disease incidence increases across the world, there has been a race towards identifying ways in which this public health crisis could be slowed down. Exercise has been brought up time and time again suggesting that it might be a preventative measure in reducing resting heart rate, an important risk factor in the development of cardiovascular disease, as well as cardiovascular disease risk itself. This study aims to explore the relationship between exercise, resting heart rate (RHR), and cardiovascular disease (CVD) risk. The primary analysis will examine how the average number of minutes spent exercising per week is associated with resting heart rate, while the secondary analysis will investigate how exercise contributes to the likelihood of having cardiovascular disease. The importance of these analyses lies in the potential to better understand how exercise influences heart health, potentially lowering resting heart rate and reducing cardiovascular disease risk. I am particularly interested in conducting these analyses to provide evidence supporting exercise as a preventive measure for cardiovascular health. I expect to find that increased exercise will be associated with lower resting heart rate and a reduced risk of cardiovascular disease.

Methods

For the descriptive analyses, I will first calculate the mean and standard deviation (SD) for continuous variables. This will include the average minutes of exercise per week (exercise) and resting heart rate (beats per minute, hr). These statistics will be computed for the entire sample, and, by cardiovascular disease status (e.g., those with and without cardiovascular disease). Additionally, for categorical variables, such as cardiovascular disease status (0 = No, 1 = Yes), I will tabulate the count and percentage of individuals with and without cardiovascular disease.

In terms of visualizations, I will use boxplots to show the distribution of the continuous variables—exercise and resting heart rate—and a bar graph to illustrate the proportion of individuals with and without cardiovascular disease. These summaries and visualizations will help in understanding the basic characteristics of the data before conducting further analysis.

For the primary hypothesis, the null hypothesis (H_0) is that there is no relationship between exercise (measured in minutes per week) and resting heart rate, while the alternative hypothesis (H_1) posits that there is a relationship between exercise and resting heart rate. To test this hypothesis, I will use linear regression to examine whether exercise (as the independent variable) is associated with resting heart rate (as the dependent variable). The significance level will be set at $\alpha = 0.05$, and a two-sided test will be conducted since we are exploring whether exercise can have either a positive or negative influence on resting heart rate.

For the secondary hypothesis, the null hypothesis (H_0) is that exercise and resting heart rate do not influence the likelihood of having cardiovascular disease, while the alternative hypothesis (H_1) is that exercise and/or resting heart rate are associated with the likelihood of having cardiovascular disease. This hypothesis will be tested using logistic regression, with cardiovascular disease status as the binary outcome (0 = No, 1 = Yes) and exercise as the

predictor variable. The significance level for this test will also be α = 0.05, and a two-sided test will be performed.

Results

Variable	Mean	Standard Deviation (SD)
Exercise (Minutes per Week)	118.6	68.7
Resting Heart Rate (Beats per Minute)	75.5	5.47

Table 1: Descriptive Statistics for Exercise and Resting Heart Rate

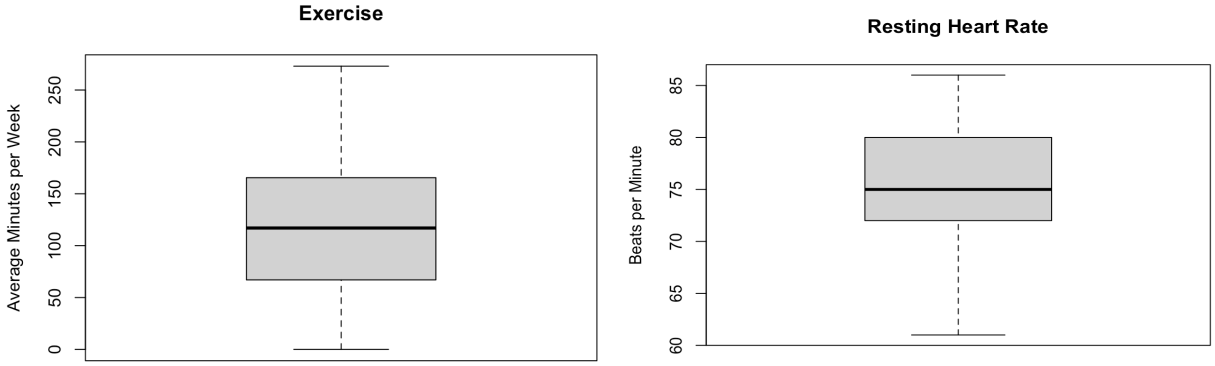

Chart 1: Boxplots Displaying Spread of Data for Exercise and Resting Heart Rate Variables

Group	Exercise Mean (SD)	Heart Rate Mean (SD)
With Cardiovascular Disease	75.3 (42.9)	78.35 (3.48)
Without Cardiovascular Disease	127.5 (69.8)	74.92 (5.63)

Table 2: Descriptive Statistics by Cardiovascular Disease Status

The mean weekly exercise duration for participants was 118.6 minutes, with a standard deviation of 68.7 minutes. The average resting heart rate for the participants was 75.5 beats per minute (bpm), with a standard deviation of 5.47 bpm. When stratified by cardiovascular disease status, participants with cardiovascular disease had a lower mean exercise level of 75.3 minutes and a higher mean resting heart rate of 78.35 bpm. In contrast, participants without cardiovascular disease exercised more, with a mean of 127.5 minutes, and had a lower mean resting heart rate of 74.92 bpm.

Cardiovascular Disease Status	Count	Proportion (%)
No Cardiovascular Disease	83	83%
Cardiovascular Disease	17	17%

Table 3: Counts and Proportions of Cardiovascular Disease Status

Regarding the distribution of cardiovascular disease status, out of the total sample, 83 participants (83%) did not have cardiovascular disease, while 17 participants (17%) were diagnosed with cardiovascular disease. These differences highlight variations in exercise levels and resting heart rate based on cardiovascular health.

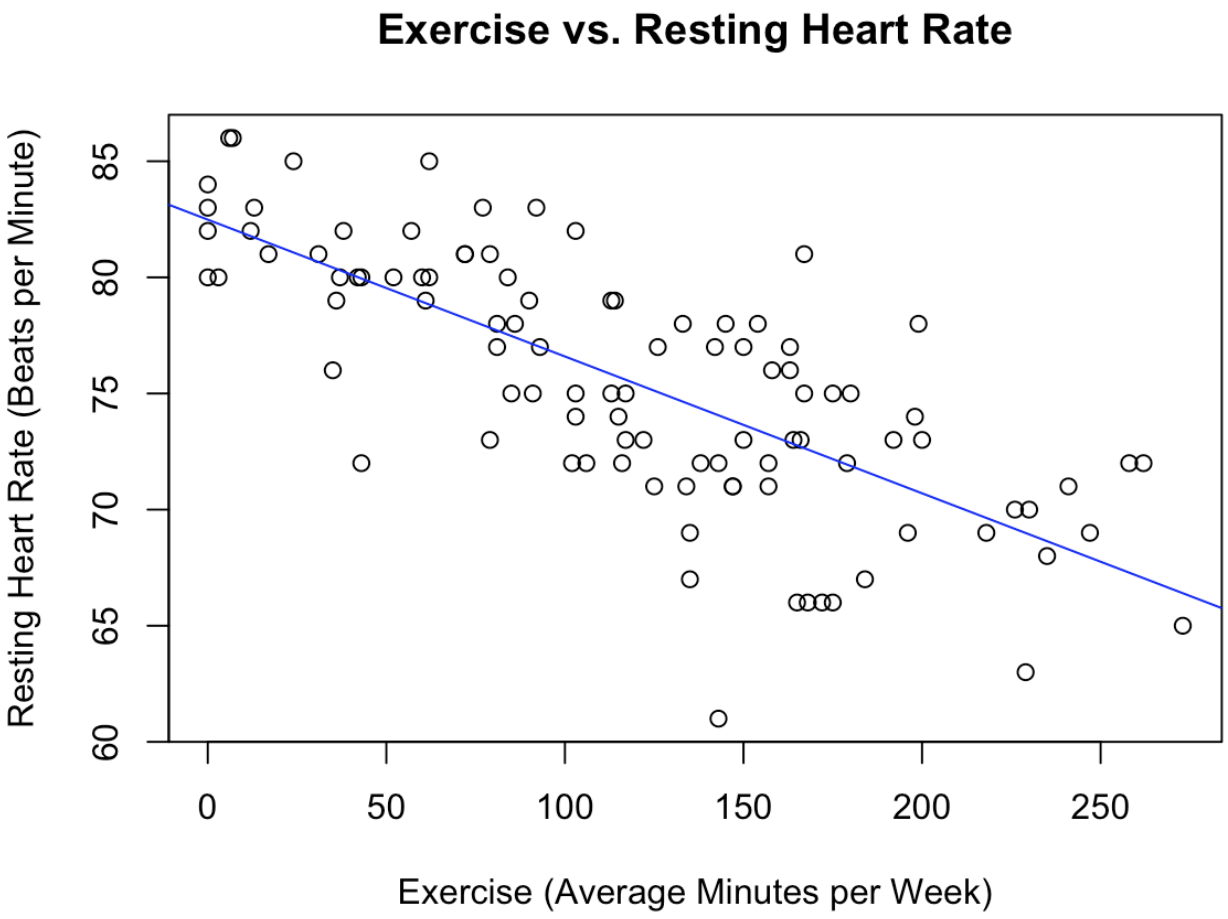

Chart 2: Linear Regression Analysis of Exercise and Resting Heart Rate

For the primary analysis, a linear regression analysis was conducted to examine the relationship between resting heart rate and exercise duration. The results showed a negative association, with an estimated coefficient of -0.059. This implies that for every additional minute of exercise per week, resting heart rate decreases by approximately 0.059 beats per minute. The p-value for this relationship was < 2e-16, indicating strong statistical significance. The 95% confidence interval for the estimate was (-0.070, -0.048), which further supports the robustness of this negative relationship.

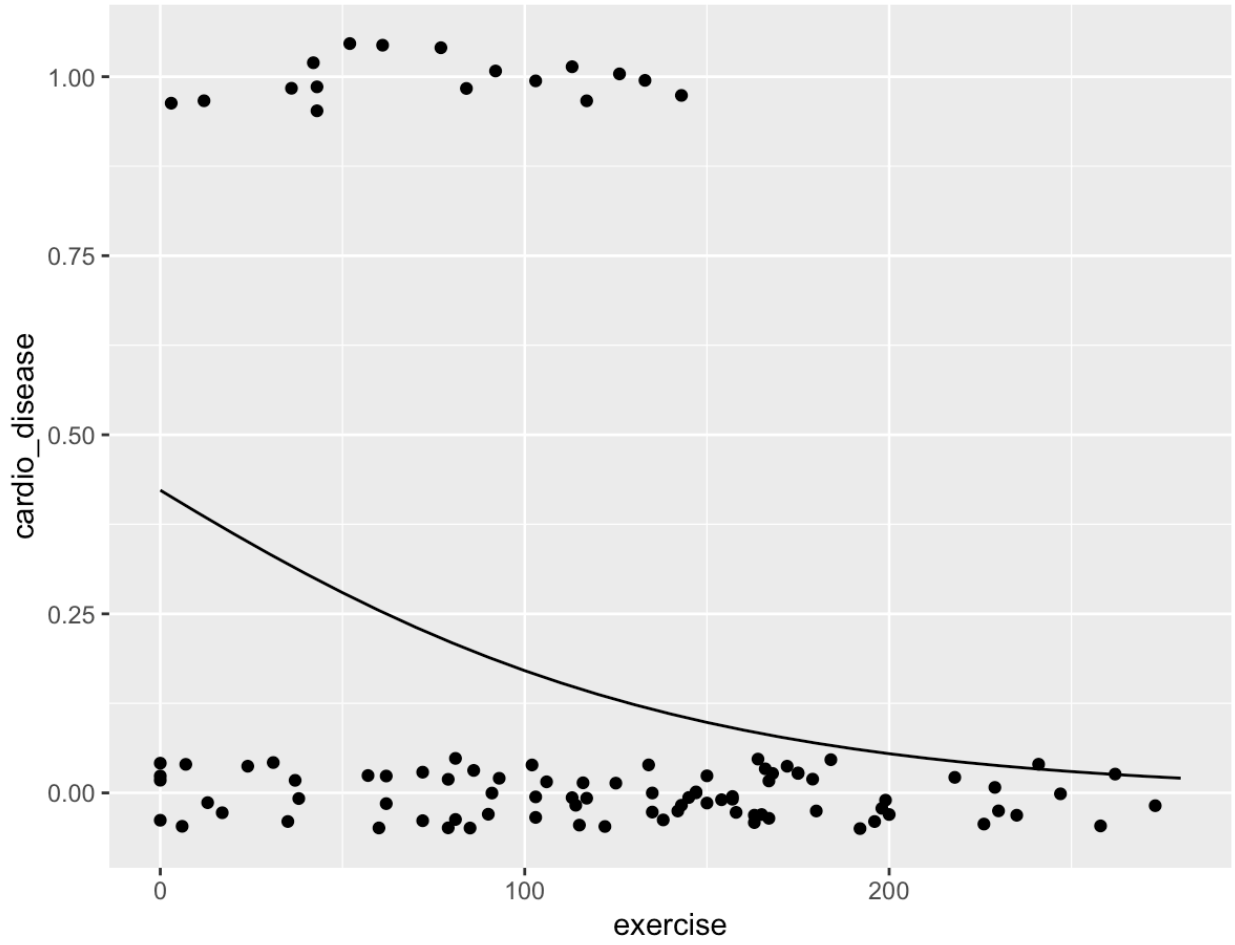

Chart 3: Logistic Regression Analysis of Exercise and Cardiovascular Disease Status

For the secondary analysis, a logistic regression analysis was performed to investigate the association between exercise duration and cardiovascular disease status. The analysis yielded an estimated coefficient of -0.013, indicating that with each additional minute of exercise per week, the odds of having cardiovascular disease decrease. The p-value for this association was 0.006, demonstrating statistical significance. The 95% confidence interval for the estimate ranged from -0.022 to -0.004, suggesting that the relationship between exercise and cardiovascular disease is consistently negative.

In summary, the descriptive statistics revealed that participants without cardiovascular disease engaged in more exercise and had lower resting heart rates compared to those with cardiovascular disease. The linear regression analysis demonstrated a negative relationship between exercise and resting heart rate, while the logistic regression analysis showed that increased exercise levels were associated with a lower likelihood of cardiovascular disease. These findings highlight the potential benefits of regular exercise in improving cardiovascular health and reducing disease risk.

Discussion

The results of this study align closely with the initial expectations. The primary analysis demonstrated a negative relationship between weekly exercise duration and resting heart rate. Specifically, as exercise levels increased, resting heart rate decreased. This supports the hypothesis that regular physical activity helps improve cardiovascular efficiency, likely due to the heart's improved ability to pump blood effectively, leading to a lower resting heart rate.

In the secondary analysis, the logistic regression results indicated that increased exercise levels were associated with a lower likelihood of having cardiovascular disease. This result also matches expectations, suggesting that individuals who exercise more frequently are at a reduced risk of developing cardiovascular disease. The negative association implies that regular physical activity may play a preventative role by improving overall heart health and mitigating risk factors such as hypertension, obesity, and poor lipid profiles.

These findings suggest that within the study population, individuals who engage in higher amounts of weekly exercise tend to have healthier heart rates and a reduced incidence of cardiovascular disease. The results reflect a broader pattern observed in public health, where lifestyle factors like regular exercise significantly impact cardiovascular outcomes.

The consistency of these results highlights the importance of promoting physical activity as a preventive measure against cardiovascular disease. For populations at risk of developing heart disease, encouraging even modest increases in weekly exercise could contribute to meaningful improvements in heart health and reduce disease burden. These insights reinforce the value of exercise-based interventions and public health policies aimed at increasing physical activity levels across different demographic groups.

Conclusion

The study found that higher levels of weekly exercise are associated with lower resting heart rates and a reduced risk of cardiovascular disease. The linear regression analysis showed a clear negative relationship between exercise and resting heart rate, with a statistically significant p-value and a 95% confidence interval that did not cross zero. Similarly, the logistic regression analysis indicated that increased exercise was associated with a lower likelihood of having cardiovascular disease, with a significant p-value and confidence interval. These results reinforce the role of physical activity in improving cardiovascular health.

Several limitations could impact the interpretation of these findings. One limitation is the absence of other potentially influential variables such as diet, smoking status, genetic predisposition, or stress levels, which can affect resting heart rate and cardiovascular health. Including these variables in the analysis might provide a more comprehensive understanding of the relationship between exercise and cardiovascular outcomes.

Another limitation lies in how exercise and cardiovascular disease status were measured. The study relied on self-reported average minutes of exercise per week, which may be subject to recall bias or overestimation. Additionally, a more detailed classification of exercise types (e.g., aerobic vs. strength training) could yield more nuanced insights. For cardiovascular disease

status, a binary classification (presence or absence) may overlook varying levels of disease severity, which could influence the results.

The study population also presents limitations. If the participants were drawn from a specific demographic or geographic region, the findings may not generalize to broader populations. Differences in age, socioeconomic status, or access to healthcare could influence exercise patterns and cardiovascular outcomes, potentially limiting the study's applicability to diverse groups.

A future study could investigate the impact of different types and intensities of exercise on resting heart rate and cardiovascular disease risk while controlling for additional variables such as diet, smoking status, and stress levels. Longitudinal studies that track participants over time could provide deeper insights into how changes in exercise habits influence cardiovascular health outcomes. Additionally, incorporating objective measures of exercise (e.g., wearable fitness trackers) could improve the accuracy of exercise data and reduce recall bias.