Impact of Tobacco Consumption on Blood Pressure and Heart Rate:

A Longitudinal Study

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Introduction

Cardiovascular diseases (CVD) are the leading cause of morbidity and preventable mortality worldwide, responsible for nearly 18 million deaths annually, which accounts for approximately 32% of all fatalities. Of these deaths, 85% are attributed to heart attacks and strokes (Benowitz & Liakoni, 2021). CVD encompasses a variety of disorders affecting the heart and blood vessels, including coronary heart disease, cerebrovascular disease, peripheral arterial disease, and rheumatic heart disease (WHO, 2021a).

Hypertension (high blood pressure) and tobacco consumption are well-established risk factors associated with CVD (WHO, 2021b; WHO, 2022). Globally, 1.28 billion adults have hypertension, with less than half of them being aware of their condition. Tobacco consumption is responsible for over 8 million deaths each year, contributing to roughly 12% of all deaths (WHO, 2022). Alarmingly, tobacco kills about half of all its users (WHO, 2022). Acute effects of smoking include heart attack, stroke, and sudden cardiac death, while chronic effects include heart failure, arrhythmias, and vascular plaque accumulation (Benowitz & Liakoni, 2021).

Although the immediate effects of smoking on heart rate (HR) and blood pressure (BP) are well-documented (Alomari & Al-Sheyab, 2016; Alomari et al., 2014), the long-term impact of smoking on BP remains unclear. Some studies suggest that smoking may decrease BP (Alomari et al., 2020; Alomari & Al-Sheyab, 2016; Okubo et al., 2003), others report increases (Al-Safi, 2005; D'Elia et al., 2013; Dochi et al., 2009), and some find no effect (Davarian et al., 2013). Conflicting results may reflect confounding factors such as age, sex, and body mass index (BMI).

Given these inconsistencies, the present study investigates the relationship between cigarette smoking and BP across varying smoking frequencies. Specifically, this study questions whether individuals smoking more than five cigarettes per day would exhibit higher systolic BP (SBP), diastolic BP (DBP), and HR compared to those smoking one to five cigarettes per day.

Methods

Participants

Data were drawn from the Framingham Heart Study, which began in 1948. From the original 4,434 participants, a subset of 780 individuals aged 44-80 years (M = 57.29, SD = 7.27) was analyzed. Only self-identified smokers were included.

Participants were categorized into three groups:

- Light smokers (≤5 cigarettes/day; n = 93)
- Moderate smokers (6–20/day; n = 471)
- Heavy smokers (≥21/day; n = 216)

Of the sample, 51.3% were female (M age = 56.63, SD = 6.97); male participants averaged 57.98 years (SD = 7.52).

(See Table 1 for the demographic breakdown.)

Materials & Procedure

The Framingham Heart Study is a landmark longitudinal investigation of CVD risk factors. Participants underwent biennial exams assessing BP, HR, smoking history, cholesterol, BMI, diabetes status, and other health metrics. Data for this analysis were collected between 1956 and 1968 across three exam periods. As this was secondary data analysis, no new ethical approvals or consent procedures were required.

Data Analysis

One-way ANOVAs were conducted to compare SBP, DBP, and HR across smoking groups. Additional ANOVAs examined sex differences within groups. Independent t-tests compared male and female participants within each smoking category.

Results

ANOVA results SBP indicated a significant effect of smoking status, $F(2, 777) = 3.08$, $p < .05$. Heavy smokers ($M = 137.55$, $SD = 21.35$) had significantly higher SBP than moderate smokers ($M = 133.21$, $SD = 20.72$).

For DBP, results approached significance, $F(2, 777) = 2.47$, $p = .09$, with heavy smokers ($M = 81.78$, $SD = 10.77$) trending higher than moderate smokers ($M = 79.82$, $SD = 11.22$).

No significant differences were found for HR, $F(2, 777) = 0.10$, $P > .05$.

When stratified by sex, female heavy smokers had higher SBP than female moderates, $F(2, 397) = 2.34$, $p = .10$ (trend level). A t-test showed moderate-smoking women had slightly higher HR than men in the same group, $t(469) = -1.66$, $p = .10$.

(See Tables 2-3 and Figures 1-2 for descriptive statics and visualizations.)

Discussion

This study examined the relationship between smoking intensity and cardiovascular measures. The hypothesis that light smokers would exhibit lower BP and HR than heavier smokers was not supported. Instead, significant differences emerged between moderate and heavy smokers, with heavy smokers showing higher SBP and DBP.

Although results for DBP and sex differences were only marginally significant, they suggest possible gender-specific effects. Female heavy smokers showed elevated SBP compared

to female moderates, and moderate-smoking women had higher HR than men. These findings align with prior research indicating sex-specific cardiovascular responses to smoking (Alomari et al., 2020).

Overall, the results highlight that heavy smoking is associated with elevated BP, reinforcing smoking as a cardiovascular risk factor. However, the absence of differences between light and heavy smokers suggests that other variables (e.g., age, BMI, family history) may confound outcomes. Future research should incorporate these covariates to clarify the smoking-BP relationship.

Table 1

Age Distribution of Participants by Smoking Status

Group	Female			Male		
	N	Mean	SD	N	Mean	SD
Light	57	59.00	7.50	36	61.47	9.21
Moderate	265	56.59	6.86	206	58.85	7.33
Heavy	78	55.03	5.53	138	55.77	6.73
Total	400	56.63	6.97	380	57.98	7.52

Note. Daily cigarette consumption: Light = 1-5, Moderate = 6-20, Heavy = 21 or more.

Table 2

Descriptive Statistics for BP and HR Based on Smoking Status

Group	Mean SBP	Mean DBP	Mean HR
Light	135.06 (24.33)	79.69 (11.80)	78.29 (13.67)
Moderate	133.21 (20.72)	79.82 (11.22)	78.76 (12.71)
Heavy	137.55 (21.35)	81.78 (10.77)	78.37 (11.85)

Note. SD within parentheses.

Table 3

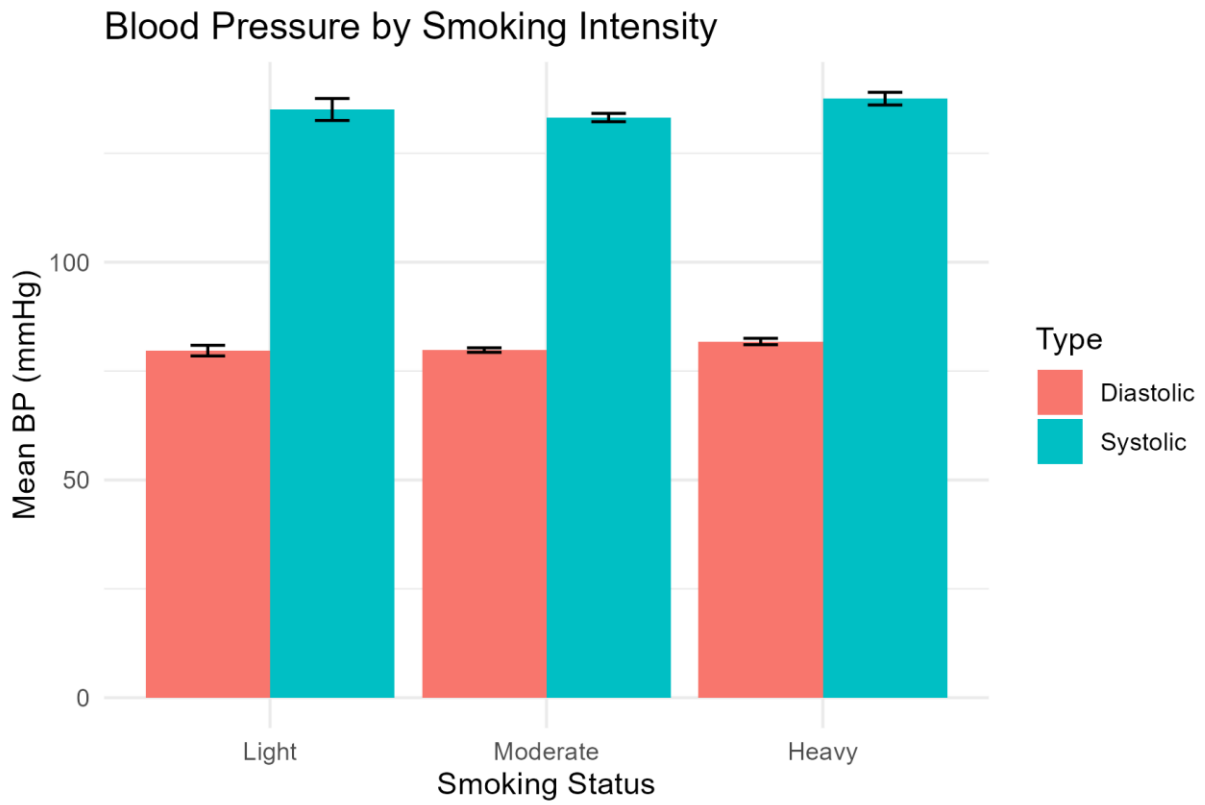
Descriptive Statistics for BP and HR based on Smoking Status and Sex

Group	Female			Male		
	Mean SBP	Mean DBP	Mean HR	Mean SBP	Mean DBP	Mean HR
Light	135.13 (26.37)	78.95 (10.93)	78.39 (13.3)	134.94 (21.05)	80.88 (13.15)	78.14 (14.42)
Moderate	132.20 (21.98)	79.30 (11.16)	79.61 (12.52)	134.50 (18.95)	80.49 (11.30)	77.66 (12.90)
Heavy	138.49 (24.05)	81.94 (11.66)	77.24 (11.66)	137.02 (19.74)	81.69 (10.28)	79.00 (11.95)

Note. SD within parentheses.

Figure 1

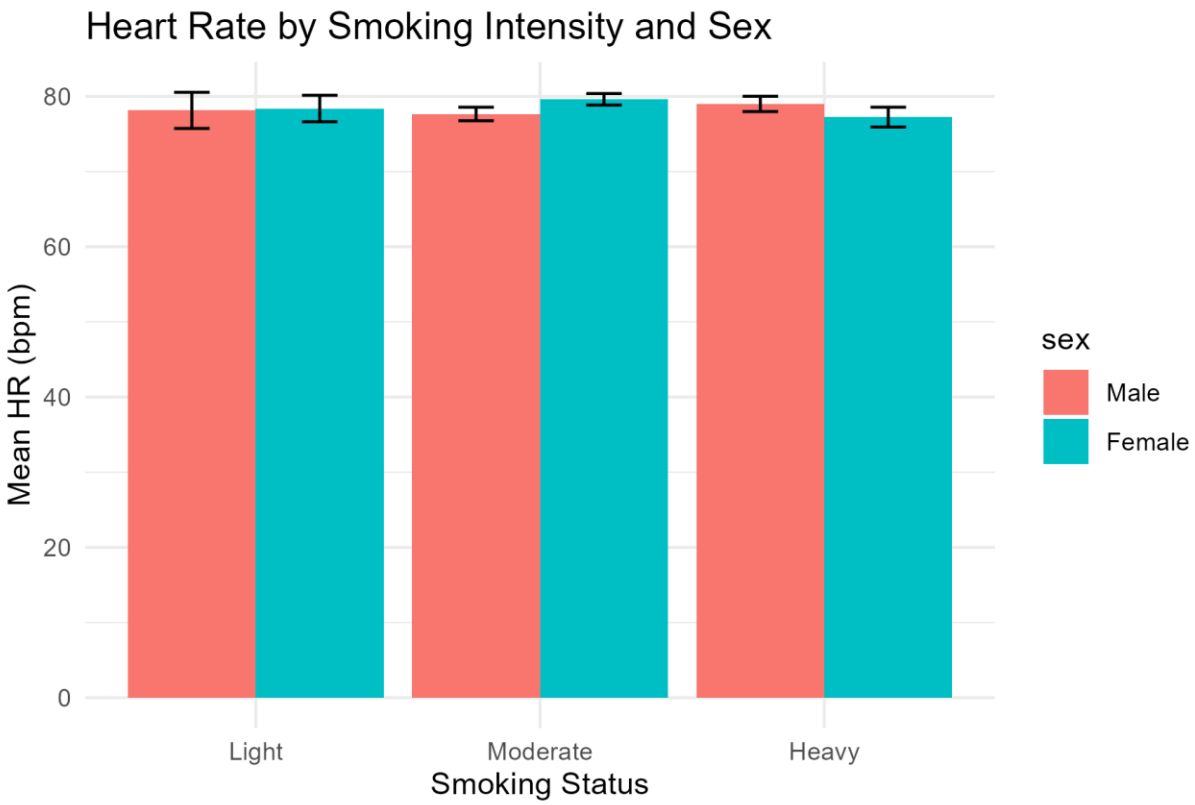
Mean Systolic and Diastolic Blood Pressure by Smoking Intensity



(Bar chart with SBP and DBP means plotted for Light, Moderate, and Heavy smokers. Error bars represent ±1 SD.)

Figure 2

Mean Heart Rate by Smoking Intensity and Sex



(Bar char with HR means plotted separately for males and females across Light, Moderate, and Heavy smoking groups. Error bars represent ±1 SD.)

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