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Impact of Alcohol Consumption Frequency and Tobacco Use on Blood Pressure (DBP, SBP, HR): A Cross-Sectional Study

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Abstract

Alcohol consumption has been associated with higher blood pressure (BP) and an increased risk of developing chronic hypertension; however, the possible exposure thresholds and effect-modifiers are uncertain. A positive response relationship exists between smoking and hypertension, too, and both combined can result in detrimental health effects. This pilot project conducted BP screenings at community events, food drive events, and church community services around Davidson County in Nashville, Tennessee, from May 2025 to July 31, 2025. From the data, the study explored the correlation of smoking and alcohol consumption and its effect on Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Heart Rate (HR). One hundred sixty-seven participants completed BP screenings at four public housing communities of Metropolitan Development Housing Authority (MDHA), three religious settings, i.e., community church, and two health fairs.

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Then, the study utilized generalized linear models to assess the association between alcohol consumption and tobacco use on BP measures. There were no significant associations between combined patterns of alcohol consumption and smoking on SBP, DBP, or HR. However, tobacco use alone was associated with a ninefold increase in HR, compared to non-users. Future studies should consider smoking patterns (e.g., daily versus occasional smoking), types (e.g., vaping versus cigarette use), and a larger population cohort to validate these results.

Keywords: Hypertension; Systolic Blood pressure; Diastolic blood pressure; heart rate; smoking; alcohol.

1. Introduction

Alcohol consumption has been associated with higher blood pressure (BP) and an increased risk of developing chronic hypertension; however, the possible exposure thresholds and effect-modifiers are uncertain. Alcohol is a psychoactive and addictive substance whose consumption may result in severe adverse health effects and about 3 million deaths each year globally, particularly at moderate-to-high consumption levels [1, 2]. Alcohol consumption has been associated with a variety of cardiovascular disease outcomes, including cardiomyopathies, coronary artery disease, and stroke [3]. The onset of hypertension is affected by not just one factor but multiple factors, including both alcohol intake and smoking.Some previous studies identified alcohol as one factor that worsens hypertension [7, 8]. In these studies, a dose-response relationship between alcohol consumption and hypertension was specifically noted; on the other hand, the relationship between smoking and hypertension was not found to be significant [9, 10]. However, a transient increase in BP while smoking cigarettes, as well as findings supportive of a causal association of smoking burden with a higher resting heart rate, were noted even though no direct relationship between smoking and hypertension has been documented [9, 10]. Similar studies have found that alcohol and smoking increase the risk of cardiovascular diseases by several fold [11, 12]. In these studies, alcohol, smoking, and hypertension are all factors that similarly affect the outcome of cardiovascular disease.On the other hand, although there are few reports of smoking as a direct cause of persistent hypertension, there are some about the risk of developing cardiovascular diseases (stroke and heart diseases). As such, the combined action of smoking and hypertension is thought to increase the incidence of cardiovascular problems [11]. However, few reports have associated smoking with the onset of exacerbation of hypertension or documented any clear evidence of a relationship between smoking and hypertension itself

Reference [9, 10].Some previous studies have investigated the relationship between hypertension and both alcohol and smoking [13]. Still, to our knowledge, none have focused on the synergistic health effects of the two together on hypertension. To help prevent cardiovascular diseases, it is essential to reduce the risk of hypertension. Therefore, obtaining information on alcohol, smoking, and blood pressure (BP) is significant. A positive response relationship exists between smoking and hypertension, too, and both combined can result in detrimental health effects. Some observations suggest that a transient increase in hypertension exists while smoking a cigarette and that smoking raises BP for more than 15 minutes [14]. Nicotine in tobacco smoke is said to play a significant role in the mechanism of transient increase in blood pressure, and nicotine stimulates the adrenal glands to release catecholamines and stimulates the sympathetic nervous system, thereby causing constriction of peripheral blood vessels, an increase in BP, and an increase in heart rate [15]. Regarding the

combined effect of alcohol and smoking in past studies, one study found that achievement of the treatment goal was reduced when alcohol consumption and smoking were continued even during the hypertension treatment period [16]. This pilot study is a part of a Team Lifestyle Immersion Program (TLIP) for improving hypertension control. The TLIP conducted BP screening at nine community health and family outdoor events in Nashville, Davidson County, Tennessee, from May 2025 to July 2025 [18]. The present study analyzed the collected data to investigate the correlation between smoking and alcohol consumption and their effects on Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Heart Rate (HR).

2. Material and methods

Using an upper arm BP monitor, three BP readings were collected. The first reading was discarded, and the remaining two were averaged and used for analysis. The TLIP also collected demographic and clinical data prior to BP collection. Participants were asked about their age, gender, tobacco use (yes/no), frequency of alcohol consumption (never/rarely, 1-3 times per month, and at least once per week), and hypertension diagnosis status (yes/no), current medication use (yes/no), history of heart attack (yes/no), history of stroke (yes/no), body weight in pounds, height, fasting status (yes/no), and current diabetes diagnosis (yes/no).

2.1. Analysis

All data were analyzed in SPSS (version 30) and SAS software packages. Continuous data was represented with mean and standard deviations (SD) or median and interquartile range (IQR). Categorical variables were presented with frequencies and percentages. The Chi-square and Fisher exact tests were used to explore differences for the categorical variables, the one-way ANOVA tests for the normally distributed continuous variables, and the Mood median tests for the non-normal continuous variables. Generalized linear models (GLM) examined the crude and adjusted associations between alcohol consumption and tobacco use and BP measures (SBP, DBP, and HR). The adjusted models included age, gender, BMI, diabetes, heart attack, stroke, BMI, BP medication use, and tobacco use. Statistically significant differences were represented with $p<0.05$.

2.2. Results

Overall

The study cohort included 167 participants. Most often, participants were non-smokers (69.5%; n=116), never/rarely consumed alcohol (70.0%; n=117), male (52.1%; n=87), obese (47.9%; n=80), older age (36.5%; n=61), currently using antihypertensive medications (53.9%; n=90), and have previous been diagnosed with hypertension (58.1%; n=97; Table 1). Participants who used tobacco were generally older (64 years old), female (33.8%; n=27), and of healthy weight (45.2%; n=14). Further, participants who never/rarely drank alcohol were often younger (59 years), compared to older participants who often reported drinking at least once a week (64 years; Table 2). Tobacco users also had significantly elevated HR than their non-user counterparts (85.1 vs 76.6 mm Hg). No significant differences were observed for either SBP or DBP. Frequency of alcohol consumption was not associated with any BP measures.

Table 1: Participants Characteristics

	Overall	**SBP**	**DBP**	**HR**
Characteristics	***N* = 167**	**136.6 (20.7)**	**80.5 (11.2)**	**79.2 (14.3)**
Tobacco Use				
Yes	51 (30.5)	135.7 (21.8)^{NS}	80.0 (12.0)^{NS}	85.1 (14.4)**
No	116 (69.5)	137.0 (20.3)	79.9 (12.1)	76.6 (13.6)
Alcohol Consumption				
Never/Rarely	117 (70.0)	136.2 (20.4)^{NS}	80.2 (12.0)^{NS}	78.3 (14.0)^{NS}
1-3/Month	33 (19.8)	138.7 (23.7)	82.4 (9.5)	81.6 (16.0)
At least once/wk**.**	17 (10.2)	135.3 (17.5)	78.5 (7.6)	80.6 (13.4)
Age, Median (IQR)	59 (21.0)			
Categorical				
18-44	36 (21.6)	132.5 (18.4)^{NS}	80.1 (11.4)**	78.9 (15.4)^{NS}
45-64	70 (41.9)	138.7 (21.5)	83.3 (11.1)	81.9 (13.2)
65+	61 (36.5)	136.6 (21.2)	77.5 (10.5)	76.3 (14.6)
Sex				
Female	80 (47.9)	137.5 (21.0)^{NS}	79.2 (11.1)^{NS}	77.3 (14.9)^{NS}
Male	87 (52.1)	135.8 (21.0)	81.7 (11.2)	81.0 (13.6)
BMI, Median (IQR)	29.9 (9.5)			
Categorical				
Healthy and Underweight (< 24.9 Kg/m^2)	31 (18.6)	134.0 (23.8)**	76.7 (9.5)**	80.0 (14.3)^{NS}
Overweight (25.0 – 29.9 Kg/m^2)	56 (33.5)	130.9 (20.9)	77.4 (11.9)	77.8 (14.4)
Obese (30.0+ Kg/m^2)	80 (47.9)	141.6 (18.3)	84.1 (10.2)	80 (79.9)
Diabetes				
Yes	52 (31.1)	139.5 (22.9)^{NS}	80.2 (11.7)^{NS}	80.8 (14.7)^{NS}
No	115 (68.9)	135.3 (19.6)	80.6 (10.9)	78.5 (14.2)
Health History				
Stroke, yes	18 (10.8)	138.7 (25.4)^{NS}	74.9 (11.7)**	68.5 (14.6)**
No	149 (89.2)	136.4 (20.2)	81.2 (10.9)	80.5 (13.8)
Heart Attack, yes	17 (10.2)	134.6 (27.3)^{NS}	75.9 (13.5)^{NS}	75.1 (14.9)^{NS}
No	150 (89.8)	136.8 (19.9)	81.0 (10.8)	79.7 (14.2)
Hypertension Medication Use				
Yes	90 (53.9)	139.1 (22.7)^{NS}	80.7 (11.7)^{NS}	77.9 (14.7)^{NS}
No	77 (46.1)	133.7 (17.9)	80.3 (10.6)	80.7 (13.7)
Previous Hypertension Diagnosis				
Yes	97 (58.1)	139.5 (21.9)**	80.9 (11.5)^{NS}	78.5 (14.7)^{NS}
No	70 (41.9)	132.6 (18.5)	79.9 (10.8)	80.2 (13.8)

**Significant differences ($p<0.05$); NS: Not significant differences; IQR: Interquartile range; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; HR: Heart Rate.

3.Multivariable Analysis Between Tobacco Use, Alcohol Consumption, and BP

3.1. Alcohol Consumption

Compared to participants who never/rarely drank alcohol, those who consumed alcohol 1-3 times/month had at least a three-fold non-significant increase in all BP measures (Table 2). For those who consumed alcohol at least once a week, there was a 1 mm Hg increase in SBP (1.15, 95% CI [-9.32, 11.63]), and a reduction in both DBP and HR.

Table 2: Adjusted GLM Analysis: Alcohol Consumption and SBP, DBP, and HR

	Alcohol Consumption	
	1-3 times per month	**At least once per week**
Blood Pressure	**vs Never/Rarely**	**vs Never/Rarely**
SBP		
β (95% CI)	3.59 (-4.30, 11.48)	1.15 (-9.32, 11.63)
P-values	0.37	0.83
DBP		
β (95% CI)	3.06 (-1.03, 7.14)	-0.78 (-6.21, 4.64)
P-values	0.14	0.78
HR		
β (95% CI)	3.37 (-1.62, 8.36)	-0.21 (-6.84, 6.42)
P-values	0.19	0.95

3.2. Tobacco Use

Tobacco use was associated with an eight-fold increase in HR (8.55, 95% [4.29, 12.8]), compared to non-users (Table 3). No significant associations were observed for SBP or DBP.

Table 3: Adjusted GLM Analysis: Tobacco Use and SBP, DBP, and HR

	Tobacco Use
Blood Pressure	**Yes vs No**
SBP	
β (95% CI)	-1.72 (-8.76, 5.02)
P-values	0.62
DBP	
β (95% CI)	-0.69 (-4.19, 2.80)
P-values	0.70
HR	
β (95% CI)	8.55 (4.29, 12.8)
P-values	**<0.0001**

3.4. Impact of Combined Alcohol Consumption and Tobacco Use

No significant associations were observed between combined tobacco use and alcohol consumption (Table 4). There was however, a 10-fold increase in HR among participants who used tobacco and consumed alcohol at least once a week (10.5 95% CI [-.271, 23.72]).

Table 4: Adjusted Interaction Between Tobacco Use and Alcohol Consumption

Blood Pressure	**Tobacco (Yes) and Alcohol (1-3 times per month)**	**Tobacco (Yes) and Alcohol (At least once per week)**
SBP		
β (95% CI)	4.46 (-12.24, 21.17)	-2.65 (-26.66, 18.36)
P-values	0.60	0.8049
DBP		
β (95% CI)	4.20 (-4.41, 12.80)	7.34 (-3.48, 18.17)
P-values	0.34	0.18
HR		
β (95% CI)	2.55 (-7.80, 13.05)	10.51 (-2.71, 23.72)
P-values	0.63	0.12

4. Discussion

In the present study, alcohol consumption did not significantly impact SBP, DBP, or HR. Additionally, the study showed no significant changes to BP from combined tobacco use and alcohol consumption. To our knowledge, no study has focused on the combined effects of alcohol and smoking from the perspective of developing hypertension. The present study showed that, with low alcohol consumption, i.e., 1-3 times per month, at least once per week, or never/ rarely, there was no significant difference in SBP, DBP, or HR. Some

observations suggest a transient increase in hypertension exists while smoking a cigarette and that smoking increases BP for more than 15 minutes [14]. Nicotine in tobacco smoke is said to play a significant role in the mechanism of transient increase in BP. Nicotine stimulates the adrenal glands to release catecholamines and stimulates the sympathetic nervous system, thereby causing constriction of peripheral blood vessels, an increase in BP, and an increase in HR [15].

The clinical implications of smoking-induced higher resting HR are not clear [19]. However, considering the well-documented detrimental effects of smoking on the risk of cardiovascular disease and our finding that this might not involve a substantial direct effect on SBP and DBP, it may be speculated that more attention should be paid to resting HR as a marker of cardiovascular health and risk prediction [20].

5. Limitations

The generalizability of these results is subject to certain limitations. This study did not specify the amount of alcohol consumed per week or month, nor was the quantity consumed defined. Only alcohol consumed or never, 1-3 times per week, or at least once a week was taken into consideration.

Another limitation was that it would be essential to consider pack-years, or other life-long smoking information, rather than a punctual estimate of smoking in the analysis, to associate it with hypertension. The number of cigarettes smoked over a period was not defined either; only whether the participants smoked or not was considered in the screening process.Moreover, although the obtained data was self-reported, the contents of the questionnaire that were filled out at the time of screening were confirmed directly with the person, which leads to self-bias. More information about the screening could be confirmed by the participant's primary care physician or public health nurse, which was not considered in the study. Some of the screening events were done at housing projects of the MDHA (Metropolitan Development Housing Authority), Nashville, TN where they are residents, therefore drinking and smoking are not considered to be very unfavorable behaviors by the subjects themselves, and their drinking, and smoking habits would not reflect the population in discussion.

6. Conclusion

The present study showed that alcohol consumption 1-3 times per month vs never/rarely and consumption once per week vs never/rarely did not reveal any significant changes in SBP, DBP, and HR. We also did not find significant changes in SBP and DBP in response to smoking. In this study, we believed the results established a positive relationship between smoking and an increase in HR. Further research with a larger population and longitudinal analysis is required to confirm these findings.

7.Institutional Review Board

This study received approval from the Meharry Medical College Institutional Review Board (IRB #FWA00003675).

8.Conflict of Interest

The authors declare no conflict of Interest. Study data requests should be made to the corresponding author.

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