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Research on the Relationship Between Cardiovascular Disease and Hypertension and Diabetes

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Abstract. While few research examined the relationship between both primary factors—diabetes and hypertension—and cardiovascular disease, the study concentrated on the interaction between the two factors and the disease. The aim of this research is to ascertain whether diabetes and hypertension will raise the risk of cardiovascular disease in persons over 40 in the United States. The findings indicate that from 2013 to 2018, 11463 US adults over 40 were evaluated for the National Health and Nutrition Examination Survey, which collected data on age, gender, race, smoking status, BMI, and the association between hypertension, diabetes, and cardiovascular disease. During data analysis, logistic regression and the chi-square test were employed. Compared to those without CVD, those with CVD were more likely to be older, male, smokers, and to have a higher BMI. They also had higher rates of diabetes and hypertension. The CVD group and the non-CVD group differ statistically significantly in terms of diabetes (<0.001) and hypertension (<0.001). Overall, the results of univariate and multivariate logistic regression indicated that diabetes and hypertension were associated with a higher risk of cardiovascular disease. Moreover, people diagnosed with cardiovascular disease were more likely to be male, smokers, older, and have a higher BMI.

Keywords: Cardiovascular disease, hypertension, diabetes, logistic regression.

1. Introduction

As the primary cause of death, cardiovascular disease (CVD) is one of the most significant public health issues[1]. Over the past few decades, the burden of CVD incidence and mortality has been rising[2]. One of the most common major modifiable CVD risk factors among US adults is hypertension[3,4], which affects roughly 1 in 3 Americans, or 65 million adults. As such, hypertension is a significant economic and public health burden.

Diabetes increases the risk of cardiovascular disease (CVD). A review of numerous studies found that individuals with diabetes had higher rates of coronary heart disease (CHD) [HR 2.00 (95% CI 1.83-2.19)], coronary death [HR 2.31 (95% CI 2.05-2.60)], and myocardial infarction (MI) [HR 1.82 (95% CI 1.64–2.03] than those without the condition [5]. The Centers for Disease Control and Prevention (CDC) estimates that 38.4 million Americans had diabetes in 2021 [6]. Researchers have documented disparities in the prevalence of both type 1 and type 2 diabetes among various racial and ethnic groups.

The association between diabetes, hypertension, and CVD will be the main focus of the study, and logistic regression and t tests will be used to determine this relationship. In order to identify the differences between the two groups, we will first list and compare a few participant characteristics

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between the CVD group and the non-CVD group using a t test. In addition, we will quickly look at the connection between the two main variables and CVD using a chi-square test. To further investigate the association between these variables, we will also use logistic regression, which incorporates both univariate and multivariate regression. Researchers will be able to investigate further using the above results, such as determining whether there is a bidirectional relationship between them.

It is well established that there is a connection between CVD and both diabetes and hypertension. Because these conditions have a significant negative influence on human health and require significant financial, material, and human resources, it makes sense to conduct this kind of research.

2. Methods

2.1. Source of data and study population

After taking into account the intricate survey design and sampling weights to be representative of the noninstitutionalized U.S. population, the research evaluated 11463 people in the US who were over 40 years old in terms of age, gender, race, smoking status, BMI, and the relationship between hypertension, diabetes, and cardiovascular disease from the National Health and Nutrition Examination Survey (NHANES, 2013–2014, 2015–2016, 2017–2018). NHANES gathers information on health, nutrition, socioeconomic status, and demographics in addition to standardizing lab tests and physical examinations. NHANES was authorized by the Institutional Review Board of the National Center for Health Statistics, and written informed permission was given by each participant. Those under 40 were not allowed to participate in the study. In the end, 9616 individuals were in the non-CVD group and 1847 participants were in the CVD group.

2.2. Variables and covariables

The subjects' self-reported interview data served as the basis for the diagnosis of diabetes, hypertension, and CVD. The study divided the participants into two groups: the CVD group comprised those who reported having heart failure (HF), coronary heart disease (CHD), angina pectoris (AP), heart attack (HA), and stroke, while the non-CVD group included those who did not. Age (40–59, 60–plus), gender, race (Mexican American, Other Hispanic, Non-Hispanic White, Non-Hispanic Black, Other Race), BMI (weight divided by square of height, <25, $\geqslant 25$), and smoking status (Every day, Someday, Not at all) were the subgroups that the research examined the results in.

2.3. Statistical analyses

The demographic parameters of the CVD group and the non-CVD group were explained by component ratios (%). We present the participant characteristics according to their status for CVD, with a mean and a percentage in parenthesis. To find out if there were any statistically significant differences between the participants with and without CVD in terms of age, gender, race, BMI, smoking status, number of participants with hypertension, and number of participants with diabetes, the author employed a T test. In addition, the Chi-square test was employed to assess the distinctions in categorical attributes (such as the presence of diabetes or hypertension) between the CVD and non-CVD groups. Three logistic models were used to show the association between the two main factors (diabetes and hypertension) and cardiovascular disease and then estimate the odds ratio (OR) with a 95% confidence interval (CI).

All of the analyses were operated with RStudio version 4.3.2, with a 2-sided α-level = 0.05.

3. Results

Table 1. Characteristics of Participants According to the Status of CVD

Characteristics	Cardiovascular Disease		p
	Yes	No	
n	1847	9616	

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Table 1. (continued).

Age	69.00[61.00,78.00]	58.00[48.00,67.00]	<0.001
Age 40-59(%)	392(21.2)	5177(52.5)	
Age>=60(%)	1453(78.8)	4439(47.5)	
Gender(%)			<0.001
Male	1056(57.2)	4464(46.4)	
Female	791(42.8)	5152(53.6)	
Race(%)			<0.001
Mexican American	175(9.5)	1417(14.7)	
Other Hispanic	161(8.7)	1052(10.9)	
Non-Hispanic White	903(48.9)	3491(36.3)	
Non-Hispanic Black	418(22.6)	2079(21.6)	
Other Race-Including Multi-Racial	190(10.3)	1577(16.4)	
Body Mass Index	30.56(7.30)	29.59(6.84)	<0.001
BMI<25(%)	358(19.4)	2305(23.9)	
BMI>=25(%)	1325(78.7)	6822(74.7)	
SMQ(%)			<0.001
Every day	322(17.4)	1328(13.8)	
Some days	49(2.7)	306(3.2)	
Not at all	1476(79.9)	7982(83.0)	
HBP=Yes(%)	1397(75.6)	4207(43.8)	<0.001
DIB=Yes(%)	688(37.2)	1616(16.8)	<0.001

The characteristics of the individuals are presented in Table 1 based on their status with CVD. 11,463 participants in total were included by the author. In the CVD group, 1,847 participants were included (median age = 69, age 40~59 = 392 (21.2%), age⩾60 = 1,453 (78.8%), men = 1,056 (57.2%), and women = 791 (42.8%)). In comparison, 9616 participants were included in the non-CVD group (median age = 58, age 40~59 = 5,177 (52.5%), age⩾60 = 4,439 (47.5%), men = 4,464 (46.4%), and women = 5,152 (53.6%)). Table 1 demonstrates that there are significant differences in age ($p<0.001$), gender ($p<0.001$), race ($p<0.001$), BMI ($p<0.001$), smoking status ($p<0.001$), hypertension ($p<0.001$), and diabetes ($p<0.001$) between the CVD group and the non-CVD group.

Table 2. Chi-square table of Hypertension

Hypertension	CVD		total
	yes	no	
yes	1397	4207	5604
no	450	5409	5859
total	1847	9616	

Table 3. Chi-square table of Diabetes

Diabetes	CVD		total
	yes	no	
yes	688	1616	2304
no	1159	8000	9159
total	1847	9616	

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Table 4. Chi-square test results

Factors	χ^2	p value	odds ratio	95%CI
Hypertension	629.16	<0.001	3.990897	3.558615~4.482171
Diabetes	401.98	<0.001	2.938351	2.631866~3.279217

Table 4 displays the results of the Chi-square test, which indicate that there are significant differences between the CVD group and the non-CVD group in terms of hypertension (p<0.001, OR, 3.99, 95%CI, 3.56~4.48) and diabetes (p<0.001, OR, 2.94, 95%CI, 2.63~3.28).

Table 5. Univariate logistic regression analysis of two major factors and CVD

Univariate	B	Wald	Odds Ratio(95% CI)	P
Hypertension	1.384	570.095	3.991(3.566~4.476)	<0.001
Diabetes	1.078	379.727	2.939(2.636~3.275)	<0.001

Table 6. Multivariate logistic regression analysis of two major factors and CVD

Multivariate	B	Wald	Odds Ratio(95% CI)	P
Hypertension	1.239	437.179	3.451(3.075~3.879)	<0.001
Diabetes	0.805	196.281	2.237(1.998~2.503)	<0.001

Table 5 and 6 used the grouping of CVD and non-CVD as the dependent variable (non-CVD group = 0, CVD group = 1), and used the two main factors (hypertension and diabetes) in the samples of the CVD and non-CVD groups as independent variables for multivariate logistic regression analysis. The overall univariate logistic regression and multivariate logistic regression results showed that Hypertension and Diabetes had an increased risk of Cardiovascular disease.

Univariate logistic regression (hypertension (p<0.001, OR, 3.99, 95%CI, 3.57~4.48), diabetes (p<0.001, OR, 2.94, 95%CI, 2.64~3.28)). Multivariate logistic regression (hypertension (p<0.001, OR, 3.45, 95%CI, 3.08~3.88), diabetes (p<0.001, OR, 2.24, 95%CI, 1.99~2.50)).

4. Discussion

According to NHANES data from 2013-2018 in the United States of America, participants with cardiovascular disease were more likely to be older, male, smokers, with a higher BMI, and with hypertension and diabetes. After adjusting confounders, hypertension and diabetes was associated with an extremely high risk of developing CVD, as the chi-square test and logistic regression showed. The findings indicate a strong correlation between the two major factors (hypertension and diabetes) and CVD, consistent with previous studies. The American Heart Association committee and stroke statistics subcommittee reported in 2006 and 2008 that age, gender, smoking, and having a higher BMI had certain relationships with CVD, including stroke and heart failure [3, 7]. Blood pressure and the risk of CVD events are continuously correlated, consistently elevated, and unaffected by other risk variables. The risk of heart failure, stroke, myocardial infarction, and kidney disease increases with blood pressure [4]. Furthermore, for people between the ages of 40 and 70, the risk of CVD doubles for every 10 mmHg increase in diastolic blood pressure or 20 mmHg increase in systolic blood pressure over the whole blood pressure range of 115/75 to 185/115 mmHg[8].

5. Conclusion

This study evaluated the two major factors, Hypertension and Diabetes in 11,463 participants recorded in the NHANES dataset [2013-2018]. The results revealed some characteristics of the participants with cardiovascular disease, revealing significant differences between the CVD group and the non-CVD group in age, gender, race, BMI, smoking status, and the presence of hypertension and diabetes. These

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findings suggest that these two major factors could potentially increase the risk of cardiovascular disease, with a clear association between them.

This study has certain strengthens in that the data we assessed covered several years, from 2013 to 2018; what's more, as the relationship between hypertension, diabetes and CVD is what we focused on and the outbreak of coronavirus since 2020 means that some other complex relationship may appear as a result, the relationship we discovered is persuasive and consistent with the conclusion of the previous article. Moreover, while most research has concentrated on the correlation between a single factor and CVD, this study incorporates two significant factors.

Addressing the study's limitations is also necessary. First, the study only assessed the common cardiovascular disease subtypes, including coronary heart disease, heart failure, angina pectoris stroke, and heart attack, and did not consider other cardiovascular disease events. Second, the study only included cardiovascular disease from the NHANES surveys, potentially missing some diagnosed cases. Third, the study only examined the basic relationship between the two primary factors, hypertension and diabetes, and cardiovascular disease. To address the need for modern medications, further studies should explore the association between cardiovascular disease and certain cancers.

Overall, these results support the need for clinical, public health, and policy actions aimed at enhancing cardiovascular health in the US. It would be beneficial to investigate cardiovascular illness in more detail.

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