Research Article
Open Access
CrossMark

Health behaviors differentially associated with depression and hypertension in U.S. adults

Abstract

Background: Unhealthy lifestyles can result in health problems such as depression and hypertension. The aim of this study is to investigate whether four modifiable and important health behaviors (smoking, alcohol use, physical activity, and diet) are associated with ensuing depression and hypertension.

Methods: Data from 1398 American adults (ages ≥ 20 years) participating in a cross-sectional study---the U.S. National Health and Nutrition Examination Survey (NHANES) 2017-2018 were evaluated. A set of weighted multiple logistic regression models was used to address the proposed aim.

Results: Our analysis showed that the overall prevalence of depression and hypertension in U.S. adults were 16.9% and 46.5%, respectively. We found that the two most often reported symptoms of depression are having problems sleeping and having feelings of low levels of energy, with rates of 14.6% and 15.2%, respectively. We also found that participants who engaged in light physical activity had greater likelihoods of experiencing depression and hypertension than those who engaged in vigorous physical activity, with odds ratios of 2.0 (95% CI: 1.2, 3.3) and 1.7 (95% CI: 1.2, 2.4), respectively. Finally, individuals with poor diets were more likely to experience depression than those eating good diets, with an odds ratio of 1.6 (95% CI: 1.2, 2.1).

Conclusion: Physical activity, a common marker of overall health, is inversely and statistically associated with both depression and hypertension. Smoking status is significantly associated with hypertension rather than depression. Diet is directly and statistically associated with depression, but not with hypertension, according to this current study.

Keywords: depression, hypertension, diet, physical activity, alcohol consumption, smoking

Volume 12 Issue 2 - 2023

Ying LIU,[1] Titilayo JAMES,[1] Silas Wang,[2] Yeleeya Li,[3] Kesheng WANG[4]

[1]Department of Biostatistics and Epidemiology, East Tennessee State University
P.O. Box 70259 Johnson City, TN 37614, USA
[2]Department of Statistics & Data Science, Dietrich College of Humanities and Social Sciences, Carnegie Mellon University, Pittsburgh, PA 15213, USA
[3]Department of Biology, University of Florida, Gainesville, FL. 32611
[4]Department of Family and Community Health, School of Nursing, Health Sciences Center, West Virginia University, Morgantown, WV 26506, USA

Correspondence: Ying Liu, Department of Biostatistics and Epidemiology, East Tennessee State University, P.O. Box 70259 Johnson City, TN 37614, USA, Tel 423-439-6662, Email liuy09@etsu.edu

Received: June 09, 2023 | **Published:** July 17, 2023

Introduction

Hypertension is a major illness that affects over116 million adults in the United States (U.S.), roughly 1 in 3.[1] According to the Centers for Disease Control (CDC), hypertension was linked to more than 500,000 deaths in the U.S. alone in 2019.[1] The estimated annual cost of treating the effects of hypertension is $131 billion, which includes costs for health care services, anti-hypertensive medications, and absenteeism from work.[1,2] Hypertension has no warning signs or symptoms. Hence, it is termed "the silent killer".[3] Hypertension is known to be a contributing factor for heart disease and stroke, which are additional major causes of mortality in the U.S. Therefore, it is imperative to act to lower rates of both depression and hypertension.

Depression is a principal contributor to overall poor health, affecting more than 280 million people worldwide.[1] According to the World Health Organization (WHO), depression is a leading worldwide cause of disability.[1,2]

According to the Global Burden of Disease 2010 Study, depressive disorders are also the leading cause and contributor to both suicide and ischemic heart disease. Therefore, depressive disorders deserve effective interventions to diminish their burdens on health.[4]

Records show that in 2020, an estimated 21 million people, about 8.4% of all U.S. adults, suffered at least one major depressive episode.[5,6] These major depressive episodes are characterized by diminished energy, sadness, and lack of interest in usual activities. Additional symptoms are suicidal thoughts, loss of memory and concentration, loss of appetite, poor sleep, and lack of self-confidence and self-worth.

In healthy subjects, depression has been found to heighten the risk for onset of cardiovascular disease.[7] In individuals with pre-existing cardiovascular diseases, the risk for cardiac morbidity and mortality is also increased.[8,9] Even though hypertension is one of the most significant and modifiable risk factors for cardiovascular disease, past studies have found depression to have a cross-sectional association with the prevalence of hypertension[9] and a longitudinal association with the incidence of hypertension.[7]

Various mechanisms have been suggested to explain how depression could lead to hypertension. These include an increased inclination toward unhealthy behaviors such as low levels of physical activity, smoking, and alcohol use.[10] The previously mentioned characteristic symptoms of depression could also play a role in the etiology of hypertension. These symptoms of depression have also been found to be associated with the prevalence of hypertension in both cross-sectional studies[11,12] and longitudinal studies.[13,14]

The existence of a relationship between behavioral factors for depression and hypertension has been proposed to arise from several important biological processes, such as inflammation, oxidative stress, neurobehavioral stress responses, brain plasticity, and mitochondrial dysfunction. These risk factors can be regulated by diet and exercise.[15,16] Furthermore, a poor diet and sedentary lifestyle is linked to obesity and its resulting effects, such as increased risks of hypertension, type 2 diabetes, high total cholesterol, LDL cholesterol

and triglyceride levels, and lower HDL cholesterol levels.[15] Additionally, increased alcohol use has been linked to hypertension[17] through the release of a high quantity of rebound glutamate from brain synapses in combination with dysregulated monoamine and neuroendocrine pathways.[18]

Another risk factor considered for depression is smoking. In smokers, a greater risk for depression is linked to an increased level of cortisol as well as the inhibitory effect of tobacco smoke on the enzyme monoamine oxidase.[18] Although cigarette smoking has many well-known harmful health effects, there is a dispute about the inconsistent effects of smoking on hypertension and myocardial infarction. Specifically, some studies have found that smoking cessation decreases inflammation but may simultaneously give rise to weight gain and obesity,[18-20] and clinical and animal studies have shown strong direct relationships of weight gain and obesity with hypertension.[20,21]

These associations demonstrate that by addressing behavioral risk factors, the prevalence of cardiovascular disease among individuals with hypertension and/or depression can potentially be reduced. At concurrent or longitudinal time points, individuals may differ in the number of risk factors present. Hence, it is logical to analyze the effect of multiple behavioral risk factors on the development of depression and hypertension.

Therefore, this study aimed to evaluate the impact of four behavioral factors– smoking status, alcohol use, physical activity, and diet- on the risks of depression and hypertension and to determine if depression and hypertension have common behavioral risk factors.

Materials and methods

Study population

In this cross-sectional study, a stratified, multistage, probability sampling approach was applied to obtain representative samples from the 50 states of the U.S. as well as the District of Columbia. American adults (at least 20 years old) were appraised using one biennial U.S. National Health and Nutrition Examination Surveys (NHANES 2017-2018). The individuals in this study completed examinations for blood pressure, interviews for depression evaluation, and were asked about their health behaviors and demographics. Their blood pressure examinations and depression interviews were executed in the Mobile Examination Center (MEC) for the NHANES survey, and interviews for demographics and health behaviors were asked at home by trained interviewers using the Computer –Assisted Personal Interview (CAPI). The National Center for Health Statistics (NCHS) Research Ethics Review Board (ERB) approved the study (NCHS IRB/ERB Protocol #2011-2017).

Outcomes

Trained interviewers evaluated the participants' depression status using The Patient Health Questionnaire (PHQ-9), a nine-item questionnaire that records the frequency of depressive symptoms over the past 2 weeks. Each symptom was scored using a 4-point ascending Likert scale ranging from 0 to 3. If an individual had not suffered a symptom at all over the past two weeks, a score of zero would be assigned for that symptom. At the other end of the scale, if an individual had suffered a symptom "nearly every day", their score would be three. Therefore, the summation of total scores on the PHQ-9 is from 0 to 27. Those with depression had a total score of at least 10, a dividing line which was suggested by past studies with indications of a high sensitivity (88%) and specificity (88%).[22]

To diagnose hypertension, certified blood pressure examiners, who had completed a training program from Shared Care Research and Education Consulting, measured participants' blood pressures using mercury sphygmomanometers and appropriately-sized arm cuffs. Three consecutive systolic blood pressure (SBP) and diastolic blood pressure (DBP) readings were recorded after resting for 5 minutes quietly in a sitting position. A fourth reading might have been added if there were any interruption in the blood pressure measurement process. The SBP and DBP calculated from the average of these recordings were used for classifying hypertension based on individual readings according to the NHANES specifications. A participant was defined as having hypertension if they met at least one of the following three conditions: (1) average SBP of at least 140 mm Hg, (2) average DBP of at least 90 mm Hg, or (3) hypertension previously diagnosed by another health care provider.[23]

Behavioral and demographic variables

Smoking status, alcohol use, physical activity and diet were the four behavioral factors considered in this study. These four factors are widely used to predict chronic diseases, including diabetes and cardiovascular disease.[16,24,25] Smoking was constructed as a binary variable: either currently smoking or not. Alcohol consumption was asked as how often alcohol was consumed in the past 12 months and was categorized into three levels: never in the last year, less than once a week, and more than once a week. Physical activity was divided into three intensity levels: vigorous, moderate, and light. Vigorous activities were activities that that led to large increases in breathing or heart rate, like running for at least 10 minutes. Moderate activities were classified as activities that led to small increases in heart rate, such as brisk walking. Light activities were classified as activities that require the least amount of effort compared to moderate and vigorous activities, such as walking slowly or, sitting in front of a computer. The participants' response to how healthy their diet was classified using a five-point Likert scale, which was dichotomized as "good" (excellent, very good, good) and "poor" (fair and poor). All these questions were asked at home by trained interviewers using CAPI.

Age, gender (male and female), and race/ethnicity (White, African American, Hispanic, and other races) were the demographic variables used in this study. Three age groups were used in this study: 20-39 years old, 40-59 years old, and 60 years of age and over. Socioeconomic status (SES) included levels of poverty and education. Poverty level (PL) was measured by a ratio of family income to the federal poverty level (FPL), adjusted for family size and place of residence. Poverty level was categorized into three groups: PL<100% of FPL, 100%FPL≤PL<300% of FPL, and PL≥300% of FPL. Educational level was divided into three categories: fewer than 12 years of education, 12 years (equivalent to a high school diploma), and more than 12 years of education.

Statistical analysis

The weighted frequency and weighted percentages were calculated for each depressive symptom and each hypertension category. The Rao–Scott chi-squared test, a test proposed for survey data analysis, was used to assess the statistical significance of the associations of both responses (hypertension and symptoms of depression) with each explanatory variable. Weighted logistic regressions were conducted to investigate the association between health behaviors and outcome variables. A p-value less than 0.05 was the criterion used to indicate statistical significance. All analyses were performed with SAS 9.4 (SAS Inc., Cary, NC).

Citation: Ying L, Titilayo J, Silas W, et al. Health behaviors differentially associated with depression and hypertension in U.S. adults. *MOJ Public Health.* 2023;12(2):106–112. DOI: 10.15406/mojph.2023.12.00417

Results

A total of 1398 American adults (>= 20 years of age) data from the U.S. 2017-2018 NHANES survey were included in this study with a representative sample of over 67 millions of non-institutionalized U.S. civilians.

Table 1 depicts the weighted frequency and weighted percentage for each item used for depression screening in this study. The two most frequently reported concerns were problems about sleeping and feeling tired or having little energy. More than 27% of adults suffered from these two symptoms greater than half time of in the past two weeks. The least reported concerns were thoughts of being better off dead nearly every day (2.0%) and about having to move or speak slowly or too fast (8.1%). Overall, hypertension was not statistically significantly associated with any individual symptom of depression.

Table 1 Weighted percentage of nine symptoms among U.S. adults 2017-2018 (n=1398)

Mental health-related quality of life questions (n)	Weighted Frequency	Weighted Percent (std. err)	Prevalence of hypertension	P*
Q1 Have little interest in doing things				0.14
0=Not at all (801)	39391497	58.6 (1.9)	43.7(2.6)	
1=Several days (348)	17124619	25.5(1.7)	47.0(3.8)	
2=More than half the days (139)	6220106	9.3(1.1)	56.2(5.9)	
3=Nearly every day (110)	4478077	6.7(0.9)	55.7(7.1)	
Q2 Feeling down, depressed, or hopeless				0.59
0=Not at all (818)	39989809	59.5(1.9)	45.7(2.6)	
1=Several days (371)	18724746	27.8(1.7)	45.6(3.6)	
2=More than half the days (109)	4629469	6.9(0.9)	55.4(6.3)	
3=Nearly every day (100)	3870275	5.8(0.8)	47.8(7.1)	
Q3 Trouble sleeping or sleeping too much				0.17
0=Not at all (535)	25966950	38.6(2.0)	43.2(3.2)	
1=Several days (452)	22612996	33.6(1.9)	48.3(3.4)	
2=More than half the days (174)	8830798	13.2(1.3)	42.4(5.4)	
3=Nearly every day (237)	9803555	14.6(1.2)	54.8(4.4)	
Q4 Feeling tired or having little energy				0.67
0=Not at all (345)	15834510	23.6(1.7)	42.6(4.2)	
1=Several days (640)	32129925	47.8(2.0)	46.8(2.9)	
2=More than half the days (191)	9051825	13.5(1.3)	49.0(5.0)	
3=Nearly every day (222)	10198040	15.2(1.3)	49.3(4.7)	
Q5 Poor appetite or overeating				0.98
0=Not at all (822)	40426142	60.1(1.9)	46.4(2.6)	
1=Several days (342)	17120430	25.5(1.7)	47(3.8)	
2=More than half the days (121)	5096939	7.6(0.9)	44.7(6.2)	
3=Nearly every day (113)	4570789	6.8(0.8)	47.1(6.0)	
Q6 Feeling bad about yourself				0.37
0=Not at all (981)	46477283	69.1(1.8)	48.5(2.4)	
1=Several days (272)	14111067	21.0(1.6)	41.6(4.2)	
2=More than half the days (71)	3104242	4.6(0.8)	38.2(8.1)	
3=Nearly every day (74)	3521707	5.2(0.9)	47.2(8.4)	
Q7 Troubling concentrating on things				0.2
0=Not at all (1014)	48259858	71.8(1.8)	44.6(1.9)	
1=Several days (225)	11424714	17.0(1.5)	42.3(4.8)	
2=More than half the days (76)	3841148	5.7(0.9)	52.6(8.1)	
3=Nearly every day (83)	3688579	5.5(0.8)	60.6(7.2)	
Q8 Moving or speaking slowly or too fast				0.55
0=Not at all (1122)	54709067	81.4(1.4)	46.8(2.2)	
1=Several days (155)	7083072	10.5(1.1)	39.9(5.4)	
2=More than half the days (69)	2675898	4.0(0.6)	49.4(7.8)	
3=Nearly every day (52)	2746262	4.1(0.8)	53.9(10.7)	
Q9 Thought you would be better off dead				0.87
0=Not at all (1288)	62696628	93.3(0.8)	46.2(2.0)	
1=Several days (80)	3122085	4.6(0.6)	55.8(16.6)	
2=More than half the days (15)	894255	1.3(0.4)	55.8(16.6)	
3=Nearly every day (15)	501331	0.7(0.2)	45.7(15.4)	

*p-value was obtained from Rao-Scott test for bivariate association for survey data.

Citation: Ying L, Titilayo J, Silas W, et al. Health behaviors differentially associated with depression and hypertension in U.S. adults. *MOJ Public Health.* 2023;12(2):106–112. DOI: 10.15406/mojph.2023.12.00417

Table 2 shows the bivariate association between each exploratory variable and two outcomes. While there was no significant association between depression and age that old adults (≥ 60 years) were found to have the lowest rates of depression (14.2%), compared to young (19.4%) and middle-aged adults (16.8%). We found that the relationship between hypertension and age was statistically significant ($p < 0.0001$), and we see that the highest prevalence of hypertension existed in old adults (72.5%).

Table 2 Prevalence of depression and hypertension within groups of varied demographics and health behaviors

	Depression % (s.e.)	P*	Hypertension % (s.e.)	P*
Overall (n=1398)	16.9(1.4)		46.5(2.0)	
Age (n)		0.31		<0.0001
20-39yrs (372)	19.4(2.4)		26.4(3.0)	
40-59yrs (450)	16.8(2.4)		42.5(3.4)	
60 and over (576)	14.2(2.2)		72.5(2.9)	
Gender		0.06		0.04
Male (1221)	14.5(1.8)		50.2(2.8)	
Female (776)	19.6(2.1)		42.2(2.8)	
Race		0.6		0.02
Non-Hispanic White (885)	16.1(1.8)		47.0(2.6)	
Non-Hispanic Black (473)	16.0(2.4)		57.9(3.2)	
Hispanic (371)	18.85(3.0)		38.0(3.6)	
Other (268)	20.4(4.2)		42.5(6.3)	
Poverty Level		0.0006		0.84
PL<100%FPL(598)	24.6(2.9)		46.7(3.4)	
100%FPL≤PL≤300%FPL(875)	18.0(2.0)		47.8(2.8)	
PL>300%FPL(524)	10.9(2.2)		452(3.7)	
Education		0.047		0.173
<12(498)	24.6(3.5)		55.0(4.0)	
12(854)	14.5(2.1)		44.9(3.4)	
>12(645)	16.5(2.0)		45.3(2.8)	
Alcohol consumption		0.0517		0.0003
Never in last year (498)	16.6(2.6)		61.2(3.9)	
<1 time/week (854)	20.0(2.3)		40.8(2.8)	
>1 time/week (645)	12.9(2.0)		45.0(3.5)	
Smoking		0.0003		0.0055
No (1125)	12.5(1.7)		51.2(2.8)	
Yes (872)	22.5(2.2)		40.3(2.7)	
Recreational physical activity		0.048		0.0043
Vigorous (355)	10.9(2.8)		35.5(4.7)	
Moderate (464)	16.3(3.0)		42.2(4.0)	
Light (1178)	19.1(1.8)		52.2(2.5)	
Diet		0.0014		0.811
Good (232)	13.2(1.5)		46.9(2.6)	
Poor (765)	22.0(2.4)		45.9(3.0)	

*p was obtained from Rao-Scott test for bivariate association for survey data.

There were significant differences by gender in depression and hypertension. Females experienced higher rates of depression (19.6%) than males (14.5%), while hypertension was more prevalent in males (50.2%) than in females (42.2%). Among different races, the highest prevalence of hypertension (was seen among non-Hispanic Blacks (57.9%), followed by non-Hispanic Whites (47.0%). The presence of depression significantly differed by SES, including poverty level and educational level ($p=0.0006$, $p=0.047$, respectively). However, SES did not have a significant relationship with hypertension. Alcohol consumption was significantly associated with hypertension ($p=0.0003$). The participants who never drank alcohol in the past year had the highest prevalence hypertension (61.2%). Smoking status was significantly associated with depression ($p=0.003$). Compared to non-smokers, participants who smoked had a higher prevalence of depression (22.5% vs. 12.5%) and a lower prevalence of hypertension (40.3% vs. 51.2%). Physical activity was significantly and inversely associated with hypertension and depression. Higher prevalence of depression and hypertension were seen in participants with light recreational physical activities compared to those with moderate and vigorous physical activities. Individuals who ate poor diets had a higher prevalence rate of depression (22%) than those with good diets (13.2%), leading to diet being statistically significantly associated with depression ($p<0.0014$). However, the relationship of hypertension with diet was not statistically significant ($p=0.8110$).

Table 3 shows the results from a set of two logistic regression models for two outcome variables. Model 1 only includes four behaviors as predictors, and Model 2 is adjusted for demographics (age, gender, race /ethnicity) and SES (educational level and poverty

level). Participants who had engaged in light physical activity had a greater likelihood of experiencing depression and had higher hypertension rates than those who had engaged in vigorous physical activity, with odds ratios of 2.6 (95% CI: 1.9, 3.6) and 2.6 (95% CI: 1.9, 3.5), respectively (Table 3). These significant relationships remained after adjustment for demographic variables and SES. It is worth noting that the smokers were less likely to have depression and hypertension than non-smokers, with odds ratios 0.6 (95% CI: 0.5, 0.7). However, smoking status did not show significant change after adjusting for demographics and SES status. Alcohol consumption follows a similar trend for depression. On the other side, the smokers are less likely to have hypertension than nonsmokers with odds ratio 0.6 (95% CI: 0.5, 0.7), the significant association kept after adjustment for demographics and SES status. Diet showed a statistically significant association with depression but not with hypertension in this study.

Table 3 Relation between behaviors and depression and hypertension among U.S. adults

	Raw OR (95% CI)	Adjusted OR (95% CI)
Depression (probability=YES)		
Alcohol consumption		
Never in last year (Reference)	1	
<1 time/week	0.5(0.4, 0.7)***	1.2(0.8, 1.7)
>1 time/week	0.6(0.5, 0.8)*	0.8(0.5, 1.2)
Smoking		
No (Reference)	1	1
Yes	0.6(0.5, 0.7)***	1.3(0.9, 1.7)
Recreational physical activity		
Vigorous (Reference)	1	1
Moderate	2.0(1.4, 2.8)**	1.5(0.8, 2.6)
Light	2.6(1.9, 3.6)***	2.0(1.2, 3.3)*
Diet		
Good (Reference)	1	1
Poor	0.9(0.7, 1.2)	1.6(1.2, 2.1)*
Hypertension (probability=YES)		
Alcohol consumption		
Never in last year (Reference)	1	1
<1 time/week	0.5(0.4, 0.7)***	0.8(0.6, 1.1)
>1 time/week	0.6(0.5, 0.8)*	0.8(0.6, 1.2)
Smoking		
No (Reference)	1	1
Yes	0.6(0.5, 0.7)***	0.8(0.6, 0.9)*
Recreational physical activity		
Vigorous (Reference)	1	1
Moderate	2.1(1.4, 2.9)**	1.4(0.9, 2.1)
Light	2.6(1.9, 3.5)***	1.7(1.2, 2.4)*
Diet		
Good (Reference)	1	1
Poor	0.9(0.8, 1.2)	1.0(0.8, 1.3)

Raw Model: only included four health behaviors.

Adjusted Model: contained raw model and additionally adjusted for demographics and SES status.

*P<0.05, **P<0.001, ***P<0.0001.

Discussion

In this study, we found that hypertension and depression occurred in varying rates among individuals with different levels of smoking, alcohol consumption, physical activity, and these results create future paths for health policy and study. We found that multiple factors, especially demographics and health behaviors, determine the frequencies of hypertension and depression. In terms of demographics, depression occurred most frequently among young adults, while hypertension was most frequent among older adults. Among those suffering from depression, sleeping problems and a feeling of lack of energy were the two most frequently reported symptoms. Hypertension was statistically significantly associated with age, gender, and race. More specifically, hypertension is more common among older adults, males and non-Hispanic Blacks. SES was significantly associated with depression, but not with hypertension. Depression is more prevalent in individuals with lower SES status than their peers with higher SES status. Therefore, we conclude that differing demographic factors have important effects on health.

Turning to the association between health outcomes and the four behaviors analyzed, only three behaviors: recreational physical activity, and diet were found to be statistically significantly associated with depression. These two factors had significant relationships in the same direction as well; for example, individuals with unhealthy behaviors were more likely to have depression. This finding is consistent with previous studies, which suggests that a larger proportion of depressed

patients was involved in eating poor diets, and only either subtle or light recreational physical activity as observed in the present study.[26,27]

On the other hand, we see an interesting pattern in that the two behaviors of smoking, and recreational physical activity were statistically significantly associated with hypertension, but in opposite directions. This suggests that smokers are less likely to have hypertension. This probably because of that smokers had lower BMIs compared to non-smokers[28,29] due to the ingestion of nicotine, which acts as an anorectic agent by raising basal metabolism and reducing appetite.[30,31] It is well known that visceral obesity is the most important risk factor for hypertension and cardiovascular disease[32] and specifically, weight gain has been shown to cause high blood pressure, tachycardia, and hyperlipidemia.[33] Thus, to some degree, it is interpretable that the lower BMI scores seen in smokers' results in a decreased risk of developing hypertension, showing that certain health behaviors considered "unhealthy" can actually lead to a lower rate of hypertension. Therefore, further study needs to be done on the costs and benefits of these behaviors and their effect on not just hypertension but overall health.

Next, the frequency of alcohol consumption is significantly associated with depression and hypertension; however, the significant association was not kept after adjustment for demographics and SES status. This may be due to a limitation of this study, whereby the use of the frequency of alcohol consumption with three overly broad categories: never, less than once a week, and more than once a week in the past year. This finding additionally contributes to a pattern of future health study based on the impact of health behaviors on health outcomes.

We further found that while smokers were less likely to have hypertension, and have higher rates of depression than nonsmokers. This observation is consistent with findings in which nicotine dependence resulted in a higher risk of depression, implying that a causal relationship might exist between smoking and depression.[18,19,34] A previous association has been reported between diet and the onset, severity, and duration of depression.[35] Daily vital nutritional supplements including vitamins, minerals, and omega-3 fatty acids are often found to be effective in the reduction of symptoms of depressed patients.[36]

In light of our findings, we conclude that it is essential that effective policies to discourage smoking and encourage healthy diets and levels of physical activity among depressed patients be implemented. The core of the management of depression involves a moderate or vigorous intensity level of aerobic physical activity which improves quality of life by reducing symptoms of depression and anxiety.[36]

In the adjusted model, possible reasons can, however, be given for the lack of an expected positive association between hypertension and two of the health factors assessed: alcohol use and diet. These are known to be modifiable behavioral risk factors for cardiovascular disease as well as other chronic diseases.[37] Physical activity is not only valuable for the control of hypertension; it is also advantageous for adequate weight management, stress reduction, and cardiac output.[37]

It is thus worth noting that as hypertensives start to receive treatments, the chances of improving their lifestyles increase, resulting in their quitting or reducing smoking or alcohol consumption as well as beginning to eat healthy diets as recommended by their physicians. There is evidence that campaigns to decrease consumption of alcohol and tobacco smoking and promote healthy diets among hypertensives are successful. The hypertensive individuals in this study also showed engagement in relatively low levels of recreational physical activity, and this is consistent with most findings,[36,37] indicating the need for the implementation of more effective strategies on physical activity.

As like other research studies, this study does have limitations. We were only able to investigate correlational relationships rather than causal relationships due to the cross-sectional nature of the study. The accuracy of our findings may have also been impacted because of the use of self-reports for the four health behaviors, which might produce some deviations related to participants' perceptions of health behaviors and health status according to social desirability. The future study will investigate the longitudinal change by combing the causal relationship.

Acknowledgments

None.

Conflicts of interest

The authors declare no conflict of interest.

References

1. WHO. *World Health Organisation*. Depression. 2022.
2. Nwankwo T, Yoon S, Burt V, et al. Hypertension among adults in the US: National Health and Nutrition Examination Survey, 2011-2012. *NCHS Data Brief*. 2013;133:1–8.
3. Paulose-Ram R, Gu Q, Kit B. Characteristics of U.S. Adults With Hypertension Who Are Unaware of Their Hypertension, 2011–2014. *NCHS Data Brief*. 2017;178:1–8.
4. Murray CJ, Lopez AD. Evidence-based health policy—lessons from the Global Burden of Disease Study. *Science*. 1996;274(5288):740–743.
5. Ferrari AJ, Charlson FJ, Norman RE, et al. Burden of Depressive Disorders by Country, Sex, Age, and Year: Findings from the Global Burden of Disease Study 2010. *PloS Med*. 2013;10(11):e1001547.
6. National Institute of Mental Health. *Prevalence of Major Depressive Episode Among Adults*. 2022.
7. van Melle J, de Jonge P, Spijkerman T, et al. Prognostic association of depression following myocardial infarction with mortality and cardiovascular events: a meta-analysis. *Psychosom Med*. 2004;66(6):814–822.
8. Adamis D, Ball C. Physical morbidity in elderly psychiatric inpatients: prevalence and possible relations between the major mental disorders and physical illness. *Int J Geriatr Psychiatry*. 2000;15(3):248–253.
9. Lett H, Blumenthal J, Babyak M, et al. Depression as a risk factor for coronary artery disease: evidence, mechanisms, and treatment. *Psychosom Med*. 2004;66(3):305–315.
10. Gislason T, Almqvist M. Somatic diseases and sleep complaints. An epidemiological study of 3,201 Swedish men. *Acta Med Scand*. 1987;221(5):475–481.
11. Gangwisch JE, Heymsfield SB, Boden-Albala B, et al. Short sleep duration as a risk factor for hypertension: analyses of the first National Health and Nutrition Examination Survey. *Hypertension*. 2006;47(5):833–839.
12. Suka M, Yoshida K, Sugimori H. Persistent insomnia is a predictor of hypertension in Japanese male workers. *J Occup Health*. 2003;45(6):344–350.
13. Lopresti AL, Hood SD, Drummond PD. A review of lifestyle factors that contribute to important pathways associated with major depression: diet, sleep and exercise. *J Affect Disord*. 2013;148(1):12–27.

14. Berk M, Kapczinski F, Andreazza AC, et al. Pathways underlying neuroprogressionin bipolar disorder: focus on inflammation, oxidative stress and neurotrophic factors. *Neurosci Biobehav Rev*. 2011;35(3):804–817.

15. Berk M, Jacka F. Preventive strategies in depression: gathering evidence for risk factors and potential interventions. *Br J Psychiatry*. 2012;201(5):339–341.

16. Stranges S, Wu T, Dorn JM, et al. Relationship of alcohol drinking pattern to risk of hypertension. *Hypertension*. 2004;44(6):813–819.

17. Clapp P, Bhave SV, Hoffman PL. How adaptation of the brain to alcohol leads to dependence: a pharmacological perspective. *Alcohol Res Health*. 2008;31(4):310–339.

18. Bowman TS, Gaziano JM, Buring JE, et al. A prospective study of cigarette smoking and risk of incident hypertension in women. *Journal of the American College of Cardiology*. 2007;50(21):2085–2092.

19. Niskanen L, Laaksonen DE, Nyyssonen K, et al. Inflammation, abdominal obesity, and smoking as predictors of hypertension. *Hypertension*. 2004;44(6):859–865.

20. Rupprecht LE, Koopmeiners JS, Dermody SS, et al. Reducing nicotine exposure results in weight gain in smokers randomised to very low nicotine content cigarettes. *Tob Control*. 2017;26(e1)e43–e48.

21. Lopresti AL, Hood SD, Drummond PD. A review of lifestyle factors that contribute to important pathways associated with major depression: diet, sleep and exercise. *J Affect Disord*. 2013;148(1):12–27.

22. Cooney GM, Dwan K, Greig CA, et al. Exercise for depression. *Cochrane database Syst Rev*. 2013;2013(9):CD004366.

23. Buelt A, Richards A, Jones AL. Hypertension: New guidelines from the International Society of Hypertension. *Am Fam Physician*. 2021;103(12):763–765.

24. Fried El, Nesse RM. The Impact of Individual Depressive Symptoms on Impairment of Psychosocial Functioning. *PLoS ONE*. 2014; 9(2):e90311.

25. Patten SB, Williams JVA, Lavorato DH, et al. Recreational physical activity ameliorates some of the negative impact of major depression on health-related quality of life. *Front Psychiatry*. 2013;4:22.

26. Pankova A, Kralikova E, Fraser K, et al. No difference in hypertension prevalence in smokers, former smokers and non-smokers after adjusting for body mass index and age: a cross-sectional study from the Czech Republic, 2010. *Tob Induc Dis*. 2015;13(1):24.

27. Gordon T, Kannel WB, Dawber TR, et al. Changes associated with quitting cigarette smoking: the Framingham study. *Am Heart J*. 1975;90(3):322–328.

28. Molarius A, Seidell JC, Kuulasmaa K, et al. Smoking and relative body weight: an international perspective from the WHO MONICA Project. *J Epidemiol Community Health*. 1997;51(3):252–260.

29. Gao K, Shi X, Wang W. The life-course impact of smoking on hypertension, myocardial infarction and respiratory diseases. *Sci Rep*. 2017;7(1):4330.

30. Sironi AM, Gastaldelli A, Mari A, et al. Visceral fat in hypertension influence on insulin resistance and β-cell function. *Hypertension*. 2004;44(2):127–133.

31. Okubo Y, Miyamoto T, Suwazono Y, et al. An association between smoking habits and blood pressure in normotensive Japanese men. *Journal of Human Hypertension*. 2002;16(2):91–96.

32. Boden JM, Fergusson DM, Horwood L. Cigarette smoking and depression: tests of causal linkages using a longitudinal birth cohort. *The British Journal of Psychiatry*. 2010;196(6):440–446.

33. Rao TS, Asha MR, Ramesh BN, et al. Understandng nutrition, depression and mental illnesses. *Indian J Psychiatry*. 2008;50(2):77–82.

34. Ain Qurrat ul, Regmi Krishna. The effects of smoking in developing hypertension in Pakistan: a systematic review. *South East Asia Journal of Public Health*. 2015;5(1):4–11.

35. Lakhan SE, Vieira KF. Nutritional therapies for mental disorders. *Nutr J*. 2008;7:2.

36. Gibbs BB, Hivert M, Jerome GJ, et Al. Physical Activity as a Critical Component of First-Line Treatment for Elevated Blood Pressure or Cholesterol: Who, What, and How?: A Scientific Statement From the American Heart Association. *Hypertension*. 2021;78(2):e26–e37.

37. Ferrari dD, Anguera LL, Carmo OL. Daily Physical Activity of Brazilian carriers of arterial hypertension: a transversal analysis. *Colomb Med (Cali)*. 2017;48(2):82–87.

Citation: Ying L, Titilayo J, Silas W, et al. Health behaviors differentially associated with depression and hypertension in U.S. adults. *MOJ Public Health.* 2023;12(2):106–112. DOI: 10.15406/mojph.2023.12.00417