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Association Between Adverse Health Behaviors and Depression in American Adults with Metabolic Syndrome

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ASSOCIATION BETWEEN ADVERSE HEALTH BEHAVIORS AND DEPRESSION IN AMERICAN ADULTS WITH METABOLIC SYNDROME

BY

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ABSTRACT

Background: Metabolic Syndrome has been defined as a complex of risk factors that increase the risk of cardiovascular disease, type 2 Diabetes and all-cause mortality. Dyslipidemia, abdominal obesity, elevated Fasting Blood Glucose and elevated Blood pressure are established clusters of risk factors for Metabolic Syndrome. Smoking, Alcohol use, sedentary behavior and Depression continue to be major public health issues. Several studies have shown association between Smoking, Alcohol use, depression and metabolic syndrome. No study has revealed association between clusters of adverse behavioral risk factors and depression in individuals with Metabolic Syndrome.

Objective: To investigate the relationship between clusters of adverse behavioral risk factors and depression in American Adults with Metabolic Syndrome.

Methods: logistic regression and NHANES 2009 – 2010 and 2011 – 2012 data were utilized to measure the association between the independent variables and the outcome variable.

Results: Smoking was significantly associated with increased odds of depression among Non-Hispanic Whites (OR = 2.67 [(95% CI = 1.66 – 4.30]), Non-Hispanic Blacks (OR = 2.38 [95% CI = 1.49 – 3.81]), Mexican Americans (OR= 2.87 [95% CI= 1.33 - 6.21]) and other races/ethnicities (OR= 2.4 [95% CI= 1.18 - 4.86}). A joint occurrence of alcohol use and smoking was associated with 2.78 (95% CI = 1.96 – 3.91), 3.00 (95% CI = 1.80 – 5.02), 2.81 (95% CI = 1.51 – 5.22), 2.86 (95% CI = 1.13 – 7.28) increased odds of depression in the total sample, NHW, NHB and MA respectively. Joint occurrence of Smoking and Sedentarism was associated with 2.30 (95% CI = 1.20 – 4.40) and 2.59 (95% CI = 1.03 – 6.54) increased odds of depression in the total sample and NHW respectively. Joint occurrence of Alcohol use, smoking and Sedentarism was associated with 2.30 (95% CI = 1.05 - 5.03) and 2.77 (95% CI = 1.03 - 6.54) increased odds of depression in the total and NHW respectively.

Conclusion: The study established that being a current smoker was significantly associated with increased odds of depression. The joint occurrence of selected behavioral risk factors was positively associated with depression in individuals who met the criteria for Metabolic Syndrome. People who are diagnosed with Metabolic Syndrome need to be evaluated for the risk of adverse behavioral risk factors and depression. Intervention should be designed to target individuals with these risk factors among those with Metabolic Syndrome.

APPROVAL PAGE

ASSOCIATION BETWEEN ADVERSE HEALTH BEHAVIORS AND DEPRESSION IN AMERICAN ADULTS WITH METABOLIC SYNDROME

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DEDICATION

This Thesis is dedicated to God and to my family.

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INTRODUCTION

Background

Metabolic Syndrome consists of a cluster of risk factors including dyslipidemia, abdominal obesity, elevated Fasting Blood Glucose or Impaired Glucose Tolerance and elevated Blood pressure to mention a few. It is a group of signs and symptoms occurring in a complex that can increase the risk of cardiovascular disease, Type 2 Diabetes and all-cause mortality (Grundy et al, 2015 and Okosun et al, 2015).

Prevalence estimates done on 1999 to 2010 National Health and Nutrition Education Survey (NHANES) data revealed in American Adults ≥ 20 years the age-adjusted prevalence of Metabolic Syndrome decreased from 25.5% (95% confidence interval: 22.5% to 28.6%) to 22.9% (95% CI: 20.3% to 25.5%). In spite of the decline, there was a bidirectional trend in the prevalence of components of metabolic syndrome. The rate of rise of blood glucose and abdominal obesity was found to be increasing (Beltrán-Sánchez et al 2013). The rate of Metabolic Syndrome is known to increase with age and this increase is exponential among older individuals compared to younger subjects (Ford et al, 2002 and Kraja et al 2006). The encumbrance of Metabolic Syndrome components is enormous in terms of economic cost and physiologic dysfunction. The presence of Metabolic Syndrome greatly increases the odds of cardiovascular disease which includes Ischemic Heart Disease (Myocardial Infarction, Angina Pectoris), Cerebrovascular diseases (Strokes, Amaurosis Fugax, total blindness), Kidney disease (Hypertension, renal failure), Aortic Aneurysm and Peripheral Arterial Disease among myriads of known complications of Metabolic Syndrome and majority of these sequelae are preventable. Subsequent development of type 2 Diabetes and increased odds of periodontal disease are

associated with Metabolic Syndrome. Increased odds of Metabolic Syndrome have been seen in individuals with Psoriasis (Ford et al 2002 and Danielsen et al, 2015).

In the literature, association between Metabolic Syndrome and a host of behavioral drivers such as smoking, alcohol abuse, sedentary life style and depression have been studied (Aizawa et al 2006). Smoking, Alcohol use, Depression and Suicide continue to be major public health issues. During 2009–2012, 7.6% of Americans aged 12 and over had depression in the previous 2 weeks (CDC). Individuals with neuropsychiatric disorders have higher rates of Metabolic Syndrome than those without mental disorders. Higher rates of anxiety, depression and life change indices have been seen in individuals with Metabolic Syndrome (Maslov et al 2009). Metabolic Syndrome and inflammation are independently associated with depressive symptoms in older subjects (Viscogliosi et al, 2012). No study has shown the relationship between clustering of behavioral risk factors and the risk of depressive symptoms in American Adults with Metabolic Syndrome.

Several definitions of the metabolic Syndrome have been applied in the Literature. The widely used Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) definition was applied in this study.

Objectives: To investigate the relationship between joint occurrence of negative behavioral risk factors and depression in American Adults with Metabolic Syndrome.

Research questions:

(1) How do selected behavioral risk factors and depression cluster among US adults with metabolic syndrome?

(2) What is the relationship between the identified behavioral risk factors and depression, stratified by race/ethnicity?

(3) Which combinations or clusters are mostly associated with depression?

METHODS

Source of data

The 2009 - 2010 and 2011 – 2012 data from the National Health and Nutrition Survey (NHANES) were used in this study. NHANES is a foremost program of the National Center for Health Statistics (NCHS) designed to evaluate the nutrition and health of the population of the United States (US). NCHS is a component of the Centers for Disease Control and Prevention (CDC) concerned with generating national vital and health statistics. NHANES surveys are stratified multistage probability sampling schemes used to select a representative sample of the civilian non-institutionalized population of the US. A nationally representative sample of about 5,000 subjects were examined each year. Subjects were surveyed in 15 counties situated across the US. Subjects were selected through a complex statistical process using the most current Census information. The country was divided into communities. The communities were divided into neighborhoods. The neighborhoods were selected at random. From each neighborhood, housing units were selected at random. Selected households were approached by interviewers who asked residents a few questions to determine if their household was eligible for the study. Subjects were interviewed at home and examined fully at Mobile Examination Centers (MECs). The institutional review board of NCHS approved the protocol for the survey (CDC/NCHS/NHANES 2015).

Inclusion and exclusion criteria

Subjects included in this study were 20 years and older who met 3 or more of the criteria for the diagnosis of Metabolic Syndrome and with values for the following variables: sex, age, income, education, race/ethnicity, waist circumference, height, weight, oral glucose tolerance test (OGTT) and fasting blood glucose (FPG), HbA1c, triglycerides, high-density lipoprotein (HDL), low-density lipoprotein (LDL), blood pressure (BP), physical activity, alcohol use, smoking status and Depression. Excluded were subjects who were below 20 years of age, or pregnant or had missing data.

Measures and variables

In the NHANES data used in this study, demographic variables were determined as reported by the subjects. Anthropometric measurements and blood samples were taken in the mobile examination centers (MECs). Comprehensive accounts of the anthropometric, venipuncture, and blood pressure measurement procedures can be found in the CDC/NCHS/NHANES anthropometry, laboratory, and physician examination procedures manuals.

Demographic variables

AGE: This is the age provided by the subjects at the screening interview. Age was classified into five groups in years (20 – 34, 35 – 44, 45 – 64, and ≥65).

SEX: Gender was classified into two groups (Male and Female).

RACE/ ETHNICITY: This variable was derived from responses to the survey questions on race/ethnicity. The races/ ethnic groups were classified into four groups namely, Non-Hispanic Whites (NHW), Non-Hispanic Blacks (NHB), Mexican Americans (MA) and other races/ethnicities (Others).

EDUCATION: This is the highest level of education completed. Education was grouped into three sets (less than high school, high school graduates, greater than high school education).

INCOME: This is the estimated total annual household income, reported in dollars. Annual household income was categorized into four groups (under $35K, $35K - >$54,999, $55K - >$74,999, and ≥$75K).

OTHER VARIABLES

ANTHROPOMETRIC: In NHANES, waist circumference was obtained by tape and assessed above the right iliac crest at the mid-axillary line. Height was measured using a fixed Stadiometer with a vertical backboard and a moveable headboard. Weight was measured using a Toledo digital weight scale in a standing position. Measurement was made at the end of a normal expiration and to the nearest 0.1 cm.

Body Mass Index (BMI): in this study, Body mass index was reported in Kg/m^2

Blood pressure (BP): Systolic and Diastolic Blood Pressures were measured in mmHg. After resting quietly in a sitting position for 5 minutes, three consecutive blood pressure readings were taken at a single examination visit using a standard protocol. In this study,

averages of the three systolic and diastolic blood pressure readings were used as representative of the subject's systolic and diastolic blood pressure values.

Fasting blood glucose (FPG): In the survey, blood samples were taken after a 9-hour fast. Blood specimens were processed, stored shipped to the Fairview Medical Center Laboratory at the University of Minnesota, Minneapolis Minnesota for analysis. Analysis involved enzymatic processes leading to the production of intermediate that causes increase in absorbance at 340 nm. The endpoint reaction was specific for glucose. Other laboratory protocols were observed.

Triglycerides, High-density lipoprotein (HDL), Low-density lipoprotein (LDL): Measurement of lipids was done after at least 8.5 hour fast. Blood specimens were processed, stored in vials at –20°C until they were shipped to University of Minnesota, Minneapolis Minnesota for analysis. Analysis involved enzyme-linked measurements. Triglyceride, HDL cholesterol and LDL cholesterol were all measured in mg/dL.

Definition of terms

Metabolic Syndrome: The NCEP/ATP III revised criteria for Metabolic Syndrome were used in categorizing individuals in the analytic sample. To be diagnosed with Metabolic Syndrome, subjects must meet 3 or more of these criteria. The criteria used in this study include:

(1) Elevated Waist Circumference: >102 cm (>40 in) in men and >88 cm (>35 in) in women.

(2) Elevated Triglycerides: ≥150 mg/dL or on cholesterol medication

(3) Reduced HDL cholesterol: <40 mg/dL (men) and <50 mg/dL (women) or on cholesterol medication

(4) Elevated Blood pressure: Systolic Blood Pressure ≥135/ Diastolic Blood Pressure ≥85 mm Hg or undergoing treatment for previously diagnosed hypertension or taking a blood pressure medication.

(5) Elevated Fasting glucose: ≥100 mg/dL or on diabetes medication.

Clustering of Behavioral factors: Clustering of adverse health behaviors was defined as joint occurrence of 2 or 3 of the following in a single individual (Okosun et al 2002):

(1)Current cigarette smoker, defined as having smoked 100 cigarettes in a lifetime or answered yes to the question; do you now smoke cigarette?

(2) Alcohol use, defined as having had 12 or more drinks of any kind in the past I year.

(3) Sedentary lifestyle, defined as having watched Television or video in sitting position or played computer games or used the computer outside of work or school for ≥3 hours per day in the previous 30 days (Shuna et al 2013).

Depression: Depression was defined using the Depression Scores from PHQ-9. PHQ-9 is a highly predictive screening tool used in characterizing depressive states and the risk of development of severe depression. Respondents were asked to choose between 1 of 4 responses to 9 questions about the occurrence of depressive symptoms during the previous 2 weeks and an additional question that gauged the difficulty with having any of the depressive symptoms. Those scoring ≥5 were characterized as having at least mild depressive symptoms (Shim et al, 2011). In this study a score of ≥5 was classified as being depressed.

Figure 1. Sample Patient Health Questionnaire-9 (PHQ-9) questions:

PATIENT HEALTH QUESTIONNAIRE-9 (PHQ-9)

Over the last 2 weeks, how often have you been bothered by any of the following problems? *(Use "✔" to indicate your answer)*	**Not at all**	**Several days**	**More than half the days**	**Nearly every day**
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

FOR OFFICE CODING 0 + _____ + _____ + _____

=Total Score: _____

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all	**Somewhat difficult**	**Very difficult**	**Extremely difficult**
☐	☐	☐	☐

Interpretation of Total Score

Total Score	Depression Severity
1-4	Minimal depression
5-9	Mild depression
10-14	Moderate depression
15-19	Moderately severe depression
20-27	Severe depression

Statistical analysis

Statistical Analysis System (SAS) 9.4 software package was used in all analyses in this study. Adjustments were made by applying appropriate sample weights, strata and cluster variables for variations in probability of selection, oversampling, and nonresponse. Survey frequency function was used to generate the descriptive statistics. Survey logistic function was used to create multiple logistic regression models to determine the association between individual behavioral risk factor and clusters (2 factors and 3 factors) of behavioral risk factors and depression using Odds Ratios (OR) stratified by race/ethnicity. Statistical adjustments were made for age, sex and education. Statistical significance was established at $\alpha = 0.05$.

RESULTS

The basic descriptive characteristics of those who met the criteria for the definition of Metabolic Syndrome (N = 2,956) is shown in Table 1. Overall there were more females (53.4%) than males (46.5%). There were more Mexican American (MA) males (51.3% [95% CI = 48.2 - 54.4]) then Non-Hispanic White (NHW) males, Non-Hispanic Black (NHB) males, and males of other races (Others) at 48% (95% CI= 43.3 – 52.8), 34% (95% CI= 29.9 - 38.1) and 48.4% (95% CI= 42.0 - 54.9) respectively. Also Non-Hispanic Black (NHB) females had higher rates (66.0% [95% CI = 61.9 - 70.1]) then NHW females (52.0%), MA females (48.7%) and females of other races (51.6%). Non-Hispanic Whites where older, more educated and earned more income than Non-Hispanic Blacks, Mexican Americans and other races/ ethnicities ($P < 0.05$).

Table 2, reveals the prevalence rates of individual behavioral risk factor and depression and the prevalence rates of clusters of adverse risk factors and depression in American Adults stratified by race/ethnicity in the study sample. Overall, Non-Hispanic Blacks had higher rates of Smoking, Sedentarism and depression compared to NHW, MA and Others. Alcohol use was more common in Non-Hispanic Whites compared to NHB, MA and Others. The prevalence of clusters or the joint occurrence of 2 or more behavioral risk factors and depression was significantly higher in Non-Hispanic Blacks than NHW, MA and Others with values of 46%, 34.7%, 39.6% and 37.6% respectively.

Table 1: Demographic Characteristics of American Adults with Metabolic Syndrome

Variable	Total N=2,956	Non-Hispanic White n=1,272	Non-Hispanic Black n=699	Mexican-American n=465	Others n=520
Sex					
Males	46.6 (43.1 - 50.1)	48.0 (43.3 – 52.8)	34.0 (29.9 - 38.1)	51.3 (48.2 - 54.4)	48.4 (42.0 - 54.9)
Females	53.4 (50.0 - 57.0)	52.0 (47.2 - 56.7)	66.0 (61.9 - 70.1)	48.7 (45.6 - 51.8)	51.6 (45.1 - 58.0)
Age (yr)					
20-34	10.0 (8.3 – 11.7)	8.0 (6.0 - 10.1)	11.6 (8.3 - 15)	20.6 (14.3 - 27.0)	12.5 (8.1 - 17.0)
35-44	13.9 (11.4 – 16.5)	12.5 (9.1 - 15.9)	14.6 (10.7 - 18.5)	22.5 (17.8 - 27.3)	15.2 (10.5 - 21.3)
45-64	46.3 (43.3 – 49.3)	46.5 (42.4 – 50.6)	50.5 (46.3 - 54.7)	42.1 (37.7 - 46.6)	43.0 (37.8 - 48.3)
65+	29.8 (27.5 - 32.1)	33.0 (30.0 – 36.0)	23.3 (19.6 - 27.1)	14.7 (10.3 - 19.1)	28.5 (23.3 - 33.7)
Income					
<$35,000	39.0 (35.1 – 42.8)	33.4 (28.5 – 38.3)	52.4 (44.7 - 60.0)	56.1 (48.4 - 63.7)	49.0 (41.9 - 56.2)
$35,000 - >$54,999	19.4 (16.7 – 22.0)	19.4 (16.2 – 22.7)	18.6 (13.7 - 23.5)	24.4 (20.0 - 29.0)	15.4 (10.0 - 20.9)
$55,000 - >$74,999	14.4 (11.9 – 16.9)	15.2 (11.8 – 18.6)	10.7 (7.8 - 13.6)	11.2 (5.7 - 16.7)	15.5 (8.8 - 22.0)
>=$75,000	27.3 (23.7 – 31.0)	32.0 (27.0 – 37.0)	18.4 (12.6 - 24.1)	8.3 (5.7 - 10.8)	20.1 (14.4 - 25.7)
Education					
<High School	8.6 (6.9 – 10.3)	4.5 (3.2 – 5.8)	4.1 (2.9 - 5.4)	35.6 (30.4 - 40.8)	19.2 (14.1 - 24.4)
High School Grad	37.2 (34.1 – 40.3)	35.6 (31.7 – 40.0)	49.3 (43.3 - 55.3)	42.8(38.7-47.0)	28.6 (21.2 - 36.0)
>High School	54.3 (50.6 – 58.0)	60.0 (55.7 – 64.1)	46.6 (40.4 - 52.9)	21.6 (16.8 - 26.4)	52.2 (44.3 - 60.1)

Values are rates (%) and 95% Confidence intervals. Metabolic Syndrome was defined according to the National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP) III criteria.

Table 2: Rates (%) of Behavioral Risk factors and Depression in American Adults with Metabolic Syndrome by Race/ethnicity

Variable	ALL N=2,956	NHW n=1,272	NHB n=699	MA n=465	Others n=520
Variables					
Current Smokers	18.7 (16.3 – 21.0)	17.8 (14.8 - 20.9)	24.6 (18.6 - 30.7)	18.5 (14.4 - 22.5)	17.6 (9.7 - 25.4)
Alcohol Use	73.9 (70.7 - 77.0)	78.7 (74.7 - 82.7)	63.0 (58.7 - 62.7)	65.0 (58.1 - 72.0)	60.0 (53.8 - 66.1)
Depression	16.2 (14.2 - 18.1)	15.6 (13.3 - 17.8)	19.5 (15.7 - 23.4)	15.5 (10.5 - 20.4)	17.0 (10.9 - 22.8)
Sedentarism	23.9 (20.6 - 27.2)	20.3 (16.0 - 24.6)	37.5 (32.5 - 42.4)	26.8 (20.0 - 33.5)	30.1 (22.0 - 38.1)
Clustering of Behavioral Risk Factors and Depression					
0	13.1 (10.5 - 15.7)	11.1 (7.6 – 14.7)	15.8 (10.2 - 21.4)	19.4 (11.9 - 26.8)	19.4 (10.9 - 27.8)
1	50.4 (45.7 - 55.1)	54.3 (46.8 - 61.8)	37.9 (29.8 - 46.1)	41.0 (26.2 - 55.8)	43.1 (33.4 - 52.8)
2	24.9 (22.1 - 27.6)	23.8 (19.6 - 27.9)	29.6 (21.7 - 37.4)	28.8 (16.6 - 41.1)	24.9 (19.9 - 29.8)
3	10.0 (8.0 - 12.0)	9.4 (6.8 - 12.0)	14.2 (10.1 - 18.3)	7.7 (3.0 - 12.4)	11.3 (2.1 - 20.6)
4	1.7 (0.8 - 2.6)	1.5 (0.4 - 2.6)	2.6 (0.6 - 4.5)	3.1 (0.0 - 8.0)	1.4 (0.0 - 4.0)

NHW, Non-Hispanic Whites, NHB, Non-Hispanic Blacks, MA, Mexican-Americans, Behavioral Risk Factors include, Smoking status defined as having smoked 100 cigarettes in a lifetime or answered yes to the question; do you now smoke cigarette? Current alcohol consumption was defined as =>1 alcoholic drink per month and Sedentarism or Sedentary behavior was defined as leisure-time sedentary behavior (LTSB; ≥ 3 vs. < 3 hours/day). Depression was defined using Depression Scores from PHQ-9

Table 3 showed the association between the selected risk factors when adjustment was made for age, sex and education among American Adults with metabolic syndrome. In the entire study sample, current smokers were significantly more likely to be depressed (OR = 2.58, 95% CI = 1.90 – 3.50, P < 0.05) 1.78 times more likely to be sedentary and 2.36 times more likely to use alcohol. Alcohol use was found to be independently associated with 2.0 (95% CI = 1.22 - 3.27), 3.39 (95% CI = 1.93 - 5.93), 3.01 (95% CI = 1.13 - 8.02) and 3.41 (95% CI = 1.48 - 7.86) increased odds of being current smoker among NHW, NHB, MA and Other racial/ethnic groups respectively.

TABLE 3: ASSOCIATION BETWEEN SELECTED RISK FACTORS AMONG AMERICAN ADULTS WITH METABOLIC SYNDROME.

Var	ALL				NHW				OR* NHB				MA				OTHERS			
	ALC	SMOK	SED	DEPRES	ALC	SMOK	SED	DEPRES	ALC	SMOK	SED	DEPRES	ALC	SMOK	SED	DEPRES	ALC	SMOK	SED	DEPRES
ALC	-	2.42**	1.07	1.40**	-	2.0**	1.23	1.27	-	3.39**	1.43	1.66	-	3.01**	3.09	1.24	-	3.41**	0.91	2.73**
SMOK	2.36**	-	1.78**	2.58**	1.96**	-	1.72	2.67**	3.4**	-	1.45	2.38**	3.07**	-	2.96	2.87**	3.33	-	1.64	2.40**
SED	1.06	1.76**	-	1.26	1.22	1.7	-	1.09	1.42	1.43	-	1.46	2.72	2.9	-	1.8	0.9	1.68	-	2.85**
DEPRES	1.39**	2.57**	1.25	-	1.28	2.67**	1.1	-	1.65	2.45**	1.43	-	1.21	2.93**	1.71	-	2.38	2.39**	2.46**	-

OR, Odds Ratio from Logistic Regression, Var, Variable, ALC, Alcohol use, SMOK, Current Smoker, SED, Sedentarism, DEPRES, Depression, NHW, Non-Hispanic Whites, NHB, Non-Hispanic Blacks, MA, Mexican-Americans. * = Adjusted for Age, Sex and Education, ** = statistically significant at α = 0.05

TABLE 4. Association between behavioral risk factor combinations and depression among US adults with metabolic syndrome

Risk Factor Combination	Total sample	OR (95% CI) * NHW	NHB	MA	Other
One					
Alcohol	1.40 (1.01 – 1.94)**	1.27 (0.74 – 2.16)	1.66 (0.91 – 3.01)	1.24 (0.67 – 2.31)	2.73 (1.04 – 7.19)**
Smoking	2.58 (1.90 – 3.50)**	2.67 (1.66 – 4.30)**	2.38 (1.49 – 3.81)**	2.87 (1.33 – 6.21)**	2.40 (1.18 – 4.86)**
Sedentary	1.26 (0.82 – 1.93)	1.09 (0.63 – 1.89)	1.46 (0.55 – 3.89)	1.80 (0.32 – 10.10)	2.85 (1.17 – 6.94)**
Two					
Alcohol + Smoking	2.78 (1.96 - 3.91)**	3.00 (1.80 - 5.02)**	2.81 (1.51 - 5.22)**	2.86 (1.13 - 7.23)**	1.86 (0.71 - 4.83)
Alcohol +Sedentary	1.40 (0.92 - 2.14)	1.29 (0.73 - 2.28)	1.39 (0.55 - 3.52)	2.55 (0.75 - 8.63)	2.22 (0.83 - 5.92)
Smoking + Sedentary	2.30 (1.20 - 4.42)**	2.59 (1.03 - 6.54)**	1.51 (0.59 - 3.87)	3.95 (0.38 - 41.0)	2.43 (0.94 - 6.27)
Three					
Alcohol+Smoking+Sedentary	2.30 (1.05 - 5.03)**	2.77 (1.05 - 5.03)**	1.74 (0.61 - 4.94)	6.87 (0.76 - 62.22)	1.22 (0.15 - 9.82)

* Adjusted for age, sex, and educational level ** Significant at α= 0.05

Table 4 shows the Association between each behavioral risk factor and joint occurrence of behavioral risk factors and the odds of depression among US adults with metabolic syndrome. As shown, Smoking was significantly associated with increased odds of depression among NHW (OR = 2.67 [(95% CI = 1.66 – 4.30]), NHB (OR = 2.38 [95% CI = 1.49 – 3.81]), MA 2.87 (1.33 - 6.21) and other races/ethnicities 2.4 (1.18 - 4.86). Among subjects reporting their race/ethnicity to be others, Alcohol use and Sedentarism independently are associated with 2.78 and 2.85 increased odds of depression ($P < 0.05$), respectively.

Variables that were independently significant were further investigated to determine the effects of their joint occurrence. The analysis was designed to determine if the clustering of these variables was associated with increased odds of depression. As shown in Table 4, Combination

of Alcohol use and Smoking, combination of smoking and Sedentarism and joint occurrence of alcohol use, smoking and Sedentarism were revealed to be associated with significantly increased odds of depression. Joint occurrence of alcohol and smoking was associated with 2.78 (95% CI = 1.96 – 3.91), 3.00 (95% CI = 1.80 – 5.02), 2.81 (95% CI = 1.51 – 5.22), 2.86 (95% CI = 1.13 – 7.28) increased odds of depression in the total sample, NHW, NHB and MA respectively. Joint occurrence of smoking and Sedentarism was associated with 2.30(95% CI = 1.20 – 4.40) and 2.59(95% CI = 1.03 – 6.54) increased odds of depression in the total sample and NHW respectively. Joint occurrence of Alcohol use, smoking and Sedentarism was associated with 2.30 (95% CI = 1.05 - 5.03) and 2.77 (95% CI = 1.03 - 6.54) increased odds of depression in the total sample and NHW respectively. These relationships were not significant in NHB, MA and Others.

DISCUSSION

Although some studies have shown a decline in the prevalence of Metabolic Syndrome in recent times, literature has shown a mixed picture in the trend of individual components of the Metabolic Syndrome. Abdominal obesity (Ford et al, 2014) and blood glucose levels are increasing (Beltrán-Sánchez et al 2013) in the US, while the prevalence of elevated blood pressure and blood lipid levels appear to be decreasing. The decline in blood pressure and decline in dyslipidemia prevalence were attributed to public health intervention and drug treatment. Several studies have demonstrated significant association between Metabolic Syndrome and depression (Cohen et al, 2010, Marijnissen et al, 2013 and Butnoriene et al, 2014). Other studies have shown association between independent behavioral risk factors and Metabolic Syndrome (Kahl et al, 2010, Chen et al 2013, Sun et al, 2014). Regardless of the public health importance of depression, suicide, smoking, alcohol use and lack of physical activity, no study has shown the relationship between joint occurrence of negative behavioral risk factors and the risk of development of depressive symptoms in American Adults with Metabolic Syndrome. This study investigated if selected behavioral risk factors and depression clustered among US adults with metabolic syndrome. The study also investigated the relationship between the identified behavioral risk factors and depression, stratified by race/ethnicity. Moreover, the study determined which combinations or clusters were mostly associated with depression.

The main findings in this study overall, Current Smoking status was significantly associated with increased odds of depression across races/ethnicities (Mineur et al, 2010 and Chaiton et al, 2015). There was significant association between clusters of negative behavioral factors and depression in American Adults with Metabolic Syndrome. This clustering was demonstrated in the entire study sample as well as across race/ethnicity. Combination of alcohol

and smoking was associated with 2.78 times increased odds of depression in the entire sample and across race/ethnicity except in other races. Joint occurrence of smoking and Sedentarism was associated with 2.30(95% CI = 1.20 – 4.40) and 2.59(95% CI = 1.03 – 6.54) increased odds of depression in the entire sample and NHW respectively. There is no significant association between occurrence of Sedentarism and depression across the races in NHW, NHB and MA except in those who identified as other races/ethnicities who had 2.85 times (95% CI = 1.17 – 6.94) increased risk of depression. This is probably due to missing values.

Joint occurrence of Alcohol use, smoking and sedentarism was significantly associated with 2.30 (95% CI = 1.05 - 5.03) and 2.77 (95% CI = 1.03 - 6.54) increased odds of depression in the entire sample and NHW respectively. This relationship is not significant in NHB, MA and Others. Missing value may also account for the lack of significant association with joint occurrence of the three adverse risk factors.

Strengths: The reliability of the NHANES data is based on the national representativeness of the data as well as quality control applied to measures and instruments use in data collection.

Limitations: The study design which is a cross-sectional study design limited the establishment of temporal relationship between dependent variable and risk factors. Missing values are not expected to introduce bias because the of the survey design. Adequate adjustments have been made by the application of appropriate weights. Self-reported behaviors may limit accuracy of some data.

Further studies are suggested and introduction of other risk factors to the mixed perhaps will establish more associations.

CONCLUSION

The study established that being a current smoker was significantly associated with increased odds of depression. The joint occurrence of selected behavioral risk factors was positively associated with depression in individuals who met the criteria for Metabolic Syndrome.

People who are diagnosed with Metabolic Syndrome need to be evaluated for the risk of adverse behavioral risk factors and depression. Intervention should be designed to target individuals with these risk factors among those with Metabolic Syndrome.

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