Multinomial Logistic Regression Model of Demographic Predictors and Confounders of Binge
Alcohol Use among Adults with Major Depression

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The author is the sole contributor to the study conception, design, material preparation, data extraction, data analysis and versions of the manuscript. The author read and approves the final manuscript.

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Abstract

Identifying sociodemographic populations with a major depressive episode (MDE) who are at increased risk for binge alcohol use (BAU) is critical for developing focused prevention programs to meet the particular needs of each population. Thus, the goal of the current exploratory retrospective study is to examine sex, race, age, education, marital status, and income as risk predictors for BAU among adults with MDE; and if the risk for BAU changes after adjusting for demographic confounders. To achieve the study goal, data from the Substance Abuse and Mental Health Services Administration's 2018 National Survey for Drug Use and Health were extracted and analyzed. The unweighted sample included 6,999 adults representing a weighted population size of 33,900,452.122 in the US. Results revealed that age and marital status significantly predicted BAU in the past month among adults with MDE. Adults under the age of 50, with a college degree, never married, divorced/separated, and with a high-middle income level or higher were at higher risk for BAU. The study's clinical implications are that understanding demographics of individuals with MDE at increased risk for BAU can inform improved tailored assessment and treatment of alcohol abuse and MDE among at-risk populations. Future research should consider examining additional potential risk factors for BAU among adults with MDE.

Key words: Demographic Predictors, Adjustment for Confounders, Binge Alcohol Use, Major Depressive Episode, Complex Survey Design.

INTRODUCTION

Alcohol is a depressant. Counterintuitively, individuals who suffer from depression often turn to it for relief from symptoms of depression, creating a vicious cycle of repeated use of alcohol that can quickly progress to addiction, harm the brain, and exacerbate depressive symptoms (Boschloo, 2012; Boschloo et al., 2013; Ross, 2004). Over 90% of United States (US) adults who drink excessively report binge drinking in the past 30 days (Esser et al., 2014). A total of 26.5% of adults aged 18 or older report that they had engaged in binge drinking in the past month (Substance Abuse and Mental Health Services Administration, 2019a). Binge drinking is most common among younger adults aged 18–34 years, but more than half of the total binge drinks are consumed by 35 and older (Kanny et al., 2018). Binge drinking is twice as common among men than women. Four in five total binge drinks are consumed by men (Substance Abuse and Mental Health Services Administration, 2019d). Binge drinking is also more common among people with household incomes of \$75,000 or more and higher educational levels (Kanny et al., 2018; Substance Abuse and Mental Health Services Administration, 2019d), although binge drinkers with lower incomes and educational levels consume more binge drinks per year (Substance Abuse and Mental Health Services Administration, 2019d).

Abundant research has confirmed the relationship between depression and alcohol consumption (Boden & Fergusson, 2011; Bravo et al., 2017; Holahan et al., 2003; Kirchner et al., 2007), as well as its influence on individuals' general health status, mortality, and burden of disease (Charlet & Heinz, 2017; Peacock et al., 2018). Psychiatric disorders in general and depressive disorders are among the most prevalent psychiatric conditions among adults and co-occur more often than expected by chance (Conner et al., 2014; Grant et al., 2004). Many past studies confirmed the prevalence of excessive alcohol use among a broad range of demographic populations

across sex, age, race, education, marital status, and income (Assari et al., 2019; Bjørk et al., 2006; Caetano, 1987; Choi & DiNitto, 2011; Fleury et al., 2014; García-Esquinas et al., 2018; Han et al., 2017; Keyes et al., 2019; Strand & Steiro, 2003). An estimated 88,000 Americans die from alcohol-related causes annually, making alcohol the third leading preventable cause of death in the US (National Institute on Alcohol Abuse and Alcoholism, 2020). Because this is a relatively common health status concern among the general population, there is an urgent need to identify individuals at greater risk, such as adults with major depression. Adults diagnosed with major depressive episode (MDE) who are at risk for BAU may directly impact their longevity, quality of life, individual safety, work productivity, and preventive treatment planning.

Although health determinants can act as a buffer against the increased risk for risky health behaviors among adults with MDE (Catalano et al., 2011; Mirowsky & Ross, 2001; Omary, 2020; Rendall et al., 2011), evidence is lacking on binge alcohol drinking risk among adults with MDE while adjusting for demographic confounders. Identifying sociodemographic populations with MDE who are at increased risk for BAU would allow for the development of focused prevention programs to meet the particular needs of each population. To address the gap in evidence, the present exploratory retrospective study had two objectives: (1) to explore if the six predictors of sex, race, age, education, marital status, and income can significantly predict the risk for BAU among adults with MDE; and (2) to examine whether the association between MDE and BAU changes after adjusting for demographic variables in question (i.e. education, marital status, and income), while holding sex, race, and age as constant variables.

METHOD

Data Source

The present study utilized public-use data and documentation from the 2018 National Survey for Drug Use and Health (NSDUH) survey obtained from the Substance Abuse and Mental Health Services Administration's (SAMHSA) (<http://www.datafiles.samhsa.gov>). The public-use data contain 56,313 records of non-institutionalized individuals representing a weighted population size of 273,753,042.56. Study participants met the following criteria: (a) were 18 years old or older; and (b) had a lifetime MDE diagnosis. Participants were considered to have a lifetime MDE diagnosis if they were depressed for at least two weeks within the last 12 months; lost interest or pleasure in daily activities; had problems with sleeping, eating, energy, and concentration; or had low self-esteem. The MDE questions were based on diagnostic criteria from the Diagnostic and Statistical Manual of Mental Disorders (fifth edition) (Substance Abuse and Mental Health Services Administration, 2019c). The unweighted sample included 6,999 adults representing a weighted population size of 33,900,452.122 in the US.

Measures

The NSDUH public health data files were extracted and analyzed. The NSDUH is the primary, nationally representative source of annual estimates on illicit drugs, alcohol, tobacco, and mental health issues among the US non-institutionalized population (including civilians living on military bases), 12 years and older (Center for Behavioral Health Statistics and Quality, 2019a), and from national, regional, state, and sub-state areas.

The survey enables users to produce estimates of demographic characteristics, drug and alcohol use, and mental health problems from national, regional, state, and sub-state areas

(<http://www.datafiles.samhsa.gov>). As NSDUH is publicly available and contains no identifying information regarding respondents, there was no risk of disclosure or violation of individual privacy; thus, informed consent was not obtained. The appropriate institutional review board approved all study procedures.

Data Coding

All NSDUH records of adults 18 years old and older with MDE were included in the study. Records with MDE were coded as “1,” and all others were coded as “0.” Only those who were coded with 1 were included in the analyses. The main independent variables were sex, race, age, education, marital status, and income. The race variable had seven categories (i.e. Hispanic, Multiple races, Asian, Native Pacific, Native Indian, Black/African American, and White). Age was categorized into four groups (i.e. 18-25, 26-34, 35-49, and 50 or older), education level included five groups (i.e. less than high school, high school graduate, some college/associate degree, college graduate, 12-17 years old), marital status included four categories (i.e. married, widowed, divorced or separated, and never married), and income included four levels (less than \$20,000, 20,000-49,999, 50,000-74,999, and 75,000 or more) (Center for Behavioral Health Statistics and Quality, 2019b). Because only participants aged 18 years and older were included in this study, category five in education level (i.e. those aged 12-17 years) was coded “0” and excluded from further analysis.

The outcome measure was BAU in the past month, defined as drinking five or more drinks for males or four or more drinks for females on the same occasion (i.e. at the same time or within a couple of hours of each other, on at least one day in the past 30 days) (Center for Behavioral Health Statistics and Quality, 2019a). The outcome measure was obtained from the "substance

use" section designed to provide data on the use of various substances in the NSDUH.

Confounders included three demographic correlates treated once as a factor and once as a potential confounder for binge alcohol use among adults with MDE: education, marital status, and income.

Missing Data

Missing data in the public-use NSDUH database were given different codes according to their type (Center for Behavioral Health Statistics and Quality, 2019b). Imputation-revised variables and selected recoded versions of these variables were included for selected demographic, drug use, and substance use disorder variables. Missing values for all imputation-revised variables were imputed using the statistical imputation procedures described in the Statistical Imputation section of the NSDUH survey documentation (Center for Behavioral Health Statistics and Quality, 2019a; Substance Abuse and Mental Health Services Administration, 2019b).

Imputation indicators were provided for each variable to determine whether an observation contained data from the survey or an imputed value (Center for Behavioral Health Statistics and Quality, 2019a).

Analyses

As the NSDUH is a national survey that uses multistage and deeply stratified sampling, data were weighted to obtain unbiased estimates for survey outcomes in the population represented.

Variance estimation variables, variance estimation cluster replicates (VEREP), variance estimation stratum (VESTR), and final analysis weight (ANALWT_C) were applied to the statistical analyses to account for the sampling method used in data collection. This ensures

accurate point estimation regarding standard errors and allows generalizability of the results to the entire US population (Center for Behavioral Health Statistics and Quality, 2019a).

A weighted multinomial logistic regression (MLR) analysis was used to examine whether the six demographic correlates significantly predict past month BAU among adults with MDE. The MLR is a prediction test of likelihood odds that indicates the chances of one event occurring compared to other events (Harrell, 2015). Because BAU (outcome measure) is a categorical variable, the MLR analysis is the appropriate statistical model for estimating the probabilities of their presence or absence. The model fit was examined using Pearson and deviance criteria; the display of statistics that measure the overall model performance was controlled. Wald Statistics, changes in log-likelihood, and odds ratios for prediction of past month BAU were also calculated.

To examine potential demographic predictors of the risk for past month BAU among adults with MDE while adjusting for the other demographic variables as potential confounding factors, a weighted MLR analysis was performed with education, marital status, and income treated once as independent variables and once as confounding variables while holding sex, race, and age as constant variables. All statistical analyses were performed using IBM SPSS ver. 26.0 premium (SPSS Corp. Inc.). A two-tailed $p < .05$ was considered statistically significant.

RESULTS

To measure the likelihood ratios of BAU in the past month among adults with MDE in all demographic groups, MLR analyses were conducted for sex, race, age, education level, marital status, and income, respectively. The MLR results confirm that among the six demographic variables significantly predicting BAU risk in the past month among adults with MDE, age, and

marital status demonstrated a substantially better fit than the intercept-only model. In contrast, sex, race, education and income were found insignificant predictors of chances to develop BAU among adults with MDE ($p < 0.05$) (Table 1).

After adjustment for confounders of education, marital status, and income, odds ratios for BAU across sex and race remained the same (Table 3). Further, the Asian group continued to be the only racial group diagnosed with MDE that had lower chances to report BAU than Whites (Exp (B) =0.50 for Asian; $p < 0.05$; Table 3 and 4). Similarly, after adjustment for confounders, all age groups continued to demonstrate a higher risk for BAU than adults aged ≥ 50 years (Exp (B) =2.10 for 18-25, Exp (B) =2.16 for 26-34, and Exp (B) =1.82 for 35-49; Table 4).

Multinomial Logistic Regression Analyses

Among adults with MDE, the estimated coefficients were as follows. Across sex, males and females were equally likely to experience BAU in the past month, whereas across racial groups, only Asians were less likely than Whites to report BAU in the past month (Exp (B) =0.49 for Asian; $p < 0.05$; Table 2). Across age groups, all age groups were more likely to report BAU in the past month than adults aged ≥ 50 years (Exp (B) = 2.09 for age group 18-25, Exp (B) =2.16 for age group 26-35, and Exp (B) =1.78 for age group 36-49; $p < 0.05$; Table 2). For education, only adults with less than a high school education were less likely to report BAU than college graduates, whereas adults with higher education levels had chances equal to those of college graduates to report BAU in the past month (Exp (B) = 0.69 for less than high school, $p < 0.05$; Table 2). Moreover, adults who never married or were divorced/separated had significantly higher chances to report BAU than married adults (Exp (B) = 1.68 for never married, Exp (B) = 1.53 for divorced/separated; $p < 0.05$; Table 2), whereas widowed adults had chances equal to

those of like married adults to report BAU in the past month. Among the different levels of income, only adults with income between \$20,000-49,000 had significantly lower chances to report BAU than those with a higher income of \$75,000 or more (Exp (B) = 0.76 for adults with income between \$20,000-49,000; $p < 0.05$; Table 2). After adjustment for confounders, the Asian group continued to be the only racial group diagnosed with MDE that had lower chances to report BAU than Whites (Exp (B) = 0.50 for Asian; $p < 0.05$; Table 4). Furthermore, when adjusting for confounders of education, marital status, and income, odds ratios for BAU across sex and race remained the same (Table 4).

DISCUSSION

The findings of this retrospective exploratory research confirmed that age and marital status significantly predicted BAU in the past month among adults with MDE. Adults with MDE at higher risk for BAU were under the age of 50, with a college degree, never married, divorced/separated, and with a high-middle income level or higher. After adjusting for demographic confounders, odds ratios for BAU across sex, race, and age groups remained the same.

Our study results suggest that younger adults with high income, never been married, and divorced/separated diagnosed with MDE are at increased risk of developing BAU (Bracke et al., 2013; Bulloch et al., 2017; Kanny et al., 2018). Results suggest that other groups, including those who are 50 years old or older, married, earn less than a college degree education, and less than high-middle income are at decreased risk of developing BAU.

Our study shows similar risk chances for BAU in the past month among adults with MDE across several demographic populations, with and without adjustment for confounders. After adjustment

for confounders, equal chances for BAU between the two sexes and all racial groups were confirmed, except for Asians who were at a decreased risk for BAU compared to Whites (Nolen-Hoeksema & Harrell, 2002; Ross, 2004; Vaeth et al., 2017; Windle & Windle, 2014).

These results raise serious concerns about the risk for BAU among adults with MDE and its severe consequences on their depressive symptoms, quality of life, and longevity.

In conclusion, a broad range of demographic groups with MDE were either at increased risk or had an equal risk for BAU. The comorbidity of major depression and alcohol abuse is well established (Grant & Harford, 1995; Hasin et al., 2004; Merikangas & Gelernter, 1990; Neupane, 2016; Petrakis et al., 2002). The vicious cycle of depressant substance use such as alcohol and its impact on dopamine and serotonin neurotransmitters result in associated unpleasant feelings, including depression, hangover, and exhaustion, which are considered alcohol withdrawal symptoms (Charlet et al., 2011). Repeated alcohol use can quickly progress to alcohol dependency, harm the brain, and lead to further depression (Bartels et al., 2002; Boschloo et al., 2013). Our study results shed light on at-risk populations with MDE prone to develop BAU with and without adjustment for confounders.

The major clinical implication from the present study is that understanding the demographic background of individuals with MDE at increased risk for BAU can inform the designing and implementation of tailored assessment and treatment of alcohol abuse and MDE among at-risk populations, i.e., the younger adults with high income, never been married, and divorced/separated who are diagnosed with MDE. Furthermore, understanding the difference between the risk for binge drinking among those with and without MDE may help determine the adult's broader risk of health risk behaviors and associated mental illness and alcohol abuse. This

new understanding can help guide clinical decision-making regarding the type and level of mental health interventions the adult may require.

However, this study had some limitations. First, the NSDUH survey is cross-sectional; thus, no directionality or causality can be assumed between the study variables. Second, because the target population comprised non-institutionalized US civilians, a small proportion (approximately 3%) of the general population was excluded, including members in military duty and institutionalized individuals (e.g., hospitals, prisons, nursing homes, treatment centers). If the mental health status of these groups differs from that of non-institutionalized civilians, the NSDUH may be slightly inaccurate in terms of mental health estimates of the general population. Third, while this is the first study to control for demographic confounders, it included only three confounders. Future studies should examine additional potential confounders that impact the risk for BAU among the diverse demographic US population with major depression and other mental health disorders. Finally, the impact of the global COVID-19 pandemic may very well lead to higher levels of depression, particularly in countries like the US that have been severely impacted by the pandemic and cause greater difficulties for at-risk populations who may turn to alcohol use to alleviate depressive symptoms. Identifying these at-risk populations and tailoring specific treatments for them are areas of clinical necessity that this study begins to address.

CONCLUSIONS

This is the first study to use a national probability sample to predict the likelihood for BAU among adults with MDE with and without adjustments for confounders. Our findings reveal a broad range of at-risk populations for BAU among adults with MDE. Clinical attention is required for the at-risk populations using tailored, focused interventions that address their unique

substance abuse and mental health challenges and needs. Special attention must be paid to age groups under 50 years old, never married, and separated/divorced who are particularly at risk for future alcohol abuse. Future research should consider examining additional potential confounders (e.g., availability of supportive networks, conflicts at home, comorbid physical and psychiatric conditions, employment) for BAU among all age groups, never married, and separated/divorced, and other at-risk populations.

Conflict of Interest:

The author Areen Omary declares that there is no conflict of interest.

Compliance with Ethical Standards:

This article does not contain any studies with human participants or animals performed by any of the authors.

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Tables

Table 1. Test of the model effects of six predictors of binge alcohol use over the past 30 days among adults with MDE*

Tests of Model Effects				
Source	df1	df2	Wald F	Sig. ^{††}
(Corrected Model)	19.00	32.00	7.50	.00
(Intercept)	1.00	50.00	40.12	.00
Sex	1.00	50.00	2.42	.12
Race	6.00	45.00	1.63	.15
Age group	3.00	48.00	15.58	.00
Education level	3.00	48.00	1.41	.25
Marital status	3.00	48.00	7.51	.00
Income	3.00	48.00	2.20	.10

* Major Depressive Episode

†† Significance level set at $p < 0.05$

Table 2. Parameter estimates of demographics as predictors of binge alcohol use over the past 30 days among adults with MDE^{*,***}

Parameter Estimates											
Binge Alcohol Use Past 30 Days **	Parameter	B	Std. Error	95% Confidence Interval		Hypothesis Test			Exp (B)	95% Confidence Interval for Exp(B)	
				Lower	Upper	t	df	Sig. ^{††}		Lower	Upper
Yes	(Intercept)	-1.43	.12	-1.68	-1.18	-11.49	50.00	.00	.23	.18	.30
	Male	.13	.08	-.03	.30	1.55	50.00	.12	1.14	.96	1.35
	Female	.00 [†]	.	.	.	.	.	.	1.00	.	.
	Hispanic	.02	.12	-.21	.27	.23	50.00	.81	1.02	.80	1.31
	Multiple race	.17	.24	-.30	.65	.72	50.00	.47	1.18	.73	1.92
	Asian	-.69	.22	-1.14	-.24	-3.08	50.00	.00	.49	.31	.78
	Native Pacific Islander	-.21	.84	-1.92	1.48	-.25	50.00	.79	.80	.14	4.41
	Native American	.19	.33	-.48	.86	.56	50.00	.57	1.20	.61	2.37
	Black	-.12	.15	-.43	.17	-.85	50.00	.39	.87	.65	1.18
	White	.00 [†]	.	.	.	.	.	.	1.00	.	.
	18-25	.74	.12	.49	.98	6.12	50.00	.00	2.09	1.64	2.67
	26-34	.77	.13	.51	1.03	5.87	50.00	.00	2.16	1.66	2.82
	35-49	.57	.11	.35	.80	5.11	50.00	.00	1.78	1.42	2.23
	50 or older	.00 [†]	.	.	.	.	.	.	1.00	.	.
	Less than High school	-.36	.17	-.71	-.01	-2.08	50.00	.04	.69	.49	.98
	High school grad	-.12	.11	-.35	.09	-1.17	50.00	.24	.87	.70	1.09
	Some college /Associate degree	-.08	.08	-.25	.09	-.96	50.00	.33	.92	.77	1.09
	College graduate	.00 [†]	.	.	.	.	.	.	1.00	.	.
	Never been married	.52	.10	.30	.73	4.77	50.00	.00	1.68	1.351	2.09
	Widowed	-.00	.26	-.53	.52	-.00	50.00	.99	.99	.587	1.69
	Divorced/ Separated	.42	.12	.17	.67	3.42	50.00	.00	1.53	1.193	1.96
	Married	.00 [†]	.	.	.	.	.	.	1.00	.	.
	Less than \$20,000	-.21	.12	-.46	.03	-1.74	50.00	.08	.80	.631	1.03
	\$20,000-49,999	-.26	.10	-.47	-.05	-2.49	50.00	.01	.76	.623	.95
	\$50,000-74,999	-.07	.14	-.36	.20	-.54	50.00	.59	.92	.697	1.23

\$75,000 or more	.00 [†]	.	.	.	.	.	.	1.00	.	.
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* Author's analysis of data from the 2018 National Survey for Drug Use and Health (NSDUH) for noninstitutionalized individuals with major depressive episodes (MDE) aged 18 and older (N=6,999)

** Reference category: no binge alcohol use in the past 30 days

*** Major Depressive Episodes

[†] Set to zero because this parameter is redundant

^{††} Significance level $p < 0.05$

Table 3. Test of the model effects of six predictors of binge alcohol use over the past 30 days among adults with MDE* with adjustment for demographic confounders

Tests of Model Effects				
Source	df1	df2	Wald F	Sig. ^{††}
(Corrected Model)	13.00	38.00	8.70	.00
(Intercept)	1.00	50.00	20.46	.00
Sex	1.00	50.00	2.61	.11
Race	6.00	45.00	1.60	.16
Age group	3.00	48.00	18.03	.00
Education level	1.00	50.00	4.17	.04
Marital status	1.00	50.00	21.86	.00
Income	1.00	50.00	3.66	.06

* Major Depressive Episode

†† Significance level set at $p < 0.05$

Table 4. *Parameter estimates of demographics as confounders of binge alcohol use over the past 30 days among adults with MDE*^{*, ***}

Parameter Estimates											
Binge Alcohol Use Past 30 Days **	Parameter	B	Std. Error	95% Confidence Interval		Hypothesis Test			Exp (B)	95% Confidence Interval for Exp(B)	
				Lower	Upper	T	df	Sig ^{††}		Lower	Upper
Yes	(Intercept)	-1.47	.18	-1.84	-1.10	-7.99	50.00	.00	.23	.15	.33
	Male	.13	.08	-.03	.30	1.61	50.00	.11	1.14	.96	1.36
	Female	.00 [†]	.	.	.	.	.	.	1.00	.	.
	Hispanic	.03	.12	-.21	.27	.25	50.00	.80	1.03	.80	1.31
	Multiple race	.18	.24	-.30	.66	.75	50.00	.45	1.19	.73	1.94
	Asian	-.68	.22	-1.12	-.23	-3.05	50.00	.00	.50	.32	.79
	Native Pacific Islander	-.26	.85	-1.97	1.44	-.30	50.00	.76	.77	.14	4.25
	Native American	.19	.34	-.49	.88	.55	50.00	.58	1.21	.60	2.41
	Black	-.12	.14	-.41	.17	-.81	50.00	.41	.88	.65	1.19
	White	.00 [†]	.	.	.	.	.	.	1.00	.	.
	18-25	.74	.11	.52	.96	6.73	50.00	.00	2.10	1.68	2.63
	26-34	.77	.12	.51	1.02	6.04	50.00	.00	2.16	1.67	2.79
	35-49	.60	.11	.37	.82	5.35	50.00	.00	1.82	1.45	2.28
	50 or older	.00 [†]	.	.	.	.	.	.	1.00	.	.
	Education level	.09	.04	.00	.18	2.04	50.00	.04	1.10	1.00	1.20
	Marital status	-.15	.03	-.22	-.08	-4.67	50.00	.00	.85	.80	.91
	Income	.07	.04	-.00	.15	1.91	50.00	.06	1.07	.99	1.16

* Author's analysis of data from the 2018 National Survey for Drug Use and Health (NSDUH) for noninstitutionalized individuals with major depressive episodes (MDE) aged 18 and older (N=6,999)

** Reference category: no binge alcohol use in the past 30 days

*** Major Depressive Episodes

[†] Set to zero because this parameter is redundant

^{††} Significance level $p < 0.05$