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Effect of depression on health behavior among myocardial infarction survivors in the United States

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Abstract

Introduction: The purpose of this study was to evaluate the effect of depression on health behavior among myocardial infarction (MI) survivors.

Methods: This retrospective, cross-sectional study used publicly available 2015 Behavioral Risk Factor Surveillance System (BRFSS) data. Our study sample includes adults aged 50 years or older who completed the 2015 BRFSS survey and reported having MI. The BRFSS participants with a *yes* response to the question, *Has a doctor, nurse, or other health care professional ever told you that you had a heart attack, also called a myocardial infarction?* were identified as MI survivors. The presence or absence of depression among MI survivors was identified using a similar question. Health behaviors, the dependent variable of this study, included physical activity, smoking status, alcohol use, body mass index, last flu immunization, last physical checkup, last blood cholesterol check, heavy drinking, and vegetable and fruit consumption. Univariate (χ^2 tests) and multivariable (binomial logistic regression) analyses were used to assess the differences in health behaviors between MI survivors with or without depression.

Results: Our final study sample consists of 20 483 older adults with MI among whom 5343 (26.19%) reported having depression. Multivariable analyses reveal MI survivors with depression are more overweight, have less physical activity, and have higher likelihood of smoking but less odds of consuming alcohol compared to MI survivors without depression.

Discussion: In this nationally representative sample of adults aged over 50 years in the United States, MI survivors with depression exhibited poorer health behaviors compared to those without depression.

Keywords: myocardial infarction, depression, health behavior

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Introduction

According to the Centers for Disease Control and Prevention (CDC)[1] estimates, myocardial infarction (MI) is one of the major causes of morbidity and mortality with about 735 000 Americans experiencing an MI each year, among which nearly 210 000 occur among those who had a previous MI. The American Heart Association has identified specific modifiable risk factors for secondary

MI prevention.[2] Mitigating these risks include lowering consumption of cigarettes and alcohol, improving nutrition, and increasing physical activity. Managing aggressive risk factors has been shown to increase survival, minimize recurrent events, and improve quality of life in MI survivors.[2]

According to a recent meta-analysis,[3] the prevalence of depression among MI survivors ranges from 9.17% to 65.88% with a pooled prevalence of 28.70%, making it one of the most common psychiatric comorbidities among MI survivors. A meta-analysis[4] of 29 studies including 16 889 MI survivors observed that there was an increased risk of all-cause mortality, cardiac mortality, and cardiac events with depression among MI survivors. Although other studies have demonstrated that depression is an independent risk factor for increased mortality at 6 months[5] and 18 months[6] post-MI, many health behaviors are detrimental in both diseases. Given the high prevalence of depression and its wide array of negative outcomes among MI survivors, it is critical to examine the effect of depression on health behavior of MI survivors to prevent secondary MI as well as reduce morbidity and mortality in this vulnerable population. Although it is well documented that comorbid depression has been associated with poorer health behaviors among individuals with other chronic conditions,[7-10] to the best of our knowledge there is no study examining the effect of depression among MI survivors. Thus, the aim of this study was to compare health behaviors between MI survivors with depression and those without depression using a nationally representative sample of individuals in the United States.

Method

Study Design

A retrospective, cross-sectional study design was used.

Data Source

The Behavioral Risk Factor Surveillance System (BRFSS) is a nationwide, health-related telephone survey that conducts approximately 500 000 interviews yearly, making the BRFSS survey the largest health survey globally. The BRFSS collects a wide range of data from US residents that includes health-related risk behaviors, chronic health conditions, use of preventable services, self-perceived health status, and access to health services as well as sociodemographic and environmental factors.[11] A publicly available BRFSS data set[12] was used for this study. The response rates of BRFSS 2015 were 48.2% and 47.2% for the landline and cell phone surveys, respectively.[13] Existing studies[14,15] have demonstrated high reliability and validity of BRFSS data.

Study Sample

The total number of respondents in the 2015 BFRSS database consists of 441 456 individuals. Our final study sample consists of older adults aged 50 years or older who participated and completed the 2015 BRFSS survey and reported having MI. The University of Arizona Human Subjects Protection Program Institutional Review Board determined that human subjects review was not required for this study.

The BRFSS participants with a *yes* response to the question, *Has a doctor, nurse, or other health care professional ever told you that you had a heart attack, also called a myocardial infarction?* were identified as MI survivors. A similar definition of MI has been used by existing studies using BRFSS data.[16,17]

Variables Measure

Dependent Variables

Health behaviors, the dependent variables of this study, include (1) physical activity, (2) smoking status, (3) alcohol consumption, (4) body mass index (BMI), (5) flu shot during the past 12 months, (6) last physical checkup, (7) last blood cholesterol check, (8) heavy drinker, (9) vegetable consumption, and (10) fruit consumption. Meeting the recommended physical activity was defined as greater than 150 minutes of moderate-to-vigorous physical activity per week. Smoking status was categorized as current smoker or nonsmoker. Alcohol consumption category of *yes* included MI survivors who reported having at least 1 drink of alcohol in the past 30 days. The BMI was categorized as normal weight or underweight and overweight or obese. The MI survivors responded *yes* or *no* to whether they received a flu shot during the past 12 months and whether they received their last physical checkup and blood cholesterol check fewer or more than 2 years ago. Heavy alcohol consumption or heavy drinker were defined as *adult men having more than 14 drinks per week and adult women having more than 7 drinks per week*. Vegetable consumption was considered *yes* if the respondents reported consuming vegetables 1 or more times per day and *no* if they consumed vegetables less than 1 time per day. Similarly, fruit consumption of 1 or more times per day or less than 1 time per day was categorized as *yes* or *no*, respectively. Further details about these variables can be found in the BRFSS 2015 data documentation.[12]

Independent Variables

Key Independent Variable

Presence or absence of depression is the key independent variable of this study. Presence of depression was

ascertained when a survey participant responded *yes* to the question, *Has a doctor, nurse, or other health care professional ever told you that you have a depressive disorder, including depression, major depression, dysthymia, or minor depression?* Existing studies using BRFSS data have used a similar definition to identify the presence of depression.[18,19]

Other Independent Variables

Other independent variables consist of various health, socioeconomic, and demographic factors. Health factors include concurrent conditions, such as cancer, arthritis, asthma, cardiovascular disease, diabetes, or hypertension. Other health variables include perceived general health, presence of activity limitations, received needed emotional support, level of physical health, level of mental health, and level of functional health. Socioeconomic factors include education, employment, family income, insurance status, and usual source of care. Demographic factors include age, sex, race/ethnicity, marital status, region of the US residence and metropolitan area. Table 1 shows how these other independent variables were categorized in this study.

Statistical Analysis

Chi-square tests were used for univariate analysis, and binomial logistic regression was used for multivariable analyses to assess the differences in health behaviors between MI survivors with or without depression. The final multivariable logistic regression models adjusted for all independent variables of this study. SAS version 9.4 (SAS Institute Inc, Cary, NC) was used to conduct all analyses, and an a priori α of 0.05 was considered to be statistically significant.

Results

Characteristics of MI Survivors

Distribution of the health, socioeconomic, and demographic factors are presented in Table 1. Our final study sample consists of 20 483 adults with MI among whom 5343 (26.19%) reported having depression. Compared to MI survivors without depression, those with depression were typically more often females, younger (50 to 64 years), separated or divorced, unemployed, without higher education, and with a lower family income. Unsurprisingly, depressed MI survivors showed significantly more health problems (arthritis, asthma, diabetes, hypertension, but not cancer) compared to MI survivors without depression. Moreover, MI survivors reported higher activity limitations and poorer physical and mental health status as well as lower functional health status in comparison to MI survivors without depression.

Health Behaviors of MI Survivors Compared to Non-MI Controls

Health behaviors of depressed MI survivors and nondepressed MI controls are exhibited in Table 2. The MI survivors with depression were more likely to be obese (42.61% vs 35.50%; $P < .0001$), have less physical activity (32.16% vs 45.08%; $P < .0001$), are more current smokers (29.49% vs 15.63%; $P < .0001$), and engage in heavy drinking (3.93% vs 3.25%; $P < .0001$) compared to MI survivors without depression. The MI survivors with depression were also less likely to consume the recommended daily amount of fruit (52.28% vs 57.61%; $P < .001$) and vegetables (69.44% vs 74.06%; $P = .0021$) compared to those without depression. However, MI survivors with depression reported less consumption of any drink compared to those without depression (28.20% vs 37.17%, $P < .0001$).

Multivariable Findings of Health Behaviors

Table 3 demonstrates that, after adjusting for all independent variables, MI survivors with depression were more likely to be overweight or obese (adjusted odds ratio [AOR] = 1.39; 95% confidence interval [CI] 1.17, 1.67; $P = .0003$), be smokers (AOR = 1.65; 95% CI 1.34, 2.03; $P < .0001$), and complete less than the weekly recommend amount of physical activity (AOR = 0.76; 95% CI 0.64, 0.89; $P = .0009$). The MI survivors with depression were found to consume less alcohol (AOR = 0.77; 95% CI 0.64, 0.91; $P = .0003$) than those without depression.

Discussion

The findings of our study demonstrate that MI survivors with depression have higher odds of poor health behaviors (increased BMI, less physical activity, and more smoking) compared to MI survivors without depression. Making appropriate interventions related to health behavior patterns is critical in reducing economic burden and reducing disease state–related morbidity and mortality.

The CDC[20] recommends that, for substantial health benefits, adults should do at least 150 minutes a week of moderate-intensity or 75 minutes a week of vigorous-intensity aerobic activity. One of the approaches to include exercise into the regular activities of an MI survivor is utilizing the cardiac rehabilitation services that encompass several different coordinated and multiple interventions (eg, exercise, education, risk modification, and counseling).[21,22] A systematic review and meta-analysis[22] of 48 randomized controlled trials (total pooled N = 8940) observed that exercise-based cardiac rehabili-

TABLE 1: Sample description of myocardial infarction (MI) survivors with and without depression[a]

	MI With Depression		MI Without Depression		
Predisposing Factors	**N**	**Weighted %**	**N**	**Weighted %**	***P* Value**
Age					<.0001
50 to 64	2319	52.87	3800	33.07	
65 and older	3024	47.13	11 340	66.93	
Sex					<.0001
Female	2895	47.71	5940	33.19	
Male	2448	52.29	9200	66.81	
Race/ethnicity					.0028
White	4177	73.73	12 544	78.16	
Non-white	1068	26.27	2329	21.84	
Marital status					<.0001
Married	2118	42.59	7761	57.62	
Widowed	1353	20.43	4097	20.93	
Separated/divorced	1510	30.93	2422	16.75	
Never married	346	6.06	807	4.69	
Education					<.0001
<High school	892	28.24	1856	21.81	
High school graduate	1787	31.43	5207	32.95	
Some college	1591	28.84	4063	29.06	
College graduate	1062	11.49	3958	16.18	
Employment status					<.0001
Employed	618	11.9	2901	21.28	
Unemployed	4697	88.1	12 167	78.72	
Family income, $					<.0001
<25k	2500	48.61	4648	31.5	
25k to 35k	569	9.61	1770	10.93	
35k to 50k	547	9.84	2018	14.38	
50k to 75k	411	6.91	1788	11.73	
>75k	414	7.64	2214	14.79	
Missing or unknown	902	17.39	2702	16.67	
Insurance status					.1277
Yes	5114	94.12	14 645	95.62	
No	218	5.88	457	4.38	
Usual source of care					.5455
Yes	5071	94.29	14 305	94.9	
No	253	5.71	772	5.1	
Region of the United States					.1109
Northeast	891	17.11	2555	18.86	
Midwest	1415	21.69	4351	23.42	
South	1831	43.56	4990	40.12	
West	1117	17.65	3053	17.6	
Metro area					.0043
Yes	2389	73.28	7311	77.36	
No	1324	26.72	3853	22.64	
Cancer					.7447
Yes	1616	28.78	4731	29.27	
No	3728	71.2	10 406	70.73	

TABLE 1: Sample description of myocardial infarction (MI) survivors with and without depression[a] (continued)

	MI With Depression		MI Without Depression		
Predisposing Factors	**N**	**Weighted %**	**N**	**Weighted %**	***P* Value**
Arthritis					<.0001
Yes	3924	73.29	8145	51.83	
No	1381	26.71	6880	48.17	
Asthma					<.0001
Yes	1428	28.33	2113	14.34	
No	3877	71.67	12 970	85.66	
Diabetes					<.0001
Yes	2342	44.09	5233	67.68	
No	2992	55.91	9880	62.62	
Hypertension					<.0001
Yes	4191	79.57	11 158	73.16	
No	1131	20.43	3920	26.84	
Perceived general health					<.0001
Excellent/very good	530	8.15	3389	21.76	
Good	1243	19.81	5263	34.44	
Fair/poor	3540	72.04	6408	43.8	
Activity limitations					<.0001
Yes	3902	75.3	6509	42.37	
No	1407	24.7	8507	57.53	
Received needed emotional support					<.0001
Always/usually	44	23.25	61	9.33	
Sometimes	37	18.52	67	8.53	
Rarely/never	126	58.23	564	82.14	
Physical health					<.0001
Good	1276	21.59	7418	50.23	
Medium	1691	32.92	4005	27.91	
Bad	2172	45.46	3103	21.86	
Mental health					<.0001
Good	1644	29.78	12 041	79.51	
Medium	1825	32.72	2125	15.09	
Bad	1666	37.51	632	5.39	
Functional health					<.0001
Good	2084	37.23	10 880	72.14	
Medium	1414	27.19	2234	15.86	
Bad	1649	35.58	1719	12.00	

[a]Based on 20 483 MI survivors aged 50 or older; 5343 (26.19%) reported having depression.

tation was associated with 20% (odds ratio = 0.80; 95% CI 0.68, 0.93) and 26% (odds ratio = 0.74; 95% CI 0.61, 0.96) reduction in all-cause mortality and cardiac mortality, respectively, compared to usual care among individuals with coronary heart disease. An existing study[23] has demonstrated that individuals with coronary heart disease and comorbid depression who completed a cardiac rehabilitation program had 73% mortality risk reduction compared to depressed individuals with coronary heart disease who did not complete the cardiac rehabilitation program. Moreover, it has also been observed that improving exercise capacities even by a modest amount is associated with reduction of depression and depression-related mortality.[23-25] Our study found that, in a nationally representative sample in the United States of MI survivors who were depressed were less likely to reach the 150 min/wk of moderate-intensity exercise goal than those without depression. This suggests that those suffering from depression may experience greater difficulty engaging in physical activity. Because symptoms of depression include

TABLE 2: Comparison of health behavior domains between survivors of myocardial infarction (MI) with and without depression[a]

	MI With Depression		MI Without Depression		
Health Behavior Domain	**N**	**Weighted %**	**N**	**Weighted %**	***P* Value**
Body mass index					<.0001
Normal weight/underweight	1149	21.84	3983	25.76	
Overweight	1755	35.55	5738	38.74	
Obese	2231	42.61	4921	35.5	
Smoking status					<.0001
Current	1403	29.49	2143	15.63	
Former	2248	40.96	7236	48.67	
Never	1661	29.55	5673	36	
Heavy drinking					<.0001
Yes	171	3.93	422	3.25	
No	1265	23.26	5078	33.42	
Last 30 d no drink	3836	72.81	9351	63.33	
Flu shot					.7115
Yes	3237	57.41	9152	56.83	
No	2083	42.59	5950	43.17	
Physical checkup, y					.1581
<2	4858	91.63	13 994	93.66	
2 to 4	178	3.49	392	2.74	
≥5	172	4.01	442	3.06	
Never	37	0.87	81	0.55	
Cholesterol checkup, y					.1346
<2	4917	93.25	14 082	94.59	
2 to 4	113	3.15	244	1.77	
≥5	52	0.89	151	1.11	
Never	110	2.71	286	2.53	
Any drink					<.0001
Yes	1471	28.2	5612	37.17	
No	3836	71.8	9351	62.83	
Fruit consumption					.001
Yes	2859	52.28	8917	57.61	
No	2295	47.72	5583	42.39	
Vegetable consumption					.0021
Yes	3597	69.44	10 682	74.06	
No	1471	30.56	3522	25.94	
Physical activity					<.0001
Recommended	1814	32.16	7043	45.08	
Not recommended	785	14.29	1779	12.62	
None	2544	50.3	5690	38.16	
Unknown[b]	200	3.26	628	4.14	

[a]Based on 20 483 MI survivors aged 50 or older; 5343 (26.19%) reported having depression.

[b]Category denotes *missing*, *do not know*, or *refused*.

hopelessness and decreased motivation and energy, simply instructing MI survivors suffering from depression on the recommended amounts of physical activity is likely to be ineffective.[26] Interventions to treat depression specifically (eg, pharmacotherapy, psychotherapy) should be considered to help eliminate these symptoms that are a barrier to adhering to the CDC recommended exercise goals.[27] However, it should be kept in mind that another

TABLE 3: Adjusted odds ratios (AOR) and 95% confidence intervals (CI) for multivariable comparison of health behaviors between myocardial infarction (MI) survivors with depression compared to MI survivors without depression[a]

Health Behavior Domain	AOR	95% CI	*P* Value
Flu immunization			
Yes	0.98	0.83, 1.16	.84
No	Ref		
Last physical checkup, y			
<2	0.91	0.68, 1.23	.5348
≥2	Ref		
Last cholesterol check, y			
<2	0.75	0.56, 1.00	.0478
≥2	Ref		
Body mass index			
Overweight/obese	1.39	1.17, 1.67	.0003
Normal weight/underweight	Ref		
Physical activity, min/wk			
≥150	0.76	0.64, 0.89	.0009
<150	Ref		
Smoking status			
Smoker	1.65	1.34, 2.03	<.0001
Nonsmoker	Ref		
Alcohol consumption			
Yes	0.77	0.64, 0.91	.0003
No	Ref		
Heavy drinking			
Yes	0.9	0.61, 1.29	.5402
No	Ref		
Vegetable consumption			
Yes	0.84	0.71, 1.00	.0458
No	Ref		
Fruit consumption			
Yes	0.93	0.79, 1.09	.3558
No	Ref		

Ref = reference.

[a]Based on 20 483 MI survivors aged 50 or older; 5343 (26.19%) reported having depression.

possible explanation for not meeting the recommended physical activity level might be the severity of MI and the clinical condition of the MI survivor. Safety concerns about unsupervised exercise in this population have led to the development of medically supervised exercise programs that have minimal risks,[28] and MI survivors should be slowly included in these supervised programs for improved health outcomes.

The American Heart Association/American College of Cardiology (AHA/ACC) recommends weight loss for individuals with coronary artery disease and a BMI ≥ 25 kg/m^2.[2,29] This is mainly owing to the fact that overweight and obesity are independent risk factors of metabolic syndrome,[30] and existing literature[31] has shown that, among older adults who are overweight or obese, with and without metabolic syndrome, have an increased cardiovascular event and mortality risk, particularly among males. Hence, metabolic syndrome should be screened for in all MI survivors to prevent negative health outcomes. Furthermore, 1 study[32] found that, in individuals presenting with a ST-elevated MI and left ventricular dysfunction, BMI appeared to be a significant predictor of inducible-ventricular tachycardia and all-cause mortality. In our study, it was found that MI survivors with depression had a larger BMI than those without depression. As previously mentioned, symptoms of depression include decreased motivation, energy, and sometimes increased appetite.[26] Therefore, it makes sense that MI survivors with depression would be at increased risk of having a higher BMI because these symptoms can lead to more inactivity, overeating, and decreased motivation to make lifestyle changes. However, according to a recent review article,[33] treatment of obesity or depression (among individuals with co-occurring obesity and depression) helps in improving the prognosis of the other condition. Health care providers should also keep in mind that individuals with depression, in many cases, are on antidepressant and/or antipsychotic treatment that can lead to weight gain.[34] Thus, the interaction of depression and obesity is complex and might be more pronounced among MI survivors. So it is critically important to develop appropriate interventions to decrease the higher BMI among MI survivors with depression for improved health outcomes.

The AHA/ACC guidelines for MI survivors recommend a goal of complete smoking cessation utilizing counseling, pharmacological therapy, and formal smoking cessation programs.[35] One of the major reasons for recommending complete smoking cessation among MI survivors is that it has been observed that smoking cessation is associated with 40% and 30% lower risk of all-cause mortality and recurrent MI, death, or heart failure hospitalizations, respectively, among MI survivors.[36] It is concerning that, according to our study findings, MI survivors with depression were more likely to continue smoking than MI survivors without depression. This behavior could be due to lack of emotional and health care–related support in the rehabilitation process of MI, and therefore, education on smoking cessation treatment options should be a part of the treatment plan. An existing study[37] demonstrated that utilization of a proactive strategy to offer intensive smoking cessation intervention using motivational interviewing to hospitalized individuals with acute coronary syndrome who were smokers was significantly associated with the use of smoking cessation counseling and increased chances of smoking abstinence

at the end of 1 year from hospitalization. Thus, health care providers can use this strategy to reduce or eliminate smoking among MI survivors post–hospital discharge.

The AHA/ACC Foundation recommends moderate consumption of alcohol, defined as up to 1 drink per day for women and up to 2 drinks per day for men, for secondary prevention of MI.[38] Although higher alcohol consumption is associated with higher risk of MI, small-to-moderate amounts of alcohol consumption among MI survivors have been observed to be associated with lower total mortality, reduced chances of major coronary event, and slowing atherosclerosis progression as well as decreased platelet activity and vascular tone.[39-41] It is reassuring that our study findings indicate that depressed MI survivors were less likely to consume alcohol compared to those without depression as comorbid depression and alcohol consumption is common[42] and is associated with persistence of symptoms.[43] Although our study findings were not able to precisely differentiate individuals who would benefit for their MI survival based on their alcohol consumption, health care providers should screen for alcohol use at routine visits to identify stressors that may be contributing to heavy consumption and refer to treatment services when necessary.

Although it is well established that addressing lifestyle factors, such as exercise, diet, and substance use, are important for reducing morbidity and mortality in post-MI survivors, it is important to recognize that changing these behaviors is difficult. Adhering to the previously mentioned health behavior guidelines requires a considerable amount of time, effort, and motivation. This can be challenging even in the absence of a depression diagnosis, which is exhibited in our findings when many individuals in the post-MI without depression group reported engaging in no physical activity. Therefore, addressing ambivalence for implementing these lifestyle recommendations is a crucial component of the treatment plan. Evidence has shown that more patient-centered approaches lead to better outcomes.[44,45] Motivational interviewing is an example of a patient-centered approached to care in which the health care provider helps patients explore and resolve existing ambivalence to behavior changes that are discussed.[46] This type of communication strategy should be used in combination with depression treatment in post-MI survivors suffering from depression.

Strengths of this study include a nationally representative sample and measuring a variety of health behaviors. Although the sample representation is conducted nationwide, these data are self-reported (eg, clinical assessment to establish validity of depression and MI diagnosis was not feasible) and are vulnerable to recall bias and over-reporting or underreporting engagement of health behaviors in question. Time since MI and the total number of previous MI events was not available within the data set and, therefore, could not be analyzed as a potential confounder. Causal inferences cannot be reached due to the cross-sectional study design.

Conclusion

The MI survivors with comorbid depression were more likely to engage in poor health behaviors than MI survivors without depression. It is important to treat comorbid depression in this population to help eliminate symptoms that may hinder the ability to implement lifestyle recommendations for secondary MI prevention. Future studies should investigate the impact of depression treatment and motivational interviewing on health-related behaviors in this population.

Acknowledgments

This study used data from a publicly available Behavioral Risk Factor Surveillance System survey. The data can be freely downloaded from the following website: https://www.cdc.gov/brfss/annual_data/annual_2015.html.

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