

The Relationship between Depression and Non-Suicide Mortality: The Importance of Health Statuses and Health Behaviors

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The link between mortality and depression remains unclear and contested. Some researchers have found that depression serves as an independent risk factor for mortality, while others suggest that the results are ambivalent at best. While most research focuses on the relationship between depression and suicide mortality, fewer studies examine the relationship between depression and non-suicide mortality. In this study, I attempt to examine how current health statuses and health behaviors explain the relationship between depression and non-suicide mortality.

There are several explanations for the link between depression and mortality. First, it may be that depressed persons with illness may be less likely to adhere to medical regimens or have more difficulty maintaining social networks. Depressed individuals are also less likely to have health insurance for a variety of reasons (Sturm et al. 1995). Second, depression may be linked to mortality through a host of health behaviors such as physical inactivity, eating problems, increased smoking, or increased levels of alcohol consumption. Third, there are viable biological mechanisms via cardiovascular pathways (i.e. stress and myocardial infarction, decreased heart rate variability).

AIMS

First, my aim is to explain how health status such as weight status, functional limitations, mediates the association between major depression and mortality. Second, I focus on how health behaviors including drinking, smoking, and exercise may mediate the effect of depression on mortality. Differences in the distributions of health statuses and health behaviors by depression status may partially explain the relationship between depression and non-suicide mortality.

Finally, I intend to examine the moderating relationship between health statuses, health behaviors, and depression on risk of death for U.S. adults.

DATA

Data come from the 1999 National Health Interview Survey. The NHIS is a national household survey of noninstitutionalized adults in the U.S. Information comes from the sample adult core, where one adult per family is chosen to respond to specific questions. The 1999 NHIS is linked to prospective mortality through the National Death Index through December of 2006 (National Center for Health Statistics 2010). 5.6% of the records that cannot be linked to the NDI due to missing information on the matching characteristics are eliminated which results in 29,050 respondents of whom 2,516 have died.

VARIABLES

The measure of depression comes from the World Health Organization Composite International Diagnostic Interview (CIDI) Short-Form (CIDI-SF). The CIDI is a valid and reliable diagnostic interview and has classification accuracy of 93% for major depressive disorder (Kessler et al. 2007). Major depressive disorder is ascertained for respondents responding positively to questions about experiencing either 2 weeks of dysphoric mood or 2 weeks of anhedonia with the symptoms lasting at least most of the time, almost every day. Additionally, seven additional questions are asked about losing interest, feeling tired, change in weight, difficulty sleeping, trouble concentrating, feeling down, and thoughts about death. These seven scores are summed to create a summary symptom score ranging from 0 to 7. Major

depressive disorder is created by positive responses to the affirmative dysphoric or anhedonia questions and a sum scale score of three or more.

Three race/ethnic categories are included: non-Hispanic white, non-Hispanic black, and Hispanic. Four age categories include 18-34, 35-49, 50-64, and 65 years and older. Education is included as a continuous measure of years of completed education. Income is defined according to the federal poverty ratio guidelines: poor (<124% of federal poverty level), low income (125-199%), middle income (200-399%), and high income (>400%). Employment is a dichotomous category (employed in past year versus unemployed). Marital status includes currently married, not married, and never married.

Health status variables include body mass, functional limitations, mental health service utilization, and health insurance. Body mass categories are included as underweight (<18.5), obese (≥ 30.0), and normal/overweight (18.5-29.9). The normal and overweight categories are collapsed due to similar relationships with mortality. Dichotomous variables measure whether a respondent has any functional limitation, has visited a psychiatrist or mental professional in the past year, and whether they currently have access to health insurance.

Health behaviors include smoking, alcohol use, and physical activity. Smoking is included as never smoker, former smoker, or current smoker. Physical activity measures the average frequency of leisure time physical activity per week. Two variables measure whether respondents typically engage in any moderate or any vigorous physical activity in the average week. Alcohol use is measured as abstainer, former user, or current user. An additional variable dichotomously measures whether a respondent has 10 or more binge drinking (5+ drinks in one sitting) episodes in the past year.

ANALYSIS

Cox proportional hazards models are used to examine the risk of death, with the average effects of the covariates on the risk of death across age (Allison 1994). Because age is used as the time to event or censor, age is not included separately in the models (Korn, Graubard, and Midthune 1997). All analyses include appropriate sample weights and adjust for the complex sample design of the NHIS.

RESULTS

Table 1 presents the weighted frequencies of all of the covariates by depression status. Results indicate clear depression differences by each of the categories. In regards to sociodemographic characteristics, non-Hispanic whites, females, and the non-married have higher proportions of major depression. Also, those categorized with higher depression have a higher education level and a lower proportion of employment. Health status variables indicate that respondents with major depression have higher proportions of either underweight or obesity and lower rates of health insurance. Moreover, those with major depression have much higher proportions of visits with mental health professionals in the past year and more functional limitations. Health behaviors indicate significant differences between smoking statuses, with 40.44% of depressed individuals indicating current smoking status. While moderate physical activity does not appear to have significant differences between groups, depressed individuals have a significantly lower proportion in the vigorous physical activity category. Depressed individuals also have lower levels of alcohol abstention, and higher levels of current and binge drinking.

[Table 1 about here]

Next, table 2 presents results from bivariate cox proportional hazards models to indicate whether the examined variables have individual relationships with non-suicide mortality. Importantly, depression shows a strong positive risk of death. As expected due to previous research, the majority of the covariates have strong relationships with mortality with the exception of the obesity category. There is a particularly strong effect (HR=2.43) for current smoking. Next, hazard coefficients are presented for a stratified sample of no depression and major depression categories to examine if health status or health behaviors exhibit variable effects. Results indicate a much higher risk of death for underweight individuals with depression (HR=7.75) compared to those without (HR=2.79). The presence of health insurance does not appear to have a protective effect on risk of death for those experiencing depression (HR=1.34; n.s.). Smoking appears to have similar effects across categories, with current smoking and particularly former smoking more detrimental to those with major depression. While vigorous activity has a protective effect for those without depression, it does not have an impact on mortality for the depressed, in part due to a small number of depressed individuals engaging in vigorous activity. Alcohol use does not appear to have a significant, positive relationship with risk of death for depressed individuals although the coefficients are similar in magnitude across categories. Finally, binge drinking of 10 or more times a year does not have a relationship with mortality for any of the categories.

Table 3 presents a multivariate framework to explore the mediating effect of health statuses and health behavior of depression on mortality. Model 1 presents the unadjusted (except for age) relationship between depression and mortality. Model 2 incorporates the sociodemographic controls which has increases the magnitude of the depression coefficient with sex and ethnicity controls. Model 3 indicates that part of the relationship is explained through

socioeconomic status variables. Model 4 incorporates the health status variables to determine if the relationship is due, in part, to health status differences. Health statuses, namely functional limitations and underweight status begin to help understand the relationship between depression and mortality, and suggest the relevance of illness. Finally, the final model incorporates health behaviors and further reduces the magnitude and significance of the depression and mortality link. A large part of the relationship is due to smoking differences among the depressed, as suggested in Table 2. But, the relationship between depression and mortality remains consistent with inclusion of some of the major predictors of death highlighting a persistent independent relationship between depression and death.

CONCLUSION

These results indicate a lasting, independent relationship between depression and mortality, with controls for major predictors of death. While these results are preliminary, they suggest future directions for this research. I intend to further refine the measures included in the study. First, I intend to include additional measures of depression. I also intend to include more refined measures of smoking and drinking to further explore these relationships. I also intend to incorporate the imputed income files to have a better specified measure of socioeconomic status. There will also be an examination of cause-specific mortality to consider if the effects of depression are primarily linked to cardiovascular mortality. This research will also focus more on the race/ethnic differences that were only touched upon in this draft. Finally, as indicated in the aims, I intend to incorporate a set of interactions to consider how health behaviors interact with depression and potential three-way interactions between race/ethnicity, depression, and mortality.

Table 1. Weighted Means and Proportions of Covariates by Major Depression Status, U.S. Adults 1999-2006

	No Depression n=26,377	Major Depression n=1,745	
	%	%	<i>p</i> value ^a
<i>Sociodemographic</i>			
Race/ethnicity			
Non Hispanic white	77.49	79.82	
Non Hispanic black	11.7	11.66	
Hispanic	10.81	8.53	<i>p</i> ≤.020
Age			
18-34	29.85	32.54	
35-49	31.89	35.76	
60-64	20.37	22.56	
≥65	17.89	9.14	<i>p</i> ≤.001
Sex			
Female	51.24	67.16	<i>p</i> ≤.001
Marital status			
Married	65.02	50.34	
Not married	16.86	28.24	
Never married	18.13	21.42	<i>p</i> ≤.001
Mean education	12.65	12.36	<i>p</i> ≤.001
Employed	73.62	69.05	<i>p</i> ≤.001
<i>Health Status</i>			
BMI Status (kg/m ²)			
Underweight (<18.5)	2.04	2.88	
Normal or Overweight (18.5-29.9)	74.14	68.5	
Obesity (≥30.0)	23.81	28.61	<i>p</i> ≤.001
Functional limitation	27.18	53.88	<i>p</i> ≤.001
Heart attack ever	3.07	3.43	<i>p</i> ≤.4201
Mental health visit	4.09	30.25	<i>p</i> ≤.001
Health insurance	86.81	79.64	<i>p</i> ≤.001
<i>Health Behaviors</i>			
Smoking status			
Never smoker	53.48	39.14	
Former smoker	23.71	20.01	
Current smoker	22.81	40.84	<i>p</i> ≤.001
Physical activity			
Any moderate activity	43.6	43.23	<i>p</i> ≤.825
Any vigorous activity	36.6	31.54	<i>p</i> ≤.001
Alcohol use			
Abstainer	21.83	14.79	
Former drinker	14.85	17.49	
Current drinker	63.32	67.72	<i>p</i> ≤.001
Binge 10+ occasions per year	10.3	16.78	<i>p</i> ≤.001

^a*P*-values are obtained from Wald tests that account for complex sampling frame

Table 2. Unadjusted Cox proportional hazard coefficients (95% Confidence Intervals) of Individual Covariates on Risk of Death by Major Depression Status, U.S. Adults 1999-2006

	Overall			No Depression			Major Depression		
	HR	95% CI		HR	95% CI		HR	95% CI	
Major depression	1.91	1.57, 2.32	***	-			-		
<i>Sociodemographic</i>									
<i>Race/ethnicity</i>									
Non Hispanic white	ref			ref			ref		
Non Hispanic black	1.38	1.21, 1.58	***	1.43	1.25, 1.65	***	0.83	0.48, 1.45	
Hispanic	0.76	.64, .90	**	0.78	0.65, 0.93	**	0.53	0.29, 0.97	*
<i>Sex</i>									
Female	0.69	.63, .76	***	0.69	0.63, 0.76	***	0.58	0.40, 0.83	**
<i>Marital status</i>									
Married	ref			ref			ref		
Not married	1.24	1.12, 1.36	***	1.23	1.11, 1.35	***	1.01	0.69, 1.49	
Never married	1.46	1.22, 1.75	***	1.40	1.16, 1.69	***	2.13	1.13, 3.99	**
<i>Education</i>									
Employed	0.95	.94, .97	***	0.95	0.94, 0.97	***	0.97	0.93, 1.02	
Employed	1.96	1.67, 2.30	***	1.83	1.55, 2.16	***	2.72	1.69, 4.37	***
<i>Health Status</i>									
<i>BMI Status (kg/m²)</i>									
Underweight (<18.5)	2.33	1.84, 2.95	***	2.17	1.69, 2.79	***	4.01	2.08, 7.75	***
Normal/Overweight (18.5-29.9)									
Obesity (≥30.0)	1.11	.99, 1.23		1.10	0.98, 1.23		1.09	0.73, 1.61	
Functional limitation	1.92	1.73, 2.14	***	1.86	1.67, 2.08	***	1.84	1.10, 3.09	*
Mental health visit	1.42	1.13, 1.80	**	1.30	0.98, 1.72		1.04	0.66, 1.62	
Health insurance	0.73	.58, .92	**	0.75	0.59, 0.96	*	0.75	0.41, 1.34	
<i>Health Behaviors</i>									
<i>Smoking status</i>									
Never smoker	ref			ref			ref		
Former smoker	1.43	1.29, 1.58	***	1.41	1.27, 1.57	***	1.86	1.17, 2.95	**
Current smoker	2.43	2.14, 2.76	***	2.38	2.08, 2.72	***	2.42	1.53, 3.84	***
<i>Physical activity</i>									
Any moderate activity	0.65	.58, .73	***	0.67	0.59, 0.75	***	0.49	0.29, 0.82	**
Any vigorous activity	0.67	.57, .78	***	0.69	0.58, 0.81	***	0.53	0.22, 1.31	
<i>Alcohol use</i>									
Abstainer	1.19	1.07, 1.34	**	1.20	1.07, 1.35	**	1.02	0.61, 1.71	
Former drinker	1.71	1.53, 1.91	***	1.72	1.53, 1.93	***	1.44	0.93, 2.22	
Current drinker	ref			ref			ref		
Binge 10+ occasions per year	1.21	.96, 1.53		1.18	0.92, 1.52		1.25	0.67, 2.32	

Table 3. Cox proportional hazard coefficients (95% Confidence Intervals) for the Relationships between Depression, Health Status, Health Behaviors, and Risk of Death, U.S. Adults 1999-2006

	1	2	3	4	5
Major depression	1.910*** (1.57 - 2.32)	1.926*** (1.59 - 2.34)	1.736*** (1.42 - 2.12)	1.442*** (1.17 - 1.78)	1.361* (1.08 - 1.72)
<u>Sociodemographic</u>					
Race/ethnicity					
Non Hispanic white (ref)					
Non Hispanic black		1.315*** (1.15 - 1.51)	1.195* (1.03 - 1.38)	1.222** (1.06 - 1.42)	1.122 (0.95 - 1.33)
Hispanic		0.742*** (0.63 - 0.88)	0.626*** (0.52 - 0.75)	0.672*** (0.56 - 0.81)	0.727** (0.59 - 0.89)
Sex					
Male (ref)					
Female		0.618*** (0.56 - 0.68)	0.587*** (0.53 - 0.65)	0.556*** (0.50 - 0.61)	0.567*** (0.50 - 0.64)
Marital status					
Married (ref)					
Not married		1.389*** (1.25 - 1.54)	1.372*** (1.24 - 1.52)	1.343*** (1.21 - 1.49)	1.312*** (1.16 - 1.48)
Never married		1.454*** (1.21 - 1.74)	1.476*** (1.23 - 1.78)	1.428*** (1.19 - 1.72)	1.454*** (1.17 - 1.81)
Education in years			0.957*** (0.94 - 0.97)	0.965*** (0.95 - 0.98)	0.990 (0.97 - 1.01)
Unemployed			1.937*** (1.65 - 2.27)	1.719*** (1.47 - 2.01)	1.704*** (1.43 - 2.03)
<u>Health Status</u>					
BMI Status (kg/m ²)					
Normal/Overweight (18.5-29.9)					
Underweight (<18.5)				2.359*** (1.88 - 2.96)	2.282*** (1.78 - 2.93)
Obesity (≥30.0)				0.985 (0.88 - 1.10)	1.001 (0.88 - 1.14)
Any functional Limitation				1.776*** (1.59 - 1.98)	1.680*** (1.48 - 1.90)
Mental health visit in past year				1.087 (0.86 - 1.37)	1.018 (0.78 - 1.33)
Health insurance				0.831 (0.66 - 1.05)	0.963 (0.74 - 1.25)
<u>Health Behaviors</u>					
Smoking status					
Never smoker (ref)					
Former smoker					1.383*** (1.21 - 1.58)
Current smoker					2.110*** (1.81 - 2.47)
Physical activity					
Any moderate activity					0.760*** (0.66 - 0.87)
Any vigorous activity					0.851 (0.70 - 1.04)
Alcohol use					
Current drinker (ref)					
Abstainer					1.352*** (1.17 - 1.56)
Former drinker					1.456*** (1.27 - 1.67)
Binge 10+ occasions per year					1.085 (0.82 - 1.43)