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The Association of a Heart Attack or Stroke with Depressive Symptoms Stratified by the Presence of a Close Social Contact: Findings from the National Health and Aging Trends Study Cohort

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Abstract

Objective—To examine whether the risk of having clinically significant depressive symptoms following a heart attack or stroke varies by the presence of a close social contact.

Methods—The National Health and Aging Trends Study is a nationally representative longitudinal survey of U.S. Medicare beneficiaries aged 65 and older initiated in 2011. 5,643 older adults had information on social contacts at baseline and depressive symptoms at the one-year follow-up interview. The PHQ-2 identified clinically significant depressive symptoms. Interview questions examined social contacts and the presence of self-reported heart attack or stroke during the year of follow-up.

Results—297 older adults reported experiencing a heart attack and/or stroke between their baseline and follow-up interviews. In regression analyses accounting for sociodemographics, baseline depressive symptoms, medical comorbidity, and ADL impairment, older adults with no close social contacts had increased odds of depressive symptoms at follow-up after experiencing a heart attack or stroke, while those with close social contacts had increased odds of depressive symptoms at follow-up after experiencing a stroke, but not a heart attack.

Conclusions—Older adults have increased odds of having depressive symptoms following a self-reported stroke, but only those with no close social contacts had increased odds of depressive symptoms following a heart attack. Social networks may play a role in the mechanisms underlying

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Conflicts of Interest

The authors declare they have no conflicts of interest to report.

depression among older adults experiencing certain acute health events. Future work exploring the potential causal relationships suggested here, if confirmed, could inform interventions to alleviate or prevent depression among at risk older adults.

Keywords

Epidemiology; medical comorbidity; longitudinal; social support

Introduction

In the United States, every year approximately 1.5 million people experience a heart attack (consisting of new or recurrent coronary attacks and silent myocardial infarctions) and 800,000 have a new or recurrent stroke (Lloyd-Jones *et al.*, 2010). Depression is also highly prevalent with 1 in 5 adults in the United States having at least mild depression symptoms (Shim *et al.*, 2011). By 2030, unipolar depressive disorders are projected to become the second leading source of disease burden as measured by disability-adjusted life years (Mathers and Loncar, 2006).

The interrelationship that heart attacks and strokes have with depression is complex, with depression increasing the risk for heart disease (Skala *et al.*, 2006) and strokes (Pan *et al.*, 2011), and heart disease and strokes being associated with elevated levels of depression (Ayerbe *et al.*, 2013; Jiang and Davidson, 2005; Ziegelstein, 2001). For example, a meta-analysis found that following a stroke there is a 39–52% five-year cumulative incidence of depression (as assessed by diagnostic criteria, symptom severity scales, or a validated question) (Ayerbe *et al.*, 2013). There are potentially significant consequences of depression in patients with heart attacks or strokes. Following an acute coronary syndrome, there is a "preponderance of evidence" (p. 1,357) that depression is a risk factor for adverse medical outcomes such as all-cause mortality (Lichtman *et al.*, 2014), and post-stroke depression is likewise associated with increased mortality as well as disability and worse recovery of function (Ayerbe *et al.*, 2013; Robinson, 2003).

Social support (which can include social integration, social networks, and relational content) (Luttik *et al.*, 2005) also may meaningfully impact physical and mental health, with social isolation and loneliness having a comparable risk for premature mortality as physical activity and obesity (Holt-Lunstad *et al.*, 2015). Small social networks and/or isolation can increase the risk of depression, heart disease, and strokes as well as potentially decrease adherence to care and engagement in healthy behaviors (Vink *et al.*, 2008; Nagayoshi *et al.*, 2014; Hemingway and Marmot, 1999; Boden-Albala *et al.*, 2005). Furthermore, social support can affect the morbidity associated with physical illnesses: Higher levels of perceived social support have been linked to faster and more complete post-stroke recovery (Glass *et al.*, 1993), while social isolation has been associated with adverse post-stroke outcomes (Boden-Albala *et al.*, 2005). Social support also may increase resilience to stress (Ozbay *et al.*, 2007) and could thereby buffer against the effects of an acute medical illness.

Despite all of the above, we have a relatively limited understanding of why depression may follow a heart attack or stroke. Although social support may have clinical management and prognostic implications for those experiencing a heart attack or stroke, social support

measures such as social isolation are absent from many large stroke databases (Aron *et al.*, 2015). While there is more information linking poor social support to depression post-heart attack, these studies often are relatively small, are geographically limited, and/or do not prospectively evaluate social support prior to the heart attack (Frasure-Smith *et al.*, 2000; Dickens *et al.*, 2004). We are unaware of prior studies that used a nationally representative sample that assessed social support and depressive symptoms at baseline and prospectively measured the occurrence of heart attacks, strokes, and depressive symptoms.

Utilizing a cohort study design, we use longitudinal data from the National Health and Aging Trends Study (NHATS) in the United States (U.S.) to address this gap in our understanding of depressive symptoms following a heart attack or stroke. We hypothesize that older adults with no close social contacts will be at risk for clinically significant depressive symptoms following a self-reported heart attack or stroke. Given that depression following a heart attack and stroke is associated with serious adverse health outcomes, an improved understanding of how physical health, mental health, and the presence of close social contacts intersect could help inform interventions to identify those at risk of having depression and also intervene on the pathways that lead to adverse outcomes after an acute medical event.

Methods

Sample

Since 2011, NHATS has been examining a nationally representative sample of Medicare beneficiaries aged 65 years and older in the U.S., with participants being interviewed yearly (Kasper and Freedman, 2015). NHATS has an unweighted response rate of 70.9% in the baseline 2011 interview and a unweighted response rate of 86.1% in the second interview one year later (conditional on participating in the baseline interview) (Kasper and Freedman, 2015). The NHATS interview was administered in English and Spanish, and older age groups and Black individuals were oversampled (Kasper and Freedman, 2015). NHATS was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board. Our cohort study consists of NHATS participants with non-missing responses to the presence of close social contacts at baseline who survived to provide information on depressive symptoms at follow-up (N=5,643).

Depression

Depressive symptoms were assessed with the two-item Patient Health Questionnaire (PHQ-2), a validated depression screening instrument that measures depressed mood and anhedonia in the prior two weeks (Kroenke *et al.*, 2003). It is scored from 0 to 6 with scores of 3 or higher indicating the presence of clinically significant depressive symptoms. Sensitivity and specificity for major depressive disorder are 83% and 90% respectively (Kroenke *et al.*, 2003). NHATS slightly modified the PHQ-2 to examine a four week period (Kasper and Freedman, 2015).

Close Social Contacts

The presence of close social contacts at baseline was assessed with this question: “Looking back over the last year, who are the people you talked with most often about important things?” The total number of contacts was derived from this question and ranged from 0 to 5, and participants are allowed to report a maximum of 5 close social contacts (Kasper and Freedman, 2015). We stratified participants into groups defined by those without (0) and those with (1–5) close social contacts because our primary focus is to examine the association between acute medical illnesses and depression in older adults who may be socially isolated.

Cardiovascular Events

NHATS evaluates the presence of a new onset heart attack or stroke at follow-up (Kasper and Freedman, 2015), which was determined by these questions: “We are interested in new health conditions that you have learned about this year. Since the time of the last interview in [last interview month and year], has a doctor told you that you had: 1) a heart attack or myocardial infarction? or 2) a stroke?”

Covariates

We examined covariates previously associated with late-life depression (Vink *et al.*, 2008) and included baseline depressive symptoms, age, gender, marital status, race and ethnicity, education, medical conditions (which include hypertension, arthritis, heart disease, osteoporosis, diabetes, lung disease, dementia, and cancer), and ADL impairments in our analyses.

Statistical Analyses

Bivariate and multivariable analyses characterized the risk of having clinically significant depressive symptoms following a self-reported heart attack or stroke stratified by the presence of close social contacts. We used the Rao-Scott F adjusted chi-square statistic (National Center for Health Statistics, 2013) to examine depressive symptoms and sample characteristic differences stratified by the presence/absence of close social contacts. We conducted a series of unadjusted and adjusted logistic regression analyses, both of which had depressive symptoms at follow-up as the outcome variable. The primary independent variables were: 1) heart attack, 2) stroke, and 3) heart attack and/or stroke. Baseline depressive symptoms, age, gender, marital status, race and ethnicity, education, medical conditions, and ADL impairment were included in the adjusted models, but not the unadjusted models; we also adjusted for history of heart attack and/or stroke when the primary independent variables were heart attack and/or stroke, respectively. Covariates were included as dummy variables and reference groups were no baseline depression, male gender, married or living with a partner, white non-Hispanic, college degree, no ADL impairment, and no history of heart attack or stroke; age and medical conditions were treated as ordinal variables in the regression analyses. Due to the complex survey design of NHATS, we employed SAS survey procedures (version 9.4, SAS Institute, Inc., Cary, NC) to calculate population-weighted adjusted estimates that account for sampling design and nonresponse. Per NHATS technical guidance (Kasper and Freedman, 2015), we applied the

Round 1 analytic weights for our analyses. We accounted for the variability of participants with missing data (many of whom were deceased) by applying the “not missing completely at random” (i.e., nomcar) option available in SAS’s survey procedures.

Results

Cohort

Of the 7,026 older adults participating in the initial interview (there were an additional 583 proxy informant and 468 nursing home interviews that did not assess the presence of close social contacts), 250 were deceased at follow-up and 5,691 completed the one-year follow-up interview. Of these, 5,643 had information on close social contacts and depressive symptoms. At the follow-up interview, a total of 297 participants reported experiencing a heart attack and/or a stroke in the intervening year; 146 endorsed having a heart attack, 128 reported having a stroke, and 23 reported both.

Characteristics by Presence of Close Social Contacts

In the NHATS cohort of older adults, a self-reported heart attack or stroke was associated with higher levels of depressive symptoms in both those with and without close social contacts. In those with close social contacts, increasing age, not being married, and a history of a heart attack and stroke were associated with depressive symptoms. Across all participants, irrespective of presence of close social contacts, minority racial/ethnicity status, not finishing high school, baseline depressive symptoms, medical conditions, and ADL impairment, on average, were associated with the presence of depressive symptoms (Table 1).

Regression Analyses

In the logistic regression analyses that did not adjust for baseline depressive symptoms or the sociodemographic covariates, older adults with and without close social contacts had increased odds of having depressive symptoms after experiencing a heart attack and/or stroke. The odds ratio estimates for depressive symptoms at follow-up in those with a heart attack and/or stroke were 2.41 (95% CI: 1.76–3.28) and 4.87 (95% CI: 1.87–12.71) for those with and without close social contacts, respectively (Table 2). In the logistic regression analyses that included baseline depressive symptoms, age, gender, marital status, race and ethnicity, education, medical conditions, ADL impairment, and history of heart attack and/or stroke, older adults with and without close social contacts had increased odds for depressive symptoms at follow-up in those with a stroke (with social contacts, OR: 2.51, 95% CI: 1.76–3.59; without social contacts, OR: 4.44, 95% CI: 1.03–19.14). In the adjusted analyses, however, only those without close social contacts had increased odds for depressive symptoms following a reported heart attack (with social contacts, OR: 1.19, 95% CI: 0.68–2.07; without social contacts, OR: 5.57, 95% CI: 1.68–18.44) (Table 2).

We also conducted a sensitivity logistic regression analysis that controlled for baseline depressive symptoms, age, gender, marital status, race and ethnicity, education, medical comorbidity, ADL impairment, and history of a heart attack or stroke and included an interaction term between the presence of close social contacts with the occurrence of a heart

attack and/or stroke with the outcome being clinically significant depressive symptoms at follow-up. The interaction term was statistically significant (N=5,270, F-value=4.2, p=0.047).

Discussion

Our hypothesis that older adults with no close social contacts at baseline will be at risk for clinically significant depressive symptoms following a self-reported heart attack or stroke was supported by our bivariate and multivariable analyses, though there was evidence of an association between depressive symptoms and stroke among older adults with close social contacts as well. Because smaller social network sizes and/or social support have been associated with an increased risk for depressive symptoms and disorders (Vink *et al.*, 2008), coronary heart disease (Hemingway and Marmot, 1999), and strokes (Nagayoshi *et al.*, 2014), our multivariable analyses included baseline depressive symptom status as well as a self-reported history of heart attacks and strokes.

These findings, though not causal, are consistent with prior work (Dickens *et al.*, 2004; Frasure-Smith *et al.*, 2000) and provide further evidence suggesting that older adults with no close social contacts may be vulnerable towards having depression following an acute medical illness. Though not examined here, the effects of having a close social contact may occur through the complicated construct of social support which is downstream of social networks/contacts (Berkman *et al.*, 2000), and there are numerous potential pathways through which the associations that we identified here could operate. For example, social support could contribute to maintaining physical and mental health, may provide protection against the full effects of mental and physical illness, and may confer resilience to stress (Ozbay *et al.*, 2007). As social support can have a significant impact on life expectancy and other health outcomes (Ozbay *et al.*, 2007; Holt-Lunstad *et al.*, 2015), it is encouraging that social impairment is potentially modifiable and interventions to improve social support are increasingly well-studied (Dickens *et al.*, 2011). Such interventions have included home visits, educational programs, group support, and intergenerational social activities (Dickens *et al.*, 2011). While we observe that social connections may have possible protective cardiovascular implications, more explicit characterization on how the presence of close social contacts affects health is required to inform the design of possible interventions.

With regards to interventions targeting the intersection of acute medical illness, social support, and depression, we identified one study that randomized 2,481 heart attack patients to care as usual or a cognitive behavioral therapy (CBT) intervention (Berkman *et al.*, 2003). In this study, depression and perceived social support were secondary outcomes and, even though mortality and recurrent heart attacks did not improve in the CBT arm, the CBT-based intervention did improve depression and perceived social support (Berkman *et al.*, 2003). This large randomized clinical trial provides evidence that social support is potentially dynamic and modifiable in a medically vulnerable population and could meaningfully inform future interventions.

Our study has several limitations. Our social support variable was based on a single self-reported question. Thus, while social support can be highly multifaceted and include the

domains of social integration, social networks, and relational content (Luttik *et al.*, 2005), our study examined the presence of close social contacts. We thereby did not examine whether different social support domains have differential effects on depressive symptoms at follow-up. Another limitation is that the absolute numbers of those experiencing a heart attack or stroke in a year are relatively small when stratified by the presence of close social contacts, which increases the variability of our point estimates and limits our ability to examine the roles of additional covariates in our multivariable analyses. The variability in our point estimates also limited our ability to compare the different number of social contacts point estimates to one another. While we could have pooled our social contact data and conducted analyses that tested for effect modification across the entire sample, a priori we elected to stratify our analyses to be less restrictive and enable the coefficients for the other variables to vary by the presence of close social contacts. Stratified analyses also allowed us to see how the association between a heart attack and/or stroke and subsequent depression may differ across strata in ways not captured by an interaction term (which was statistically significant in sensitivity analyses). Another limitation is that 250 participants died between the initial and follow-up interview and, given the morbidity associated with depression, heart attacks, strokes, and social isolation, it is likely that these deceased participants may have had relatively high levels of these conditions that could have further enriched our analyses; indeed, 4.8% of those without social contacts at baseline were deceased at follow-up compared to 3.2% of those with close social contacts. Unfortunately, we do not know the cause of death and our ability to examine the association of heart attacks, strokes, depressive symptoms, and close social contacts in the deceased participants is limited. An additional methodologic issue is that depression was not assessed with a diagnostic psychiatry interview such as the Structured Clinical Interview for DSM Disorders (First *et al.*, 2002). The PHQ-2, however, was validated against a structured mental health professional interview and performed well (Kroenke *et al.*, 2003). Lastly, we do not know the temporal relationship between depressive symptoms and the occurrence of a heart attack or stroke. For instance, it is possible that a participant may have had a heart attack or stroke many months prior to the follow-up interview and, in the interim, experienced a significant life event (e.g., death of loved one, another acute illness) that may be a more proximal causal factor as to whether the older adult has clinically significant depressive symptoms.

Conclusion

Using a large nationally representative cohort sample of Medicare beneficiaries that assessed close social contacts and depressive symptoms at baseline and prospectively measured the occurrence of a heart attack, stroke, and depressive symptoms, we found that: 1) those with no close social contacts have increased odds for having depressive symptoms following a heart attack or stroke and 2) those with close social contacts have increased odds for having depressive symptoms following a stroke, but not following a heart attack. Future studies could consider examining whether different social support domains have a differential effect on outcomes in those experiencing heart attacks and strokes (or potentially other acute health events). Further exploration of the potential causal relationships suggested here could inform interventions to reduce depression and, possibly, illness-related morbidity and mortality.

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Key Points

1. This study examined a nationally representative sample of Medicare beneficiaries aged 65 years and older in the United States.
2. Those with no close social contacts have increased odds for having depressive symptoms following a heart attack or stroke.
3. Older adults with close social contacts have increased odds for having depressive symptoms following a stroke, but not following a heart attack.

Table 1

Characteristics of participants stratified by depressive symptoms at follow-up and the presence of a close social contact at baseline

Sample Characteristics	0 Close Contacts							1–5 Close Contacts						
	PHQ-2 Positive N=69			PHQ-2 Negative N=316			p value[a]	PHQ-2 Positive N=686			PHQ-2 Negative N=4,572			p value[a]
	N	%	SE	N	%	SE		N	%	SE	N	%	SE	
Age at Baseline, Years							0.171							0.006
65–69	13	17.1	5.2	58	25.5	2.8		120	25.7	1.7	932	30.3	0.6	
70–74	12	23.1	6.8	70	26.1	3.5		134	23.5	1.7	1,011	25.9	0.6	
75–79	13	23.2	6.1	68	21.0	2.3		144	19.7	1.5	933	18.9	0.6	
80–84	10	13.5	4.4	67	16.0	2.4		147	17.0	1.5	885	13.8	0.5	
85+	21	23.1	4.1	53	11.3	1.9		141	14.1	1.2	811	11.0	0.5	
Gender, Female	33	50.9	6.5	155	45.9	3.3	0.506	426	59.2	2.4	2,662	56.5	0.9	0.299
Marital Status [b]							0.369							<0.001
Married or Living with Partner	19	34.1	6.8	112	38.6	3.0		307	50.3	2.3	2,451	60.5	0.8	
Separated or Divorced	18	23.7	5.3	55	19.0	3.1		108	17.4	1.5	510	11.2	0.4	
Widowed	28	37.8	6.3	114	30.8	2.9		241	28.4	1.7	1,469	25.4	0.7	
Never Married	4	4.3	3.0	31	11.5	2.8		30	4.0	1.1	140	2.9	0.3	
Race and Ethnicity [c]							0.011							<0.001
White, non-Hispanic	30	61.2	6.5	194	78.3	2.1		425	75.6	2.3	3,309	84.4	0.8	
Black, non-Hispanic	27	21.3	4.2	95	12.8	1.2		179	10.8	1.1	895	7.1	0.4	
Other	11	17.6	5.9	22	8.9	1.6		78	13.6	2.2	334	8.5	0.6	
Education [d]							0.039							<0.001
Did Not Finish High School	32	42.5	6.9	89	24.3	2.4		247	30.5	2.3	1,013	17.3	0.9	
High School Degree or Equivalent	20	27.8	6.0	81	27.4	2.9		187	28.5	2.4	1,239	26.8	0.9	
Some College or Vocational Training	4	9.2	4.5	63	19.3	2.5		113	19.5	2.1	966	22.6	0.8	
College Degree	13	20.4	7.0	78	29.0	2.2		134	21.5	1.8	1,323	33.3	1.4	
Depression Screen Positive at Baseline, Yes [e]	22	32.2	6.5	45	11.7	1.8	<0.001	248	37.2	2.8	467	9.4	0.5	<0.001
Heart Attack at Baseline, Yes [f]	11	15.3	4.7	34	8.2	2.0	0.082	144	20.0	1.7	650	13.1	0.5	<0.001
Heart Attack at Follow-Up, Yes [g]	5	6.5	2.7	6	1.8	0.7	0.012	31	4.4	0.8	127	2.6	0.3	0.017
Stroke at Baseline, Yes [h]	11	16.2	4.3	36	9.7	2.0	0.085	123	16.7	1.4	421	7.8	0.5	<0.001

Sample Characteristics	0 Close Contacts						p value[a]	1–5 Close Contacts						p value[a]
	PHQ-2 Positive N=69			PHQ-2 Negative N=316				PHQ-2 Positive N=686			PHQ-2 Negative N=4,572			
	N	%	SE	N	%	SE		N	%	SE	N	%	SE	
Stroke at Follow-Up, Yes [i]	7	6.8	2.5	6	1.5	0.7	0.006	40	5.8	0.9	98	1.8	0.2	<0.001
Heart Attack and/or Stroke at Baseline, Yes [j]	17	23.9	5.8	62	16.5	2.4	0.127	223	30.4	1.9	944	18.7	0.6	<0.001
Heart Attack and/or Stroke at Follow-Up, Yes [k]	12	13.3	3.3	11	3.1	1.0	<0.001	64	9.2	1.1	210	4.1	0.3	<0.001
Medical Conditions at Baseline [l]							0.008							<0.001
0–25 Percentile	17	23.1	6.1	116	44.3	3.1		145	22.1	2.0	1,396	33.2	0.7	
25–50 Percentile	16	29.5	6.3	84	24.1	2.6		158	23.9	1.8	1,315	28.7	0.8	
50–75 Percentile	18	23.6	5.0	67	19.7	2.0		169	23.4	1.9	1,061	22.0	0.6	
75–100 Percentile	17	23.8	5.6	47	11.9	1.7		206	30.6	1.9	767	16.1	0.6	
ADL Impairments at Baseline, Yes [m]	30	47.8	7.0	79	21.4	2.6	<0.001	325	50.0	2.0	1,208	24.4	0.7	<0.001

Notes: SE: standard error

[a] p values determined by Rao-Scott F adjusted chi-square statistic.

There are missing data with the number of participants per social network grouping (without close and with close contacts, respectively) equaling:

[b] 381, 5256;

[c] 379, 5220;

[d] 380, 5222;

[e] 381, 5230;

[f] 385, 5254;

[g] 385, 5256;

[h] 385, 5252;

[i] 385, 5253;

[j] 385, 5250;

[k] 385, 5251;

[l] 382, 5217;

m368, 5025.

Table 2

Logistic regression analyses of the association of heart attacks and strokes with depressive symptoms at follow-up, stratified by the presence of a close social contact

	0 Close Contacts			1–5 Close Contacts		
	N	Odds Ratio	95% Confidence Interval [a]	N	Odds Ratio	95% Confidence Interval [a]
Unadjusted Analyses	385			5,256		
Heart Attack at Follow-Up, Yes		3.89	1.25–12.12		1.73	1.10–2.73
Stroke at Follow-Up, Yes		4.90	1.41–17.09		3.41[f]	2.38–4.89
Heart Attack and/or Stroke at Follow-Up, Yes		4.87	1.87–12.71		2.41[g]	1.76–3.28
Adjusted Analyses [b]	353			4,925		
Heart Attack at Follow-Up, Yes [c]		5.57	1.68–18.44		1.19	0.68–2.07
Stroke at Follow-Up, Yes [d]		4.44	1.03–19.14		2.51[h]	1.76–3.59
Heart Attack and/or Stroke at Follow-Up, Yes [e]		5.28	1.60–17.41		1.65[i]	1.13–2.40

[a] Intervals based on 95% Wald confidence limits.

[b] Analyses adjusted for baseline depression, age, gender, marital status, race and ethnicity, educational status, medical conditions, and ADL impairment. Also adjusted for history of:

[c] heart attacks,

[d] strokes, or

[e] heart attacks and strokes.

There are missing data with the number of participants equaling:

[f] 5253;

[g] 5251;

[h] 4922;

[i] 4917.