Stroke, Depression, and Functional Health Outcomes Among Adults in the Community

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The objective was to determine the association between stroke and depression, the co-occurrence of stroke and depression, and functional health outcomes among adults in the US population. Data were drawn from the Midlife Development in the United States Study (MIDUS) (N = 3032), a nationally representative sample of adults age 25 to 74. Multiple logistic regression analyses were used to determine the association between stroke (past 12-month prevalence), depression (past 12-month prevalence), and functional health outcomes (past 12 months) and to determine whether there is an interaction between depression and stroke in predicting impairment in functioning. Almost one third (29.2%) of adults with stroke in the past year also had depression in the past year (odds ratio 3.5, 95% confidence interval 1.4, 8.9). The co-occurrence of stroke and depression was associated with significantly greater limitations in walking and climbing stairs and poorer general physical functioning than that associated with either without the other. There was evidence of interaction between depression and stroke in predicting limitations, specifically with a statistically significant effect in walking short distances (*P* = .045). These findings are consistent with previous clinical data and extend those data by suggesting that the co-occurrence of depression and stroke is associated with even poorer functional health outcomes, compared with each alone, and that there may be synergism between the two disorders related to this effect.

Keywords: stroke; epidemiology; major depression; functioning

I n recent years, the results of several studies have suggested that stroke and depression co-occur more often than would be expected by chance.[1-8] Specifically, a number of studies have shown that mood symptoms are associated with increased morbidity and premature mortality in stroke patients.[9-12]

Previous results cumulatively suggest that there is an association between stroke and depression and that the impact of depression on impairment in functioning is significant and potentially long-lasting among persons who have experienced a stroke. Yet, a number of questions remain. Specifically, it is not clear whether, and to what degree, having both depression and stroke affects functional health outcomes (eg, physical and social functioning), compared with either without the other, among adults in the community. These data are important from a clinical and public health perspective in efforts to determine the health risks associated with stroke and depression as well as the potential burden of disease associated with untreated depression among those with stroke. Also, the majority of previous studies that have examined the association between stroke and depression have been conducted in clinical samples.[13-16] Therefore, it is also not clear whether depression is associated with stroke or with other characteristics associated with selection into

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treatment and whether these associations are generalizable to the population at large.

Against this background, the goal of the current study was to determine the association between stroke, depression, and functional health outcomes among adults in the general population, overcoming limitations of previous studies. First, the study investigated the association between stroke and depression. Second, the study examined the association between stroke and the likelihood of poor functional health outcomes. Third, the study investigated the relationship between the co-occurrence of stroke and depression and poor functional health outcomes. We hypothesized that the co-occurrence of stroke and depression would be associated with significantly poorer functional health outcomes compared with those with either disorder but not both.

Method

Sample

The Midlife Development in the United States Survey (MIDUS) is a nationally representative study of 3032 persons age 25 to 74 years in the noninstitutionalized civilian population of the 48 coterminous US states, carried out between January 1995 and January 1996.[17,18] The subjects were grouped by marital status (married, never married, divorced, widowed), and educational attainment was dichotomized into those who had and had not completed high school. All respondents completed a 30-minute telephone interview (70.0% response rate) and filled out 2 mailed questionnaires (86.8% conditional response rate in the subsample of telephone respondents). The overall response rate was 60.8%. The data reported here were weighted to adjust for differential probabilities of selection and nonresponse. More details on the MIDUS design, field procedures, and sampling weights are available elsewhere.[19]

Diagnostic Assessment

The MIDUS diagnoses were based on the Composite International Diagnostic Interview (CIDI) Short Form scales, a series of diagnostic-specific scales that were developed from item-level analyses of the CIDI questions in the National Comorbidity Survey.[20-22] Current (past 12-month) diagnoses of major depression, generalized anxiety disorder, alcohol/substance use disorders, and panic attacks were made with the CIDI Short Form.

Measure of Physical Health Problems

Respondents completed a chronic conditions checklist that asked whether they had experienced or been diagnosed in the past 12 months with a list of chronic health conditions, which included stroke.

Measure of Health-Related Outcomes

All respondents were asked a series of questions about their physical and social functioning. These included, "How often have you been limited in your ability to walk several blocks (in the past month)?" Questions included topics such as climbing stairs, lifting groceries, and walking distances. There were also items that inquired about effort into health maintenance and other indicators of poor health (eg, sleep problems).

Analytic Strategy

First, F-based tests for independence were used to determine the association between stroke and the likelihood of mental disorders and poor health outcomes. All tests were 2-sided and significance was set at .05. Second, multivariate logistic regression analyses were used to determine the association between stroke and mental disorders. The same method was used to determine the association between stroke and functional health outcomes. Unadjusted odds ratios (with 95% confidence intervals) and subsequently adjusted odds ratios, controlling for differences in sociodemographic characteristics, and other health risk factors were computed. Next, multivariate logistic regression analyses, with interaction terms, were used to determine the association between the co-occurrence of stroke and depression and poor health outcomes.

Results

Sociodemographic Characteristics Associated With Stroke

Stroke (past 12 months) was reported by 0.8% (n = 24) of the sample. Of those with stroke, 29.2% (7/24) had experienced depression within the past 12 months. Participants with stroke had significantly older mean age (57.9 [SD 12.3]) vs. 46.8 [SD 13.1]) (F_1 =16.9, $P < .0001$) compared with those without stroke. There were no significant differences in gender, race, education, or marital status between those with and without stroke.

Table 1.   Association Between Stroke and Mental Disorders Among Adults in the Community

	Unadjusted OR (95% CI)	Adjusted OR[a] (95% CI)	Adjusted OR[b] (95% CI)
Major depression (n = 7)	2.5[c] (1.05, 6.2)	3.5[c] (1.4, 8.9)	3.0[c] (1.1, 8.4)
Panic attacks (n = 2)	1.7 (0.5, 6.6)	2.3 (0.6, 9.0)	1.3 (0.3, 5.7)
Alcohol/substance use disorder (n = 4)	7.3[c] (2.4, 21.9)	10.3[c] (3.1, 34.0)	8.9[c] (2.7, 30.0)

NOTE: OR = odds ratio; CI = confidence interval.
[a] Adjusted for differences in gender, age, education, race, and marital status.
[b] Adjusted for differences in gender, age, education, race, marital status, and comorbid mental disorders.
[c] $P < .05$.

Table 2.   Association Between Stroke and Physical Limitations Among Adults in the Community

	No Stroke (n = 2589)	Stroke (n = 24)	P Value
Bathing and dressing oneself[a]	3.85 (.54)	3.22 (.99)	<.0001
Climbing stairs	3.44 (.93)	2.22 (1.4)	<.0001
Walking 1 block	3.78 (.65)	2.6 (1.3)	<.0001
Walking several blocks	3.6 (.83)	2.1 (1.4)	<.0001
Walking 1 mile	3.45 (.95)	2.1 (1.4)	<.0001

Values are mean (SD).
[a] Level of functional impairment reported on a Likert scale from 1 to 4 (no impairment to severe impairment).

Association Between Stroke and Mental Disorders (Past 12 Months) Among Adults in the Community

There was an association between stroke (past 12 months) and major depression and alcohol/substance use disorders (see Table 1). The relationship between stroke and panic attacks was not statistically significant. Given the relationship between age, and other potentially confounding characteristics, and stroke in the population, we adjusted for these and other demographic factors. After we adjusted for differences in age, gender, race, marital status, and education, stroke remained significantly associated with depression and alcohol/substance use disorders during the past 12 months.

Participants with stroke had higher levels of each type of limitation in physical health functioning, compared with those without stroke (see Table 2). Our results also show that depression and stroke were each independently associated with impairment in daily physical functioning, even after adjustment for each and for differences in sociodemographic characteristics and personality factors (see Table 3). There was evidence of an interaction between depression

and stroke in the likelihood of being unable to walk several blocks (P =.045) and an interaction of marginal statistical significance (P = .1) for walking 1 mile, bathing, and climbing the stairs.

Discussion

These data are consistent with and extend previous findings in several ways.[13-16,23] First, the data show that the association between stroke and depression is generalizable to the population, whereas previous investigations were limited to treatment-seeking samples.[13-16] Second, the data also show that the previously noted higher prevalence of alcohol/substance use disorders among stroke patients is generalizable to the community. Third, these data suggest that those who experience both stroke and depression have exponentially poorer functional health outcomes, with evidence of synergism between stroke and depression.

These data are consistent with and extend previous findings of an association between stroke, depression, and other mental disorders in clinical and community-based samples. The link between

Table 3.   Adjusted Association Between Mental Disorders and
Physical Limitations Among Adults in the Community

	Bathing and Dressing Oneself ($n = 10$)	Climbing Stairs ($n = 16$)	Walking 1 Block ($n = 14$)	Walking Several Blocks ($n = 14$)	Walking 1 Mile ($n = 17$)
Depression	−.047 (.021)	−.066 (.001)	−.084 (<.0001)	−.078 (<.0001)	−.085 (<.0001)
Stroke	−.082 (.0001)	−.072 (.001)	−.136 (<.0001)	−.104 (<.0001)	−.078 (<.0001)
Interaction term	−.036 (.12)	−.034 (.127)	−.027 (.2)	−.044 (.045)	−.035 (.1)
Gender	.008 (.7)	−.094 (<.0001)	−.059 (.003)	−.06 (.002)	−.071 (<.0001)
Age	−.051 (.011)	−.215 (<.0001)	−.139 (<.0001)	−.208 (<.0001)	−.253 (<.0001)
Marital status	.091 (<.0001)	.057 (.003)	.068 (<.0001)	.056 (.003)	.064 (.001)
Education	−.104 (<.0001)	−.096 (.006)	−.145 (<.0001)	−.143 (<.0001)	−.105 (<.0001)
Race	.043 (.026)	.082 (<.0001)	.069 (<.0001)	.054 (<.003)	.068 (<.0001)

Values are B (*P* value).

depression and stroke, which has been found in numerous previous clinical studies,[13-16,23] appears to be generalizable to the population, suggesting that this link does not only occur among the most severe cases and is not associated with the bias of selection into treatment. Similarly, the association between stroke and alcohol/substance use disorders is consistent with previous reports from clinical samples,[24] suggesting that this link is also unlikely to be attributable only to selection into treatment.

The strength of the association between stroke and alcohol/substance use disorders is noteworthy. The relationship between alcohol consumption and risk of stroke has been controversial. Some evidence suggests that alcohol consumption may protect against risk of stroke, whereas other data indicate that heavy alcohol consumption is a risk factor for stroke.[25-31] Alcohol/substance use disorders showed a stronger association with the likelihood of stroke than depression, and this association persisted after adjustment for depression. This link is consistent with previous clinical data, which show that alcoholism is a risk factor for stroke among young adult patients[26] and epidemiologic findings that heavy regular alcohol consumption is associated with increased risk of stroke.[27] There is some evidence to suggest that light to moderate alcohol consumption may have beneficial effects, but these data are not consistently replicated.[28] Although these data cannot confirm that the onset of depression followed stroke, and our results did not reach statistical significance possibly because of small cell size, the same pattern emerged in this national sample.

The mechanism of the association between the co-occurrence of stroke and depression and poor functional health outcomes is not known, although there are several possibilities. It may be that those who have a stroke and are depressed are slower to seek help for stroke. Longer time to treatment for stroke is associated with poorer prognosis and long-term physical outcomes.[25-29] Specifically, previous studies have found depression to be associated with delayed help-seeking among those with physical illnesses.[27] Therefore, one possibility is that depression is associated with delay to treatment for stroke, which then increases the likelihood of poor health outcomes among those with stroke (and depression). This is pure speculation, because we have no data on time to treatment in this sample. There are also theory and data to suggest that vascular depression in the elderly may be a subtype related to, and possibly a consequence of, stroke.[31] In addition, it may be that simply having 2 serious conditions, rather than 1, leads to more severe limitations, although the statistical interactions in these analyses suggest that the co-occurrence of the 2 has a greater impact and potential biological significance that exceed the individual effects of either. Alternatively, it is conceivable that a person with stroke is less able to function as a result of feeling depressed and that this effect is evident in these comparisons.

Limitations of this study are numerous, and the results should be interpreted accordingly. First, the participants of the study were age 74 and younger. Therefore, we do not have data on people who are at highest risk for stroke, which is a considerable shortcoming in restricting generalizability to those less than 74 years of age. Second, the small cell size of several comorbid groups substantially limits our ability to detect statistically significant differences. However, the base rates of mental disorders are consistent with previous population-based studies, so there is no reason to suspect that these results are biased in any way for the population they represent.

Still, these results need replication with larger data sets where larger cell sizes can give more stable results. Third, the only information we had on stroke is a single self-report item. There was no information on the type of stroke (ischemic or hemorrhagic). However, the association between stroke and depression has not differed between types of stroke in past studies, and self-report is the most common and well-accepted method of assessment in epidemiologic studies.[32] Still, there might be persons who have experienced stroke and did not know, or seek medical care, and therefore are missing from the cases in this data set. Also, we had no data from physical exams or brain imaging in the current data set. There were also no available data concerning at what time throughout the past 12 months the stroke or depression was diagnosed. This negation of specific time of occurrence for each disorder regrettably hindered the investigation between a causal link between depression and stroke, and therefore this study only suggests an association between the two. In addition, cognitive impairment has been shown to result from a stroke and also may be associated with depression. Therefore, cognitive impairment may be a confounder in this study. Fourth, we were only able to examine the prevalence of stroke and not incidence attributable to the cross-sectional nature of the data set. Fifth, the cross-sectional nature of the data did not allow us to gather any information in terms of the sequence of onset of stroke and depression or other mental disorders.

Future studies that use longitudinal, epidemiologic data to investigate the association between stroke, depression, and physical outcomes and daily functioning are needed to advance our understanding of the sequential and potentially causal associations between these problems. Although studies are needed to determine the direction and precise mechanism of these associations, both the possibility that depression increases risk of stroke and the likelihood that those with stroke will develop depression should be considered in the design of public health prevention and intervention strategies. This is especially true in light of recent evidence that recovery from stroke was significantly faster in treated,[33] compared with nontreated, depressed patients with stroke, highlighting the importance of psychiatric treatment for both problems. Poststroke fatigue, which is likely to be associated with this functional impairment, is often difficult to distinguish and may overlap with major depression,[34] highlighting the importance of providing treatment for both.[35]

References

1. Dhoudt T, Derksen P, Hooijer C, et al. Depressogenic medication as an aetiological factor in major depression: an analysis in a clinical population of depressed elderly people. *Int J Geriatr Psychiatry*. 1999;14:878-881.
2. Sato R, Bryan RN, Fried LP. Neuroanatomic and functional correlates of depressed mood: the Cardiovascular Health Study. *Am J Epidemiol*. 1999;150:919-929.
3. Carson AJ, MacHale S, Allen K, et al. Depression after stroke and lesion location: a systematic review. *Lancet*. 2000;356:122-126.
4. Goonick PJ, Hernandez M. Treatment of depression in comorbid medical illness. *Expert Opin Pharmacother*. 2000;1:1367-1384.
5. Berg A, Palomaki H, Lentihalmes H, Lonnqvist J, Kaste M. Poststroke depression in acute phase after stroke. *Cerebrovasc Dis*. 2001;1:14-20.
6. Alexopoulos GS, Kiosses DN, Klimstra S, Kalayam B, Bruce ML. Clinical presentation of the "depression-executive dysfunction syndrome" of late life. *Am J Geriatr Psychiatry*. 2002;10:98-106.
7. Hawkins BT, Brown RC, Davis TP. Smoking and ischaemic stroke: a role for nicotine? *Trends Pharmacol Sci*. 2002;23:78-82.
8. Hamalainen J, Kapico J, Isometsa E, et al. Cigarette smoking, alcohol intoxication, and major depressive episode in a representative population sample. *J Epidemiol Comm Health*. 2001;55:573-576.
9. Yamashita H, Fujikawa T, Yanai L, Morinobu S, Yamanaki S. Cognitive dysfunction in recovered depressed patients with silent cerebral infarction. *Neuropsychobiology*. 2002;45:12-18.
10. Ramasubbu S. Psychological models of post-stroke major depression. *Br J Psychiatry*. 2000;176:294-296.
11. Kauhanen ML, Korpelainen JT, Hiltunen P, et al. Aphasia, depression, and nonverbal cognitive impairment in ischaemic stroke. *Cerebrovasc Dis*. 2000;10:455-461.
12. House A, Knapp P, Bamford J, Vail A. Mortality at 12 and 24 months after stroke may be associated with depressive symptoms at 1 month. *Stroke*. 2001;32:696-701.
13. Dam H. Depression in stroke patients 7 years following stroke. *Acta Psychiatr Scand*. 2001;103:287-293.
14. Morris PL, Shields RB, Hopwood MJ, Robinson RG, Raphael B. Are there two depressive syndromes after stroke? *J Nerv Ment Dis*. 1994;182:230-234.
15. Vataja R, Pohjasvaara T, Leppavuori A, et al. Magnetic resonance imaging correlates of depression after ischemic stroke. *Arch Gen Psychol*. 2001;58:925-931.
16. Dundas R, Morgan M, Redfern J, Lemic-Stojcevic N, Wolfe C. Ethnic differences in behavioural risk factors for stroke: implications for health promotion. *Ethn Health*. 2001;6:95-103.
17. Brim OG, Baltes PB, Bumpass LL, et al. *National Survey of Midlife Development in the United States (MIDUS)*.

Ann Arbor, Mich: Inter-university Consortium for Political and Social Research; 1995-96.

18. Kessler RC, DuPont RL, Berglund P, Wittchen HU. Impairment in pure and comorbid generalized anxiety disorder and major depression at 12 months in two national surveys. *Am J Psychiatry*. 1999;156:1915-1923.

19. Kessler RC, Mickelson KD, Zhao S. Patterns and correlates of self-help group membership in the United States. *Soc Policy*. 1997;27:27-46.

20. Kessler RC, McGonagle KA, Zhao S, et al. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: results from the National Comorbidity Survey. *Arch Gen Psychiatry*. 1994;51:8-19.

21. Wittchen HU. Reliability and validity studies of the WHO Composite International Diagnostic Interview (CIDI): a critical review. *J Psychiatr Res*. 1994;28:57-84.

22. Kessler RC, Andrews G, Mroczek D, Ustun B, Wittchen H-U. The World Health Organization Composite International Diagnostic Interview Short Form (CIDI-SF). *Int J Methods Psychiatr Res*. 1998;7:171-185.

23. Astrom M. Generalized anxiety disorder in stroke patients: a 3-year longitudinal study. *Stroke*. 1996;27:270-275.

24. Zetola VH, Novak EM, Camargo CH, et al. Stroke in young adults: analysis of 164 patients. *Arq Neuropsiquiatr*. 2001;59:740-745.

25. Steffen DC, Payne MG, Greenberg DL, et al. Hippocampal volume and incident dementia in geriatric depression. *Am J Geriatr Psychiatry*. 2002;10:62-71.

26. Downhill JE Jr, Robinson RG. Longitudinal assessment of depression and cognitive impairment following stroke. *J Nerv Ment Dis*. 1994;182:425-431.

27. Kubota M, Yamaura A, Ono J. Prevalence of risk factors for aneurysmal subarachnoid haemorrhage: results of a Japanese multicentre case control study for stroke. *Br J Neurosurg*. 2001;15:474-478.

28. Mazzaglia G, Britton AR, Altmann DR, Chenet L. Exploring the relationship between alcohol consumption and non-fatal or fatal stroke: a systematic review. *Addiction*. 2001;96:1743-1756.

29. Ruitenberg A, van Swieten JC, Witteman JC, et al. Alcohol consumption and risk of dementia: the Rotterdam Study. *Lancet*. 2002;359:281-286.

30. Mazzaglia G, Britton AR, Altmann DR, Chenet L. Exploring the relationship between alcohol consumption and non-fatal or fatal stroke: a systematic review. *Addiction*. 2001;96:1743-1756.

31. Scheier MF, Matthews KA, Owens JF, et al. Optimism and rehospitalization after coronary artery bypass graft surgery. *Arch Intern Med*. 1999;26:829-835.

32. Clark MS, Smith DS. Psychological correlates of outcome following rehabilitation from stroke. *Clin Rehabil*. 1999;13:129-140.

33. Aben I, Verhey F, Honig A, Codder J, Lobisberg R, Maes M. Research into the specificity of depression after stroke: a review on an unresolved issue. *Prog Neuropsychopharmacol Biol Psychiatry*. 2001;25:671-689.

34. Staub F, Bogonsslavsky J. Fatigue after stroke: a major but neglected issue. *Cerebrovasc Dis*. 2001;12:75-81.

35. Gainotti G, Antonucci G, Marra C, Paolucci S. Relation between depression after stroke, antidepressant therapy, and functional recovery. *J Neurol Neurosurg Psychiatry*. 2001;71:258-261.