The Sunnybrook Stroke Study
A Prospective Study of Depressive Symptoms and Functional Outcome

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Background and Purpose—To assess the prevalence of depressive symptoms, their clinical correlates, and the effects of depressive symptoms on stroke recovery, a relatively unselected, well-diagnosed cohort of consecutive stroke survivors was followed prospectively.

Methods—Consecutive admissions to a regional stroke center who met World Health Organization and National Institute of Neurological Disorders and Stroke criteria for stroke were eligible. Subarachnoid hemorrhage and brain stem strokes were excluded. Patients underwent CT, single-photon emission CT, and standardized neurological and cognitive examinations at entry. At 3 months and 1 year after stroke, depressive symptoms were assessed with the Montgomery Asberg Depression Rating Scale (MADRS) and the Zung Self-Rating Depression Scale (SDS). Functional outcome was measured with the Functional Independence Measure, and handicap was assessed by the Oxford Handicap Scale.

Results—We assessed 436 patients at entry (mean±SD age, 74.9±11.6 years). There were 150 patients available for assessment at 3 months and 136 at 1 year. Marked depressive symptoms were noted in 22% (SDS) to 27% (MADRS) at 3 months and 21% (SDS) to 22% (MADRS) at 1 year. Patents with marked depressive symptoms had more neurological impairment (P=.008), were more likely to be female (P<.05), and were more likely to have previous histories of depression (P<.03). There was no relationship between depressive symptoms and age, lesion volume, or side of lesion. Depressive symptoms were correlated with functional outcome (r=.31, P<.0001) and handicap (r=.41, P<.0001) at 3 months and 1 year (r=.28, P<.001; r=.35, P<.0001).

Conclusions—Depressive symptoms and functional outcome are correlated. In view of the prevalence of depressive symptoms in this population, diagnosis and treatment of depression are important in optimizing recovery. (Stroke. 1998;29:618-624.)

Key Words: depression ■ outcome

The co-occurrence of depressive symptoms and physical illness is one of the hallmarks of affective disorders in late life.1 The exact nature of this relationship, however, is still unclear. Neurological diseases are among the physical illnesses best studied with respect to their relationship with depression. Because the neuroanatomic and physiological features of these disorders are well documented, their study has heuristic value and may shed light on the etiology of depression in the absence of these conditions. It is therefore not surprising that the relationship between depression and cerebrovascular disease has received considerable attention in view of the discrete nature of the lesions and epidemiology of stroke. While stroke remains the third most common cause of death with annual incidence rates of 5 to 8 per 1000, there has been a gradual, continuous decline in mortality.2 This has resulted in increasing numbers of survivors left with physical and mental impairments as well as disabilities in activities of daily living.3

Despite 20 years of intensive research, there is still significant controversy about the relationship between cerebrovascular accidents and depression. Questions regarding the true prevalence and severity of poststroke depressive symptoms, the relationship with clinical correlates such as lesion laterality, and their effect on outcome await more definitive answers. For example, the prevalence of poststroke depression has varied from 18% to 61%.4 Some studies have suggested that depressive symptoms largely remit over time,5 while others have suggested a remarkably chronic course.6 A recent review of 25 studies that examined the relationship between depression and lesion laterality noted 14 studies that showed no differences between right- and left-sided lesions, 8 studies that showed that depression was more common with left-sided lesions, and 3 studies that demonstrated that depression was more common with right-sided lesions.7

Numerous methodological problems in poststroke depression research have been suggested to account for the differences in these findings. These include the definition and classification of stroke,8 the phenomenology and nosology of depressive symptoms,9 the validity of the rating methodology...
Selected Abbreviations and Acronyms

- FIM = Functional Independence Measure
- HMPAO = hexamethylpropyleneamine oxime
- HSS = Hemispheric Stroke Scale
- MADRS = Montgomery Asberg Depression Rating Scale
- MMSE = Mini-Mental State Examination
- OHS = Oxford Handicap Scale
- SDS = Zung Self-Rating Depression Scale
- SPECT = single-photon emission computed tomography

Employed, and differences in the selected cohorts (acute inpatients versus admitted rehabilitation samples versus community samples). In an attempt to address some of these concerns, the present study was designed to prospectively follow a large, relatively unselected sample of carefully diagnosed acute stroke patients and determine the frequency, severity, and course of depressive symptoms, their clinical correlates, and their effects on functional outcome.

Subjects and Methods

Site and Subjects

The site of the Sunnybrook Stroke Study was a university-affiliated health science center located in a largely middle-class, residential neighborhood in northern Toronto with a regional catchment area population of approximately 250,000. The 500-bed, acute care portion of the hospital serves as a regional stroke center. All consecutive stroke admissions between August 1990 and May 1993 were eligible for inclusion. During this time, it was the standard practice for all patients with a diagnosis of stroke to be admitted for investigation and treatment. Emergency records were also reviewed during this time to ensure that all possible subjects were available for inclusion. The diagnosis of stroke was made clinically according to World Health Organization MONICA Project and National Institute of Neurological Disorders and Stroke criteria.

For the purposes of this study, patients with a diagnosis of subarachnoid hemorrhage and vertebrobasilar strokes were excluded. Subarachnoid hemorrhage is managed differently, has a different prognosis, and is often excluded from medical studies of stroke. Similarly, vertebrobasilar strokes have different mortality rates and prognosis compared with hemispheric stroke. The methodology of limiting study to hemorrhagic cerebral infarctions is similar to other studies. Patients with aphasia were not excluded; assessments were always attempted unless patients were globally aphasic or had severe comprehension deficits. Written informed consent was obtained from all subjects or their substitute consent-givers after a detailed description of the study.

Measures

After admission, data on demographics, other medical illness, past psychiatric and medical history, and medications were collected with a standardized questionnaire. As part of the standard clinical stroke protocol, patients received a CT scan and an HMPAO-SPECT scan as well as carotid Doppler and cardiac investigations when indicated. A standardized neuropsychological battery that included an MMSE was also performed as part of the clinical routine. A multidisciplinary stroke care team was involved as part of the care protocol, including occupational therapy, physiotherapy, and speech therapy. All patients were assessed by a rehabilitation medicine specialist and offered rehabilitation services as appropriate.

At 3 months and 12 months after stroke, the following assessment battery was administered:

Neurological Assessment

Neurological status was assessed by a stroke neurologist (S.E.B.) using the standardized HSS of Adams et al. The scale measures impairment in consciousness, vision, language, and motor and sensory function.

The scale ranges from 0 (no impairment) to 100 (severely impaired in all domains).

Depressive Symptom Assessment

Depressive symptoms were assessed with subjective and objective measures. The objective, observer-rated MADRS is a 20-item scale that measures the severity of depressive symptoms. While the scale has been shown to correlate well with the Hamilton Depression Rating Scale, its lack of emphasis on physical symptoms has led some investigators to suggest that it is a more valid measure of depression in elderly patients compared with the Hamilton Depression Rating Scale. Cutoff scores for the MADRS were as follows: 0 to 6 (normal), 7 to 19 (mild), 20 to 34 (moderate), and >34 (severe). The SDS is a 20-item, self-reported index of the frequency of experienced depressive symptoms. This scale has recently been shown to have a sensitivity of 97% and specificity of 63% for depressive disorder in a general medical clinic according to the Diagnostic and Statistical Manual of Mental Disorders, edition 5. Cutoff scores for the SDS were as follows: <50 (normal), 50 to 59 (mild), 60 to 69 (moderate), and >69 (severe). All depression scales were administered by a research nurse trained by a psychiatrist specialized in the assessment and management of poststroke mood disorders.

Functional Outcome

Functional outcome was measured with the FIM and the OHS. The FIM is an 18-item scale measuring levels of dependence and is scored from 18 (total assistance in all areas) to 126 (complete independence in all areas). Subscales assess function in self-care, sphincter control, mobility, locomotion, communication, and social cognition. Compared with the more commonly used Barthel Index, it is found to be more sensitive and also includes measures of communication and cognition, important components of poststroke functioning.

The OHS, also known as the modified Rankin Disability Scale, is an observer-rated, global measure of handicap assessing any limitation in the patient’s social role. It is rated from 0 (no symptoms) to 5 (severely handicapped, totally dependent, requiring constant attention day and night) and has been shown to have good interrater reliability.

Lesion Localization

Lesion localization from CT was determined for each patient and will be the subject of a future analysis. Lesion volume estimates were obtained by tracing the CT lesion on each slice in which it appeared with digitizing software, multiplying each area by the 1-cm slice thickness, and summing the volume of each slice.

During the follow-up period, patient and family were questioned, and medical records were examined to document any psychiatric contact or the prescription of psychotropic medication. Any patients suspected by the stroke care team to be clinically depressed were assessed and, if necessary, were treated by a geriatric psychiatrist (N.H.).

Data Analysis

Descriptive statistics were used to summarize data. Between-group comparisons were made with the Student’s t test or ANOVA for continuous variables and χ2 test of independence for dichotomous variables. Multiple regression was used to test the strength of the association between depression and psychiatric risk factors. Tests were two-tailed, with results considered significant at P < .05. Univariate correlations were assessed with the Pearson correlation coefficient adjusted for multiple correlations with a Bonferroni correction.

Results

Between August 1990 and May 1993, there were 436 patients with 450 hemispheric strokes that met inclusion criteria for this study. Mean ± SD age of this group was 74.9 ± 11.6 years (median age, 77 years). Fifty-one percent were men, 93% were white, and 51% were married. Only 4% of the sample resided in a long-term care facility before admission. We found that
stroke or depression, and lesion volume. Patients without completed measures were more likely to be female ($P<.03$), older ($P<.001$), and have higher HSS scores ($P<.001$).

### Depressive Symptoms

The prevalence of symptoms of depression is shown in the Figure. When standardized cutoff scores were used at 3 months, 27% of patients were rated as having marked depressive symptoms on the MADRS (scores $\geq 7$) and 22% on the SDS (scores $\geq 50$). At 1 year, 22% of patients were rated as depressed on the MADRS and 21% on the SDS. Only a small number of patients at either 3 months or 1 year scored in the moderate or severe ranges of either rating scale. Of the 120 patients scoring in the nondepressed range, 12 (10%) were taking antidepressants at the 3-month assessment. Similarly, 13 of 133 patients (10%) scoring in the nondepressed range were taking antidepressants at the 1-year assessment. In contrast, 19% and 24% of patients scoring in the depressed ranges at 3 months and 1 year, respectively, were on antidepressants. When we examined the changes in marked depressive symptoms over time, 30% of those with marked symptoms at 3 months remitted by 1 year, 45% were markedly symptomatic at both assessments, and 25% developed symptoms only after the 3-month assessment. There were no cases of mania detected in the sample.

There were no differences in age, marital status, or lesion volume between subjects with depressive symptoms and those without. In contrast, depressed patients had higher HSS scores ($t(32)=-2.85$, $P<.008$), were more likely to be female [$X^2(1)=3.84$, $P<.05$], and were more likely to have histories of previous depressive episodes [$X^2(1)=4.97$, $P<.03$]. There were no significant differences between patients with left-sided versus right-sided lesions on either the 3-month or 12-month depression scales, although there was a trend for higher depression scores on the SDS after a right-sided lesion compared with left-sided lesion [$t(144)=1.87$, $P<.06$]. ANOVAs on each depression scale at 3 months and 1 year revealed no significant effects of sex, side of lesion, or history of depression.

A stepwise multiple regression with the 3-month MADRS as the dependent measure and age, sex, side of lesion, MMSE, lesion volume, and history of depression as potential predictors produced a significant model [$F(1,116)=5.79$, $P<.02$], although this could only account for 5% of the variance. The

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**TABLE 1. Description of Subjects (n=436)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Median (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>74.9±11.6</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Primary school</td>
<td>50 (11.5%)</td>
</tr>
<tr>
<td>High school</td>
<td>168 (38.5%)</td>
</tr>
<tr>
<td>College</td>
<td>38 (8.7%)</td>
</tr>
<tr>
<td>University</td>
<td>65 (14.9%)</td>
</tr>
<tr>
<td>Residence</td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>392 (89.9%)</td>
</tr>
<tr>
<td>Retirement home</td>
<td>19 (4.4%)</td>
</tr>
<tr>
<td>Nursing home</td>
<td>12 (2.8%)</td>
</tr>
<tr>
<td>Living alone</td>
<td>122 (31.1%)</td>
</tr>
<tr>
<td>Type of stroke*</td>
<td></td>
</tr>
<tr>
<td>Hemispheric infarct</td>
<td>388 (86.2%)</td>
</tr>
<tr>
<td>Hemispheric hemorrhage</td>
<td>62 (13.8%)</td>
</tr>
<tr>
<td>Side of stroke*</td>
<td></td>
</tr>
<tr>
<td>Left hemisphere</td>
<td>219 (48.7%)</td>
</tr>
<tr>
<td>Right hemisphere</td>
<td>221 (49.1%)</td>
</tr>
<tr>
<td>Bilateral</td>
<td>10 (2.2%)</td>
</tr>
<tr>
<td>Lesion volume, cm$^3$</td>
<td>44.48±62.89</td>
</tr>
</tbody>
</table>

*Number of strokes=450.

38.5% had a high school education and 23.6% had attended college or university. There were 388 infarcts (86.2%) and 62 hemorrhages (13.8%). Lesion location was left-sided in 219 (48.7%), right-sided in 221 (49.1%), and bilateral in 10 (2.2%) (Table 1). Of the initial sample meeting inclusion criteria on entry, 109 patients had died before the 3-month assessment of stroke or its medical complications, and 140 had died before the 1-year assessment. Assessments were completed in 150 patients (46% of survivors) at 3 months and 133 (45% of survivors) at 1 year. The reasons for missing data at 3 months and 1 year (noted as percentage of survivors) included the following: patients too ill/disabled (14%, 15%), patients too cognitively impaired (8%, 7%), patients too aphasic (6%, 5%), patients refused (12%, 14%), and other (eg, moved away) (13%, 12%). The percentage of overlap between patients assessed at 3 months and 1 year was 80% for both depression rating scales. There were no suicides documented in the sample. There was no significant difference between those patients with completed measures and those without with respect to marital status, history of depression scores on the SDS after a right-sided lesion compared with left-sided lesion [$t(144)=1.87$, $P<.06$]. ANOVAs on each depression scale at 3 months and 1 year revealed no significant effects of sex, side of lesion, or history of depression. A stepwise multiple regression with the 3-month MADRS as the dependent measure and age, sex, side of lesion, MMSE, lesion volume, and history of depression as potential predictors produced a significant model [$F(1,116)=5.79$, $P<.02$], although this could only account for 5% of the variance. The
only variable that contributed significantly to the model was a history of depression. A stepwise multiple regression with the 3-month SDS as the dependent measure and age, sex, side, MMSE, lesion volume, and history of depression as potential predictors produced a significant model \([F(3,112) = 5.06, P < .005]\), which accounted for 11% of the variance. In addition to history of depression, age and lesion volume also contributed significantly to the model. Similar models with 1-year depression scores were not significant.

### Relationship Between Depressive Symptoms and Functional Outcome

Correlations between depression rating scale scores and outcome measured by the FIM and the OHS are shown in Table 2. For comparison, correlation scores of the HSS were calculated as well. In an attempt to determine whether depressive symptoms at 3 months predicted functional outcome at 1 year, the scores on the SDS and MADRS at 3 months were correlated with 1-year scores on the FIM and OHS. As noted in Table 2, most of these correlations were significant even after adjustment for multiple correlations.

A series of multiple regression analyses were performed to determine the predictors of depression. When we used 3-month scores on the MADRS as the dependent measure and 3-month HSS, MMSE, lesion volume, and 3-month OHS as the predictors, the model was significant \([F(4,92) = 5.06, P < .005]\), with 3-month OHS and 3-month HSS being the significant predictors. When we used 1-year scores on the MADRS as the dependent measure and 3-month MADRS, 1-year HSS, MMSE, lesion volume, and 1-year OHS as the predictors, the model was significant \([F(5,69) = 5.70, P < .0001; R^2 = .39]\), with 3-month MADRS, 1-year OHS, and 1-year HSS as the significant predictors. FIM scores could not be included in this analysis because of a high degree of collinearity. Two repeated-measures ANOVAs comparing patients with marked depressive symptoms and those without on the OHS at 3 months and 1 year revealed significant main effects of depression \([F(1,141) = 8.55, P < .004]\) with the MADRS and \([F(1,140) = 19.54, P < .0001]\) with the SDS but no effects of time or a group \(\times\) time interaction with either the MADRS or SDS. Similar repeated-measures ANOVAs on the FIM revealed a significant main effect of depression as measured by the SDS \([F(1,133) = 17.92, P < .0001]\) but no effect of depression as measured by the MADRS \([F(1,134) = 1.0, P > .05]\). There were no effects of time or group \(\times\) time interaction.

The correlations between depression scale scores and the FIM subscales are shown in Table 3. While most of the subscales (except sphincter control and communication) were significantly correlated with both depression scales at 3 months, the social cognition subscale had the highest correlation coefficients. At 1 year there were almost no significant correlations, although social cognition remained significantly correlated with the MADRS \((r = -.34, P < .0001)\), and there was a trend with the SDS \((r = -.25, P < .003)\).

### Discussion

The major findings of the Sunnybrook Stroke Study relate to the frequency of depressive symptoms after hemispheric stroke, their correlation with some but not all of the previous predictors of poststroke depression, and the significant relationship between depressive symptoms and functional outcome. The major strength of this study was the ability to follow one of the largest groups to date of poststroke patients over the course of a year. The nature of the inception cohort (consecutive admissions to a regional stroke center) places the sample in the middle of a continuum of those studies that have focused on rehabilitation units or inpatient medical wards and those studies of community samples. Samples from rehabilitation units tend to be preselected for positive rehabilitation potential, while the published studies from medical inpatient wards, largely American, have tended to be much younger and may have been influenced by regional practice patterns in terms of criteria for admission. These studies may include patients with more severe and persistent disabilities. For example, in the influential follow-up studies of Robinson et al., the average ages of the samples were between 56 and 63, with a large percentage of black subjects (60% to 70%) of low socioeconomic status. Conversely, the community sampling

### Table 2. Product-Moment Correlations Between Depression Rating Scale Scores and Outcome

<table>
<thead>
<tr>
<th></th>
<th>3-mo SDS</th>
<th>1-y SDS</th>
<th>3-mo MADRS</th>
<th>1-y MADRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-mo FIM</td>
<td>-31</td>
<td>-35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-y FIM</td>
<td>-.28</td>
<td>-.26</td>
<td>-.21</td>
<td>-.27</td>
</tr>
<tr>
<td>3-mo OHS</td>
<td>41</td>
<td>.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-y OHS</td>
<td>.35</td>
<td>.36</td>
<td>.29</td>
<td>.29</td>
</tr>
<tr>
<td>3-mo HSS</td>
<td>.28</td>
<td>.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-y HSS</td>
<td>.28</td>
<td>.19</td>
<td>.21</td>
<td>.06</td>
</tr>
</tbody>
</table>

*Significant at Bonferroni-adjusted \(P < .003\).

### Table 3. Product-Moment Correlations Between Depression Rating Scale Scores and FIM Subscales

<table>
<thead>
<tr>
<th></th>
<th>3-mo SDS</th>
<th>1-y SDS</th>
<th>3-mo MADRS</th>
<th>1-y MADRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotion</td>
<td>-35</td>
<td>-26</td>
<td>-37</td>
<td>-17</td>
</tr>
<tr>
<td>Mobility</td>
<td>-.27</td>
<td>-.22</td>
<td>-.26</td>
<td>-.19</td>
</tr>
<tr>
<td>Self-care</td>
<td>-.27</td>
<td>-.14</td>
<td>-.30</td>
<td>-.19</td>
</tr>
<tr>
<td>Sphincter control</td>
<td>-.16</td>
<td>-.12</td>
<td>-.22</td>
<td>-.17</td>
</tr>
<tr>
<td>Social cognition</td>
<td>-.38</td>
<td>-.25</td>
<td>-.43</td>
<td>-.34</td>
</tr>
<tr>
<td>Communication</td>
<td>-.05</td>
<td>-.17</td>
<td>-.12</td>
<td>-.29</td>
</tr>
</tbody>
</table>

*Significant at Bonferroni-adjusted \(P < .002\).
methods\textsuperscript{5,31} may include patients with extremely mild deficits and/or no disabilities. The present study’s sample, however, more closely reflects the age and sex distribution of stroke found in community samples\textsuperscript{31,32} and is representative of other stroke registries.

Another strength of the present study is the use of well-recognized, valid, and reliable measures of depression and outcome. The subjective, self-rated SDS and objective, observer-rated MADRS have been examined previously in poststroke populations and have demonstrated acceptable sensitivity, specificity, and predictive value.\textsuperscript{31} A potential weakness of the present study is the lack of a structured diagnostic interview for depression. There has been significant interest in classification of poststroke depressive syndromes into “major” and “minor” subtypes. According to studies by Robinson et al.\textsuperscript{34,35} it is only the patients with major depression who demonstrated characteristic localization findings and abnormal dexamethasone suppression test results. The validity of this classification, however, has been challenged by others who have argued that diagnosable depression is mainly a function of symptom severity and frequency rather than a qualitative difference in symptom characteristics.\textsuperscript{3} While studies have suggested that certain rating scales may overestimate the rates of depressive disorders,\textsuperscript{36} we chose to measure the severity of depressive symptoms with reliable, valid, and easily administered rating scales. From a clinical standpoint, these results may be more meaningful since stroke services would be able to screen their patients with similar rating scales, but it might not be feasible to provide a diagnostic psychiatric assessment for every patient. The rates of marked depressive symptoms in the present study (21% to 27%) are almost identical to the frequency of depressive disorders in a recent community study in Perth, Australia (23%).\textsuperscript{31} These rates are slightly lower than those quoted by two other community samples by House et al\textsuperscript{37} (32%) and Wade et al\textsuperscript{38} (32%) and much lower than rates from inpatient or rehabilitation units (e.g., Robinson et al\textsuperscript{39} [47%] and Sinyor et al\textsuperscript{40} [49%]). While the nature of the different samples and the instruments used to detect/assess depression likely account for some of the variation in the studies, another potential confounder is the time (after stroke) of the assessment, since some studies have noted a decline in the incidence and prevalence of depressive symptoms over time.\textsuperscript{5,14} The prevalence of depressive symptoms in the present study may also be an understimation for two additional reasons. At both 3 months and 12 months, approximately 10% of the sample of patients scoring in the nondepressed ranges were being treated with antidepressants, many of whom might have otherwise scored higher on the rating scales. Furthermore, it is also possible that a number of patients who refused to be assessed (12% to 14% of total survivors) may have been depressed and/or refused assessment because of significant depressive symptoms. Support for this possibility can be demonstrated in the fact that this group of patients with missing data was more likely to be female and to have higher scores on the HSS characteristics noted to be correlated with depressive symptoms in the rest of the sample.

The majority of patients with depressive symptoms scored in the mild range of symptom severity on both rating scales. A similar pattern of generally mild depressive symptom severity has been noted in other studies.\textsuperscript{5,31} With respect to the course of depressive symptoms, the prevalence declined only slightly from 3 months to 12 months in the group as a whole, with 30% of those with significant symptoms remitting over time. While differences between studies may be the result of cohort differences and methodological variations, these results appear intermediate between those of Robinson et al.,\textsuperscript{39} who noted that most depression was chronic, and House et al.,\textsuperscript{38} who found little diagnosable depression persisting by 1 year. Our results are similar to other community samples which demonstrated that approximately 33% of patients recover\textsuperscript{37} and approximately 40% have persistent symptoms.\textsuperscript{31}

Significant correlates of depression in the present study were female sex, HSS score, and history of depression, although only the latter was a significant predictor of depression as measured by both the MADRS and SDS when examined with multiple regression. The importance of previous psychiatric history has been noted by other investigators.\textsuperscript{31,41–46} The lack of a relationship between significant depressive symptoms and lesion laterality is not consistent with the studies of Robinson et al.,\textsuperscript{14} although this group has often noted that the relationship with laterality is only evident in patients with diagnosed major depressive disorder and may be specific to left frontal lesions. As mentioned previously, however, most studies of depression in stroke patients have found no differences in prevalence of depression between right- and left-hemisphere lesions, regardless of the nature of the sample or the assessment measures utilized.\textsuperscript{7} Taken together, these results suggest that depression after stroke may not be significantly different from any other depressive illness in late life with respect to risk factors.\textsuperscript{1} This lack of specific predictors for poststroke depression has been used as the rationale for the need to screen all stroke patients for depression.\textsuperscript{42}

The most impressive finding in the present study relates to the significant correlation between depressive symptoms and measures of activities of daily living and social handicap. These results are all the more significant when the mild nature of the depressive symptoms mentioned earlier is considered. While the results do not allow for speculation on the direction of causation, 3-month depression scores were significantly correlated with functional outcome at 1 year, suggesting a risk factor for poor prognosis after stroke. Several other prospective studies have examined the relationship between depression and functional outcome, although all these studies used extremely small sample sizes.\textsuperscript{40,45–48} While the present study confirms the negative correlation between depression and functional outcome, several studies have also documented group differences in changes over time that were not replicated in this study. For example, Parikh et al\textsuperscript{40} demonstrated that patients with either major or minor depression improved over 2 years, although at a slower rate and with poorer final scores than nondepressed patients. Conversely, Loong et al\textsuperscript{46} in a small sample of rehabilitation unit patients found equal rates and degrees of improvement in activities of daily living in depressed and nondepressed patients, although initial and final functional status were significantly negatively impacted by depression. These assessments were conducted approximately 3 weeks after stroke for baseline and 7 weeks after stroke for follow-up. While sample differences might once again account for the discrepancies, the sampling times of the present study (3
months and 12 months) may represent a period whereby little change in functional status actually occurs, thus masking a time effect.

This study has highlighted the prevalence of significant depressive symptoms after stroke and their negative impact on functional recovery despite their relatively mild nature. These results should not be surprising, especially in view of the findings of the Medical Outcomes Study, which demonstrated that patients with depressive symptoms, even in the absence of a depressive disorder, had poor functioning, ie, functioning that was worse than or comparable to that of patients with major chronic medical conditions. 49 The present study emphasizes the need for all practitioners who manage stroke patients to screen for depressive symptoms in view of their relationship with prognosis. Double-blind controlled trials have documented the efficacy of tricyclic antidepressants, 50 trazodone, 51 and selective serotonin reuptake inhibitors 52,53 in treating post-stroke depression. What is still unclear is whether improvements in depressive symptoms will also improve functional status, or whether this will require further individualized rehabilitation therapies. Additional studies of poststroke outcome should attempt to address this issue.

Acknowledgments

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