Depression occurs in one third of patients with stroke and is associated with increased mortality, poorer functional outcome, and increased caregiver distress. Stroke management guidelines recommend routine screening for depression. Because guidelines also recommend screening for other forms of psychological distress such as anxiety, a general distress measure may be useful provided depressive disorders are detected. Many depression and distress screening tools commonly used in medical settings have not been well validated in stroke populations.

The Patient Health Questionnaire-9 (PHQ-9), Hospital Anxiety and Depression Scale (HADS), Beck Depression Inventory II (BDI-II), Distress Thermometer (DT) and Kessler-10 (K-10) are depression or distress measures commonly used in primary and/or specialist care settings. The PHQ-9 has been recommended for use in stroke due to its brevity and strong psychometric properties. Along with the 2-item PHQ-2, it has been evaluated in patients with nonphasic stroke with promising results. Similarly, the HADS depression (HADS-D) and anxiety (HADS-A) subscales and total score (HADS-Total) have been validated for use with patients with stroke without communication problems. Several other depression measures commonly used in stroke practice (eg, Geriatric Depression Scale) also have evidence supporting their use.

Evidence for diagnostic accuracy of the BDI-II, DT, and K-10 is lacking in stroke populations. Diagnostic accuracy of the original BDI has been evaluated, but not the

**Background and Purpose**—Screening tools for depression and psychological distress commonly used in medical settings have not been well validated in stroke populations. We aimed to determine the accuracy of common screening tools for depression or distress in detecting caseness for a major depressive episode compared with a clinician-administered structured clinical interview for Diagnostic and Statistical Manual of Mental Disorders Fourth Edition as the gold standard.

**Methods**—Seventy-two participants underwent a diagnostic interview for major depressive episode and completed the Patient Health Questionnaire-2 and -9, Hospital Anxiety and Depression Scale, Beck Depression Inventory-II, Distress Thermometer, and Kessler-10. Internal consistency, sensitivity, specificity, likelihood ratios, and posttest probabilities were calculated. Each measure was validated against the gold standard using receiver operating characteristic curves with comparison of the area under the curve for all measures.

**Results**—Internal consistency ranged from acceptable to excellent for all measures (Cronbach α=0.78–0.94). Areas under the curve (95% CI) for the Patient Health Questionnaire-2, Patient Health Questionnaire-9, Hospital Anxiety and Depression Scale depression and total score, Beck Depression Inventory-II, and Kessler-10 ranged from 0.80 (0.69–0.89) for the Kessler-10 to 0.89 (0.79–0.95) for the Beck Depression Inventory-II with no significant differences between measures. The Distress Thermometer had an area under the curve (95% CI) of 0.73 (0.61–0.83), significantly smaller than the Beck Depression Inventory-II (P<0.05).

**Conclusions**—Apart from the Distress Thermometer, selected scales performed adequately in a stroke population with no significant difference between measures. The Patient Health Questionnaire-2 would be the most useful single screen given free availability and the shortest number of items. (Stroke. 2012;43:1000-1005.)

**Key Words:** assessment of depression ■ depression ■ distress ■ sensitivity/specificity ■ stroke

Depression occurs in one third of patients with stroke and is associated with increased mortality, poorer functional outcome, and increased caregiver distress. Stroke management guidelines recommend routine screening for depression. Because guidelines also recommend screening for other forms of psychological distress such as anxiety, a general distress measure may be useful provided depressive disorders are detected. Many depression and distress screening tools commonly used in medical settings have not been well validated in stroke populations.

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Evidence for diagnostic accuracy of the BDI-II, DT, and K-10 is lacking in stroke populations. Diagnostic accuracy of the original BDI has been evaluated, but not the
BDI-II, although a factor analytic study in a neurorehabilitation population indicated the measure provides a meaningful severity score of depression in patients with stroke. The DT, a single-item distress measure commonly used in oncology, is being used in a UK-based stroke service enhancement project. The K-10, a distress screening scale used in several population-based surveys, is being used by Australian general practitioners within a national government rebated mental healthcare plan.

Validation studies of the PHQ-9, PHQ-2, and HADS have several methodological limitations. Recruitment has occurred between 2 weeks and 6 months poststroke, whereas stroke guidelines recommend depression screening beyond the 6-month period. Furthermore, in the PHQ-9 validation study, a clinician interview was only administered to patients endorsing symptoms of depression on the PHQ-9, and the study population was limited to patients 1 to 2 months after ischemic stroke with minimal aphasia or cognitive impairment. These findings therefore need to be replicated, preferably with a more heterogeneous group of patients with stroke. Stroke clinicians might manage patients for many years postevent and screening measures should be validated across all time points in the recovery pathway.

The aim of the present study was to examine performance of these commonly used depression-specific or distress measures with regard to internal consistency, concurrent validity, and diagnostic accuracy in detecting a major depressive episode (MDE) compared with a clinician-administered structured diagnostic interview for the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition as the gold standard. A heterogeneous sample of patients with stroke representing those seen in postacute inpatient and outpatient stroke services was examined.

Methods

Eligible participants had a confirmed stroke ≥3 weeks prior, were aged ≥18 years, and able to attend a local health site for assessment in the Hunter region of New South Wales, Australia. Exclusion criteria included inability to read or understand English or severe cognitive or physical impairment precluding participation. Patients with expressive dysphasia or dysarthria with adequate receptive and expressive communication strategies were included. Ethics approval was gained from the Hunter New England Human Research Ethics Committee (No. 08/0820/5.02).

Outpatients were recruited through the Community Stroke Team, Hunter Medical Research Institute Research Register, stroke clubs, and hospital discharge lists. Consecutive rehabilitation unit inpatients were also approached. Consenting participants were interviewed using the Structured Diagnostic Interview for the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition MDE module by a trained clinical psychologist at the hospital or health site. Participants self-completed the HADS and BDI-II using pencil and paper and PHQ-9, DT, and K-10 by computer touchscreen. Outpatients completed their assessments during 1 appointment; inpatients had the option of having a break if fatigued.

Measures

The Structured Diagnostic Interview for the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition MDE module was used as the gold standard (criterion standard). A depression case was defined as a positive score on the Structured Diagnostic Interview for the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition diagnosis of MDE. Selected questionnaires were administered for the depression-specific (“Depression”: PHQ-2, PHQ-9, HADS-D, BDI-II) and multifactorial/general distress (“Distress”: DT, K-10, and HADS-Total) measures of symptom burden.

The 9-item PHQ-9 is based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition diagnostic symptoms of MDE. Responses are rated 0 to 3 in reference to the past fortnight (total score range 0–27) with higher scores indicating greater severity. The PHQ-2 is the sum of the first 2 items (range 0–6). Previously recommended cutoffs for the PHQ-9 and PHQ-2 are ≥9 and >2, respectively. The PHQ-9 also provides a preliminary diagnosis of “major depressive syndrome” using a scoring algorithm (∓5 items, including Items 1 and/or 2, are rated ≥2 unless suicidality item endorsed, which can be rated ≥1).

The 14-item HADS consists of 2 7-item subscales assessing depression and anxiety. The HADS was developed for medical settings and omits somatic symptoms of depression. Responses are rated 0 to 3 in reference to the past week (subscale scores range 0–21) with a higher score indicating greater severity. The HADS total score (HADS-Total) is scored by adding the HADS-A and HADS-D subscales (range, 0–42). Clinical cutoffs have been provided for HADS-D (>7), whereas past studies suggest an ideal cutoff for the HADS-Total of 11 in patients with stroke.

The 21-item BDI-II was developed to detect changes in depressive symptoms in mental healthcare settings. Responses are on a scale of 0 to 3 in reference to the past fortnight (total score range 0–63) with higher scores indicating greater severity. A clinical cutoff of >13 has been suggested.

The single-item DT is a visual analog scale recommended for use in oncology services. It is found to be comparable to the HADS in detecting distress in patients with cancer. Response options range from 0 (“no distress”) to 10 (“extreme distress”) in reference to the past week. The recommended cutoff for clinically significant emotional distress in oncology patients is ≥4.

The 10-item K-10 is a measure of nonspecific psychological distress designed as a brief screen for “serious mental illness.” It discriminates well between people with a diagnosed mental health disorder (anxiety, mood or nonaffective psychosis) and all other community respondents. Responses are on a scale of 1 to 5 in reference to the past month (total score range 10–50) with higher scores indicating greater levels of distress. The recommended cutoff for clinically significant psychological distress is ≥19.

Statistical Analysis

Group differences were examined using independent-samples t tests or χ² tests. Missing data were replaced by the rounded mean item value if ≤20% of items were missing. Internal consistency was assessed with Cronbach α. Concurrent validity was examined as Pearson product-moment correlations between the continuous scale scores. For each scale, receiver operating characteristic curves were constructed and area under the curve (AUC) and CIs (binomial exact) calculated. Each receiver operating characteristic curve AUC was compared with chance (AUC=0.5) and with the receiver operating characteristic curves of the other scales with the method of DeLong et al used to calculate SE and results expressed as a z-statistic. The sensitivity, specificity, likelihood ratio positive and negative, and posttest probability positive and negative were calculated for established and ideal cut points. PASW Statistics Version 18.0.0 (SPSS Inc, an IBM Company, Chicago, IL), MedCalc Version 11.3.8 (MedCalc Software, Mariakerke, Belgium), and Microsoft Excel 2007 were used.

Results

Recruitment strategies identified 124 potential participants. Nonparticipation reasons included refusal (n=28), distance (n=5), illness or cognitive impairment (n=5), uncontactable/missed (n=10), and unable to read (n=3). One patient’s data were lost due to technical issues. The final sample (n=72) were aged 25 to 91 years (mean, 66.7 years; SD, 13.1), 38
We examined the performance of several depression and distress screening tools in a stroke population. Overall, this study of a heterogeneous group of patients with stroke able to complete a self-report measure found that, apart from the DT, selected measures performed comparably. Performance differences between longer and shorter tools were not of sufficient size to justify length of time lost in administration (opportunity cost).

Study findings support previous literature indicating the PHQ-2, PHQ-9, and HADS are appropriate for use in patients with stroke without aphasia. Identifying depression and distress screening tools in a stroke population. Overall, this study of a heterogeneous group of patients with stroke able to complete a self-report measure found that, apart from the DT, selected measures performed comparably. Performance differences between longer and shorter tools were not of sufficient size to justify length of time lost in administration (opportunity cost).

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these measures, we have included participants who varied in
time since stroke and number of strokes, representing patients
seen across a range of inpatient and outpatient services.
Findings are therefore relevant for clinicians who see patients
with stroke at both early and late stages of the recovery
pathway. Specificity of the PHQ-2 was equivalent to that
previously seen in the early postacute period.15 For the
PHQ-9, specificity was lower but acceptable. However,
previously recommended PHQ-2 and PHQ-9 cutoffs resulted
in lower sensitivity than ideal. Supporting previous litera-
ture,16,17 ideal cut points seen for the HADS-D were lower
than traditionally recommended cut points.
This study provides diagnostic accuracy information for
depression measures not previously evaluated in a stroke
population. The AUC of the BDI-II (0.89) was the highest of
all measures examined and was within the range seen for the
BDI at different time points over the first 18 months post-
stroke (AUCs 0.86–0.93).22 The K-10 performed equiva-
ently to the depression-specific measures and correlates
strongly with the PHQ-2, PHQ-9, and the BDI-II. However,
the DT demonstrated the lowest AUC of all measures. It did
not demonstrate a sensitivity–specificity combination that
met with guidelines for a good depression screening tool21
and had the weakest correlations with the other scales.
Although factor analysis of the K-10 has identified a depres-
sion specific factor,35 the DT addresses global distress in a
single item, potentially capturing a range of nondepressive
states of emotional distress (reducing sensitivity). Alterna-
tively, the item’s presentation format may have impacted the
results: patients with stroke have been found to be less likely
to correctly complete visual analog scales than healthy
control subjects,36 and visual analog mood scales have been
found to lack sensitivity when used with patients with
stroke.22 Further work is required to determine the role for
the DT in stroke care.
Study strengths included a sample that covered a long
period after stroke; inclusion of patients with multiple
strokes; use of a strong criterion standard; examination of
multiple instruments contemporaneously; and use of an ap-
propriate range of accuracy statistics and receiver operating
characteristic comparisons. Study limitations included small
sample size (leading to low numbers of depression cases)
resulting in low precision of the accuracy statistics; no formal
assessment of cognitive and functional status; nonrandomiza-
tion of test order potentially resulting in test fatigue; and
having the same assessor administer the Structured Diagnos-
tic Interview for the Diagnostic and Statistical Manual of Mental Disorders,
Fourth Edition; MDE, major depressive episode; PHQ, Patient Health Questionnaire;
HADS-D, Hospital Anxiety and Depression Scale-Depression; BDI, Beck Depression Inventory.

Figure 1. ROC curves for depression measures versus SCID
cases of MDE. Area under the curve (95% CI): PHQ-2=0.83
(0.72–0.91), z=4.76; PHQ-9=0.82 (0.71–0.90), z=4.93; HADS-
D=0.87 (0.77–0.94), z=7.27; BDI-II=0.89 (0.79–0.95), z=8.48.
P<0.001 for all. ROC indicates receiver operating characteristic;
SCID, Structured Diagnostic Interview for the Diagnostic and
Statistical Manual of Mental Disorders, Fourth Edition; MDE,
major depressive episode; PHQ, Patient Health Questionnaire;
HADS-D, Hospital Anxiety and Depression Scale-Depression;
BDI, Beck Depression Inventory.

Figure 2. ROC curves for distress measures versus SCID cases
of MDE. Area under the curve (95% CI): DT=0.73 (0.61–0.83),
z=2.99; K-10=0.80 (0.69–0.89), z=3.94; HADS-Total=0.85
(0.75–0.93), z=6.21, P<0.005 for all. ROC indicates receiver
operating characteristic; SCID, Structured Diagnostic Interview
for the Diagnostic and Statistical Manual of Mental Disorders,
Fourth Edition; MDE, major depressive episode; DT, Distress
Thermometer; K-10, Kessler-10; HADS, Hospital Anxiety and
Depression Scale.
None.
References


Depression Screening in Stroke: A Comparison of Alternative Measures With the Structured Diagnostic Interview for the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (Major Depressive Episode) as Criterion Standard
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