Preliminary Screening Recommendations for Patients at Risk of Depression and/or Anxiety more than 1 year Poststroke

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Goal: Depression and anxiety are important complications of stroke but are underdiagnosed in community settings. The current study identified which patients were at increased risk of developing either disorder more than1 year poststroke to assist in targeted screening. *Methods:* Crosssectional survey of 147 adults who had a stroke more than 1 year ago were recruited from stroke advocacy/support groups and an outpatient register. Participants completed the Hospital Anxiety and Depression Scale (HADS) and reported whether they had emotional problems as a stroke inpatient (single item: yes/no). Standardized self-report measures evaluated medical (physical independence, health-related quality of life), cognitive (memory, executive functioning), and psychological (social support) variables. Demographic and stroke-related (stroke type, year) information were also recorded. *Findings:* Between 53% and 80% of respondents (n = 117) screened positive for depressed mood and/or anxiety (HADS subscale cut-offs: ≥8 or ≥4). Logistic regression analyses indicated that stroke survivors who reported having emotional problems as inpatients (odds ratio [OR]: 0.23), were female (OR: 3.42), and had poor health-related quality of life (OR: 0.45-0.53) and cognitive problems (OR: 0.68-0.74), were more likely to screen positive for either disorder. Models based on these variables predicted screening outcomes with 91% accuracy. *Conclusions:* Community-based stroke survivors who reported experiencing emotional problems as inpatients, were female, or had poor health-related quality of life (chronic pain, disturbed sleep, communication difficulties) and/or cognitive issues were at greater risk of being depressed/anxious. Targeted screening of these patients may help to identify those who are most in need of more comprehensive clinical assessments and evidence-based interventions.

Key Words: Stroke—depression—anxiety—screening—chronic

Depression and anxiety are the most common psychological sequelae of stroke.[1] Indeed, lifetime prevalence rates indicate that 25%-30% of stroke survivors experience symptoms of depression (eg, low/sad mood, anhedonia, apathy, irritability, disturbed sleep and/or appetite),[2] or anxiety (eg, excessive worry, restlessness, irritability, disturbed sleep, fatigue, concentration difficulties),[3] and up to 50% of these patients experience both.[4,5] Poststroke depression or anxiety may occur as a result of vascular damage to those areas of the brain that are involved in mood regulation (frontal−subcortical−limbic networks),[6] concerns about the risk of further strokes, and/or the psychological distress associated with ongoing physical (eg, hemiparesis, hemiplegia), cognitive (eg, memory loss) and communication (eg, dysarthria, aphasia) problems.[7] Left untreated, depression, and anxiety may hinder physical recovery, leading to poorer health-related quality of life, greater caregiver burden and higher mortality rates.[2,8]

Until recently, stroke survivors were thought to be at greatest risk of suffering from depression and/or anxiety within the first 12 months.[7,9] Consequently, treatment guidelines recommend that patients are screened in the

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initial 6 weeks after their stroke and again prior to discharge from rehabilitation.[10] However, there is increasing research to suggest that the rates of depression and anxiety remain stable or increase in the years after a stroke.[4,5,11] Although important, it has proven difficult to identify which patients are most at risk of developing long-term depression and/or anxiety, and who are therefore in need of ongoing screening.[8,12] Previous research suggests that patients with a premorbid history of depression/anxiety or those with symptoms at 6-months poststroke may be at an increased risk of ongoing/recurrent symptomology[5,11]; but it remains unclear whether demographic (ie, age, sex, employment), medical (physical dependence, pain, sleep, communication), cognitive, and/or psychological/social variables (eg, social support)[11,13-16] are also useful for predicting who is at risk of developing depression and anxiety.

The current study therefore examined data from a sample of community-based adults who had a stroke more than 1 year ago in order to: (1) determine how many stroke survivors screened positive for probable depression and/or anxiety; (2) identify which demographic (age, sex, time poststroke, relationship and employment status), medical (physical independence, health-related quality of life [pain, sleep, communication]), cognitive (memory, executive functioning), and psychological (emotional problems as an inpatient, social support) variables increased the risk that a stroke survivor would screen positive for depression and/or anxiety; and (3) construct models to predict which stroke survivors were most likely to screen positive for depression and/or anxiety, for the purposes of developing preliminary recommendations relating to long-term screening.

Method

Participant Recruitment and Eligibility

An existing dataset consisting of 183 community-based, adult (≥18 years), stroke patients (ischemic or hemorrhagic) was selected for secondary analysis.[17] Participants were originally recruited (2016-2018) for a survey about experimental stroke treatments.[17] Recruitment was limited to Australian stroke survivors and was conducted via 8 stroke advocacy organizations and support groups ($N_{participants} = 114$). An outpatient stroke registry also mailed out 500 paper-based surveys to a random selection of members aged more than or equal to18 years, from which a further 69 responses were received (13.8% response rate). The study was originally approved by the University of Adelaide Human Research Ethics Committee (Approval Number: H-2016-094) and informed consent was obtained from each respondent prior to participating. Overall, 10 surveys were conducted via telephone with the first author (DJU), with the remaining 173 surveys completed online or by mail. Only those respondents who had a stroke more than 1 year prior to data collection were included in the current analysis (N = 147).

Screening for Depression and/or Anxiety More Than 1 Year Poststroke

The Hospital Anxiety and Depression Scale (HADS)[18] was used to screen participants for depressive (HADS-D) and anxiety (HADS-A) symptoms by measuring how frequently (Not at all = 0; Sometimes = 1; Very often = 2; Nearly all the time = 3) participants had experienced 14 symptoms (eg, agitation, anhedonia, worry, panic) during the previous week (total score range: 0-42; HADS-D and HADS-A score range: 0-21; higher scores indicate more serious symptomology). The reliability and validity of the HADS has been previously established in stroke.[19] Although HADS subscale scores greater than or equal to 8 are used to indicate probable depression or anxiety within the general population,[18,19] modified cut-offs have been validated in various stroke samples.[20-23] Most relevant to the current study is research that examined a community-based stroke sample and found that subscale scores of 4 or more were optimal for identifying patients with depression and/or anxiety.[20] Lower cut-offs, such as this, have additionally been recommended when screening for mental health disorders because false negative diagnoses are more problematic than false positives.[24] Both the modified (HADS subscale scores ≥4) and standard cut-off (HADS subscale scores ≥8) scores were therefore utilized in the current study, in order to compare the outcomes of each and to assist in the evaluation of the data.

Potential Predictors for Depression and/or Anxiety More Than 1 Year Poststroke

A range of demographic and self-reported medical, cognitive, and psychological outcomes were analyzed, based on measures validated for stroke and/or clinical samples, as outlined below.

Demographic Variables

Respondents' age, sex, time poststroke (years), relationship status (married/partnered, single/separated/divorced/widowed), and work status (employed, not employed due to age, not employed due to health) were included in the current analysis. Additional information relating to type of stroke (ischemic, hemorrhagic) and years of education was collected for descriptive purposes.

Medical Variables

Physical independence was assessed using the Nottingham Extended Activities of Daily Living Scale,[25] which measures the level of assistance required to perform 22 tasks during the preceding 2 weeks (4-point Likert scale:

On my own = 3; On my own with difficulty = 2; With help = 1; No = 0). Lower scores indicate greater physical dependence (range: 0-66).

Health-related quality of life was examined using 3 items (relating to pain, sleep, and communication) from the Assessment of Quality of Life instrument (Version 4-D).[26] Item scores range from 1 to 4, with lower total scores indicating poorer quality of life (ie, severe/unbearable pain, regularly interrupted sleep, difficulty communicating with others; score range: 3-12).

Cognitive Variables

The memory/thinking subscale of the Stroke Impact Scale[27] was used to evaluate cognitive functioning. Respondents used a 5-point Likert scale to indicate their degree of difficulty (Extremely difficult = 1; Somewhat difficult = 3; Not difficult at all = 5) in performing 4 memory (eg, remembering dates and appointments) and 3 executive functioning (eg, solving everyday problems, thinking quickly) tasks over the past week. Lower scores indicate poorer cognition (range: 7-35).

Psychological Variables

In addition to completing the HADS, participants indicated whether they had experienced emotional problems (ie, felt more sad, angry, worried or moody) as an inpatient following their stroke (single item: no, yes). Whether or not respondents received psychological and/or psychiatric treatment at that time was also recorded (single item: no, yes). Finally, the level of social support provided by partners, family and/or friends was measured using the 12-item Multidimensional Scale of Perceived Social Support[28] (7-point Likert scale: Very strongly disagree = 1; Neutral = 4; Very strongly agree = 7). Lower scores indicate less social support (range: 12-84).

Data Preparation and Statistical Analysis

Summary results (means [SDs], frequencies [percentages]) were calculated for the full sample (N = 147) and for the 2 subgroups that were identified on the basis of the modified cut-offs (Poststroke depression and/or anxiety: Yes [n = 117]; Poststroke depression or anxiety: No [n = 30]) and standard cut-offs (Poststroke depression and/or anxiety: Yes [n = 78]; Poststroke depression or anxiety: No [n = 69]). Respondents who screened positive for depressed mood and/or anxiety were combined into the 1 group because the primary objective of the study was to identify persons who were at risk of either for screening purposes. In the few instances where participants omitted a response to one or more questionnaire items (<5%), multiple imputations were performed for each respondent based on their mean item scores.[29]

Separate multivariate logistic regressions were conducted using the Purposeful Selection of Covariates approach[30] to identify which demographic, medical, cognitive, and psychological variables increased the probability that a patient would screen positive for depression and/or anxiety more than 1 year poststroke based on modified (model 1) and standard (model 2) HADS cut-offs. In line with this approach, exploratory univariate analyses were initially performed to identify any statistical differences ($P < .20$) between the positive and negative screen subgroups (nominal/categorical data: Pearson chi-square tests; continuous and ordinal data: Mann Whitney U tests because data were skewed), and odds ratios (ORs) with 95% confidence intervals were calculated for each predictor variable included in the final regression models ($P < .05$).[30] An OR greater than 1 represented the increased odds of a stroke survivor screening positive for depression and/or anxiety per unit increase on the corresponding measure (higher scores = higher odds). An OR less than 1 represented the decreased odds of a stroke survivor screening positive for depression and/or anxiety (lower scores = higher odds).[30] For the categorical variables that were examined, an OR less than 1 indicated that: respondents who experienced emotional problems as inpatients (Coded: Yes = 0; No = 1) and respondents who were male (Coded: Male = 0; Female = 1) were at increased odds of depression and/or anxiety more than 1 year poststroke. ORs greater than 1 were inverted (1/OR), where needed, to assist in their interpretation.

Bootstrapped beta-coefficient standard errors were used to assess the statistical significance of the predictor variables (based on 1000 samples).[31] Likelihood ratio and Hosmer and Lemeshow tests were conducted to assess the quality and 'fit' of the logistic regression models, respectively.[30] A receiver operating characteristics curve and C-statistics (based on the area under the curve) were generated for each model using a conservative probability cut-off of .70, in order to determine how accurately (Perfect = 1.0; Not better than chance = .5) each model discriminated between respondents who screened positive for depression and/or anxiety and those who screened negative for both.[32] Statistical power for the logistic regression was evaluated retrospectively, based on a minimum event-to-predictor ratio of 5:1.[33] All analyses were performed using IBM SPSS Statistics for Windows (version 24.0).[34]

Results

Demographic and Clinical Details

Data from a total of 147 stroke survivors, aged between 27 and 96 were analyzed (refer to Table 1). The majority of participants had their stroke within the previous 10 years (n = 127; 86%) and had a high school education. Men and women were equally represented, many of whom were married/partnered. Most participants were retired due to their age, although approximately one third were unemployed for health reasons. Ischemic strokes

Table 1. *Summary demographic and clinical details for the full sample and subgroups that screened positive or negative for depression and/or anxiety more than 1 year poststroke*

				Post-stroke depression and/or anxiety									
				(HADS-D and/or HADS-A Scores ≥4)					(HADS-D and/or HADS-A Scores ≥8)				
		Complete sample (N = 147)		Yes (n = 117)		No (n = 30)			Yes (n = 78)		No (n = 69)		
Demographic variables		M	SD	M	SD	M	SD	*P*	M	SD	M	SD	*P*
Age, years*		60.8	16.7	59.2	16.5	67.4	16.0	.015†	58.6	16.3	63.3	16.9	.088†
Time poststroke, years*		6.2	5.6	6.1	5.4	6.7	6.5	.901†	6.3	5.7	6.1	5.6	.845†
Education, years		13.2	4.8	13.0	4.7	13.2	5.2	.339†	12.7	4.9	13.7	4.6	.149†
		N	%	N	%	N	%		N	%	N	%	
Sex, male*		75	51.0	55	73.3	20	26.7	.055π	33	42.3	42	60.9	.025π
Relationship status:*								.053π					.163π
Married/partnered		100	68.0	84	72.0	16	53.3		57	73.1	43	62.3	
Single/separated/divorced/widowed		47	32.0	33	28.0	14	46.7		21	26.9	26	37.7	
Employment status:*								.014π					.009π
Not employed due to age		58	39.5	41	35.0	17	56.7		26	33.3	32	46.4	
Not employed due to health		46	31.3	43	36.8	3	10.0		33	42.3	13	18.8	
Employed		43	29.2	33	28.2	10	33.3		19	24.4	24	34.8	
Stroke type:								.490π					.040π
Ischemic		82	55.8	67	57.3	15	50.0		46	59.0	36	52.2	
Hemorrhagic		37	25.2	30	25.6	7	23.2		23	29.5	14	20.3	
Unsure		28	19.0	20	17.1	8	26.8		9	11.5	19	27.5	
Medical variables	Score range	M	SD	M	SD	M	SD		M	SD	M	SD	
Physical independence*	0-66	50.1	17.8	48.1	18.4	57.9	13.0	.001 †	46.4	19.1	54.3	15.3	.002†
Health-related quality of life*	3-12	9.8	1.8	9.4	1.7	11.1	1.1	.000†	8.8	1.7	10.8	1.2	.000†
Cognitive variables													
Cognition*	7-35	29.5	6.5	28.3	6.8	34.1	1.4	.000†	26.4	7.1	33.0	3.2	.000†
Psychological variables													
Depression	0-21	6.2	4.4	7.4	4.1	1.7	1.0	.000†	9.0	4.1	3.1	1.8	.000†
Anxiety	0-21	6.6	4.6	8.0	4.1	1.4	1.0	.000†	9.8	3.8	3.1	2.2	.000†
Inpatient emotional problems:*								.000π					.000π
Yes	95	64.6	88	75.2	7	23.3		66	84.6	29	42.0		
Received inpatient psych treatment	43	45.3	40	34.2	3	10.0		28	35.9	21	30.4		
No		52	35.4	29	24.8	23	76.7		12	15.4	40	58.0	
Social support*	12-84	65.1	15.0	64.1	14.9	69.2	14.3	.075†	60.3	15.6	70.6	12.1	.000†

Abbreviations: Dep, depression; HADS-A, Hospital Anxiety and Depression Scale -Anxiety Subscale; HADS-D, Hospital Anxiety and Depression Scale-Depression Subscale; M, mean; N, number; SD, standard deviation; *P, =P* value; psych, psychological/psychiatric.

Note: * = variables included in multivariate logistic regression analyses.

Tests performed to compare poststroke depression and anxiety subgroups: † = Mann Whitney U test; π = Pearson chi-square.

Table 2. *Multivariate logistic regression analyses identifying predictors of depression and/or anxiety more than 1 year poststroke (N = 147)*

Model 1: HADS-D and/or HADS-A Scores ≥ 4	β	SE†	Wald's x^2	df	*P*†	OR (95% CI)
Emotional problems as inpatient*	−1.469	.89	6.97	1	.002	0.23 (.08-.69)
Health-related quality of life	−.644	.28	8.48	1	.003	0.53 (.34-.81)
Cognition	−.392	.13	8.48	1	.001	0.68 (.52-.88)
Constant	21.66	5.26	16.95	1	.000	n/a
Model evaluation			x^2	df	*P*	
Likelihood ratio test			88.93	3	.000	
Hosmer & Lemeshow test			8.19	7	.316	
Model 2: HADS-D and/or HADS-A Scores ≥8	β	SE†	Wald's x^2	df	*P*†	OR (95% CI)
Sex€	1.229	.53	6.16	1	.008	3.42 (1.30-9.01)
Health-related quality of life	-.805	.20	21.94	1	.000	0.45 (.32-.63)
Cognition	-.306	.11	18.83	1	.000	0.74 (.64-.85)
Constant	16.87	4.75	30.97	1	.000	n/a
Model evaluation			x^2	df	***P***	
Likelihood ratio test			111.85	3	.000	
Hosmer and Lemeshow test			12.16	8	.114	

Abbreviations: CI, confidence interval; *df*, degrees of freedom; HADS-A, Hospital Anxiety and Depression Scale-Anxiety Subscale; HADS-D, Hospital Anxiety and Depression Scale-Depression Subscale; N, number; OR, odds ratio; *P*, *P* value; SE, standard error.

†Values based on 1000 bootstrapped samples.

*Coded: Emotional problems as inpatient Yes = 0, No = 1.

€Coded: Male = 0, Female = 1.

were most common. Physical independence, health-related quality of life and cognition scores were approaching the upper limits for the scales (maximum scores: 66, 12, 35; respectively). The mean overall HADS score was 12.8 (SD = 7.9), with the HADS-D and HADS-A subscale scores ranging from 0 to 20, respectively. Approximately two thirds of participants reported having emotional problems after their stroke while they were in hospital; less than half of this number received psychological/psychiatric treatment at the time. Social support scores were in the moderate-to-high range (maximum score: 84).

Predictors of Positive Depression and/or Anxiety Screening More Than 1 Year Poststroke

When using the modified HADS cut-offs (≥4), 80% (n = 117) of the sample screened positive for depression and/or anxiety, with the remaining 20% (n = 30) screening negative for both. Of those who screened positive, 14% (n = 16) screened positive for depression, 18% (n = 21) screened positive for anxiety, and 68% (n = 80) screened positive for both depression and anxiety. Based on the standard HADS cut-offs (≥8), 53% (n = 78) of participants screened positive for depression and/or anxiety and 47% (n = 69) screened negative. Of the 78 respondents who screened positive, 19% (n = 15) screened positive for depression, 36% (n = 28) screened positive for anxiety, and 45% (n = 28) screened positive for both.

Descriptive statistics for the respective positive and negative screening subgroups are provided in Table 1, in addition to the results of the exploratory univariate analyses. For both cut-off scores, the same nine predictors were found to differ significantly at the initial $P < .20$ level (age, sex, relationship status, employment status, physical independence, health-related quality of life, cognition, inpatient emotional problems, social support). These variables were combined to form the preliminary logistic regression models, which were then refined in accordance with the Purposeful Selection of Covariates methodology.[30]

The results of the final multivariate logistic regression models are provided in Table 2. Model 1 (based on modified HADS subscale cut-off ≥4) found that stroke survivors who reported experiencing emotional problems as inpatients, poorer health-related quality of life (pain, disturbed sleep, communication difficulties), and poorer cognition, were more likely to screen positive for depressed mood and/or anxiety ($P < .05$). Specifically, stroke survivors who experienced emotional problems as inpatients were 4.34 times more likely to screen positive for depression and/or anxiety (model 1) and, for each point lower that respondents scored on measures of health-related quality of life (score range: 3-12) and cognition (score range: 7-35), they were 1.88 and 1.47 times more likely to screen positive for depression and/or anxiety, respectively.

Model 2 (standard HADS subscale cut-off ≥8) found female stroke survivors were more likely than male stroke survivors to screen positive for depression and/or anxiety, in addition to respondents with poor health-related quality of life and low cognition scores ($P < .05$). The ORs calculated for model 2 indicated that female stroke survivors were 3.42 times more likely than males to screen positive for depression and/or anxiety, and for each point

lower that respondents scored on measures of health-related quality of life and cognition, they were 2.22 and 1.35 times more likely to screen positive for depression and/or anxiety, respectively. In model 2, the variable pertaining to experiencing emotional problems as inpatients also approached significance $P = 0.59$). Likelihood ratio tests confirmed that each of the proposed models was better than the respective intercept-only/null model (ie, comparison regression models with no independent variables) at predicting which patients would screen positive for depression and/or anxiety more than 1 year poststroke. Hosmer and Lemeshow tests also indicated that the 'goodness-of-fit' for each model was adequate (see Table 2). Statistical power was confirmed, based on an observed event-to-predictor ratio of 11:1 for model 1 and 8:1 for model 2.[33]

The receiver operating characteristic curves for model 1 and model 2 are shown in Figures 1 and 2, respectively. Each model was found to have discriminated between respondents with depression and/or anxiety (positive screen subgroup) and respondents without depression or anxiety (negative screen subgroup) with a very-high level of accuracy (model 1 and 2: C = .91; $P < .001$). The sensitivity (percentage of positive screens correctly identified) of each model was also high (model 1: 95.2%; model 2: 89.7%), despite conservative probability cut-offs of .70 being used. The specificity rate (percentage of negative screens correctly identified) of each model was lower (model 1: 58.1%; model 2: 71.0%), although still within the acceptable range for clinical screening purposes.[24] Misdiagnosis rates were generally low, although the false positive rate for model 2 was higher and the false negative rate lower than those found in model 1 (model 1: false positive rate = 15.4%; false negative rate = 16.7%; model 2: false positive rate: 33.3%; false negative rate: 8.7%).

Discussion

The current study analyzed self-report data from a cohort of community-dwelling adults who had suffered a stroke more than 1 year prior, in order to determine which patients were most likely to screen positive for probable depression, anxiety or both. The overall percentage of respondents who screened positive for depression and/or anxiety ranged from 53% to 80%, depending on the cut-off that was used (HADS-D or HADS-A $\geq$ 8 and $\geq$ 4, respectively). Comorbid depression and anxiety was the most common outcome, with 24% and 54% of participants screening positive, based on the respective cut-offs. These findings are noteworthy because the small number of studies that have examined the prevalence of comorbid depression and anxiety in stroke survivors suggest that 50%-70% of stroke survivors with one diagnosis may also have the other.[3,35]

Of the remainder, 14% and 18% screened positive for depression, and 19% and 36% screened positive for anxiety. These rates are broadly consistent with previous studies in the U.K. and New Zealand, which reported positive depression or anxiety cases ranging from 25% to 35%, based on standard HADS cut-off scores.[13,15] However, the fact that more people in the current study screened positive for anxiety than depression is significant, given the opposite has typically been reported in the literature.[1,2] Although the current study did not screen for specific anxiety disorders (eg, generalized anxiety, agoraphobia, social anxiety), future research should consider doing so because the recommended treatments for each differ.[3,36]

In terms of predicting which community-based stroke survivors were most at risk of depression and/or anxiety, this study initially suggested a broad number of potential factors (eg, younger age, being unemployed due to health, more physically dependent), some of which have been identified by previous studies.[13-15] However, the results of the final models, which differentiated between patients with positive and negative screens with high levels of accuracy, highlight 4 main predictors, namely: emotional problems as an inpatient following stroke, female sex, health-related quality of life, and cognition. Specifically, stroke survivors who reported feeling 'more sad, angry, worried, or moody' while admitted as inpatients were 4 times more likely to screen positive for depression and/or anxiety a year or more, later (model 1). These findings extend previous research, which identified mood symptoms at 6-months poststroke as a predictor of long-term depression/anxiety.[11] It also lends further support to published recommendations advocating for ongoing monitoring of patients who experience emotional problems as inpatients,[37] even when the number and severity of the symptoms fall below the thresholds specified by diagnostic guidelines.

Female stroke survivors were also found to be 3 times more likely than males to screen positive for depression and/or anxiety in the current sample (model 2). These findings were not unexpected, given women experience a greater lifetime prevalence of depression and anxiety disorders compared with men in the general population,[38,39] potentially due to a range of biological (eg, hormonal), psychological (eg, internalization of symptoms), and social (eg, higher likelihood of experiencing traumatic events) factors.[38,39] However, given that some previous studies have reported that males may experience worse psychological outcomes than females,[11,13,14,16] and others have found that females are more likely than males to experience poststroke anxiety rather than depression,[15,35] further research appears necessary to further clarify any differences.

Across each of the models, stroke survivors with poor health-related quality of life (ie, chronic pain, disturbed sleep, communication difficulties) and/or cognitive problems were also more likely to screen positive for depression and/or anxiety. The 2-way link between pain, sleep, communication, cognition, and mental health is widely recognised,[2,14] and is equally important here, given the

potential for improvement in each of these areas following medical and/or psychological intervention.[40,41] Regular cognitive screening appears particularly important from both a psychological and medical perspective, given that cognitive decline is also associated with worse physical recovery and higher rates of mortality after a stroke.[42] Stroke severity, which influences health-related quality of life and cognition following a stroke,[43] has also been previously identified as a predictor of poststroke depression and/or anxiety.[11] However, given stroke severity also typically influences physical dependence, and this variable was not found to predict longer term depression and/or anxiety in this sample, the current results suggest that pain, sleep, communication, and cognition may be more accurate predictors in the years after a stroke.

From a practical perspective, the ongoing monitoring of a stroke survivor's mood, health-related quality of life, and cognition is likely to be best conducted by the patient's consulting medical practitioner (eg, General Practitioner, Neurologist, Geriatrician), although there is evidence to suggest that other allied-health professionals (eg, Occupational Therapists, Speech Therapists) may also screen people in community settings.[44] A number of freely-available empirically-validated psychological screening tools exist, both for nonaphasic (eg, HADS[18]; Patient Health Questionnaire-9[45]) and aphasic (Stroke Aphasic Depression Questionnaire[46]) patients. A range of health-related quality of life (eg, Assessment of Quality of Life questionnaire[26]) and cognitive (eg, Oxford Cognitive Screen [47]) screens have also been validated for use among the stroke populations, improving the usefulness of these measures in this context.

Study Limitations

The predictive utility of the proposed models now requires validation in a larger prospective study,[31] preferably involving an international sample, given regional differences in the type and amount of treatment available to stroke survivors [48]. In addition, the potential for selection bias arising from the recruitment of participants from stroke advocacy and support groups should also be considered when interpreting the findings. Specifically, stroke survivors with more severe ongoing physical, cognitive, and/or psychological problems may be more likely to be involved with groups of this nature, and also to respond to a survey on experimental stroke treatments, which could have increased the rates of anxiety and depression in the

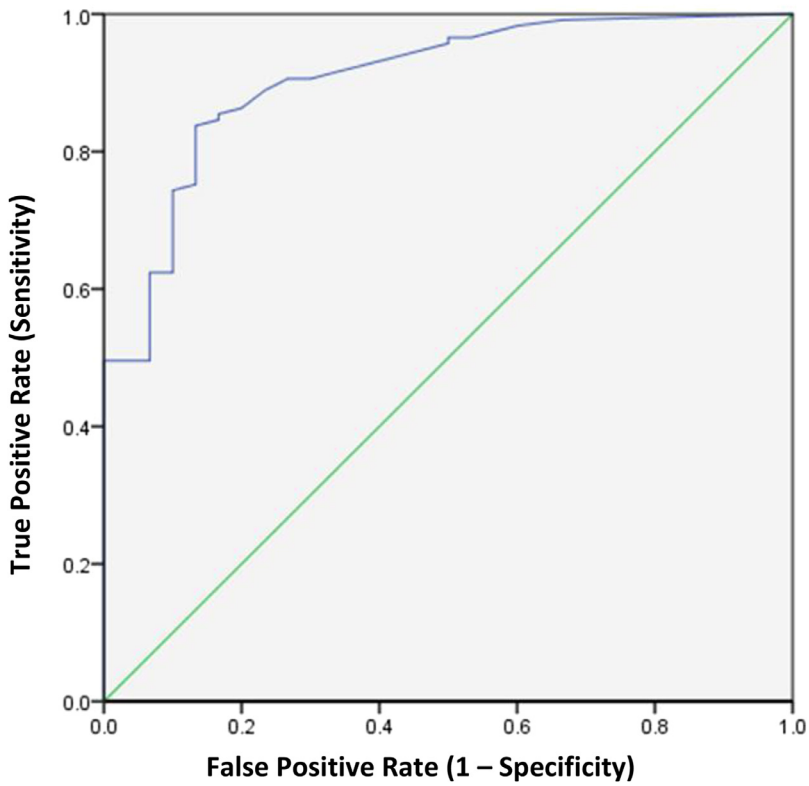

Figure 1. *Discriminatory accuracy of a model used to predict depression and/or anxiety screening outcomes (HADS-D and/or HADS-A scores ≥4) more than 1 year poststroke as assessed by a receiver operator characteristics (ROC) curve.* Abbreviations: *HADS-A, Hospital Anxiety and Depression Scale-Anxiety Subscale; HADS-D, Hospital Anxiety and Depression Scale-Depression Subscale.*

Note: Predicted frequencies were calculated using .70 cut-off. Area under curve (AUC): C = .91 (95% CIs: .85-.96), $P < .001$. Sensitivity (percentage of positive screens correctly predicted) = 95.2%. Specificity (percentage of negative screens correctly predicted) = 58.1%.

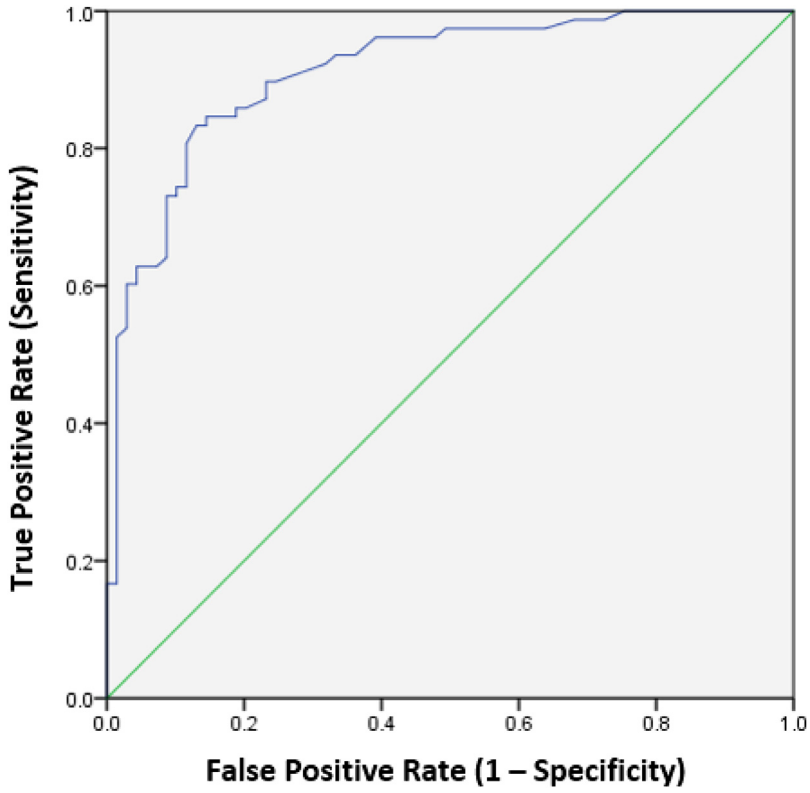

Figure 2. *Discriminatory accuracy of a model used to predict depression and/or anxiety screening outcomes (HADS-D &/or HADS-A scores ≥8) more than 1 year poststroke as assessed by a receiver operator characteristics (ROC) curve.* Abbreviations: *HADS-A, Hospital Anxiety and Depression Scale-Anxiety Subscale; HADS-D, Hospital Anxiety and Depression Scale-Depression Subscale.*

Note: Predicted frequencies were calculated using .70 cut-off. Area under curve (AUC): C = .91 (95% CIs: .87-.96), $P < .001$. Sensitivity (percentage of positive screens correctly predicted) = 89.7%. Specificity (percentage of negative screens correctly predicted) = 71.0%.

current sample. A reliance on self-report measures to establish whether participants had experienced emotional problems as inpatients may have also reduced the reliability of the data, particularly where a long period had elapsed since the stroke. Future studies should consider sourcing additional collateral information from family members and/or hospital records to improve the accuracy of the data used to construct the predictive models. Lastly, a number of other potentially important variables (ie, severity and location of the stroke)[2] could not be examined because the majority of participants were recruited from the community, rather than from hospitals or stroke registries. Consequently, it is not known whether these variables also assist in predicting who is at risk of depression and/or anxiety beyond 1 year poststroke.

Conclusions

The present findings suggest that large numbers of community-based stroke survivors may be at risk of depression and/or anxiety more than 1 year after their stroke. When left untreated, depression and anxiety can hinder physical recovery, and lead to poor health-related quality of life, higher mortality rates, and greater caregiver burden.[2,8] Although routine screening of all community-based stroke survivors for depression and anxiety is impractical, the current findings suggest that patients who experienced emotional problems as inpatients and who have ongoing pain, sleep, communication, and/or cognitive problems may have an increased risk of depressed and anxious feelings, particularly if they are female. These patients may therefore benefit from targeted screening. Importantly, following a positive depression/anxiety screen, more rigorous assessment should be undertaken by a specialist (eg, Clinical Psychologist, Psychiatrist) and, where appropriate, evidence-based treatment(s) provided.

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Conflicts of Interest

The authors declare no interests.

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