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Clinical predictors of functional recovery at six month post-stroke

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ABSTRACT

Aim: To investigate predictors of functional recovery at six-month among Nigerians with first-ever stroke. **Methods:** Participants with first ever stroke were recruited at stroke-onset from the University College Hospital, Ibadan, Nigeria. Stroke severity was measured using the National Institute of Health Stroke-Scale. Stroke was classified using the results of the CT scan of the brain. The weighted-standard values of Barthel Index and Frenchay Activities Index were combined to indicate Comprehensive Activities of Daily Living (CADL). The presence of depressive features and Trunk-Control (TC) were measured using the Centre for Epidemiological Scale-Depression and the Postural Assessment-Scale for Stroke-Patients respectively. Measurements were taken every month for six months. Data were analyzed using multivariate regression and survival analyses at $p = 0.05$. **Results:** Sixty-five participants were recruited. Ten died within a week of stroke onset. Fifty-five (mean age = 57.4 ± 14.8 years, 28 males) participants completed the study; Twenty-six (47.3%) had ischaemic stroke and 29 (52.7%) had haemorrhagic stroke. Forty of the 55 participants were married and of the 40, 31 reported spousal support. Type of stroke ($\beta = 7.5$) and age ($\beta = -0.4$) significantly predicted functional recovery after controlling for co-morbidity ($\beta = -2.1$), brainstem lesion ($\beta = -0.2$), stroke severity ($\beta = -0.6$) and TC ($\beta = 0.7$) and the scores on depressive symptoms ratings ($\beta = -0.1$). **Conclusion:** Functional recovery at six-month is better in individuals who had haemorrhagic stroke. However, functional recovery decreases as age increases. The combination of haemorrhagic stroke with the presence of co-morbidity predicted death after stroke.

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Key words: Stroke, Ischaemia, Haemorrhage, Rehabilitation, Functional recovery

INTRODUCTION

One of the major consequences of stroke is death. Residual disabilities that negatively impact the stroke survivor's functional independence and quality of life are another major consequence.[1-10] Stroke is one of the leading cause of death and leading cause of disability worldwide.[10] It is also the most common cause of loss of functional ability among the elderly.[10-19] Even in developed countries with advanced healthcare systems, 60% of persons who suffer stroke either die, become permanently disabled, or dependent functionally.[9-10]

Social mandates directed towards healthcare providers and healthcare facilities are rigorously challenged for accountability. Healthcare providers are continually challenged to account for effectiveness of the use of the healthcare facilities at their disposal and the care they provide.[20] Factors predicting prognosis and outcomes in patients suffering from chronic health conditions, such as stroke, at an early stage are very important and highly imperative. These factors facilitate decisions on type of care that would be provided to patients, projecting length and outcomes of rehabilitation, communicating discharge plan with patients and relatives and anticipating the needs

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for home adjustments and community support. A better understanding of the factors that predict prognosis and recovery from stroke will potentially assist in designing preventive measures and treatment strategies to improve motor function post-stroke.

Recovery, both neurologically and functionally, after stroke has been shown to be rapid within the first six-month and continues slowly thereafter.[21,22] Although many factors have been reported to influence functional recovery after stroke,[17-19,23,24] factors determining functional recovery at the 6-month have not been well established. This is probably due to the fact that most of the previous studies covered at least 14 days after the incidence of stroke[12,13,25-30] and the clinical and personal variables of the patients at stroke onset were not considered as determinants in their analysis. In this study, we collected multiple data within 24 hours of onset for 6 months from first ever stroke survivors. The data were analyzed to determine the predictors of functional recovery.

METHODS

The protocol for this study was ethically cleared and approved by the joint University of Ibadan and University College Hospital Research Ethics Committee in Nigeria. All participants consented before inclusion in the study. For participants who were initially unconscious, consent was initially obtained by proxy from participants' relatives. The processes were repeated after such participant regained consciousness and were capable of giving consent. Participants were recruited consecutively from the accident and emergency unit of UCH. Physiotherapy was provided throughout the study period by one of the authors (CAG) and outcome measurements were taken by a research assistant. Each participant received physiotherapy in a standardized format for six months. Each of the participants was treated daily for the first 14 days of stroke and subsequently at every other day for the 12-month period. Achievement of trunk control both from lying to sitting and in sitting position were pre-requisites for the commencement of standing. The ability to shift weight from one lower limb to the other and the achievement of at least 45% of body weight distribution on the affected limb were taken as pre-requisites for ambulatory re-education. None of the participants received any other physiotherapy treatment other than the one that was provided by the researcher (CAG). The achievement of active wrist and at least fingers' flexion with or without mild spasticity were pre-requisites to graduate the patient to restraining the unaffected upper limb for between eight to ten waking hours per day to improve functional performance of the affected upper limb. A patient who had commenced ambulation but has not been able to achieve heel-strike and heel-off had 30 minutes of bicycle ergometer training for every other day. When the achievement of heel-strike and heel-off had been achieved with or without the achievement of swing-through, a patient was graduated to 20-30 minutes of treadmill training for three times per week with a least a day interval. The social supports were monitored to prevent over-dependency on the informal caregivers especially after hospital discharge in order to promote functional independence. None of them received physiotherapy from any other source throughout the duration of involvement in the study. Participants were treated daily for the first 14 days of stroke and subsequently at every other day for a six-month period. Treatments were individualized and progression was based on the achievement of the pre-determined goals or outcomes. Patient was progressed to the next stage of functional training if they matched with or surpassed the expected outcomes. Social support was monitored to avoid additional physiotherapy-related interventions to promote functional independence from informal caregivers, especially after hospital discharge. The presence and quality of social support received by each patient was measured on a visual analogue scale (scale ranged between 0 and 10).

Stroke severity was measured using US-National Institute of Health Stroke-Scale.[31] Participants were interviewed for socio-demographic data at when they became stable and alert. The presence and type of co-morbidities were also documented. The stroke types were classified using the clinical indices[3,24] and the results of brains' computed topography (CT) scan. Urinary incontinence was defined as the report of urinary accidents (wetting of bed or cloth) or the presence of an indwelling catheter. Bowel incontinence was defined as report of faecal accidents. Barthel Index[32] and Frenchay Activities Index[33] were administered monthly for 6-month post-stroke and their weighted-standardized scores were combined to indicate functional recovery. Depression features and Trunk-Control were measured fortnightly for 6-month using the Centre for Epidemiological Scale-Depression[34] and the Postural Assessment-Scale for Stroke-Patients[35] respectively. Data were analyzed using descriptive statistics, linear regression and survival analyses ($p=0.05$).

RESULTS

Sixty-five participants were recruited into this study (33 males and 32 females), 10 participants, all with history of diabetes mellitus and had haemorrhagic stroke, died within two-week of stroke onset. Fifty-five (28 males and 27 females) participants with a mean age of 57.4±14.8 years completed all aspects of this study.

Thirty (54.6%) participants had at least one co-morbid condition with diabetes mellitus been the most common (49.1%), followed by coronary heart disease (20%), obesity (1.5%) and HIV/AIDS (1.5%) respectively. Details of the other clinical history of the participants are presented in Table 1. Fifty-one (92.7%) participants had high blood pressure at stroke onset irrespective of their type of stroke. Those who suffered hemorrhagic stroke had systolic and diastolic blood pressure readings of 198±15.6mmHg and 120±18.1mmHg respectively at stroke onset. They also had blood glucose level of (172±23.4) and (85±13.1) at stroke onset and 24 hours post-stroke even in those with no previous history of diabetes mellitus. Fifty-two (94.6%) had bladder incontinence while 58.2% had both bowel and bladder incontinence.

The marital statuses of the 55 participants who completed the study are presented in Table 2. Three, 40, 1 and 11 participants were single, married, separated and widowed respectively. Of the 40 married participants, 23 reported having spousal support. Detailed information on other demographic characteristics including type of marriage, highest educational qualification, and occupational status are also reported in Table 2.

At 6-month post-stroke, the functional performance was significantly higher ($p < 0.001$) among (i) the participants without co-morbidity (76.2±14.1) than those with co-morbidity (59.3±11.1), (ii) those who suffered haemorrhagic stroke (77.2±16.2) than those who suffered ischaemic stroke (60.3±15.2), and (iii) those with educational qualifications above secondary school (73.3±10.2) level than those with secondary education and below (60.3±15.2). Each of Trunk Control ($r= 0.56$), stroke severity ($r= -0.48$), depression scores ($r= 0.50$) and age ($r= -0.69$) significantly correlated with functional performance at 6-month. Details of the correlation coefficients of all the variables with functional performance at 6-month are presented in Table 3.

Table 1: Clinical history of the participants

Variable	N	Percentage
Type of stroke		
Ischaemic stroke	26	47.2
Hemorrhagic stroke	29	52.7
Side of the brain affected		
Left	44	80
Right	11	20
Speech problem		
Aphasia	11	20
Dysartheria	11	20
Severity of stroke		
Moderate	15	27.3
Severe	40	72.7
Location of brain lesion		
Cortex	53	96.4
Sub-cortex	2	3.6

None of sex, side of lesion, occupational status, limb dominance, blood pressure and glucose level at the onset of stroke or stroke severity predicts functional recovery at 6-month post-stroke ($p>0.05$).

Age ($\beta= -0.4$) and type of stroke (with those who had haemorrhagic stroke having better outcome)($\beta= 7.5$) were the most important predictors of functional performance at 6-month post-stroke after controlling for marital status

Table 2: Socio-demographic variables of the participants

Variables	N	Percentage
Age group		
20–39	5	9.09
40–59	23	41.82
60–79	25	45.46
80–89	2	3.63
Marital status		
Singled	3	5.5
Married	40	72.7
Widowed	11	20.0
Separated	1	1.8
Type of marriage		
Monogamy	23	57.5
Polygamy	17	42.5
Spouse support		
Not applicable	15	5.5
Spouse support	22	76.4
No spouse support	18	18.2
Highest educational qualification		
No-formal	10	18.2
Primary	6	10.9
Secondary	25	45.5
Post-secondary	4	7.2
University	10	18.2
Occupational status		
Students	3	5.5
Non-skilled	16	29.1
Semi-Skilled	17	30.9
Skilled	8	14.6
Professional	4	7.3
Retiree	3	5.5
Unemployed	3	5.5

Table 3: Relationship between socio-demographics and clinical predictors of post-stroke functional recovery at 6-month

Variables	r	p-Value
Marital status	−0.45	0.01
Educational qualification	0.45	0.01
Trunk control	0.56	0.04
Incontinence	0.57	0
Depression	0.5	0.02
Type of stroke	0.65	0
Location of brain lesion	0.52	0.04
Co-morbidity	0.56	0.02
Age	−0.69	0
Spousal support	0.46	0
Stroke severity	−0.48	0

p<0.05

(β= 1.2), educational level (β= 0.2), presence or absence co-morbidity health condition (β= -2.1), presence of brainstem lesion (β= -0.2), stroke severity (β= -0.6), and trunk control performance (β= 0.7) and depression scores (β= -0.1) at 2-week post-stroke. Age contributed 48% while type of stroke contributed 42% to post-stroke functional recovery (Table 4). The combination of haemorrhagic stroke with the presence of co-morbid health conditions especially diabetes mellitus predicted death within 2-week of stroke.

DISCUSSION

This study investigated the clinical predictors of clinical predictors of functional recovery at 6 months post-stroke in first-ever stroke survivors. The study involved stroke patients who had suffered the first-ever stroke. This was done to eliminate the effect of residual disability that might be present in stroke patients with recurrent stroke episode.

Diabetes mellitus was the most common co-morbid health problem found among the participants. Diabetes has been shown to be as a major risk factor to stroke.[22] Fortunately, diabetes especially the adult-onset type can be modified by lifestyle adjustment and exercise.[42] There is need to improve on public awareness on lifestyle adjustment and modification among Nigerians in order to stem-down stroke incidence. The blood sugar levels of all the participants who had hemorrhagic stroke were higher than normal level at onset of stroke, even though many of them were not known to have diabetes mellitus before the stroke. This shows that high blood sugar is consistent with haemorrhagic stroke at the onset of stroke. Therefore, care should be taken in concluding the diabetic status of stroke patients at the onset of stroke especially those who had suffered haemorrhagic stroke and calls for extra caution on early control blood sugar of stroke patients in order to prevent the patient from retrogressing into hypoglycaemia which could be detrimental to their survival and subsequent functional recovery.

The results of this study indicate that functional recovery post-stroke is not influenced by either the blood pressure or blood glucose level at the onset of stroke. However, those who were documented to have been diagnosed of diabetes mellitus had higher chance of death when they suffered haemorrhagic stroke. This is evident as all the ten participants who died had history of diabetes mellitus and then suffered haemorrhagic type of stroke. This finding suggests that the risk of death during immediate post-stroke period is high among individuals who suffer haemorrhagic stroke and have had previous history of diabetes mellitus.

The result that age and type of stroke (with those who had haemorrhagic stroke having better outcome) were the major predictors of post-stroke functional recovery contributing high percentages shows that age and type of stroke are the major predictors of prognosis in rehabilitation after stroke. However, this result shows that haemorrhagic stroke predicts death in stroke patients at immediate post-stroke period. Although, patients who suffered haemorrhagic stroke are likely to die within few weeks of stroke, they have better outcome in functional recovery if they survive. It was observed that as age increases, the tendency to recover into pre-stroke functional status decreases. This may be attributed to the age related changes in the nervous system of the elderly which are not common in the younger age.[25]

Depression is associated with many chronic and disabling illnesses including stroke.[35-37] This may be due to the fact that the onset of stroke is sudden and it is usually associated with emotional problems (depression, anxiety and sometimes some personality disorders.[12,35-38] These factors frequently have negative effects on the emotional and psychological

Table 4: Linear regression analysis of socio-demographic and clinical predictors of post-stroke functional recovery at 6-month

Model	Standardized coefficients					95% confidence interval for B	
	B	Standard error	Beta	t-value	p-value	Lower bound	Upper bound
Constant	100.08	20.25		4.94	0.00	59.21	140.95
Marital status	1.59	3.42	0.07	0.47	0.64	−5.30	8.49
Educational level	−0.16	1.12	−0.12	−0.14	0.89	−2.41	2.01
Trunk control score	0.72	0.53	0.14	1.39	0.17	−0.33	1.79
Presence of incontinence	1.39	3.45	0.05	0.40	0.69	−5.57	8.35
Depression score	0.05	0.13	0.04	0.36	0.72	−0.21	0.30
Type of stroke	7.48	3.26	0.30	2.29	0.03	0.89	14.06
Location of brain lesion	−0.20	0.45	−0.05	−0.45	0.66	−1.11	0.71
Presence of co-morbidity	−2.14	3.02	−0.07	−0.71	0.48	−8.23	3.95
Age	−0.44	0.12	−0.49	−3.76	0.00	−0.68	−0.20
Spousal support	0.50	0.61	0.12	0.82	0.42	−0.73	1.72
Stroke severity	−0.59	0.51	−0.15	−1.16	0.25	−1.60	0.44

p<0.05, Regression equations: Functional recovery at 6-month post-stroke = 100.01 + 7.48(Haemorrhagic stroke)– 0.44(Age)

well-being of stroke survivors. However, the positive association of availability of spousal support with increase in functional recovery may have been related to ameliorating of depression through the provision of spousal support for those who were married. This finding corroborates that of Gbiri et al[3] who concluded that spouse support helps alleviate emotional problem, reduces sense of stigmatization and makes a stroke survivor happy. Also, the higher chance of people with higher educational attainment to recover functional status could be attributed to knowledge. Education is expected to inform better knowledge which would translate to increased goal and aspiration.

That severity of stroke significantly influences recovery of functional activities of stroke survivors and that the combination of stroke severity and presence of co-morbidity did not only influence recovery but predicts death in stroke survivors may be attributed to the presence of aphasia as the present of co-morbidity alone was a weak determinant of functional recovery. Sensory deficit, aphasia and dysarthria contributed to the stroke severity in the participants in this study. This may be due to the fact that aphasia and dysarthria may be associated with emotional expression and possible depression, anxiety and frustration. An individual who sustains a left-brain stroke may have inability to solve problems, is often more easily angered and frustrated, has impaired retention of information, and may have language difficulties or apraxia. Language difficulties may translate to difficulty in understanding directions for the therapy, or these individuals may be limited in keeping track of their home activity. With communication difficulty, there may be increased levels of frustration. Those with apraxia may have spatial or timing errors, such as a delay in initiation or inappropriate pauses.[37]

The significant influence of trunk-controls on functional recovery post-stroke shows that if effort is paid to trunk-control in stroke rehabilitation programme, much would be achieved in terms of functional recovery. Therefore, clinicians and healthcare providers in the field of rehabilitation should not trivialize trunk-control's contribution to total recovery of comprehensive function in stroke patients. It should attract much attention during the rehabilitation process. The finding that location of brain lesion influenced functional recovery post-stroke can be attributed to functionality of the brain. This corroborates previous opinion that autonomic function is usually impaired in stroke survivors.[45] Various clinical and socio-demographic variables that influence the stroke survivors' functional recovery made prediction of prognosis in this set of population more complex as no single factor can be isolated for projecting the outcome of prognosis. Therefore, clinicians should consider every determinant during assessment of a stroke victim.

CONCLUSION

Functional recovery at six-month is better in individuals who had haemorrhagic stroke. However, functional recovery decreases as age increases. The combination of haemorrhagic stroke with the presence of co-morbidity predicted death after stroke. There is positive association between functional performance at 6-month post-stroke and each of degree of trunk control, availability of spousal support for those were married, absence of incontinence and levels of educational attainment while the degrees of stroke severity and depression had negative and presence of co-morbid health problem had negative correlation with functional performance. Neither gender, side of affectation, occupational status, limb dominance, blood pressure and glucose level at the onset of stroke nor stroke type predicts functional recovery at 6-month post-stroke.

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CAG – Conceptualization, Treatment of Patients, Data Collection, Data analysis and Scientific manuscript writing; **AOA –** Conceptualization, Data Collection, Data analysis and Scientific manuscript writing; **AO –** Conceptualization, Data analysis and Scientific manuscript writing; **AEA –** Data analysis and Scientific manuscript writing; **CWVS –** Data analysis and Scientific manuscript writing

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