Depression, Cognitive Impairment and Physical Functional Outcome and Their Associated Factors in Stroke Patients in Community Hospital Care.

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Abstract:

Depression, Cognitive Impairment and Physical Functional Outcome and Their Associated Factors in Stroke Patients in Community Hospital Care.

Aims: There have been inconsistent reports about the relationships between factors associated with clinical and psychosocial outcomes of stroke in previous research studies. The aim of this research study is to examine the relationship between depression, cognitive function and physical functional outcome and their associated factors in stroke patients in two community hospitals in Singapore, where the step down post acute care is given to the patients.

Methodology: An Observational Cohort Study on 200 stroke patients in two community hospitals was conducted. The patients were examined after seeking their informed verbal consent upon their admissions and upon their planned discharges, using Barthel Index for ADL dependency, Geriatric Depression Scale, Abbreviated Mental Test and the NIHS Scale for Neurological Impairment.

Results: On admission, 120 (60%) patients were depressed, 107 (54.5%) were cognitively impaired and 53.5 % of the patients had severe functional impairment (Barthel Index < = 50). Among the patients with planned discharges, 34 patients had ADL dependency (Barthel Index < = 50) upon discharge. Significant independent predictors of depression were severe neurological impairment (OR=3.29, CI=1.09; 9.03), cognitive impairment (OR=3.57, 95%CI =1.82; 7.03 and multifocal lesion (O.R. =1.98, 95% C.I. = 1.02; 3.84).

Significant independent predictors of post stroke cognitive impairment were age more than 81 years (O.R. =6.78, 95% C.I. = 2.34; 19.64), less than secondary level education (O.R = 4.73, 95% C.I. = 1.41, 13.11), severe neurological impairment (O.R. = 5.00, 95% C.I. = 1.70, 14.67) and depression (O.R. = 3.19, 95% C.I. = 1.61, 6.30). Significant independent predictors of ADL dependency were cognitive impairment (OR= 6.85, 95%CI=1.82, 24.90), severe neurological impairment (OR=5.18 95%CI=1.07, 25.08) , post stroke dysphagia (O.R. = 3.82, 95% C.I. = 1.28, 11.38), severe functional impairment on admission (O.R.=18.58, 95%C.I. = 2.13, 161.94)

Conclusion: Significant number of stroke patients are depressed and cognitively impaired during hospitalization, which are, significant factors associated with ADL dependency in stroke patients.

Background And Literature Review

Definition:

Stroke, according to W.H.O. definition is, "a syndrome of rapidly developing clinical signs of focal or global disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin". This includes subarachnoid hemorrhage but excludes transient Ischemic attack (TIA), subdural haematoma and hemorrhage or infarction caused by infection or tumor.[1]

Categories of cerebrovascular accident (C.V.A.) include ischemia-infarction and intracranial hemorrhage.[2]

Cerebral ischemia is caused by a reduction in blood flow that lasts for several seconds to a few minutes. The neurological symptoms are manifested within 10 seconds because neurons lack glycogen and suffer rapid energy failure.[2] Cerebral hemorrhage produces neurological symptoms by producing a mass effect on neural structures or from the toxic effects of blood itself.[2]

Frequency and important causes of ischemic & hemorrhagic Stroke [2]

Stroke Subtype:	**Frequency**(%)	**Important Causes:**
Ischemic Thrombotic / Embolic	85%	Atherosclerosis of intracranial arteries Atrial Fibrillation; Mural Thrombus; Myocardial infarction.

Stroke Subtype:	**Frequency**(%)	**Important Causes:**
Hemorrhagic Intraparenchymal / Subarachnoid	15 %	Hypertension; Arteriovenous malformation. Ruptured aneurysm.

Global Scenario of Stroke:

Stroke is one of the major global health concerns. Worldwide stroke is the second most common cause of death after ischemic heart disease.[3] It leaves behind 4.38 million people dead and 9 million stroke survivors in a year with two third of the stroke deaths occurring in non-industrialized countries.[1, 3] Hence among the non-communicable diseases stroke has one of the highest mortality rates.

Overall in the world Cerebrovascular disease has been projected to be the fourth most common cause of disability adjusted life years (DALY) by 2020 after ischemic heart disease, unipolar depression and road traffic accidents.[4] DALY was developed to assess the global burden of disease. It is calculated as the sum of years of life lost and years of life lived with disability. [3]

The overall incidence rate of stroke is around 2-2.25 per thousand population and a total prevalence rate is around 5 per thousand population.[1] It has been estimated that one in four men and nearly one in five women aged 45 years can expect to have stroke if they live to their 85 th year.[1]

Although the life time risk of having an acute stroke is higher in men than women, the converse is true for the life time risk of dying of a stroke.[1] Double the number of females (about 16%) are likely to die as compared to males (about 8%) and this has largely been attributed to the higher mean age at stroke onset in women.[1]

Stroke is one of the most disabling diseases being the leading neurological cause of disability in the elderly in industrialized countries. [5] More than half of the survivors of severe stroke remain severely disabled [6] and after completed rehabilitation in Stroke units, only a third of those who survive are discharged back to their own homes to a somewhat independent life, with no or only mild or moderate disability.[7] One year after stroke onset, only 65% of the patients are functionally independent.[1]

Stroke also has a great economic impact. It has been estimated that the cost of stroke in U.S. is 30 billion dollars annually. Out of this 30 billion dollars, 17 billion dollars is the direct cost i.e. total hospital, physician, rehabilitation and equipment charges and 13 billion dollars is the indirect cost in terms of lost productivity.[8] Total cost of acute hospitalization accounts for only 20% of the total direct and indirect costing of stroke[8]

Stroke not only causes significant physical health and economic burden world over but also has psychosocial effects, which directly or indirectly affects

the recovery.

Depression has been reported as the most probable frequent emotional disorder that occurs after stroke. [9,] The prevalence of post stroke depression varies from 20-65% [9, 10.] Inspite of such a high prevalence of post stroke depression, it is commonly unrecognized and untreated in clinical practice. [10.]

Overview of Stroke in Singapore:

Stroke has been the third leading cause of death in Singapore after ischemic heart disease and cancer since 1970 and comprises 10-12% of all deaths, [11,14] though it slipped to fourth position in 1995 after pneumonia.[14]

Age and sex standardized death rate of stroke patients in Singapore has seen a downward trend and this has mainly been attributed to decrease in risk factors for stroke in the local population.[11] There are also ethnic differences in stroke mortality rates in Singapore with Malays having the higher rate as compared to Chinese and Indians.[12]

Substantial numbers of stroke patients have been found to be functionally dependent after hospital discharges. N P Fong et al [17] in their three month prospective study on stroke patients in Singapore found that 63.3% of the stroke patients were still moderately or severely impaired.

Similarly substantial numbers of stroke patients have also been found to be depressed during their rehabilitation. Chan Keen et al [18] in their prospective study in Singapore found that the percentage of stroke patients who were depressed on admissions and upon their discharges from the hospital was 55 % and 28.6% respectively. They had diagnosed depression in their study subjects using Hamilton depression scale and psychiatric examination using DSM-III revised criteria.

Likewise significant number of elderly patients are demented. Kua et al [19] in their study found the overall prevalence of dementia to be 1.8%. They also found that this rate increased to 4.8% for those who were 80-84 years of age and 12% for those who were 85 years and more. Hsein et al [20] in their study on elderly Chinese population found the prevalence of cognitive impairment to be 7.7% when diagnosed by the assessment tool ECAQ and 13.2% when IQCODE was used as an assessment tool.

In Singapore the mean cost per discharge for acute stroke patients has been reported to be 7,547 Singapore dollars with a range of 320-68,614 Singapore dollars. The break up of this expenditure has been reported as 38.2% of the charges as ward fee, 14.5% as radiology fee, 10.3% as doctor's fee, drugs and therapy making 8.4% and 7.3% of the total charges respectively.[13] The mean length of stay in acute care hospital is 17 days.[13] The cost of hospital care has been reported to be highly co-related to length of hospital stay.[13]

The graying population (more than equal to 65 years) in Singapore is constantly increasing. It has increased from 3.3% to 4.9% to 6.6% of the total population since 1970 to 1980 to1990.[11,16] and is expected to be 20.0 % of the total population by 2030[16]. An important factor responsible for the graying of the population is the ageing of the baby boomers (the cohort born between 1945 – 1955) [16]

Since ageing is an unmodifiable risk factor for stroke [14, 15] hence with the expected increase in the ageing population in Singapore, the number of hospital admissions, mortality and morbidity from stroke is expected to increase.

Outcomes of Stroke:

(1) Functional recovery:

Henrik et al[21] in their research study on 223 patients found that patients with most severe stroke who achieve a good functional outcome (Barthel index > = 50) are generally characterized by younger age, the presence of a spouse at home, and early neurological recovery. They did not find comorbid conditions to be significantly related to functional recovery.

Meins et al [22] found in their prospective study on 302 patients that independence in ADL as assessed by Barthel index > = 85, 24 months after discharge, was 43.2% and it's significant predictors were barthel index > = 50 on admission, urinary continence and absence of coronary artery disease.
They also found that good functional outcome as assessed by Modified Rankin Score of < = 3, 24 months after discharge, was 38.4% and it's significant predictors were urinary continence, absence of coronary artery disease, admission barthel index score of > = 50, mild motor paresis and good sitting balance.

K C Johnston et al [23] in their research study on 256 patients found that the increasing age, severity of stroke at onset and prior disability are significant predictors of poor outcome as assessed by barthel index < 60 or death.

Maurizio et al [24] in their prospective study on 3628 patients found that impaired consciousness on admission, limb weakness, progressive worsening of infarct,

ischemic heart disease, cardiac arrythmias were significant predictors of severe disability on discharge. In their study they did not find age to be an independent predictor of poor outcome but found hypercholesterolemia to be related significantly to a better outcome.

Margaret et al [25] in their research study on 3760 patients from 96 rehabilitation facilities constructed a predictive index using logistic regression to achieve the following, viz. eating, grooming, and dressing the upper body, continence in bladder and bowel and transfer between a bed and chair with supervision only. They found that this stage was achieved by 26.1% of the patients functioning below it at rehabilitation admission. Significant factors in the predictive index were disability onset of less than 60 days, living alone, employed before stroke. They also found that 95.3% of the patients who achieved this were discharged home as opposed to only 66.8% of those who did not achieve this.

Peter Appelros et al [26] in their prospective study on 377 subjects found that 1 year mortality was 33%. After 1 year , 37% of the survivors were dependent and 9% of the survivors had a recurrent stroke within a year. In their study they found that dependency was associated with age, stroke severity and heart failure.

H. Henn et al [27] in their prospective study on 152 patients found that dependency (score of 3-5 on Glasgow outcome scale) at 3 months was related to severity of clinical deficit at stroke onset, previous stroke and increasing age.

Likewise Marco et al [28] in their prospective study found that increasing age and clinical deficit at stroke onset predicted the poor outcome (as assessed by death or score of > = 3 on Rankin scale) at 4 months following stroke.

N.A. taub et al [29] in their prospective study found that at 3 months after stroke onset 9% were severely disabled, 15% were moderately disabled and at 12 months 11% had moderate or severe disability for which initial incontinence was a significant predictor.

Stefano et al [30] in their 1 year prospective study 172 patients found that 43.3% of the patients maintained the level of functional ability which they achieved during inpatient rehabilitation treatment, 23.6% improved and the remaining 23.6% worsened. They found that the patients more than 65 years of age and with hemineglect had a higher probability of worsening. They also found that post discharge rehabilitation (performed by 46.5% of the final sample) was significantly and positively associated with functional improvement and it's absence was associated with functional worsening.

Henrik et al [31] in their prospective study on 1000 patients found that stroke type had no influence on mortality, neurological outcome, functional outcome or the time course recovery. They found that severe stroke at onset had an adverse prognostic value on the stroke outcome.

M.R. Frankel et al [32] in their study found that co morbidities like diabetes mellitus, hypertension, and ischemic heart disease and type of stroke do not predict the functional outcome in stroke patients though Maurizio et al [24] in their prospective study on 3628 patients found ischemic heart disease and cardiac arrhythmias as significant predictors of severe disability at discharge. They also found that impaired consciousness on admission, limb weakness, progressive worsening were also predictors of severe disability on discharge.

(2) Post stroke dementia & Cognitive impairment:

In different research studies varying percentages of post stroke dementia & cognitive impairment have been reported.

T. Pohjasvaara et al [33] in their study on 337 patients between 55-85 years of age at three months after stroke found that 31.8% of the patients had post stroke dementia (107/337); 28.4% had stroke related dementia (Alzheimer's disease plus vascular dementia excluded); and 28.9% had dementia after first ever stroke. For the diagnosis of dementia they had done the clinical examination of the patients using DSM-III criteria They also found a significant relationship between dementia and dysphasia, major dominant stroke syndrome, history of previous cerebrovascular disease and low educational level.

Raquel et al [34] in their prospective study on 251 patients found that 75 (30%) patients were demented at three months follow up. 25 patients had dementia before the stroke onset. They had assessed dementia in the patients on the basis of

clinical examination using DSM-IV criteria. In their research study they found that the significant correlates of dementia were increasing age, previous nephropathy, atrial fibrillation, severe neurological impairment & previous mental decline.

Domenco et al [35] in their prospective study at stroke onset and one year after stroke onset found that 57 (16.8%) of the patients had post stroke dementia. They had used a proxy-informant interview based on ICD-10 criteria for diagnosing dementia.. They found that post stroke dementia was significantly related to atrial fibrillation, aphasia & severity of stroke at onset.

David et al [36] in their prospective study on 453 patients found that mortality rate was 15.90 deaths /100 person years among the demented patients against 5.37 deaths / 100 person years among the non-demented group. They also found that dementia is a significant predictor for decreased survival even after adjusting for other known predictors of mortality. They had diagnosed dementia in patients using modified DSM-III revised criteria.

H. Henon et al [37] in their prospective study on 202 subjects found that independent predictors of post stroke dementia are aging, pre-existing cognitive decline, severity of deficit on admission, diabetes mellitus and silent infarcts.

David et al [38] in their cross sectional study found that the crude incidence rate of

dementia was 8.49 cases/ 100 person years in stroke patients and 1.37 cases per 100 person years in control. They also concluded that cerebral hypo- perfusion is the basis for some cases of dementia after stroke.

D.W. Desmond et al [39] in their research study on 453 patients at three months after stroke found that 119/453 (26.3%) of the stroke patients were demented and the significant predictors of dementia were location of lesion, severity of the presenting stroke, diabetes mellitus, previous stroke, old age, low education and non-white ethnicity. They had diagnosed dementia using DSM-III revised edition criteria.

L. Zhu et al [40] in their 3 year prospective study on 1551 subjects of more than 75 years of age with no sign or history of stroke found that the incidence of stroke was 26.8 per 1000 person years. Subjects with mild dementia had a relative risk of 2.6 of developing stroke after controlling for the confounding factors. They also found out that the subjects with cognitive impairment had a relative risk of 2.0 of developing stroke. Hence mild dementia and cognitive impairment are associated with an increased incidence of stroke among the subjects more than equal to 75 years of age. They had assessed patients for dementia using revised DSM-III criteria and had assessed them for cognitive decline using MMSE scale.

Li Zhu et al [41] in their cross sectional study found that the stroke patients were 3 times more demented than those without stroke (O.R.= 3.6) and that stroke was

also significantly associated with cognitive impairment without dementia (O.R.= 2.4). In their research study they also concluded that the population attributable risks of dementia and cognitive impairment in relation to stroke were 18.4% and 8.5% respectively. They had assessed patients for dementia using revised DSM-III criteria and cognitive assessment was done using MMSE scale.

Steffano et al [42] in their prospective study on 273 study subjects found that cognitive impairment is a significant predictor of poor functional outcome in stroke survivors even after adjusting for age and severity of stroke. For cognitive assessment they had done neuropsychological examination to detect the presence of hemispatial neglect and language disorders in the patients.

Likewise Tarja et al [43] in their research study on 486 patients at 3 months after stroke found that cognitive impairment has an important functional consequence on the stroke patients. Cognitive assessment was done using MMSE scale.

T. Pohjasvaara et al [44] in their prospective study at 3 and 15 months on 486 patients found that worsening in cognition and worsening of depression between 3 and 15 months follow up had an independent effect on the dependent living 15 months after ischemic stroke. Cognitive assessment was done using MMSE scale.

Mahito et al [45] in analyzing data from a double blind trial found that the depressed

patients whose depression remitted had significant recovery in cognitive function as compared to the patients whose mood did not remit. They had assessed the change in cognition using MMSE scale.

R.M. Parekh et al [46] in their prospective study on 103 patients did not find a significant correlation between depression and cognitive impairment. Whereas R.G. Robinson et al [47] in their prospective study on 103 patients found a significant relationship between depression and cognitive impairment.

C.S. Kase et al [48] in their prospective study on 74 patients found that there was a significant decline in the cognitive function when the pre and post stroke cognitive performance was measured. They also found that the depression was frequent in stroke patients but the intellectual decline in stroke patients is independent from presence of depression.

(3) Post stroke depression:

Depression has been reported to be the most probable frequent emotional disorder occurring after stroke.[9] The reported frequency of post stroke depression in different studies ranges from 20- 65%. This wide variation of post stroke depression is due to different criteria for patient selection and study done over a different time period following stroke.[9]

Post stroke depression goes commonly unrecognized and untreated in clinical practice.[10]

Eran et al [9] in their prospective study found that the patients whose mood improved had a greater recovery in ADL than the patients whose mood did not improve. They had diagnosed depression in the patients on the basis of a structured psychiatric examination and DSM-1V diagnostic criteria.

Tarja et al [10] studied a consecutive series of 486 patients with ischemic stroke aged from 55 to 85 years. Of these, 277 patients underwent a comprehensive psychiatric evaluation, including the Present State Examination, from 3 to 4 months after ischemic stroke. The criteria of the Diagnostic and Statistical Manual of Mental Disorders, (DSM-III -R) were used for the diagnosis of depressive disorders. They found that the frequency of any depressive disorder was 40.1% (n=111). Major depression was diagnosed in 26.0% (n=72) and minor depression in 14.1% (n=39). Major depression with no other explanatory factor besides stroke was diagnosed in 18.0% (n=49) of the patients. Comparing depressed and non depressed patients , they found no statistically significant difference in sex, age, education, stroke type, stroke localization, stroke syndrome, history of previous cerebrovascular disease, or frequency of DSM-III-R dementia. According to the multiple logistic regression model, dependency in daily life correlated with the diagnosis of depression and with the diagnosis of major depression A history of previous depressive episodes also correlated with the diagnosis of depression and with the diagnosis of major depression, whereas solely stroke-related major depression correlated with stroke severity as measured on the Scandinavian Stroke Scale .

Mervi et al [49] in their prospective study on 594 patients found that age and neurological impairment were significant predictors of depression. They also found that among the depressed stroke patients who were given some therapy (extra rehabilitation and social encouragement), 41% of the patients with active programs were depressed as compared to 54% in the control group. They had used Beck`s Depression Inventory (B.D.I.) for diagnosing depression.

In a 3 month and 1 year prospective study on 150 patients N. Herrmann et al [50] found that depressed stroke patients were more females, more neurologically impaired and had more previous history of depression as compared to non-depressed patients. In their study they also found out that depression was not co-related to age, side of lesion or lesion volume. They also found that at three months marked depressive symptoms were 22% to 27% and 21% to 22% at 1 year by Zung self Rating scale and Montgomery Asberg Depression Rating Scale respectively.

Stefano et al [51] in their case control study on 290 patients found that depressed patients despite of having the same neurological impairment as non-depressed patients, were more ADL disabled on admission and on discharge.They also found that both the depressed and non-depressed stroke patients made the same average functional recovery but the non-depressed patients were twice as likely to show excellent recovery on ADL as compared to the non-depressed group. They had assessed patients for depression using Hamilton depression scale and clinical

examination.

Likewise Philip et al [52] in their prospective study on 49 study subjects at 2 and 14 months after stroke onset found that the mean recovery in ADL was not statistically different between the depressed and the non-depressed patients but more depressed patients deteriorated overtime.

Allen et al [53] in their prospective study on 448 patients found that depression was correlated to mortality at 12 and 24 months. They had assessed mood symptoms by the Present State examination and the General Health Questionnaire (GHQ)-28.

Ng K C et al [54] in their prospective study on 52 patients found that 52% of the patients were depressed. They found that depression was significantly associated with degree of functional impairment but no significant association was found between depression and type, site of stroke and with cognitive impairment. They had diagnosed depression in the patients using Hamilton depression scale and clinical examination of the patients.

Jong-ling et al [55] in their cross sectional study on 1471 patients found that 62.2% of the patients were depressed as compared to 33.4% of the non-stroke patients and depression score correlated highly with ADL living. Depression in the patients was diagnosed using Geriatric Depression Scale.

M.L.Kauhamen et al [56] in their prospective study on 106 patients found that 53% of stroke patients were depressed at 3 months and 42 % of the patients were depressed at 12 months. They also found that depressed patients were more functionally dependent and more neurologically impaired as compared to non-depressed patients and there was a significant association between post stroke depression and cognitive impairment. They diagnosed depression in the patients using DSM-III-R criteria.

Michael et al [57] in their research study on stroke patients found that 18% of the patients were depressed 3-5 years after stroke and depression was co-related to functional dependence, female gender and large lesion volume. They had assessed depression in the patients using DSM-III-R criteria.

Peter et al [58] in their prospective study on 191 patients found that post stroke depression correlated with major functional impairment, living in a nursing home, being divorced and was not associated with age, gender, social class, cognitive impairment and prestroke physical illness. Depression in the patients was diagnosed using DSM-III criteria.

In the met analysis on 48 reportings done by Alan et al [59] regarding lesion location and post stroke depression, no significant association was found between the two variables..

4. MORTALITY:

Risk of death following stroke increases with increasing age. [60, 61, 62, 64]

and with the presence of co-morbid conditions like Ischemic heart disease [62, 69]and atrial fibrillation [60, 62, 69] and recurrent stroke [62] though Megherbi et al [70] in their study found that diabetes mellitus is not significantly correlated to mortality in stroke patients.

5.RECURRENCE OF STROKE:

Stroke recurrence is associated with increased chances of death.[71]

Increasing age has been found to be significantly correlated to recurrence of stroke.[62, 65]

Patients with PICH are at risk for both ischemic stroke or TIA and recurrent hemorrhage [74]

Diabetes mellitus [62], atrial fibrillation, [75] hypertension [60], myocardial Infarction, [60] major hemispheric stroke syndromes [75] have been found to be correlated with recurrence of stroke.

History of TIA, male gender, atrial fibrillation and hypertension have been found to be significantly correlated to recurrence of stroke . [71]

6. **EPILEPSY:**

Stroke patients with more severe stroke at onsets have more chances of developing seizures [66,77]. Seizures are more common after hemorrhagic strokes than after infarctions, [66,76] in younger patients and in patients with more cortical

involvement.[76] Early post stroke epilepsy has been found to be independently correlated to in-hospital mortality. [67, 77]

Epilepsy as a complication in stroke patients has been observed to occur earlier as compared to the other complications such as pain and depression [78]

Epilepsy has been found to be significantly correlated with poor functional recovery and poor quality of life in stroke patients.[84]

Early post stroke onset epilepsy has been significantly found to be the predictor of late epilepsy [81, 85] and poor functional outcome. [85]

7. FALL:

Patients who fall during their rehabilitation in hospitals have been found to be more likely to fall post discharge as well [82]. Various associated risk factors for fall after stroke are increasing age [86], heart disease [83, 86] urinary incontinence [83] and depression [73, 80, 82, 86] Most falls occurred during transfers or from sitting in a wheelchair or on some other kind of furniture. [79]

8. **Urinary incontinence:**

Post stroke urinary incontinence is more commonly seen in the aged stroke patients than the younger ones.[87,88] Stroke patients with urinary incontinence have more institutionalization rates than those who are continent. [89.]

Urinary incontinence on admission is associated with poorer functional outcome.[91]

Stroke patients with urinary incontinence have more chances of mortality than the continent patients. [89, 90]

Increasing age, diabetes mellitus and severity of stroke have been identified as the factors significantly associated with post stroke urinary incontinence.[92]

Summary:

After reviewing some of the previous research studies on stroke patients we can conclude that even though the intense research is going on for years now in the area of stroke, still a consensual agreement on relationships between different predictors, associated factors and various clinical and psychosocial outcomes of stroke has not been reached. For example younger age has been found to be significantly associated with better functional outcome following stroke [21,23] but Maurizio et al [24] in their study did not find age to be significantly associated with functional recovery in stroke patients. Similarly increasing age has been found to be a significant predictor for post stroke depression but N. Hermann et al [50] did not find age to be significantly associated with post stroke depression.

Likewise R.M. Parekh et al [46] did not find significant relationship between depression and cognitive impairment but R.G. Robinson et al [47] found a significant relationship between cognitive deficits and depression in stroke patients.

Aims of the study:

The aims of this study are:

1. To describe the prevalence of functional impairment and rate of functional recovery in stroke patients during their rehabilitation in community hospitals.
2. To determine the rates of depression and cognitive impairment associated with stroke.
3. To evaluate the factors associated with post stroke depression, post stroke cognitive impairment and functional recovery.
4. To evaluate whether post stroke depression and cognitive impairment were independently associated with functional recovery.

Method And Materials

Study Design:

An Observational Cohort Study.

Study Setting:

In-Hospital clinical data set was collected from two community hospitals in Singapore, Ang Mo Kio Community hospital and St. Luke's Hospital.

In both the community hospitals stroke patients are referred from the acute care hospitals. In community hospitals post acute, step down medical and rehabilitation care is given to the stroke patients.

Study Period:

Clinical data set was collected at the point of admission of the patients to the two community hospitals and upon their discharges from the hospitals.

The clinical data was collected from both hospitals from 9/04/02 – 10/09/02

Study Subjects:

Stroke patients were recruited for the study from the two community hospitals with certain inclusion and exclusion criteria.

Inclusion Criteria:

(a) All Stroke patients fulfilling the criteria of W.H.O. definition of stroke, viz. Rapidly developed clinical signs of focal disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than vascular origin. Sub-arachnoid hemorrhage included.

(b) Singapore Citizens / Permanent Residents.

Exclusion Criteria:

(a) Unconscious Patients.

(b) Severe Aphasia.

Methods:

The Stroke patients falling under inclusion criteria were examined at two different points after seeking their informed verbal consent, viz.

(a) Upon their admissions to the two community hospitals.

and

(b) Upon their discharges from the community hospitals.

The Clinical data set was collected on daily basis from the community hospitals. Information pertaining to certain variables was retrieved from the case sheets . Also the patients were examined neurologically using NIHS Scale, functionally using Barthel Index and for depression and cognitive impairment using Geriatric Depression Scale and Abbreviated Mental Test respectively, by a qualified medical doctor with the help of an interpreter for non english speaking patients.

Information on the following variables was recorded upon the admission of patients to the hospitals.

Socio-Demographic Variables:

(1) Name & Nric No.

(2) Age.

(3) Gender.

(4) Date of Admission to acute care hospitals.

(5) Date of Admission to community hospitals.

(6) Marital Status (Married, Unmarried or Divorced/ widow/er).

(7) Education (Less than equal to secondary or more than secondary level).

(8) Living Arrangement (Family member or Non Family member).

(9) Care Giver (Present or absent.).

Neurological Variables:

(1) Severity of Stroke as assessed by NIHS Scale.

(2) Lesion Type (Hemorrhage or Infarction).

(3) Lesion Location (Cortical or Non Cortical).

(4) Lesion Distribution (Focal or Multi focal. If multifocal, then is the stroke recurrent or non recurrent).

(5) Post Stroke Dysphagia. (Present or Absent).

(6) Post Stroke Urinary Incontinence. (Present or Absent).

(7) Post Stroke Aspiration Pneumonia. (Present or Absent).

(8) Post Stroke Epilepsy. (Present or Absent).

(9) On Admission Ryles tube (Present or absent).

(10) On Admission Urinary Catheter (Present or absent).

Clinical and Functional Status:

(1) Activities of Daily life as assessed by Barthel Index..

(2) Visual Impairment (Present or absent).

(3) Hearing Impairment (Present or absent).

(4) Cognitive Impairment as assessed by Abbreviated Mental Test.

(5) Depression as assessed by Geriatric Depression Scale.

(6) Hypertension (Present or Absent).

(7) Diabetes (Present or Absent).

(8) Smoking (Present or Absent).

(9) Ischemic Heart Disease (Present or Absent).

(10) Atrial Fibrillation (Present or Absent).

(11) Hyperlipidaemia (Present or Absent).

Information on the following variables was collected for the patients who were shifted back (unplanned discharges) to acute care hospitals because of the complications they had developed during their hospitalization:

(1) Diagnosis of the medical complication/s.

(2) Date of medical complication/s.

The information on the following variables was recorded at the point of discharge (planned -discharges) of the patients from the two hospitals:

(1) Date of discharge.

(2) Destination of discharge (own home, nursing home)

(3) Neurological impairment as assessed by NIHS Scale.

(4) Activities of daily life as assessed by Barthel Index.

(5) Cognitive Impairment as assessed by Abbreviated Mental Test.

(6) Depression as assessed by Geriatric Depression Scale.

Clinical Definitions and Measurements:

Definitions of the different terminologies used in the study are as follows:

(1) *Stroke*: Rapidly developed clinical signs of focal disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than vascular origin. Sub-Arachnoid hemorrhage included.

(2) *Care Giver*: A person whom the patient identified as his/her main care giver.

(3) *Visual Impairment:* Visual acuity was tested using finger counting method.

(4) *Hearing impairment*: Hearing ability was tested using the whispering method.

(5) *Vascular Risk Factors*:

(a) *Hypertension:* Previous diagnosis or current antihypertension treatment or blood pressure values during admission of more than 160/90 mm of Hg. on more than equal to two recordings taken after clinical stabilization.

(b) *Diabetes Mellitus:* Previous diagnosis or current treatment with insulin or oral antidiabetics or fasting serum glucose of more than equal to 7.8 mmol/L (>140mg/dl)

(c) *Ischemic Heart Disease*: Previous diagnosis or history of typical symptoms with evidence/s on various diagnostic tool e.g. E.C.G., Serum Enzyme level/s, Echocardiogram.

(d) *Atrial Fibrillation*: History of chronic atrial fibrillation, confirmed by at least 1 E.C.G. or presence of the arrhythmia during hospitalization.

(6) *Planned discharge*: If the patient was duly discharged from the community hospital either to his/ her own home or to a nursing home then it was defined as a planned discharge.

(7) *Unplanned discharge*: If the patient had developed some medical complication during the stay in the community hospital and was subsequently shifted to acute care hospital then it was defined as an unplanned discharge.

(8) *Severity of Neurological Impairment:* Neurological impairment of the stroke patients was assessed by using NIHS Scale.[93-95] It includes items to assess level of conscious, gaze, visual fields, facial palsy, motor strength, ataxia, sensory system language, dysarthria and extinction/ inattention. The scale scores from 0-42 with 42 as severe neurological impairment.

NIHS Scale has been shown to have intra and inter-rater reliability [93]. It has predictive validity for long term stroke outcome [94] and has been shown to predict post acute care disposition among stroke patients as well.[95]

It was divided into three categories, viz. mild, moderate and severe neurological impairment with the following cut-off scores: (a) 1-6 as mild impairment (b) 7-12 as moderate impairment (c) 13-42 as severe impairment.

(9) *Functional impairment*: Activities of daily life were assessed using Barthel Index.[99] It is a 10 item scale used to measure activities of daily living. It's score ranges from 0-100 with a score 100 meaning complete independence. It includes activities such as grooming, walking, bladder/ bowel control, dressing, climbing stairs, feeding and bathing.

It was divided into three categories, viz. mild, moderate and severe functional impairment with the following cut-off scores:

(a) 0-50 as severe impairment (b) 51-75 as moderate impairment (c) 76-99 as mild impairment.

ADL Dependency: It was defined as the barthel index score less than equal to 50 at the time of planned discharge from the hospitals.

(10) *Depression*: Depression was defined using Geriatric Depression Scale (Short Form). [97,98] The short form scores from 0-15, on a 15 item questionnaire, with a score of > 5 points suggestive of depression .

Geriatric Depression Scale (Short form) has been found to be a suitable instrument to diagnose depression in the general population [97] and in the elderly Chinese population in Singapore with a sensitivity of 84% and a specificity of 85.7% [98]

It was divided into no depression and depression with the following cut off points:

(a) 0-4 as no depression. (b) 5-15 as depression

(11) *Cognitive impairment*: Cognitive impairment was assessed using Abbreviated Mental Test (A.M.T.).[96] It is a 10 item scale. This scale scores from 0-10 with a score of less than equal to 7 indicating cognitive decline. In elderly patients AMT has been shown to give predictive information about cognitive status as determined by MMSE and also a prediction of likely MMSE score.[96] Abbreviated Mental Test is a validated scale to identify cognitive impairment in older Chinese population .[103] Abbreviated Mental Test has been found to have a sensitivity of 97% and 91% for the patients 60-74 years of age and 75 years and above respectively , the specificity being 83% and 100% respectively in the older Chinese population. [103]

It was divided into cognitive impairment present or absent with the following cut off points:[103]

(a) 0-7 as cognitive impairment present (b) 8-10 as no cognitive impairment.

Data Analysis:

The data set was uploaded in the SPSS data file and analyzed using Statistical package for social sciences (SPSS), version 11.0.

Statistical analysis used to assess three outcomes in the research study were:

(1) Post stroke depression (As assessed on admission to the community hospitals):

(a) Prevalence of depression in stroke patients on admission and on discharge.

(b) Univariate logistic regression analysis was done to find out significant factors associated with post stroke depression (on admission)

(c) Multivariate backward logistic regression at probability level for entry at .05 and removal at .10 was done to establish a predictive model for post stroke depression (on admission to community hospitals). Backward logistic regression technique was used as it was the most parsimonious model.

(d) Univariate logistic regression analysis was done to find out significant factors associated with recovery from depression.

(e) Multivariate forward logistic regression analysis was done at probability level for entry at .05 and removal at .10 to find out the factors associated with recovery from depression.

(2) Post stroke cognitive impairment (As assessed on admission to community hospitals):

(a) Percentages of cognitively impaired patients on admission and from the community hospitals.

(b) Univariate logistic regression analysis was done to find out significant factors associated with post stroke cognitive impairment (on admission)

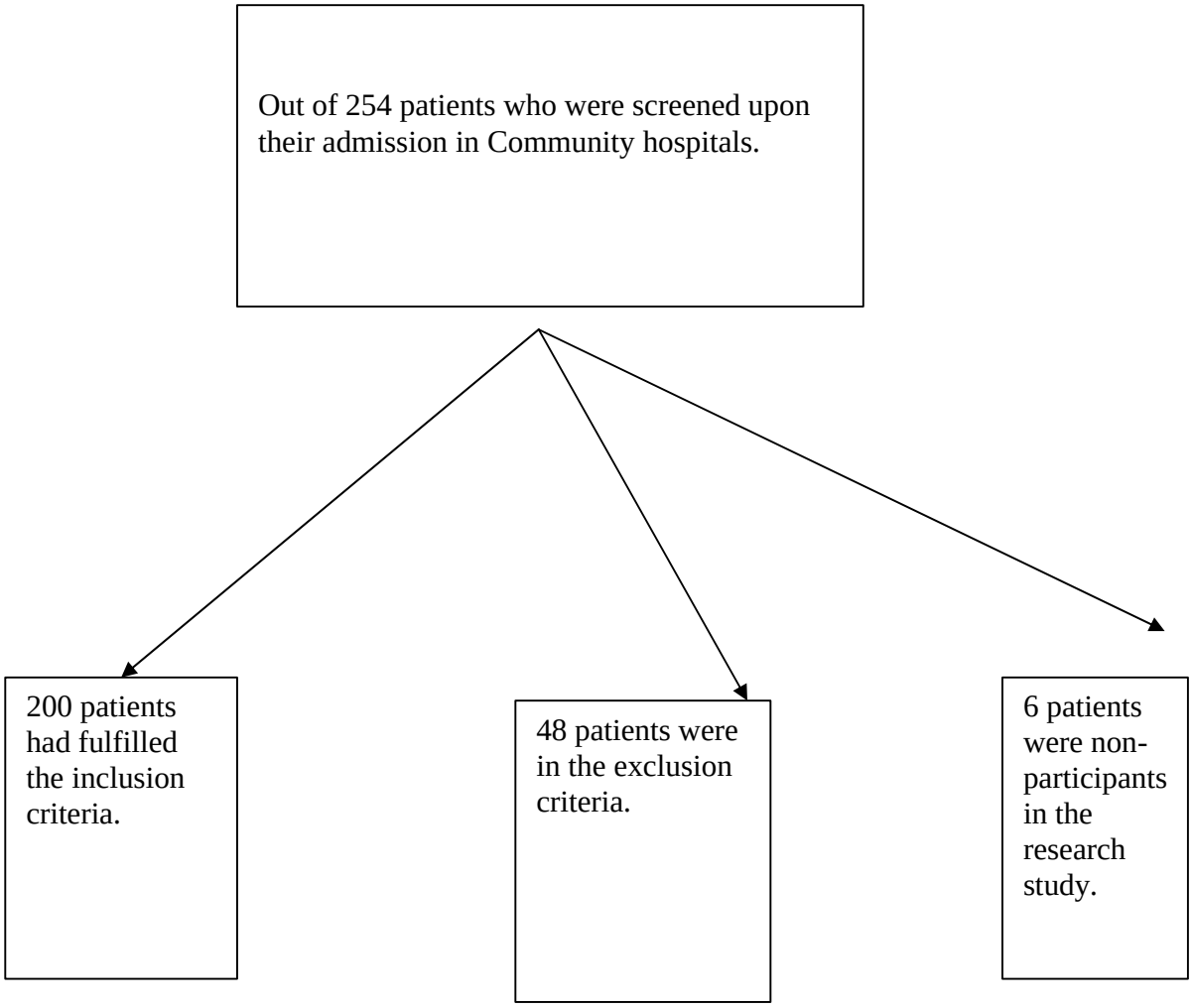
(c) Multivariate forward logistic regression at probability level .05 and removal at 0.10 was done to establish a predictive model for post stroke cognitive impairment (on admission to community hospitals)

(2) *ADL Dependency on planned discharges from the hospitals:*

Predictors of ADL dependency were identified using univariate logistic regression. The significant predictors were then put into multivariate forward logistic regression at probability level for entry at .05 and removal at .10 to build a predictive model for ADL dependency, which was defined as Barthel Index score of less than equal to 50 on planned discharge from hospitals.

(N.B.): Multivariate forward logistic regression was used to establish the predictive models for recovery from depression; post stroke cognitive impairment; ADL dependency whereas backward logistic regression was used to establish the predictive model for post stroke depression as they were the most parsimonious models respectively for the outcomes of interest.

Results


Out of 254 patients who were screened upon their admission in Community hospitals.
200 patients had fulfilled the inclusion criteria.
48 patients were in the exclusion criteria.
6 patients were non-participants in the research study.

1 Description of the study population:

1.1Socio-Demographic Variables: (Ref.: Table 1)

(1) *Age:* 31.5% (n= 63) of the patients had age less than 65 years, 49.5% (n=99) and 19% (n= 38) had age between 66-80 years and more than 81years respectively.

(2) *Gender:* 54.5% (n= 109) of the patients were males.

(3) *Ethnicity:* 88.5% (n= 177) patients were Chinese and 7% (n=14) and 4.5% (n=9) were Malays and Indians respectively.

(4) Marital status: 50.5% (n=101) of the patients were married, 6.5 %(n=13) were unmarried and 43% (n= 86) were either widow/er or divorced/ee.

(5) *Living arrangement:* 10% (n=20) of the patients were living alone

(6) *Care Giver*: 12.5% (n=25) of the patients did not have a care giver.

(Table 1): *Frequencies of different Socio-Demographic variables***:**

Socio-demographic Variables		**Number: 200 (%)**
Age:	Less than 65 years:	63 (31.5%)
	66-80 years:	99 (49.5%)
	More than 81 years	38 (19%)
***Gender* :**	Males	109 (54.5%)
	Females	91 (45.5%)
Ethnicity:	Chinese:	177 (88.5%)
	Malay:	14 (7%)
	Indian	9 (4.5%)
Marital Status:	Married:	101 (50.5%)
	Unmarried:	13 (6.5%)
	Widow/er/Divorced/ee	86 (43%)
Education Level:	Less than equal to secondary:	168 (84%)
	More than secondary level:	32 (16%)
Living Arrangement:	Living with Someone	180 (90%)
	Living Alone:	20 (10%)
Care Giver:	Present:	175 (87.5%)
	Absent:	25 (12.5%)

1.2 Clinical Variables: (Ref. Table 2)

(1) Length of stay in the hospitals:

The mean length of stay in acute care hospital was 15.2 days (S.D. = 9.5) and the mean length of stay in community hospital was 34.4 days (S.D. = 18.4) for the planned discharges and 21.0 days (S.D. = 11.8) for unplanned discharges.

(2) Mean NIHS and B.I. scores on admission and on discharge:

Mean NIHS score on admission was 7.7 (S.D = 4.0) and upon discharge was 4.5 (S.D. = 2.9). Mean Barthel Index score on admission was 47.2 (S.D. = 27.7) and upon discharge was 71.1 (S.D. = 20.0).

(3) Visual and Hearing Impairment:

10% (n = 20) patients were visually impaired and 5% (10) had hearing impairment.

(4)Co morbidities:

87.5% (n = 175) of the patients had hypertension,

47% (n = 94) had diabetes mellitus, 45.5% (n = 91) were smokers,

22.5% (n =45) had ischemic heart disease, 7% (n = 14) had atrial fibrillation and 72% (n = 144) of the patients had hyperlipdaemia.

(5) Depression and cognitive impairment:

Upon admission 60% (n = 120) of the patients were depressed and 54.5% (n = 109) of the patients had cognitive impairment.

(6) Functional Impairment:

On admission 4.5% (n= 9) of the patients had mild functional impairment, 42% (n= 84) and 53.5% (n= 107) of the patients had moderate and severe functional impairment on admission.

Table 2: ***Frequencies of Clinical Variables***:

Clinical Variables		**Number: 200 (%)**
Visual Impairment:	Present:	20 (10%)
	Absent:	180 (90%)
Hearing Impairment:	Present:	10 (5%)
	Absent:	190 (95%)
Hypertension:	Present:	175 (87.5%)
	Absent:	25 (12.5%)
Diabetes Mellitus:	Present:	94 (47%)
	Absent:	106 (53%)
Smoking:	Present:	91 (45.5%)
	Absent:	109 (54.5%)
Ischemic Heart Disease:	Present:	45 (22.5%)
	Absent:	155 (77.5%)
Atrial Fibrillation:	Present:	14 (7%)
	Absent:	186 (93%)
Hyperlipidaemia:	Present:	144 (72%)
	Absent:	56 (28%)
Cognitive Impairment: (A.M.T.)	Present:	109 (54.5%)
	Absent	91 (45.5%)
Depression (G.D.S.)	Present:	120 (60%)
	Absent	80 (40%)
Mean Length of stay in Acute Care Hospitals: (S.D.)		15.12 Days (9.56)
Mean Length of stay in Community Hospitals: (S.D.) ***(Planned Discharges***):		34.43 Days (18.41)
Mean Length of stay in Community hospitals: (S.D.) ***(Unplanned discharges):***		21.05 Days (11.82)
Mean NIHS Score on Admission (S.D.)		7.7 (4.0)
Mean NIHS Score on Discharge (S.D.)		4.5 (2.9)
Mean B.I. Score on Admission (S.D.)		47.2 (27.7)
Mean B.I. Score on Discharge (S.D.)		71.1 (20.0)
Functional Impairment On Admission:	Mild:	9 (4.5%)
	Moderate:	84 (42%)
	Severe	107 (53.5%)

1.3 Neurological Variables: (Ref. Table 3)

(1) Lesion type and location:

12.5% (n= 25) of the patients had hemorrhagic lesions, 28.5% (n= 57) had cortical lesions.

(3) *Recurrent C.V.A:*

49.5% (n= 99) had multifocal lesions, 42.5% (n= 85) had recurrent C.V.A.

(4) Post Stroke Complications:

25% (n= 50) had post stroke dysphagia, 59% (n=118) had post stroke urinary incontinence, 5% (n =10) had post stroke aspiration pneumonia; 2% (n = 4) had post stroke epilepsy

(4) On Admission Tubing:

6% (n= 12) of the patients had urinary catheter on admission.

13.5% (n= 27) had ryle`s tube on admission.

(5) Neurological impairment:

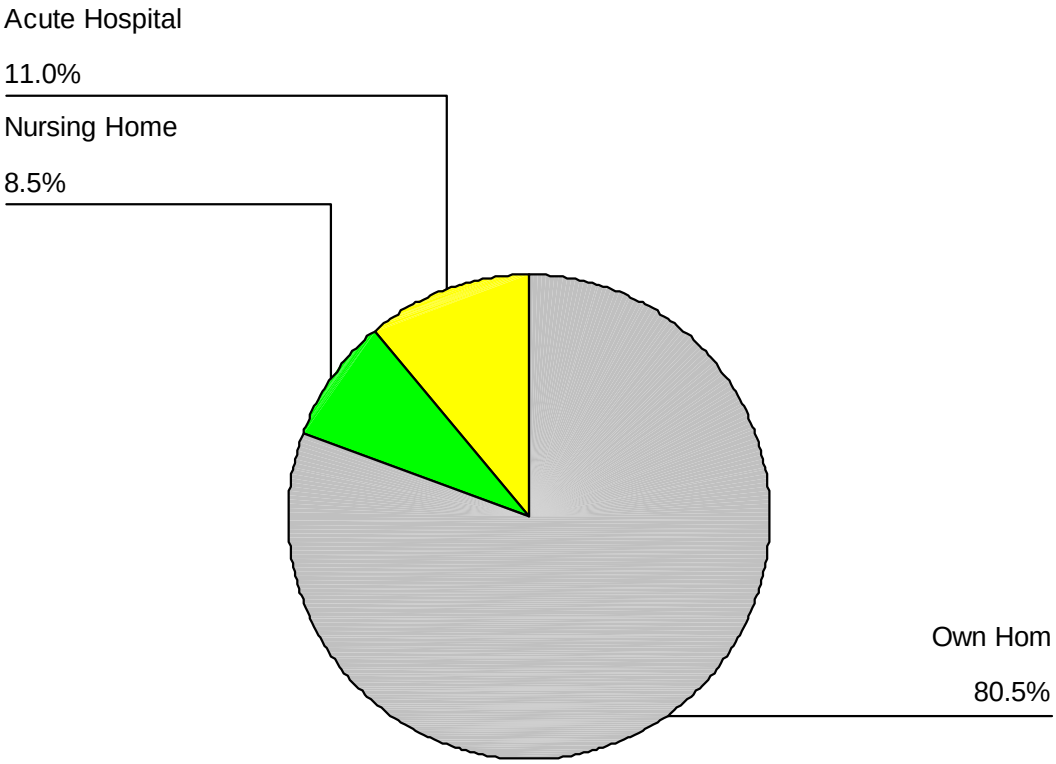
On admission 47.5% (n = 95) of the patients had mild neurological impairment, 36.5% (n= 73) and 16% (n = 32) of the patients had moderate and severe neurological impairment respectively.

Table 3*:* **Neurological Variables**

Neurological Variables		**Number: 200 (%)**
Lesion Type:	Hemorrhage: Infarction:	25 (12.5%) 175 (87.5%)
# Lesion Location:	Cortical: Non-Cortical:	57 (28.5%) 127 (63.5%)
**** Recurrent C.V.A***:	Present: Absent:	85 (42.5%) 99 (49.5%)
** ***Lesion Distribution:***	Focal Multifocal	85 (42.5%) 99 (49.5%)
Post Stroke Dysphagia:	Present: Absent:	50 (25%) 150 (75%)
Post Stroke Urinary Incontinence:	Present: Absent:	118 (59%) 82 (41%)
Post Stroke Aspiration Pneumonia:	Present: Absent:	10 (5%) 190 (95%)
Post Stroke Epilepsy:	Present: Absent:	4 (2%) 196 (98%)
On Admission Ryle`s Tube:	Present: Absent:	27 (13.5%) 173 (87.5%)
On Admission Urinary Catheter:	Present: Absent:	12 (6%) 188 (94%)
Neurological Impairment On Admission:	Mild: Moderate Severe	95 (47.5%) 73 (36.5%) 32 (16%)

16 Missing Information (8%), * 16 Missing Information (8%), ** 16 Missing Information (8%)

2. *Discharge- Destinations: (Figure 1)*



Discharge Destination:	**Number (%)**
Own Home	161 (80.5%)
Nursing Home	17 (8.5%)
Acute Care Hospital	22 (11%)

3.**Post stroke depression**:

3.1 Prevalence of stroke-associated depression;

Upon admission 120 (60%) of the patients were depressed and upon discharge 68 patients remained depressed including 8 new cases of depression. Out of 22 unplanned discharges 17 patients were found to be depressed.

Prevalence of depression at different time periods during hospitalization was as follows:

(a) *Prevalence of depression on Admission:* 120/ 200 = 60%

(b) *Prevalence of depression during hospitalization*:

Upon admission 120 (60%) of the patients were found to be depressed and 8 patients developed depression during their stay in community hospitals. Hence the prevalence of depression during hospitalization was:

120 + 8 / 200 = 64%

(c) *Prevalence of depression at the time of discharge***:**

Among the planned discharges (n = 178), 68 patients were found to be depressed upon discharge from the hospitals. Hence the prevalence of depression upon planned discharges was:

68 / 178 = 38.20%

(d) *Rate of recovery and non-recovery from depression***:**

Out of 178 planned discharges, 103 patients were depressed on admission. Out of these 103 patients, 43 patients had recovered from depression and 60

patients remained depressed upon their discharges.

Hence the rate of recovery from depression was : 43 / 103 = 41.74% and the rate of non-recovery from depression was : 60 / 103 = 58.25%

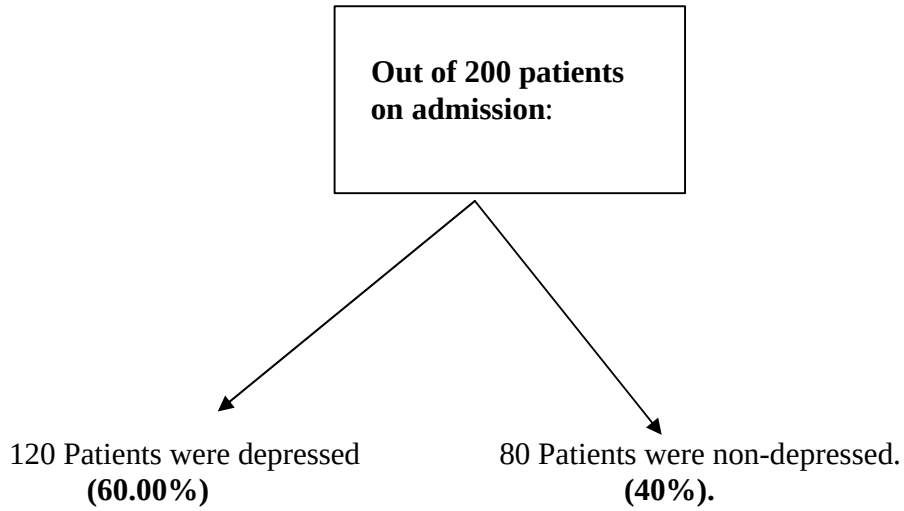
(e) *Rate of developing depression (new cases) during the stay in community hospital:*

Out of 178 planned discharges, 75 patients were not depressed on admission. But out of these 75 patients, 8 patients were found to be depressed on discharge. Hence the rate of developing depression during the stay in community hospitals was: 8/75 = 10.66%.

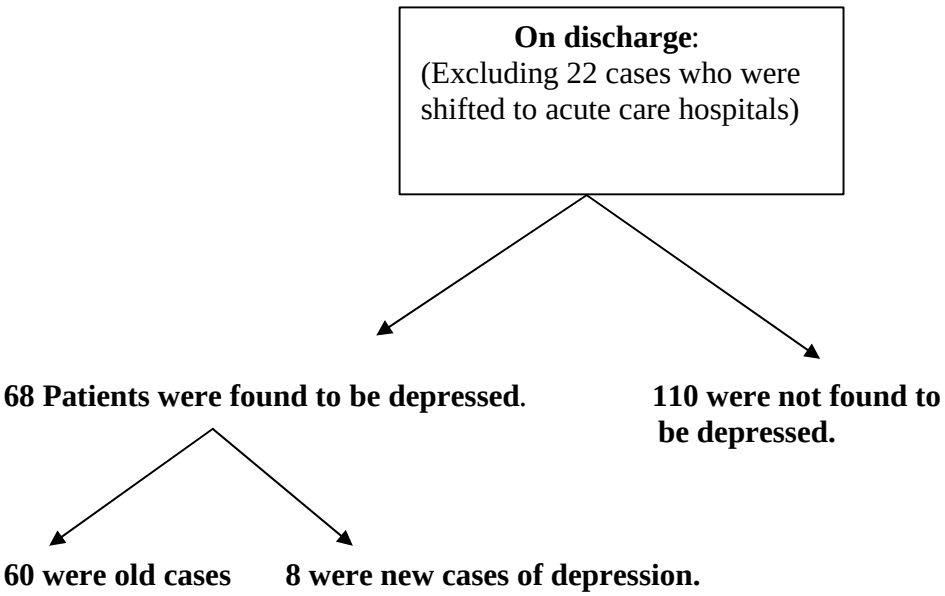
(f) *Percentage of the depressed patients receiving antidepressant drugs*:

25.58% of the depressed patients were receiving antidepressant drugs.

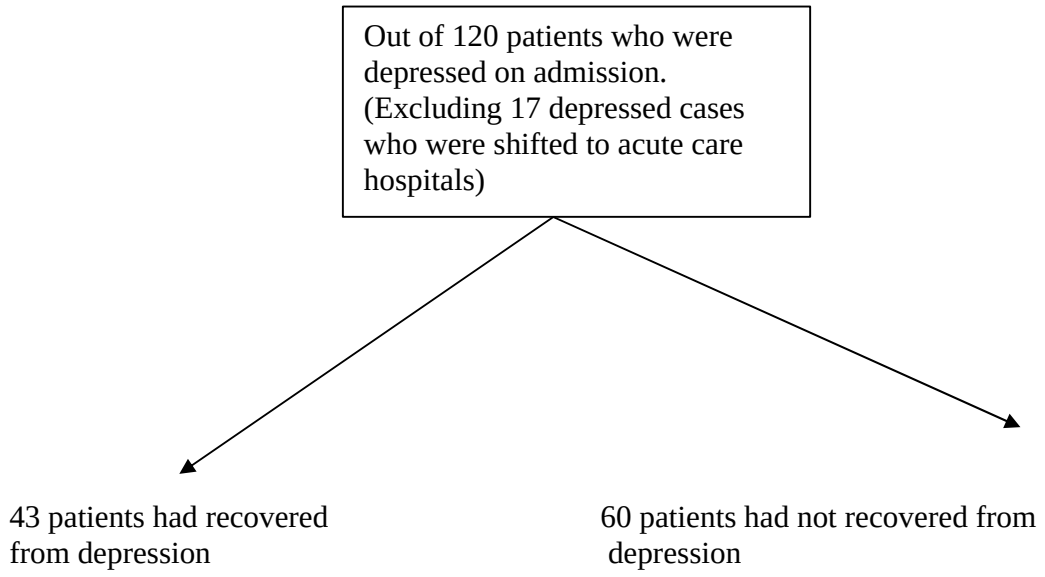
Flow Chart of Depressed and Non-Depressed patients During Hospitalization:



- Out of 22 patients who were shifted to acute care hospitals subsequently, 17 were found to be depressed on admission.



Recovery from depression:



3.2 Univariate analysis of factors associated with depression in stroke patients (Ref: Table 4):

Univariate logistic regression was performed to identify the significant variables associated with post stroke depression.

Among the socio-demographic variables the significant factor associated with post stroke depression was:

- Education less than equal to Sec. level (O.R.-2.56, 95%C.I. - 1.18; 5.55).

Among the clinical variables, the significant variables associated with post stroke depression were:

- Cognitive impairment (O.R.-4.23, 95% C.I.- 2.31, 7.73)
- Functional Impairment:
  - (a) Moderate (O.R.-8.77, 95%C.I.-1.05, 73.14)
  - (b) Severe (O.R.-18.92, 95%C.I.-2.25, 155.32)
- Ischemic heart disease (O.R.-2.14, 95% C.I.-1.03, 4.47)

Among the neurological variables, significant factors associated with post stroke depression were:

- Multifocal lesion (O.R.-1.86, 95% C.I.-1.02, 3.38)
- On Admission Ryles tube: (O.R. - 2.61, 95% C.I.-1.00, 6.80)
- Urinary incontinence (O.R.-2.63, 95% C.I.-1.47, 4.73)
- Neurological impairment:
  - (a) Moderate (O.R.-2.36, 95%C.I.-1.25, 4.42)
  - (b) Severe: (O.R.-6.25, 95%C.I.-2.22, 17.63)

Table 4. Univariate analysis of factors associated depression in stroke patients:

Socio Demographic Variables:		Depressed: N=120 (60%)	Non Depressed N=80 (40%)	Sig.	O.R.	95% C.I.
Age:	> = 65 yrs.	36 (30.0)	27 (33.7)		**1.00**	
	66-80 yrs.	59 (49.1)	40 (50.0)	>0.05	1.10	0.58, 2.09
	> = 81 yrs.	25 (20.8)	13 (16.2)	>0.05	1.44	0.62, 3.32
Gender:	Male:	63 (52.5)	46 (57.5)		**1.00**	
	Female	57 (47.5)	34 (42.5)	>0.05	1.22	0.69 , 2.16
Ethnicity:	Chinese	105 (87.5)	72 (90.0)		**1.00**	
	Malay	10 (8.3)	4 (5.0)	>0.05	1.71	0.51 , 5.67
	Indian	5 (4.1)	4 (5.0)	>0.05	0.85	0.2 2, 3.30
Marital Status:	Married	60 (50.0)	41 (51.2)		**1.00**	
	Unmarried	9 (7.5)	4 (5.0)	>0.05	1.53	0.4 4, 5.32
	Divorced/Widow/er	51 (42.5)	35 (29.1)	>0.05	0.99	0.55 , 1.78
Education:	>=Sec	13 (10.8)	19 (23.7)		**1.00**	
	< = Sec.	107 (89.1)	61 (76.2)	**<0.05**	2.56	1.18 , 5.55
Living Arrangement:	Living with someone:	108 (90.0)	72 (90.0)		**1.00**	
	Living Alone:	12 (10.0)	8 (10.0)	>0.05	1.00	0.38 , 2.56
Care Giver:	Present:	103 (85.8)	72 (90.0)		**1.00**	
	Absent:	17 (14.1)	8 (10.0)	>0.05	1.48	0.60 , 3.62

Clinical Variables:		Depressed N=120 (60%)	Nondepressed N=80 (40%)	Sig	O.R.	95%C.I.
Visual Impairment:	Present:	12 (10.0)	8 (10.0)	>0.05	1.00	0.38, 2.56
	Absent:	108 (90.0)	72 (90.0)		**1.00**	
Hearing Impairment:	Present:	6 (5.0)	4 (5.0)	>0.05	1.00	0.27 , 3.66
	Absent:	114 (95.0)	76 (95.0)		**1.00**	
Hypertension:	Present:	104 (86.6)	71 (88.7)	>0.05	0.82	0.34, 1.96
	Absent:	16 (13.3)	9 (11.2)		**1.00**	
Diabetes Mellitus:	Present:	56 (46.6)	38 (47.5)	>0.05	0.96	0.54 , 1.70
	Absent:	64 (53.3)	42 (52.5)		**1.00**	
Smoking:	Present:	57 (47.5)	34 (42.5)	>0.05	1.22	0.69, 2.16
	Absent:	63 (52.5)	46 (57.5)		**1.00**	
IschemicHeartDisease	Present:	33 (27.5)	12 (15.0)	**<0.05**	2.14	1.03, 4.47
	Absent:	87 (72.5)	68 (85.0)		**1.00**	
Atrial Fibrillation:	Present:	10 (8.3)	4 (5.0)	>0.05	1.72	0.52 , 5.70
	Absent:	110 (91.6)	76 (95.0)		**1.00**	

Hyperlipidaemia:	Present:	86 (71.6)	58 (72.5)	>0.05	0.95	0.51, 1.80
	Absent:	34 (28.3)	22 (27.5)		**1.00**	
Cognitive Impairment:	Present:	82 (68.3)	27 (33.7)	**<0.01**	4.23	2.31, 7.73
	Absent:	38 (31.6)	53 (66.2)		**1.00**	
Functional Impairment:	Mild	1 (0.8)	8 (10.0)		**1.00**	
	Moderate	44 (36.6))	40 (50.0)	**<0.05**	8.77	1.05,73.14
	Severe	75 (62.5))	32 (40.0)	**<0.01**	18.92	2.25,155.3

Neurological Variables:		**Depressed: N=120 (60%)**	**NonDepressd N=80 (40%)**	**Sig.**	**O.R.**	**95% C.I**
Lesion Type:	Hemorrhage	14(11.6)	11 (13.7)		**1.00**	
	Infarction	106(88.3)	69 (86.2)	>0.05	1.20	0.51, 2.81
Lesion Location:	Cortical	36 (30.0)	21 (26.2)		**1.00**	
	Non Cortical	75 (62.5)	52 (65.0)	>0.05	0.84	0.44, 1.60
Lesion Distribution:	Focal	45 (37.5)	40 (50.0)		**1.00**	
	Multifocal	67 (55.8)	32 (40.0)	**<0.05**	1.86	1.02, 3.38
Recurrence:	Present	22 (18.3)	14 (17.5)	>0.05	1.04	0.49, 2.19
	Absent	96 (80.0)	64 (80.0)		**1.00**	
Neurological Impairment:	Mild	44 (36.6)	51 (63.7)		**1.00**	
	Moderate	49 (40.8)	24 (30.0)	**<0.01**	2.36	1.25, 4.42
	Severe	27 (22.5)	5 (6.2)	**<0.01**	6.25	2.22,17.63
On Admission Ryle`s Tube:	Present	21 (17.5)	6 (7.5)	**<0.05**	2.61	1.00, 6.80
	Absent	99 (82.5)	74 (92.5)		**1.00**	
On Admission UrinaryCatheter:	Present	10 (8.3)	2 (2.5)	>0.05	3.54	0.75,16.62
	Absent	110 (91.)	78 (97.)		**1.00**	
Dysphagia:	Present	35 (29.1)	15 (18.7)	>0.05	1.78	0.89,3.92
	Absent	85 (70.8)	65 (81.2)		**1.00**	
Urinary Incontinence:	Present	82 (68.3)	36 (45.0)	**<0.01**	2.63	1.47,4.73
	Absent	38 (31.6)	44 (55.0)		**1.0**	
Aspiration Pneumonia:	Present	7 (5.8)	3 (3.7)	>0.05	1.58	0.39 ,6.33
	Absent	113 (94.1)	77 (96.2)		**1.0**	
Epilepsy:	Present	3 (2.5)	1 (1.2)	>0.05	2.02	0.20,19.75
	Absent	117 (97.5)	79 (98.7)		**1.0**	

3.3 Multivariate analysis of significant variables associated with depression in stroke depression (Ref. Table 5)

The variables which were significant on univariate analysis were then put into multivariate logistic model and on backward wald logistic regression analysis the significant variables associated with post stroke depression and their odds ratio, adjusted for age, gender, ethnicity and living arrangement were :

(a) Severe Neurological Impairment: (O.R.-3.29, 95% C.I. =1.09, 9.03);

(b) Cognitive impairment: (O.R.-3.57, 95% C.I. = 1.82, 7.03) and

(c) Multi focal lesion (O.R.-1.98, 95% C.I. = 1.02, 3.84)

Table 5: Multiple logistic regression: significant variables associated with depression in stroke patients*

Variables	Beta	Sig.	O.R. #	95%C.I.
Cognitive Impairment:	1.275	<0.01	3.57	1.82 ,7.03
Severe Neurological Impairment:	1.19	<0.05	3.29	1.09 ,9.03
Multi-Focal Lesions	0.685	<0.05	1.98	1.02 ,3.84

* at probability of entry at 0 .05 and removal at 0.10

 # OR adjusted for Age, Gender, Ethnicity and Living arrangement

3.4 ***Factors associated with recovery from depression in stroke patients*****:**

(Ref. Table 6)

2.4 On univariate logistic regression analysis the significant variables which were associated with recovery from depression in stroke patients were:

(a) Absence of Cognitive impairment on admission (O.R.-2.77, 95%C.I.-1.21; 6.30)

(b) Absence of Cognitive impairment on discharge (O.R.-4.88, 95%C.I.-2.07; 11.54)

(c) Post stroke urinary incontinence (O.R.-4.81, 95%C.I.-2.08; 11.09)

(d) On admission Ryles tube (O.R.-5.40, 95%C.I.-1.16; 25.12)

Table 6: ***Univariate analysis of the factors associated with recovery from depression in stroke patients***:

Socio Demographic Variables:		**Recovery N=43 (41.7%)**	**Non-Recovery N=60(58.3%)**	**Sig.**	**O.R.**	**95% C.I.**
Age:	> = 65 yrs.	14 (32.5)	17 (28.3)	>0.05	1.82	0.55 , 5.92
	66-80 yrs.	23 (53.4)	29 (48.3)	>0.05	1.53	0.51 , 4.56
	> = 81 yrs.	6 (13.9)	13 (23.3)		**1.00**	
Gender:	Male:	21 (48.8)	31 (51.6)	>0.05	0.82	0.38 , 1.77
	Female	22 (51.1)	29 (48.3)		**1.00**	
Ethnicity:	Chinese	38 (88.3)	52 (86.6)	>0.05	0.65	.08 , 4.85
	Malay	3 (6.9)	6 (10.0)	>0.05	0.42	.04 , 4.63
	Indian	2 (4.6)	2 (3.3)		**1.00**	
Marital Status:	Married:	23 (53.4)	31 (51.6)	>0.05	0.79	0.35 , 1.79
	Unmarried	3 (6.9)	5 (8.3)	>0.05	0.81	0.17 , 3.87
	Divorced/Widow/er	17 (39.5)	24 (40.0)		**1.00**	
Education:	> = Secondary:	6 (13.9)	6 (10.0)	>0.05	1.39	0.43 , 4.45
	< = secondary	37 (86.0)	54 (90.0)		**1.00**	
Living Arrangement:	Living with someone:	38 (88.3)	56 (93.3)	>0.05	0.61	0.16 , 2.25
	Living Alone:	5 (11.6)	4 (6.6)		**1.00**	
Care Giver:	Present:	35 (81.3)	54 (90.0)	>0.05	0.51	0.17 , 1.52
	Absent:	8 (18.6)	6 (10.0)		**1.00**	

Clinical Variables:		**Recovery N=43 (41.7%)**	**Non-Recovery N=60**	**Sig**	**O.R.**	**95%C.I.**
Visual Impairment:	Present:	5 (11.6)	6(10.0)		**1.00**	
	Absent:	38 (88.3)	54(90.0)	>0.05	0.88	0.26 , 2.99
Hearing Impairment:	Present:		5 (8.3)		**1.00**	
	Absent:	43 (100)	55(91.6)	>0.05	930.	0.,8.4E+16
Hypertension:	Present:	38 (88.3)	53(88.3)		**1.00**	
	Absent:	5 (11.6)	7(11.6)	>0.05	1.33	0.38 , 4.68
Diabetes Mellitus:	Present:	16 (37.2)	29(48.3)		**1.00**	
	Absent:	27 (62.7)	31(51.6)	>0.05	1.84	0.84 , 4.03
Smoking:	Present:	18 (41.8)	31(50.0)		**1.00**	
	Absent:	25 (58.1)	29(50.0)	>0.05	1.52	0.70, 3.28
Ischemic heart Disease:	Present:	8 (41.8)	19(31.6)		**1.00**	
	Absent:	35 (81.3)	41(68.3)	>0.05	1.99	0.79, 5.03
Atrial Fibrillation:	Present:	2 (4.6)	6(10.0)		**1.00**	
	Absent:	41 (95.3)	54(90.0)	>0.05	2.01	0.38,10.48
Hyperlipidaemia:	Present:	33 (76.7)	40(66.6)		**1.00**	
	Absent:	10 (23.2)	20(33.3)	>0.05	0.62	0.25, 1.48
Cognitive Impairment (on Ad.)	Present:	23 (53.4)	47 (78.3)		**1.00**	
	Absent	20 (46.5)	13 (21.6)	**<0.01**	2.77	1.21, 6.30
Cognitive Impairment (On Dis)	Present	10 (23.2)	38 (63.3)		**1.00**	
	Absent	33 (76.7)	22 (36.6)	**<0.01**	4.88	2.07, 11.54
Functional Impairment :***(OnAd)***	Mild-Moderate	21 (54.5)	21 (31.7)	>0.05	2.15	0.96 , 4.80
	Severe:	20 (46.5)	43 (68.3)			**1.00**

Neurological Variables:		**Recovery N=43 (41.7%)**	**Non-Recovery N=60**	**Sig.**	**O.R.**	**95% C.I**
Lesion Type:	Hemorrhage:	7 (16.2)	6 (10.0)	>0.05	1.66	0.54 , 5.14
	Infarction	36 (83.7)	54 (90.0)		**1.00**	
Lesion Location:	Cortical:	15 (34.8)	15 (25.0)	>0.05	1.55	0.62 , 3.40
	Non-Cortical:	26 (60.4)	29 (48.3)		**1.00**	
Lesion Distribution:	Focal:	18 (41.8)	22 (36.6)	>0.05	1.02	0.45 , 2.27
	Multifocal:	24 (55.8)	32 (53.3)		**1.00**	
Recurrence:	Present:	8 (18.6)	12 (20.0)		**1.00**	
	Absent:	33 (76.7)	48 (80.0)	>0.05	0.99	0.37 , 2.65
Neurological Impairment: ***(OnAd)***	Mild:	23 (53.4)	20 (33.3)	>0.05	1.70	0.61, 4.75
	Moderate:	11 (25.5)	27 (45.0)	>0.05	0.53	0.18 , 1.57
	Severe:	9 (20.)	13 (21.6)		**1.00**	
On Admission Ryle`s Tube:	Present:	2 (4.65)	12 (20.00)		**1.00**	
	Absent:	41 (95.34)	48 (80.00)	**<0.05**	5.40	1.16 , 25.12
On Admission Urinary Catheter:	Present:	1 (2.32)	5 (8.33)		**1.00**	
	Absent	42 (97.67)	55 (91.66)	>0.05	3.88	0.38, 30.02
Post Stroke Dysphagia:	Present:	8 (18.60)	18 (30.00)		**1.00**	
	Absent:	35 (81.39)	42 (70.00)	>0.05	1.99	0.79 , 5.03
Post Stroke UrinaryIncontinence:	Present	18 (41.86)	49 (81.66)		**1.00**	
	Absent:	25 (58.13)	11 (18.33)	**<0.01**	4.81	2.08 , 11.09
Post Stroke Aspiration Pneu:	Present:	1 (2.32)	5 (8.33)		**1.00**	
	Absent:	42 (97.67)	55 (91.66)	>0.05	4.89	.0.58 ,41..21
Post Stroke Epilepsy:	Present:	1 (2.32)	1 (1.66)		**1.00**	
	Absent:	42 (97.67)	59 (98.33)	>0.05	0.63	.07 , 10.45

3.5 Multivariate analysis of the factors associated with recovery from depression in stroke patients: **(Ref. Table 7)**

Variables which were significantly associated with the recovery from depression were put in multivariate forward logistic regression at probability level .05 and removal at .10 to identify the significant variables. The significant variables were

(a) Absence of cognitive impairment on discharge (O.R.-3.74, 95% C.I.-1.45, 9.60)

(b) Absence of urinary incontinence. (O.R.-4.07, 95% C.I.-1.57, 10.54)

Table 7. Multiple logistic regression analysis: significant factors associated with recovery from depression *

Variables		Beta	S.E.	Sig.	O.R.	95% C.I.
Cognitive impairment (On Discharge):	Absent	1.31	0.48	<0.01	3.74	1.45; 9.60
Urinary Incontinence:	Absent	4.07	0.48	<0.01	4.07	1.57; 10.54

* at probability level .05 and removal at .1

4 Cognitive Impairment in Stroke Patients

4.1 Prevalence of cognitive impairment

On admission 109 (54.5%) of the patients were cognitively impaired.

Among planned discharges, 61 patients (34.26%) were cognitively impaired.

Univariate analysis of factors associated with cognitive impairment on admission

On univariate logistic regression the factors significantly associated with cognitive impairment on admission were (**Ref. Table 8**):

Socio-Demographic variables:

(a) Age: 66-80 years (O.R.-2.03, 95%C.I.-1.06, 3.81)

< = 81 years (O.R.-6.09 95%C.I.-2.42, 15.42)

(b) Gender: Females (O.R.-1.83, 95%C.I.-1.04, 3.23)

(c) Marital Status: Widow/er, Divorced/ee: (O.R.-1.88, 95%C.I.-1.04, 3.32).

(d) Educational Level: < = secondary level (O.R.-4.52, 95%C.I.-1.91, 10.66)

Clinical Variable:

(a) Depression (O.R.-4.23, 95%C.I.-2.31, 7.73).

(b) Functional impairment: Severe (O.R.15.72, 95%C.I.-1.89, 130.44)

Neurological variable:

(a) Neurological impairment: Moderate (O.R.-2.96, 95%C.I.-1.57, 5.58)

Severe (O.R.-7.10, 95%C.I.-2.66, 18.91)

(b) On admission Ryle`s tube: (O.R.-5.81, 95%C.I.-1.93, 17.51)

(c) Urinary incontinence: (O.R.-3.51, 95%C.I.-1.94, 6.33)

(d) Post stroke aspiration pneumonia: (O.R.-8.06, 95%C.I.-1.002, 64.66)

Table 8: Univariate Analysis of the factors associated with cognitive impairment on admission:

Socio Demographic Variables		*Cognitively Impaired No: 109(54.5%)*	*Normal Cognition No: 91(45.5%)*	*Sig.*	*O.R.*	*95%C.I.*
Age:	> = 65 yrs.	24 (22.0)	39 (42.8)		**1.00**	
	66-80 yrs.	55 (50.4)	44 (48.3)	**<0.05**	2.03	1.06,3.81
	< = 81 yrs.	30 (27.5)	8 (8.7)	**<0.01**	6.09	2.42,15.42
Gender:	Male	52 (47.7)	57 (62.6)		**1.00**	
	Female	57 (52.2)	34 (37.3)	**<0.05**	1.83	1.04, 3.24
Ethnicity:	Chinese:	95 (87.1)	82 (90.1)		**1.00**	
	Malay	9 (8.2)	5 (5.4)	>0.05	1.55	0.50, 4.8
	Indian	5 (4.5)	4 (4.3)	>0.05	1.07	0.28, 4.1
Marital Status:	Married:	49 (44.9)	52 (57.1)		**1.00**	
	Unmarried	5 (4.5)	8 (8.7)	>0.05	0.66	0.20, 2.1
	Widow/Divorced	55 (50.4)	31 (34.0)	**<0.05**	1.88	1.04, 3.3
EducationLevel:	> Secondary:	8 (7.3)	24 (26.3)		**1.00**	
	< = Secondary	101(92.6)	67 (73.6)	**<0.01**	4.52	1.91,10.66
Living Arrangement:	Living with someone:	101 (92.6)	79 (86.8)		**1.00**	
	Living Alone	8 (7.3)	12 (13.1)	>0.05	0.52	0.20, 1.33
Care Giver:	Present:	99 (90.8)	76 (83.5)		**1.00**	
	Absent:	10 (9.1)	15 (16.4)	>0.05	0.51	0.21, 1.20

Clinical Variables		Cognitively Impaired No: 109(54.5%)	Normal Cognition No: 91(45.50%)	Sig.	OR.	95%C.I.
Visual Impairment:	Present:	12 (11.0)	8 (8.7)	>0.05	1.28	0.50,3.29
	Absent:	97 (88.9)	83 (91.2)		**1.00**	
Hearing Impairment	Present:	4 (36.6)	6 (6.5)	>0.05	0.54	0.14, 1.97
	Absent:	105 (96.3)	85 (93.4)		**1.00**	
Hypertension:	Present	97 (88.9)	78 (85.7)	>0.05	1.34	0.58, 3.11
	Absent:	12 (11.0)	13 (14.2)		**1.00**	
Diabetes Mellitus:	Present	54 (49.5)	40 (43.9)	>0.05	1.25	0.71, 2.18
	Absent:	55 (50.4)	51 (56.0)		**1.00**	
Smoking:	Present	49 (44.9)	42 (46.1)	>0.05	0.95	0.54, 1.66
	Absent:	60 (55.0)	49 (53.8)		**1.00**	
Ischemic Heart Dis:	Present	30 (27.5)	15 (16.4)	>0.05	1.92	0.96, 3.85
	Absent:	79 (72.4)	76 (83.5)		**1.00**	
Atrial Fibrillation:	Present	10 (9.1)	4 (4.3)	>0.05	2.19	0.66 ,7.25
	Absent:	99 (90.8)	87 (95.6)		**1.00**	
Hyperlipidaemia	Present	78 (71.5)	66 (72.5)	>0.05	0.95	0.51, 1.77
	Absent:	31 (28.4)	25 (27.4)		**1.00**	
Depression:	Present:	82 (75.2)	38 (41.7)	**<0.01**	4.23	2.31, 7.73
	Absent:	27 (24.7)	53 (58.2)		**1.00**	
Functional Impairment:	Mild:	1 (0.9)	8 (8.7)		**1.00**	
	Moderate	37 (33.9)	47 (51.6)	>0.05	6.28	0.75, 52.37
	Severe:	71 (65.1)	36 (39.5)	**<0.05**	15.7	1.89 ,130.44

Neurological Variables		Cognitively Impaired No: 109(54.5%)	Normal Cognition No: 91(45.5%)	Sig.	O.R.	95%C.I
Lesion Type:	Hemorrhage	12 (9.1)	13 (14.2)		**1.00**	
	Infarction:	97 (88.9)	78 (85.7)	>0.05	1.34	0.58, 3.11
Lesion Location:	Cortical:	37 (33.9)	20 (21.9)		**1.00**	
	Non Cortical	66 (60.5)	61 (67.0)	>0.05	0.58	0.30, 1.11
Lesion Distribution:	Focal:	49 (44.9)	36 (39.5)		**1.00**	
	Multifocal:	53 (48.6)	46 (50.5)	>0.05	0.84	0.47, 1.51
Recurrent C.V.A:	Yes:	18 (16.5)	18 (19.7)	>0.05	0.79	0.38, 1.64
	No:	89 (81.6)	71 (78.0)		**1.00**	
Neurological Impairment	Mild:	36 (33.1)	59 (64.8)		**1.00**	
	Mod.:	47 (43.1)	26 (28.5)	**<0.01**	2.96	1.57, 5.58
	Severe:	26 (23.8)	6 (6.5)	**<0.01**	7.10	2.66, 18.91
On Adm. Ryle`s Tube:	Present:	23 (21.1)	4 (4.3)	**<0.01**	5.81	1.93, 17.51
	Absent:	86 (78.8)	87 (95.6)		**1.00**	
***Dysphagia*:**	Present	32 (29.3)	18 (19.7)	>0.05	1.68	**0.87, 3.26**
	Absent:	77 (70.6)	73 (80.2)		**1.00**	
***Urinary Incontinence*:**						
	Present:	79 (72.4)	39 (42.8)	**<0.01**	3.51	1.94, 6.33
	Absent:	39 (35.7)	52 (57.1)		**1.00**	
***AspirationPneumonia*:**	Present:	9 (8.2)	1 (1.0)	**<0.05**	8.06	1.00, 64.6
	Absent:	100 (91.7)	90 (98.9)		**1.00**	
Epilepsy:	Present:	1 (0.9)	3 (3.2)	>0.05	0.27	0.02, 2.66
	Absent:	108 (99.0)	88 (96.7)		**1.00**	

Multivariate analysis of the factors associated cognitive Impairment in stroke patients on admission: (Ref. Table 9)

Variables which were significant on univariate analysis were then put into the multivariate forward logistic model at probability level of .05 and removal at .10 to establish a predictive model for post stroke cognitive impairment.

The significant predictors were:

- Age more than 81 years (O.R. - 6.78, C.I. - 2.34, 19.64)
- Education less than equal to secondary level (O.R.-4.73, C.I. - 1.41, 13.11)
- Severe neurological impairment (O.R.-5.00, C.I. - 1.70, 14.67)
- Depression (O.R.-3.19; C.I.-1.61, 6.30)

Table 9: Multiple logistic regression of cognitive impairment on admission in stroke patients*

Variables		**Beta**	**Sig.**	**O.R.**	**95% C.I.**
Age:	> = 81 years	1.91	<0.01	6.78	2.34, 19.64
Education:	Less than equal to Sec. Level	1.55	<0.01	4.73	1.41 , 13.11
***Neurological Impairment*:**	Severe	1.61	<0.01	5.00	1.70, 14.67
Depression:	Present:	1.16	<0.01	3.19	1.61, 6.30

* at probability of entry at 0 .05 and removal at 0.10

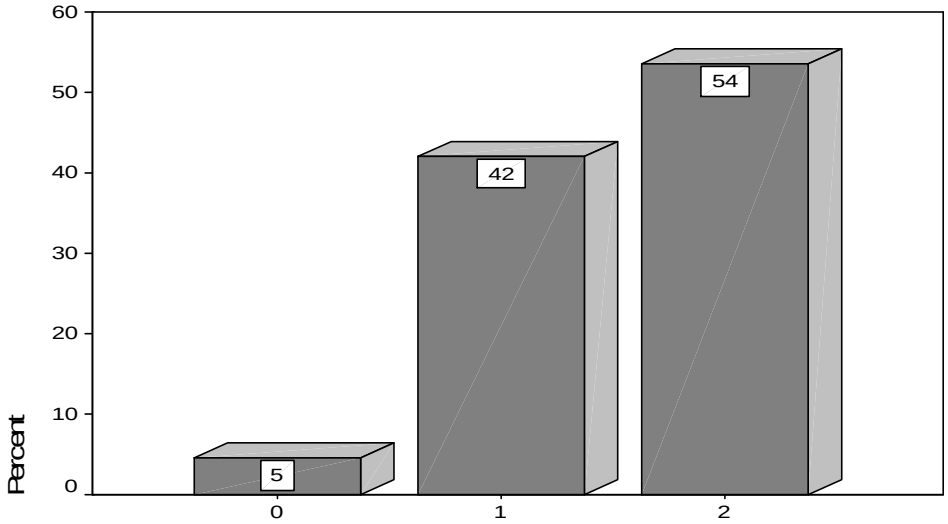
5. Change in Functional status during hospitalization:

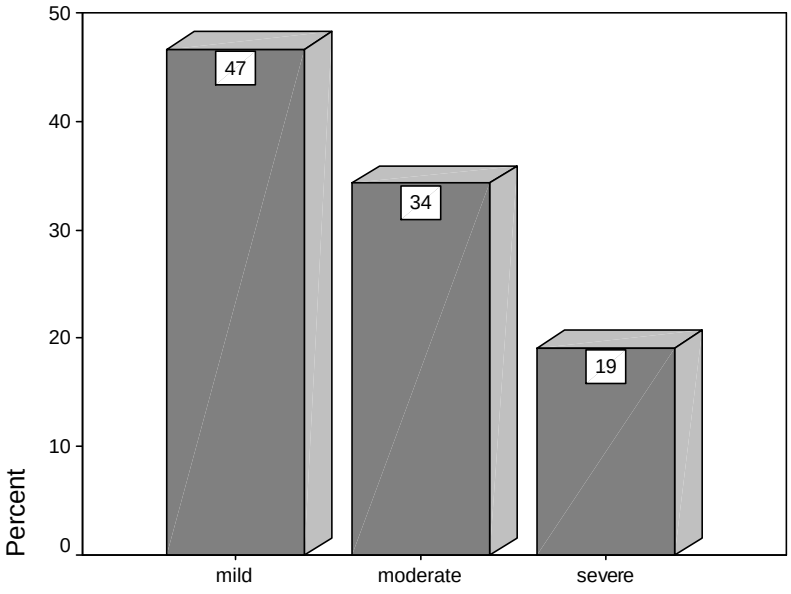
5.1 Prevalence of Functional Status:

Mean Barthel Index score on admission was 47.2 (S.D.= 27.7) and upon discharge was 71.1 (S.D. = 20.0).

On admission the proportion of the patients with mild, moderate and severe functional impairment was 5%, 42% and 54% respectively. And upon discharge the % age was 47%, 34% and 19% respectively. (**Ref. Figure 2)**

Functional Status on admission & on discharge: (FIGURE 2)





5.2 Univariate analyses of factors associated with ADL dependency at discharge:

Univariate logistic regression was performed to find out the significant predictors of ADL dependency upon planned discharge(Barthel Index < = 50),the significant predictors were: **(Ref. Table 8)**

Socio-Demographic Variables:

- Age > = 81 years (O.R.-4.45, 95%C.I. - 1.45, 13.60)

Clinical Variables:

- Cognitive impairment in admission (O.R.-9.11, 95% C.I.-3.05, 27.12)
- Depression on admission (O.R.-3.45, 95%C.I.- 1.41, 8.43)
- Functional Impairment (On Admission):

  Severe (O.R-48.28, 95%C.I.-6.42, 363.72)

Neurological Variables:

- Post stroke dysphagia (O.R.-7.85, 95%C.I.-3.44, 17.98)
- Post stroke urinary incontinence (O.R.-18.38, 95%C.I.-4.24, 17.58).
- On admission Ryles tube (O.R.-14.23, 95%C.I.-4.88, 41.54)
- Neurological Impairment:

  Moderate (O.R.-6.15, 95%C.I.-1.91, 19.92)

  Severe (O.R.-42.28, 95%C.I.-12.73, 174.21)

(Table 10): Predictors of ADL dependency (Barthel index < = 50 upon planned discharges:

Socio Demographic Variables		***ADL Dependent 34 (19.1%)***	***ADL Ind. n = 144 (80.9%)***	***Sig.***	***O.R.***	***95%C.I.***
Age:	> = 65 yrs.	6 (17.6)	51 (35.4)			
	66-80 yrs.	17 (50.0)	72 (50.0)	>005	2.00	0.74 , 5.44
	< = 81 yrs.	11 (32.4)	21 (14.6)	**<0.01**	4.45	1.45 , 13.60
Gender:	Male	17 (50.0)	80 (55.6)		**1.00**	
	Female	17 (50.0)	64 (44.4)	>0.05	1.25	.59, 2.64
Ethnicity:	Chinese:	28 (82.4)	129 (89.6)		**1.00**	
	Malay	4 (11.8)	9 (6.3)	>0.05	2.04	.58, 7.12
	Indian	2 (5.9)	6 (4.2)	>0.05	1.53	.29, 8.00
Marital Status:	Married:	17 (50.0)	76 (52.8)	>0.05	**1.00**	
	Unmarried	3 (8.8)	9 (6.3)	>0.05	1.49	.36, 6.09
	Widow/Divorced	14 (41.2)	59 (41.0)		1.06	.48, 2.32
EducationLevel:	> Secondary:	4 (11.8)	25 (17.4)		**1.00**	
	< = Secondary	30 (88.2)	119 (82.6)	>0.05	1.57	.50, 4.86
Living Arrangemet:	Living with someone:	34 (100.0)	127 (88.2)		**1.00**	
	Living Alone		17 (11.8)	>0.05	.001	.0, 3.1E+09
Care Giver	Present	33 (97.1)	123 (85.4)		1.00	
	Absent	1 (2.9)	21 (14.6)	>0.05	.178	.02; 3.06

Clinical Variables:		**ADL Dep. N= 34 (19.1%)**	**ADL Independent N= 144 (80.9%)**	**Sig.**	**O.R.**	**95%C.I.**
Visual Impairment:	Present:	6 (17.6)	13 (9.0)	>0.05	2.15	.75, 6.16
	Absent:	28 (82.4)	131(91.0)		**1.00**	
Hearing Impairment:	Present:		9 (6.3)	>0.05	.001	.0,1.5e+14
	Absent:	34 (100.0)	135 (93.7)		**1.00**	.
Hypertension:	Present:	31 (91.2)	126 (87.5)	>0.05	1.47	**.**40, 5.32
	Absent:	3 (8.8)	18 (12.5)		**1.00**	
Diabetes Mellitus:	Present:	17 (50.0)	62 (43.1)	>0.05	1.32	.62, 2.79
	Absent:	17 (50.0)	82 (56.9)		**1.00**	
Smoking:	Present:	16 (47.1)	66 (45.8)	>0.05	**1.05**	.49, 2.22
	Absent:	18 (52.9)	78 (54.2)		1.00	
Ischemic heart Disease:	Present:	10 (29.4)	10 (6.9)	>0.05	1.72	.74, 4.01
	Absent:	24 (70.6)	134 (93.1)		**1.00**	

Atrial Fibrillation:	Present:	2 (5.9)	3 (4.9)	>0.05	**.83**	.17, 4.01
	Absent:	32 (94.1)	58(95.1)		**1.00**	
Hyperlipidaemia:	Present:	21 (61.8)	106 (73.6)	>0.05	**0.57**	.26, 1.26
	Absent:	13 (38.2)	38 (26.4)		**1.00**	
Cognitive Impairment	Present:	30(88.2)	65 (45.1)	**<0.01**	9.11	3.05, 27.1
	Absent	4 (11.8)	79 (54.9)		**1.00**	
Depression	Present	27 (79.4)	76 (52.8)	**<0.01**	3.45	1.41, 8.43
	Absent	7 (20.6)	68 (47.2)		**1.00**	
Functional Impairment :	Mild-Moderate	1 (3.0)	83 (60.1)		**1.00**	
(On admission)	Severe	32 (97.0)	55 (39.9)	**<0.01**	48.28	6.4, 363.7

Neurological Variables:		**ADL Dependent N=34 (19.1%)**	**ADL Ind. N= 144(80.9%)**	**Sig.**	**O.R.**	**95% C.I**
Lesion Type:	Hemorrhage:	2 (5.9)	21(14.6)		**1.00**	
	Infarction	32 (94.1)	123 (85.4)	>0.05	2.73	.60, 12.26
Lesion Location:	Cortical:	11 (35.5)	37 (38.0)		**1.00**	
	Non-Cortical:	20 (64.5)	95 (72.0)	>0.05	**0.70**	.30, 1.62
Lesion Distribution:	Focal:	14 (45.2)	63 (47.7)		**1.00**	
	Multifocal:	17 (54.8)	69 (52.3)	>0.05	1.10	.50, 2.43
Recurrence:	Present:	9 (18.4)	24 (17.1)	>0.05	1.74	.72, 4.19
	Absent:	25 (81.6)	116 (82.9)		1.00	
Neurological Impairment:	Mild:	4 (11.8)	89 (61.8)		**1.00**	
(On admission)	Moderate	13 (38.2)	47 (32.6)	**<0.01**	6.15	1.9, 19.92
	Severe	17 (50.0)	8 (5.6)	**<0.01**	42.28	12.7,174.2
On Admission Ryle`s Tube:	Present:	13 (38.2)	6 (4.2)	**<0.01**	14.23	4.88 , 41.54
	Absent:	21 (61.8)	138 (95.8)		**1.00**	
On Admission Urinary Catheter:	Present:	2 (5.9)	6 (8.4))	>0.05	1.43	.27, 7.45
	Absent	32 (94.1)	138 (91.6)		**1.00**	
Post Stroke Dysphagia:	Present:	19 (55.9)	20 (13.9)	**<0.01**	7.85	3.44, 17.98
	Absent:	15 (44.1)	124 (86.1)		**1.00**	
Post Stroke Urinary Incontinence:	Present	32 (94.1)	5 (3.5)	**<0.01**	18.38	4.24, 17.58
	Absent:	2 (5.9)	139 (96.5)		**1.00**	
Post Stroke Aspiration Pneumonia:	Present:	4 (11.8)	1 (1.6)	>0.05	3.70	.93, 14.62
	Absent:	30 (88.2)	60 (98.4)		**1.00**	
Post Stroke Epilepsy:	Present:	2 (5.9)	1 (0.7)	>0.05	8.93	.78, 101.60
	Absent:	32 (94.1)	143 (99.3)		**1.00**	

5.3 Multivariate Analyses of ADL Dependency on discharge:

Variables which were significant in univariate logistic regression analysis were then put into multivariate forward logistic regression analysis at probability level .05 and removal at .10 to identify the significant variables.

The significant variables were:

Clinical Variables:

- Cognitive impairment (O.R.-6.85, 95%C.I.-1.82, 24.90)
- Severe functional impairment (O.R.-18.58, 95%C.I.-2.13, 161.94)

Neurological variables:

- Post stroke dysphagia (O.R.-3.82, 95%C.I.-1.28, 11.38)
- Severe neurological impairment (O.R.-5.18, 95%C.I.-1.07, 25.08)

Table 11: **Multivariate Forward Logistic Regression forADL Dependency***

Variables		**Beta**	**S.E**	**Sig.**	**O.R.**	**95%C.I.**
Post Stroke Dysphagia:	Present	1.34	0.55	<0.05	3.82	1.28 ,11.38
Functional Impairment (Admission):	severe	2.92	1.10	<0.01	18.58	2.13, 161.94
Cognitive Impairment:	Present:	1.92	0.66	<0.01	6.85	1.82, 24.90
Neurological Impairment:	Severe	1.64	0.80	<005	5.18	1.07, 25.08

***at probability of .05 & removal at .10**

Discussion and Conclusions

Discussion:

The frequency of depression is said to be varying from 20-65%, depending on the study design, study population, assessment tool and the study period.

Our findings indicate that a large percentage of the stroke patients (60%) were depressed during their rehabilitation. Chan Keen Loong et al [18] and Ng K C et al [54] also noted the depression rate in the stroke patients undergoing rehabilitation in Singapore close to ours (55%). However the percentage of depressed stroke patients upon their planned discharges from the hospital in our study was 38.2% which is much higher than the percentage (28.6%) reported by Chan Keen Loong et al [18] in their study on stroke patients in Singapore during their rehabilitation. The possible reason for this may be due to the difference in the sample population size, which was 200 and 55 patients respectively, or due to the difference in the scale to diagnose depression.

One of the important research question in our study was to find out the factors associated with post stroke depression. In our study factors significantly associated with post stroke depression in multiple logistic regression analysis were severity of neurological impairment, multifocal lesion and cognitive impairment. Severity of neurological impairment has been consistently reported to be an important associate of post stroke depression.[10, 49, 50, 56]

Severe stroke at onset may be taken as a collateral finding of multifocal lesion

and vice-versa, hence that explains the significant association of multifocal lesion with post stroke depression. Association of multifocal lesion and severe neurological impairment with post stroke depression indicates that more severe the brain injury, more are the chances of post stroke depression.
Hence we can conclude that post stroke depression is not purely reactive in nature but is significantly associated with the extent of post stroke brain injury. Another finding in our study which gives credence to this opinion is the lack of independent significant association of functional impairment to post stroke depression, as serious ADL impairment understandably will lead to reactive depression.

There have been contradictory reportings on association of cognitive impairment and post stroke depression. In our study there was a significant correlation between cognitive impairment and post stroke depression which was also established in the studies done by M.L.Kauhanen et al [56] and R.G. Robinson et al [47] but not in the studies done by Ng K C et al [54] and peter et al. [58]

In our study among the sociodemograhic variables increasing age, gender ethnicity, marital status living arrangements were not significant correlates of depression, though low education was a significant predictor in the univariate logistic analysis but not in multivariate analysis. In previous research studies therehave been inconsistent reportings regarding the association of sociodemograhic variables and post stroke depression .Increasing age was an

independent associate factor of depression in the study done by Mervi et al [49] but not in research studies done by Tarja et al, [10] and Peter Burvill et al. [58] Likewise gender has been reported as a significant predictor of post stroke depression by Michael et al [57] but Peter Burvill et al [58] in their study did not find gender as a significant associate factor of post stroke depression. In our research study, though proportion of the patients with low or no education was more than the educated ones, still in multivariate logistic model educational level was not a significant predictor of depression. A similar finding was reported by Tarja et al [10] in their research study.

Also in our study we did not find any significant association between the lesion type or location and post stroke depression. A similar reporting has been done by Ng K C. [54] Alan et al [59] in their meta-analysis study on 48 previous studies on the topic found no support for the hypothesis that the risk of depression after stroke is affected by the location of brain lesion.

In our study we also found that significant proportion of stroke patients were cognitively impaired (54%). The significant correlates of post stroke cognitive impairment were increasing age, low education, severe neurological impairment and depression.

Increasing age was also found to be a significant correlate of post stroke cognitive impairment by Allan et al. [100]. T.K. Tatemichi et al (1992) [101] in their

study found that increasing age and low education are significantly associated with post stroke cognitive impairment but T.K. Tatemichi et al (1994)[102] did not find increasing age and educational level to be significantly associated with post stroke cognitive impairment. The increasing age (more than 81 years) in our study may be a significant correlate of cognitive impairment because of the concomitant degenerative process which sets in with the increasing age.

In our study we found that severe neurological impairment and not functional impairment is a significant correlate of post stroke cognitive impairment. This indicates that stroke induced brain injury affects cognition as well. Since depression in our study is also a significant associated factor of post stroke cognitive impairment, hence we can conclude that stroke induced brain injury influences but is not a sole contributor to post stroke cognitive decline.

In our study we found both cognitive impairment and depression to be significant independent predictors of each other. The question that arises from this finding is, are the two outcomes a simultaneous process following stroke or one precedes the other? We emphasize the need to conduct an intense clinical research to look for the temporal relationship between the two as more concerted efforts may then be applied to identify and treat the entity which is causative of the other outcome so that the incidence of the other is reduced in the stroke subjects.

Also in our study we found post stroke cognitive impairment to be an independent

predictor of ADL dependency and post stroke depression .The absence of cognitive impairment upon the discharge of the patients from the hospitals was also an independent predictor of recovery from depression thereby suggesting the close association of cognitive impairment and depression in stroke patients Hence we emphasize the importance of identifying and treating the cognitive decline in stroke patients very judiciously.

In our study we found that depression in stroke patients largely goes unrecognized and untreated in clinical practice as has been found in previous research studies, [10] as only 25.58% of the depressed patients were receiving antidepressant drugs in our study.

The third outcome that we had analyzed in our research study was the functional status of the stroke patients on admission and on discharge from the community hospitals.

We found that the significant predictors of dependent living (Barthel Index > = 50) in our study were post stroke dysphagia, cognitive impairment, severe neurological impairment and severe ADL dependency on admission.

Severe neurological impairment has been consistently reported to be a significant correlate of dependency or poor functional outcome in previous

researches [23, 24, 26, 42.] as has been post stroke cognitive decline [42,43, 44]

In our study we found that increasing age was not an independent significant predictor of ADL dependency as has also been established by Maurizio et al [24], though K.C. Johnston [23] and Henrik et al [21] in their study found that increasing age has adverse prognostic value in the functional recovery in stroke patients. Also we did not find a significant relationship between lesion type and location and functional dependency. Herik et al [31] also in their research study did not find lesion type and location to be having a significant prognostic value on the stroke recovery. Comorbid conditions were not a significant correlate of dependent living in our study. A similar finding was reported by Henrik et al [21] but Maurizio et al [24] in their study found ischemic heart disease and cardiac arrhythmias as a predictor of serious disability on discharge. Likewise urinary incontinence has also been reported to have an adverse prognostic value on functional recovery in previous research studies [87, 91]

In our study we found that ADL dependency on discharge was associated with depression and cognitive impairment , which has also been reported by Chan Keen et al [18] and Stefano et al [51]

In our study, depression, though a significant correlate of ADL dependency on univariate analysis but on multivariate analysis it was not a significant predictor. Since this in-hospital research study is a part of a prospective study, where the post discharge follow up assessment of the stroke

patients is also being done, so what remains to be seen is if post stroke depression is a significant correlate of ADL dependency or not as has been reported in previous research studies.

Limitations of the study:

(1) Though the patients were assessed for depression by using a validated questionnaire, Geriatric Depression Scale, but this was not followed by a psychiatric evaluation, which may have affected the reporting of prevalence of depression in the study.

(2) Similarly Abbreviated Mental Test, a validated questionnaire, to assess cognitive impairment, was used in the study, but cognitive impairment was not confirmed by any clinical examination, which may have affected the reporting of cognitive impairment rate in the patients as well.

(3) One of the exclusion criteria in the research study was severe aphasia and therefore the reporting of rate of cognitive impairment in the study is biased. Also since Cognitive impairment is an independent correlate of post stroke depression, therefore under-reporting of cognitive impairment rate may have affected the reporting of prevalence of depression as well in the study.

(4) Since the research study was conducted in the community hospitals and some of the stroke patients are discharged to their homes directly from the

acute care hospitals without getting admitted to the community hospitals hence there is a selection bias and the reporting on the three outcomes in the study viz., depression, cognitive impairment and ADL dependency may have been affected by this bias.

Conclusions:

(1) Large number of stroke patients are depressed during their rehabilitation in community hospitals and depression goes largely untreated. Hence we suggest that depression in stroke patients should be diagnosed and treated judiciously.

(2) A large proportion of the patients were cognitively impaired and cognitive impairment in our study was a significant correlate of ADL dependency and post stroke depression. This suggests that patients could be more actively identified for special intervention like some form of cognitive behavioral therapy or pharmacotherapy like acetylcholinestaerase inhibitors.

(3) Severe neurological impairment was a significant correlate of post stroke depression, cognitive impairment and ADL dependency in our study . This suggests that treatment and rehabilitation strategies aimed at maximizing early neurological recovery in the patients may be potentially beneficial.

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CRF (Appendix1)

Serial No.------

Date ----------

(Protocol sheet for data collection)

Hospital: 1. AMKCH ( ) 2. SLK ( )

Name:

NRIC No:

Age:

Gender: 1. Male ( ) 2.Female ( )

Ethnicity: 1.Chinese ( ) 2.Malay ( ) 3.Indian ( ) 4.Others ( )

Address & Phone No:

Language Proficiency: 1.English ( ) 2.Chinese ( )
3. Malay ( ) 4.Tamil ( ).

Housing Type: 1. Bungalow ( ) 2.Condominium ( )
3. Semi- Detached Houses ( ) 4.Terrace houses ( )
5. Private Apartment (with no condo facilities) ( );
6. HDB 5-Rooms ( ) 7.HDB 4-Rooms ( )
8. HDB 3-Rooms ( ) 9.HDB 2-Rooms ( )
10 HDB 1-Room ( )

(Date Of Admission to Acute Hospital :___); & (To AMCH/ SLH :___)

A. Marital Status: 1. Married ( ) 2. Unmarried ( ) 3. Divorced/ Widow/er ( ).

B. Education: 1. Less than Sec. Level ( ) 2. More than Sec. Level ( )

C. Living Arrangement:

Whom are you living with?	1. Living with Someone( )	2. Living Alone ( )

D. Care Giver:

Is there anyone taking care of you for your medical needs?	1. Present ( )	2. Absent ( ) Reasons: _____ _____

E.	Severity of Stroke	As assessed by NIHS	Score-------
F.	Functional Status:	As assessed by Barthel Index	Score--------
G.	Visual Impairment (Finger Counting Method):	1. Present ( )	2. Absent ( )
H.	Hearing Impairment (Whispering Method):	1. Present ( )	2. Absent ( ).
I.	Cognitive Status:	As assessed by Abbrev. Mental Test	Score----------
J.	Depression:	As assessed by Geriat. Dep. Scale	Score----------
K.	Lesion Type:	1. Hemorrhagic( )	2. Infarction ( )

L.	Lesion Location:	1. Cortical ( ).	2. Non-Cortical ( )
M.	Lesion Distribution:	1. Focal ( )	2 Multi-Focal ( )
N.	Post Stroke Dysphagia:	1. Present ( ).	2. Absent ( ).
O.	Post Stroke Urinary Incontinence:	1. Present ( )	2.Absent
P.	Stroke Related Complications:		
	(a) Post Stroke Related Aspiration Pneumonia:	1. Present ( ).	2. Absent ( ).
	(b)Post Stroke Epilepsy	1. Present ( ).	2. Absent ( ).
Q.	Vascular Risk Factors:	1. Present ( )	2. Absent ( ).
	(a) Hypertension	1. Present ( )	2. Absent ( )
	(b) Diabetes	1. Present ( )	2. Absent ( )
	(c) Smoking	1. Present ( )	2. Absent ( ).
	(d) Ischemic heart Disease	1. Present ( ).	2. Absent ( ).
	(e) Atrial Fibrillation	1. Present ( ).	2. Absent ( ).

(f)Hyperlipidaemia	1. Present ( ).	2. Absent ( ).

Is the patient admitted in the hospital with:-	1. Ryle`s Tube ( )	2. Urinary ( )	3. Other support/s( )

Assessment at the Time of Discharge: (Date of discharge: -----)

A.	Neurological Impairment	Assessed by NIH Scale	Score: ----
B.	Functional Status:	Assessed by Barthel Index	Score: ----
C.	Cognitive Status	Assessed by Abbrev. Mental Test	Score: ----
D.	Depression	Assessed by Geriatric Depression Scale	Score: ---

Scales: **(APPENDIX 2)**

NIHSS (National institute of health stroke scale).

a. Level of Consciousness:	0 Alert
	1 Not alert, but arousable with minimal stimulation
	2 Not alert, requires repeated stimulation to attend
	3 Coma
1.b. Ask patient the month and their age:	0 Answers both correctly
	1 Answers one correctly
	2 Both incorrect
1.c. Ask patient to open and close eyes and	0 Obeys both correctly
	1 Obeys one correctly
	2 Both incorrect
2. Best gaze (only horizontal eye movement):	0 Normal
	1 Partial gaze palsy
	2 Forced deviation
3. Visual Field testing:	0 No visual field loss
	1 Partial hemianopia
	2 Complete hemianopia
	3 Bilateral hemianopia (blind including cortical blindness)
4. Facial Paresis (Ask patient to show	0 Normal symmetrical movement
Teeth or raise eyebrows and close eyes	1 Minor paralysis (flattened nasolabial fold, asymmetry on smiling)
Tightly):	2 Partial paralysis (total or near total paralysis of lower face)
	3 Complete paralysis of one or both sides (absence of facial movement in the upper and lower face)

5. Motor Function - Arm (right and left):	0 Normal (extends arms 90 (or 45) degrees for 10 seconds without drift)
	1 Drift
Right arm ____	2 Some effort against gravity
Left arm ____	3 No effort against gravity
	4 No movement
	9. Untestable
6. Motor Function - Leg (right and left):	0 Normal (hold leg 30 degrees position for 5 seconds)
	1 Drift
Right leg ____	2 Some effort against gravity
Left leg ____	3 No effort against gravity
	4 No movement
	9. Untestable
7. Limb Ataxia:	0 No ataxia
	1 Present in one limb
	2 Present in two limbs
8. Sensory (Use pinprick to test arms, legs,	0 Normal
Trunk and face -- compare side to side):	1 Mild to moderate decrease in sensation
	2 Severe to total sensory loss
9. Best Language (describe picture, name items,	0 No aphasia
Read sentences)	1 Mild to moderate aphasia
	2 Severe aphasia
	3 Mute
10. Dysarthria (read several words):	0 Normal articulation
	1 Mild to moderate slurring of words
	2 Near unintelligible or unable to speak
	9 Intubated or other physical barrier

11. Extinction and inattention:	0 Normal
	1 Inattention or extinction to bilateral simultaneous stimulation in one of the sensory modalities
6/24/97	2 Severe hemi-inattention or hemi-inattention to more than one modality

(Appendix 3) **Barthel index __:_**

Activity Score

FEEDING

0 = unable

5 = needs help cutting, spreading butter, etc., or requires modified diet

10 = independent _____

BATHING

0 = dependent

5 = independent (or in shower) _____

GROOMING

0 = needs to help with personal care

5 = independent face/hair/teeth/shaving (implements provided) _____

DRESSING

0 = dependent

5 = needs help but can do about half unaided

10 = independent (including buttons, zips, laces, etc.) _____

BOWELS

0 = incontinent (or needs to be given enemas)

5 = occasional accident

10 = continent _____

BLADDER

0 = incontinent, or catheterized and unable to manage alone

5 = occasional accident

10 = continent _____

TOILET USE

0 = dependent

5 = needs some help, but can do something alone

10 = independent (on and off, dressing, wiping) _____

TRANSFERS (BED TO CHAIR AND BACK)

0 = unable, no sitting balance

5 = major help (one or two people, physical), can sit

10 = minor help (verbal or physical)

15 = independent _____

MOBILITY (ON LEVEL SURFACES)

0 = immobile or < 50 yards

5 = wheelchair independent, including corners, > 50 yards

10 = walks with help of one person (verbal or physical) > 50 yards

15 = independent (but may use any aid; for example, stick) > 50 yards _____

STAIRS

0 = unable

5 = needs help (verbal, physical, carrying aid)

10 = independent _____

TOTAL (0–100): _____

The Barthel ADL Index: Guidelines

1. The index should be used as a record of what a patient does, not as a record of what a Patient could do.
2. The main aim is to establish degree of independence from any help, physical or Verbal, however minor And for whatever reason.
3. The need for supervision renders the patient not independent.
4. A patient's performance should be established using the best available evidence. Asking the patient, friends/relatives and nurses are the usual sources, but direct observation and common sense is also important. However direct testing is not needed.
5. Usually the patient's performance over the preceding 24-48 hours is important, But occasionally longer periods will be relevant.

(Appendix 4) **Abbreviated Mental Test**

Ask the patient following questions:

(1) Age: ( ).

(2)Time (to nearest hour): ( )

(3)Address for recall at end of test: 42 West Street (Ask patient to repeat the address to ensure it has been heard correctly) ( )

(4)Year: ( )

(5)Name of hospital: ( )

(6)Recognition of two persons (e.g. doctor and Nurse): ( )

(7)Date of birth: ( ).

(8)Year of start of First World War or the National day of Singapore ( )

(9)Name of Prime minister or President of Singapore ( ).

(10)Count backwards from 20 to 1 ( ).

Instructions for Scoring:

Score 1 in the bracket for each Correct Point or a Cross for the wrong Answer.

Score: 8-10 Normal

< 7 Abnormal Cognition

(Appendix 5)

Geriatric Depression Scale (Short Form):

Choose the best answer for how you have felt over the past week:

1. *Are you basically satisfied with your life? YES* / **NO**
2. *Have you dropped many of your activities and interests?* **YES** / *NO*
3. *Do you feel that your life is empty?* **YES** / *NO*
4. *Do you often get bored?* **YES** / *NO*
5. *Are you in good spirits most of the time? YES* / **NO**
6. *Are you afraid that something bad is going to happen to you?* **YES** / *NO*
7. *Do you feel happy most of the time? YES* / **NO**
8. *Do you often feel helpless?* **YES** / *NO*
9. *Do you prefer to stay at home, rather than going out and doing new things?* **YES** / *NO*
10. *Do you feel you have more problems with memory than most?* **YES** / *NO*
11. *Do you think it is wonderful to be alive now? YES* / **NO**
12. *Do you feel pretty worthless the way you are now?* **YES** / *NO*
13. *Do you feel full of energy? YES* / **NO**
14. *Do you feel that your situation is hopeless?* **YES** / *NO*
15. *Do you think that most people are better off than you are?* **YES** / *NO*

Answers in **bold** indicate **depression.** & Tick Yes Or No as the patient answers

Scoring:
Intervals: 0-4: No depression.

5 + : Depression.