Med & Health 2013; 8(1): 19-27

ORIGINAL ARTICLE

Prospective Study of Functional Recovery of Stroke Patients at Three Months Post Admission: Outcomes and Implications for Post Stroke Care Provision

ALI MF[1], AZIZ NA[1], AZNIDA FAA[1],RIZAL AM[2], AZMIN S[3]

[1]Department of Family Medicine, [2]Department of Community Health, [3]Department of Medicine (Neurology), Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Malaysia.

ABSTRAK

Pemulihan fungsi fizikal pesakit selepas strok boleh menentukan prognosis jangka masa panjang mereka. Selain kaedah rehabilitasi, terdapat faktor-faktor lain yang boleh mempengaruhi tahap pemulihan ini. Kami menilai tahap pemulihan fizikal jangka pendek pesakit strok iskemik yang mendapat rawatan di hospital tertier serta faktor-faktor yang mempengaruhinya. Ini dapat mengesyorkan rawatan lanjut strok selepas kemasukan hospital. Kajian pemerhatian dijalankan selama tiga bulan. Indeks Bathel yang telah diubah suai (MBI) digunakan untuk menilai tahap fungsi fizikal dan kertas soal selidik "Patient Health Questionnaire-9" (PHQ-9) untuk mengesan tahap kemurungan pesakit pasca strok. Sejumlah 46 pesakit strok terlibat di dalam kajian ini. Walaubagaimanapun, hanya 37 pesakit berjaya mendapat pemeriksaan susulan dan dianalisa. Purata umur bagi pesakit adalah 67.2 (±11) tahun. Melayu merupakan kaum majority (50%) diikuti dengan kaum Cina (41.3%) dan India (8.7%). Tekanan darah tinggi adalah faktor risiko paling tinggi (89.1%) diikuti dengan masalah kolesterol (65.2%) dan diabetis (63.0%). Purata kadar perbezaan MBI ialah 45.2 (SD 27.0) dengan median MBI 17.0 (IQR 33.0) pada permulaan kajian dibandingkan dengan 85.0 (IQR 42.0) selepas tiga bulan ($p<0.001$,CI 35.98,55.45). Prevalen kemurungan selepas strok (PHQ-9≥10) adalah sebanyak 21.6%. Kami mendapati bahawa pesakit yang mempunyai kemurungan pada masa tiga bulan dan mereka yang pernah mengalami strok sebelum ini mempunyai pemulihan fungsi yang lebih rendah ($p<0.035$). Pemulihan yang nyata dari segi fungsi fizikal telah ditunjukkan oleh pesakit strok dalam tempoh tiga bulan pertama selepas strok. Faktor seperti kemurungan dan pernah mengalami strok boleh mempengaruhi kadar pemulihan, oleh itu perlu untuk di saring pada peringkat awal.

Address for correspondence and reprint requests: Dr. Mohd Fairuz Ali, Department of Family Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Center, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia. Tel: 03-91456117 Fax: 03-91456680 Email: phere1@gmail.com

Kata kunci: strok, angin ahmar, pemulihan, rehabilitasi, Malaysia

ABSTRACT

Functional recovery in the immediate post stroke period predicts the long-term prognosis of post stroke patients. Despite the advancement in stroke rehabilitation in improving the physical function of survivors, there are other factors that may influence functional recovery. We aimed to assess the functional recovery of ischaemic stroke patients attending a tertiary hospital and its associated factors in order to make recommendations for post stroke care after hospital admission. A three months prospective observational study looking at functional recovery using the Modified Barthel's Index (MBI) and depression (Patient Heath Questionnaire-9) score of post stroke patients. There were 46 ischaemic stroke patients who were recruited for the study. At three months, only 37 patients were eligible for analysis. The mean age was 67.2 (SD 11) years with the Malays (50%) making up the majority of the patients, followed by Chinese (41.3%) and Indians (8.7%). There was a total of seven (15.2%) deaths. Hypertension was the most common risk factor (89.1%) followed by dyslipidaemia (65.2%) and diabetes mellitus (63.0%). The mean MBI difference was 45.2 (SD 27.0) with a median MBI of 17.0(IQR 33.0) at baseline compared to 85.0(IQR 42.0) at three months ($p < 0.001$, CI 35.98,55.45). The prevalence of depression (PHQ-9 10) was 21.6%. Lower functional recovery was found among depressed patients ($p <0.026$) and among patients with recurrent stroke ($p< 0.035$). Significant functional recovery can be seen as early as three-months post stroke. Factors such as recurrent stroke and depression may affect functional recovery post stroke; hence should be routinely screened.

Keywords: acute stroke, cerebrovascular accident, function recovery, patient admission, rehabilitation, Malaysia

INTRODUCTION

Stroke is one of the main causes of adult disability and has been the top four leading causes of death in developing countries. It is expected that the prevalence of stroke would be doubled in the next decade, corresponding to the increase in life expectancy and in lifestyle related illnesses namely hypertension, hyperlipidaemia and obesity. In Malaysia alone, stroke ranked as the fifth highest cause of death in 2009 with a mortality rate of 8.43 per 100 000 population (MOH 2009).

Management of stroke is through a multidisciplinary approach incorporating acute stroke units, seamless transfer of care from hospital to home, structured rehabilitation and comprehensive long term care to address post stroke complications and also management of secondary risk factors (NICE 2008; Yong & Foster 2007; Langhorne et al. 2011). It is acknowledged that approximately

two thirds of stroke survivors would survive the acute episode of stroke but many of these survivors may be living with various degrees of disabilities and dependent for the rest of their life (Internet Stroke Center 2013). Fragmented community services post transfer of care was identified as one of the barriers for optimum recovery; together with other issues related to the elderly population such as exposure to the risk of falls, dementia and safety (Young 2001).

Over the last two decades, stroke rehabilitation has been acknowledged as an integral part of stroke recovery, with specific restorative and repetitive learning processes tailored to individual disabilities; this is the key to improving the survivor's physical function in performing activities of daily living and mobility over time (Langhorne et al. 2011). Nonetheless, the degree of recovery depends on several factors, namely the patient's age, functional independence, support system and premorbid condition (Langhorne et al. 2009; Jorgensen et al. 1995; Musicco et al. 2003). Cardiovascular risk factors, notably diabetes, were also identified to influence the recurrence and rate of recovery. For example, a study done by Hamidon and Raymond found that diabetes is an independent risk factor influencing post stroke complications, which may result in poorer outcome after strokes as these patients tend to be more prone to infection and already had pre existing end organ damages secondary to diabetes (Hamidon & Raymond 2003).

The management of these risk factors requires long term commitment by medical personnel extending beyond in-hospital care. Guidelines have advocated the need of structured transfer of care from hospital to primary care as an important element for long term care and control (Langhorne et al. 2005). This study looked at early functional recovery and its associated factors in post ischemic stroke patients after they have been discharged from a tertiary hospital back to the community. It is hoped that the findings of this trial can be used to initiate a better transfer of care plan from the hospital to the community doctors by incorporating multidisciplinary team collaboration between in hospital physicians, primary care doctors, rehabilitation personnel and other support team members.

METHODOLOGY

This study was approved by the Medical Research and Ethics Committee of the Universiti Kebangsaan Malaysia (UKM).

DESIGN

A prospective study looking at 37 newly diagnosed stroke patients admitted to Universiti Kebangsaan Malaysia Medical Centre (UKMMC) from December 2010 to June 2011 with a primary diagnosis of stroke based on the WHO definition of stroke (Hatano 1976). Those who were comatose or somnolent and had substantial physical and cognitive impairment as a result of previous neurological and mental illness were excluded from the study. Each patient was seen at admission. Those who consented were assessed in terms of their functional status using

the Modified Barthel Index (MBI) at baseline and at three months.

The MBI was developed by Shah et al. (1989) derived from the original 1965 Barthel's Index by Mahony and Barthel, a 10-question self reported questionnaire that measures physical disability based on ability to perform basic activities of daily living (ADL) (Mahoney & Barthel 1965). It is the most common instrument used to measure functional disability in stroke rehabilitation studies (Sangha et al. 2005). A score of less than 50 was taken as "dependent" since subjects below this score were unlikely to be able to perform any basic activities of daily living (ADL) such as showering and mobilising without being assisted. The demographic and clinical information of the stroke patients were also assessed at baseline.

All stroke patients in this study were followed up as standard care for any stroke patient admitted to the hospital. At three months post stroke, patients were reassessed for functional status using the MBI and also for depression using the Patient Health Questionnaire 9-item depression scale (PHQ-9). This 9-item self-administered questionnaire was developed by Spitzer (Spitzer et al. 1999). It is based on the 9 DSM-IV symptoms of depression, which facilitates its use as a depression diagnostic tool as well as a screening instrument. It has been validated for use in primary care and stroke patients (Dietrich et al. 2003).

Other outcomes such as mortality and placement post hospital discharge, were also collected. Those who were not contactable physically at the respective outpatient clinics were interviewed by phone. A defaulter was labelled for patients who failed to be contacted through the clinic appointments and by phone.

STATISTICAL ANALYSIS

Data was analysed using the Statistical Package for the Social Sciences (SPSS) version 13. Descriptive statistics were used to described demographic and clinical profiles. Functional recovery comparing baseline and three months MBI scores were analysed using the Wilcoxon signed Rank Test. Bivariate association between the demographic and clinical profiles were analysed using the Student's T Test and ANOVA. A p-value of less than 0.05 and confidence interval of 95% were considered as statistically significant.

RESULT AND ANALYSIS

A total of 46 ischaemic stroke patients were recruited during the 6-month study period. At the end of the three months observational period, seven patients (15.2%) had died and two patients (4.3%) were lost to follow up. A total of 37 patients (84.7%) were still alive and continued in the study. A significant proportion of the patients were living at home (69.6%) with their family members, 6.5% readmitted to hospitals for various reasons and 4.3% were living in nursing homes. The demographic and clinical profiles are as presented in Table 1 and Table 2 respectively.

Looking into the clinical profile of the stroke patients, 30.4% of the subjects

Table 1: Demographic characteristics of respondents

Demographic Characteristic	Mean(SD)	Frequency (%) (N=46)
Age (years)	67.2±11	
Age (category)		
<64		17 (37.0)
65-74		20 (43.5)
75-84		7(15.2)
>85		2 (4.3)
Ethnicity		
Malay		23(50)
Chinese		19(41.3)
Indian		4(8.7)
Gender		
Male		25(54.3)
Female		21(45.7)
Status		
Married		39(84.8)
Single		7(15.2)
Living Alone		
No		38(82.6)
Yes		8 (17.4)
Work		
Employed		14 (30.4)
Unemployed		32(69.6)

Table 2: Risk profiles of patients

Risk Factors	Frequency (%) (N=46)
Hypertension	41(89.1)
Dyslipidaemia	30(65.2)
Diabetes	29(63.0)
Smoking	13(28.3)
Alcohol	7(15.2)
Previous CVA	14(30.4)
Atrial Fibrillation	4(8.7)
TIA	3(6.5)
Ischaemic Heart Disease	13(28.3)
Family history of CVA	11(23.9)
Family history of CVS	11(23.9)

had recurrent strokes and 6.5% had had TIA in the past. Hypertension (89.1%) was the commonest risk factor for stroke patients in this study followed by dyslipidaemia (65.2%) and diabetes mellitus (63.0%).

The functional status of the patients at the end of the three months observational period demonstrated a significant improvement in terms of the MBI score (Table 3). The PHQ-9 score, which was also assessed at the end of the observed period demonstrated that 21.6% of patients had some form of depression.

Bivariate analysis of functional recovery and PHQ-9 demonstrated that lower functional recovery was significantly found among depressed patients ($p<0.026$). Among other variables, only patients with recurrent stroke were found to have had lower functional recovery ($p<0.05$).

DISCUSSION

This was a prospective study that observed the functional outcome of 37 post stroke patients after being discharged from a tertiary hospital care in Malaysia. At baseline 78.4% of patients were found to be dependent and 21.6% were independent. At three months post stroke, only 18.9% of the patients were still dependent with functional recovery from baseline to three months noted to be significant ($p<0.01$) with a mean difference in Barthel's Index of 45.2 (SD 27.0). These findings showed that the speed and extent of recovery are important in planning the care and the need for rehabilitation during the recovery period.

Table 3: Change in functional status from baseline to 3 months follow up

Variable	Median (IQR)		Mean changes(SD)	Z score	p value	CI
	Baseline	3 months				
Modified Barthel Index	17 (33)	85(42)	45.2 (27.0)	-5.18	<0.001*	35.98-54.45

*using T test Wilcoxon signed Rank Test $p < 0.05$

Local studies looking at functional outcomes showed that the number of stroke patients who were still dependent on their carer within the three to six months follow up varied from 18.9% to 40% which is comparable to the present findings (Jaya et al. 2002; Rameezan & Zaliha 2005).

However, most outcome studies on stroke varied in their methodology and used different tools to access function and used different cut off points to define dependency level. Therefore, it was not possible to compare outcomes between these studies. In spite of this, this study also demonstrated that a significant number of stroke survivors were still dependent on their carers well after they have been discharged from hospital; thus the need for good outpatient medical support network for a structured and continued medical care.

Our stroke patients were mainly elderly with multiple risk factors with a mean age of 67.2±11 years old. This is expected as most strokes occur in the elderly and is comparable to other studies conducted in Asian and Western countries (Venketasubramanian 1999; Rothwell et al. 2004). With the increasing life span of the world's population, the mean age for stroke is expected to rise unless effective health promotion and risk prevention efforts are made in the community, especially by the primary health care services (Krishnamoorthy 2007).

The top five risk factors identified in this study were all modifiable risk factors through better lifestyle choices and better preventive measures from the health care system in the community. Similarly, hypertension was identified to be the most common risk factor for stroke locally and despite the high prevalence of hypertension in the world, the level of awareness, treatment and control of hypertension in the community remain low especially in developing countries including Malaysia (Internet Stroke Center 2013; Jaya et al. 2002; Rampal et al. 2008). Dyslipidaemia and diabetes were the second and third commonest risk factors for stroke in this study. These two lifestyle diseases are also among the top risk factors associated with stroke in the East Asian region including Australia (Burke & Venketasubramanian 2006; Ong & Raymond 2002). These three risk factors are sufficient for the diagnosis of metabolic syndrome, which is strongly associated with higher cardiovascular consequences and was also found to have more negative outcomes from stroke (Hamidon & Raymond 2003; Oh et al. 2013). Despite this, our study did not find any significant association of these factors with functional recovery after stroke.

One third or 30.4% of the subjects recruited in this study had a previous stroke and another 28.3% had ischemic heart disease in the past, which may suggest the lack of attention given to secondary prevention strategies. Previous studies had shown that, patients with previous stroke had slower functional recovery when compared to patients with a first ever stroke as many of them suffered some form of residual disability hampering the recovery process (Kwakkel et al. 1996; Hankey et al. 2002; Jorgensen et al. 1997). This study did not directly assess the association between functional recovery and number of stroke due to the small sample size (Kwakkel et al. 1996).

Nearly 21.6% of the patients were found to have depression at three months. This is not uncommon, as post stroke depression (PSD) has been reported to occur in approximately 10% to 50% of all stroke patients after a few months post stroke (Glamcevski & Pierson 2005; Sulaiman et al. 2002). Local studies reported that the prevalence of depression ranges from 36% at one to two months to 66% at three to six months post stroke (Glamcevski & Pierson 2005; Sulaiman et al. 2002). PSD has been associated with increased mortality, disability, length of hospital stay and reduced health-related quality of life (Townend et al. 2007). Similarly, our study also found that patients with depression at three months had a significantly lower functional recovery from their stroke with a mean difference of 22.79 (SD=2.88, 42.69) in the PHQ-9 score when compared to the non depressed stroke patients. Depression is a very debilitating mental problem that may result in social isolation causing patients to be unable to perform certain activities that can affect the rehabilitation process and hinder recovery.

Depression not only delays functional recovery, but on the other hand, those with delayed functional recovery may also succumb to depression (Glamcevski & Pierson 2005; Townend et al. 2007). Nevertheless, Townend et al. (2007) reported that depression may also occur even with the improvement of functional status (Townend et al. 2007). It was suggested that rather than the rate of recovery, the initial impact of disability brought by the stroke insult could pre determine the onset of depression. Despite the detrimental effect of depression, PSD is often under-recognised and under-treated in the community even within non-stroke patients (MOH 2006). This may stem from the social stigma associated with the condition or failure to recognise the depressive symptoms as significant by the sufferers or by the treating primary care doctors (Lotfi et al. 2010).

For primary care physicians, this study demonstrates the need to be aware of the caveats of managing stroke patients after being discharged to the community. These include mandatory screening for cardiovascular risk factors and depression, documentation of functional status and provision of rehabilitation. The management should be coordinated between hospital and primary care services. The coordination of care is important, as management of stroke care post discharge is complex, involving managing risk

factors, preventing recurrent stroke and further rehabilitation. It is also prudent to reintegrate them back to the community (Aziz et al. 2008). Hence, there is a need for the local health system to plan a coordinated transfer of care pathway to ensure continuous medical treatment and support given not only to the patients but also their carers and family.

Therefore, information from this study can be used to improve this transitional process and also community stroke management especially during the rehabilitation stages. It is hoped that by identifying the prevalence of the risk factors of stroke and factors associated with its functional recovery, primary and secondary prevention strategies of stroke can be enhanced. This is vital in the effort to restructure the medical care organisation and support network for stroke patients beyond acute in hospital care to the community.

ACKNOWLEDGMENT

The authors acknowledge Universiti Kebangsaan Malaysia for providing the fundamental research grant and center for data collection.

REFERENCES

Aziz, N.A., Leonardi-Bee, J., Phillips, M., Gladman, J.R., Legg, L., Walker, M.F. 2008. Therapy-based rehabilitation services for patients living at home more than one year after stroke. *Cochrane Database Syst Rev* 2:CD005952.

Burke, T., Venketasubramanian, R. 2006. The epidemiology of stroke in the East Asian region: a literature-based review. *Int J Stroke* **1**(4):208-215.

Dietrich, A.J., Oxman, T.E., Burns, M.R., Winchell, C.W, Chin, T. 2003. Application of a depression management office system in community practice: a demonstration. *J Am Board Fam Pract* **16**(2):107-114.

Glamcevski, M.T., Pierson, J. 2005. Prevalence of and factors associated with poststroke depression: a Malaysian study. *J Stroke Cerebrovasc Dis* **14**(4):157-161.

Hamidon, B., Raymond, A. 2003. Risk factors and complications of acute ischaemic stroke patients at Hospital Universiti Kebangsaan Malaysia (HUKM). *Med J Malaysia* **58**(4):499-505.

Hankey, G., Jamrozik, K., Broadhurst, R., Forbes, S., Anderson, C. 2002. Long-term disability after first-ever stroke and related prognostic factors in the Perth Community Stroke Study, 1989-1990. *Stroke* **33**(4):1034-1040.

Hatano, S. 1976. Experience from a multicentre stroke register: a preliminary report. *Bull World Health Organ* **54**(5):541.

Internet Stroke Center. 2013. Stroke Statistics. Available from: http://www.strokecenter.org/patients/about-stroke/stroke-statistics/. [Accessed on 3/12/2013].

Jaya, F., Win, M.N., Abdullah, M.R., Abdullah, M.R., Abdullah, J.M. 2002. Stroke patterns in Northeast Malaysia: a hospital-based prospective study. *Neuroepidemiology* **21**(1):28-35.

Jørgensen, H.S., Nakayama, H., Raaschou, H.O., Olsen, T.S. 1997. Acute stroke: prognosis and a prediction of the effect of medical treatment on outcome and health care utilization. The Copenhagen Stroke Study. *Neurology* **49**(5):1335-1342.

Jørgensen, H.S., Nakayama, H., Raaschou, H.O., Vive-Larsen, J., Støier, M., Olsen, T.S. 1995. Outcome and time course of recovery in stroke. Part II: Time course of recovery. The copenhagen stroke study. *Arch Phys Med Rehabil* **76**(5):406-412.

Kwakkel, G., Wagenaar, R.C., Kollen, B.J., Lankhorst, G.J. 1996. Predicting disability in stroke--a critical review of the literature. *Age Ageing* **25**(6):479-489.

Langhorne, P., Bernhardt, J., Kwakkel, G. 2011. Stroke rehabilitation. *Lancet* 377(9778):1693-1702.

Langhorne, P., Coupar, F., Pollock, A. 2009. Motor recovery after stroke: a systematic review. *Lancet Neurol* **8**(8):741-754.

Langhorne, P., Taylor, G., Murray, G., Dennis, M., Anderson, C., Bautz-Holter, E., Dey, P., Indredavik, B., Mayo, N., Power, M., Rodgers, H., Ronning, O.M., Rudd, A., Suwanwela, N., Widen-Holmqvist, L., Wolfe, C. 2005. Early supported discharge services for stroke patients: a meta-analysis of individual patients' data. *Lancet* **365**(9458):501-506.

Lotfi, L., Flyckt, L., Krakau, I., Mårtensson, B., Nilsson, G.H. 2010. Undetected depression in primary healthcare: occurrence, severity and co-morbidity in a two-stage procedure

of opportunistic screening. *Nord J Psychiatry* **64**(6):421-427.

Mahoney, F., Barthel, D.1965. Functional Evaluation: The Barthel Index. *Md State Med J* **14**:61-65.

Ministry of Health (MOH). 2006. Clinical Practice Guidelines, Management of Stroke Available from: http://www.acadmed.org.my/index.cfm?&menuid=67. [Accessed on 21/5/2011].

Ministry of Health (MOH). 2009. Malaysian Health Facts 2009. Available from: http://www.moh.gov.my/v/stats_si. [Accessed on 10/10/2011].

Musicco, M., Emberti, L., Nappi, G., Caltagirone, C. 2003. Early and long-term outcome of rehabilitation in stroke patients: the role of patient characteristics, time of initiation, and duration of interventions. *Arch Phys Med Rehabil* **84**(4):551-558.

National Institute for Health and Clinical Excellence (NICE). 2008. Stroke: the diagnosis and initial management of acute stroke and transient ischaemic attack. (Clinical guideline 68.) Available from: http://www.nice.org.uk/Guidance/CG68/NiceGuidance/pdf/English. [Accessed on 5/18/2013].

Oh, M.Y., Ko, S.B., Lee, S.H., Kim, C., Ryu, W.S., Kim, C.H., Yoon, B.W. 2014. Association between metabolic syndrome and functional outcome in patients with acute ischaemic stroke. *Eur J Neurol* **21**(1):177-179

Ong, T.Z., Raymond, A.A. 2002. Risk Factors for Stroke and Predictors of One-Month Mortality. *Singapore Med J* **43**(10):517-521.

Rameezan, B.A., Zaliha, O. 2005. Functional Status of Acute Stroke Patients in University Malaya Medical Centre (UMMC), Kuala Lumpur, Malaysia. *Med J Malaysia* **60**(5):548-59.

Rampal, L., Rampal, S., Azhar, M.Z., Rahman, A.R. 2008. Prevalence, awareness, treatment and control of hypertension in Malaysia: A national study of 16,440 subjects. *Public Health* **122**(1):11-18.

Rothwell, P.M., Coull, A.J., Giles, M.F., Howard, S.C., Silver, L.E., Bull, L.M., Gutnikov, S.A., Edwards, P., Mant, D., Sackley, C.M., Farmer, A., Sandercock, P.A., Dennis, M.S., Warlow, C.P., Bamford, J.M., Anslow, P. 2004. Change in stroke incidence, mortality, case-fatality, severity, and risk factors in Oxfordshire, UK from 1981 to 2004 (Oxford Vascular Study). *Lancet* **363**(9425): 1925-1933.

Sangha, H., Lipson, D., Foley, N., Salter, K., Bhogal, S., Pohani, G., Teasell, R. 2005. A comparison of the Barthel Index and the Functional Independence Measure as outcome measures in stroke rehabilitation: patterns of disability scale usage in clinical trials. *International Journal of Rehabilitation Research* **28**(2):135.

Shah, S., Vanclay, F. & Cooper, B. 1989. Improving The Sensitivity Of The Barthel Index For Stroke Rehabilitation. *J Clin Epidemiol* **42**(8):703-709.

Spitzer, L.R., Williams, J.B.W., Kroenke, K. 1999. Patient Health Questionnaire. Prime Pfizer Incorporated.

Sulaiman AH, Zainal N, Tan KS, Tan C. 2002. Prevalence and associations of post-stroke depression. *Neurol J Southeast Asia* **7**:71-75.

Krishnamoorthy, M. 2007. Killer Stroke: Six Malaysian Hit Every Hour. The Star Online. Available from: http://www.thestar.com.my/story.aspx/?file=%2f2007%2f4%2f24%2fnation%2f17524877 [Accessed on 8/25/2011].

Townend, B.S., Whyte, S., Desborough, T., Crimmins, D., Markus, R., Levi, C., Sturm, J.W. 2007. Longitudinal prevalence and determinants of early mood disorder post-stroke. *J Clin Neurosci* **14**(5):429-434.

Venketasubramanian, N. 1999. Stroke in Singapore - An Overview. *Singapore Med J* 40(1):48-52.

Young, J. 2001. The primary care stroke gap. *Br J Gen Pract* **51**(471):787-788.

Young, J., Forster, A. 2007. Review of stroke rehabilitation. *BMJ* **334**(7584):86-90.