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Cognitive and Affective Predictors of Rehabilitation Participation After Stroke

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Abstract

Objective—To examine associations between cognitive and affective impairments and rehabilitation participation during stroke rehabilitation.

Design—Secondary analyses of stroke patients who received acetylcholinesterase inhibitors during inpatient rehabilitation.

Setting—University-affiliated inpatient rehabilitation facilities.

Patients—Individuals admitted to inpatient stroke rehabilitation with impairment in attention, memory or executive functions ($N=44$).

Interventions—Secondary analysis of individuals receiving inpatient stroke rehabilitation care plus random assignment to one of two acetylcholinesterase inhibitors or no drug at rehabilitation admission.

Main Outcome Measure(s)—Correlations between measures of cognitive (Digit Span, Hopkins Verbal Learning Test, and Executive Interview) and affective impairments (Hamilton Rating Scale for Depression and Apathy Evaluation Scale) and participation (Pittsburgh Rehabilitation and Participation Scale) were examined. Significant correlates of participation were examined in a linear multiple regression model.

Results—Executive functions and depressive symptoms were significant correlates of participation. After controlling for baseline disability, executive functions predicted participation, but depressive symptoms did not, $F_{4,32}=9.35$; $R^2=.54$, $P<.001$.

Conclusions—These findings are an important first step toward understanding potentially modifiable clinical factors that contribute to rehabilitation participation, and overall functional status after rehabilitation. A better understanding of cognitive impairment and rehabilitation participation may be used to develop strategies for improving functional outcomes after stroke.

Keywords

Patient Compliance; Rehabilitation; Stroke; Cognition

Approximately 20% of adults who sustain stroke are referred to inpatient rehabilitation facilities (IRFs).^{1–3} To qualify for admission to inpatient rehabilitation, individuals must require close medical supervision by a rehabilitation physician, 24 hour nursing care, and a coordinated multidisciplinary rehabilitation program. In addition, individuals must be able to participate in an intense rehabilitation regime, consisting of at least 3 hours of therapy daily, and be expected to achieve significant practical improvement over a short period of time.⁴ Despite these intensive programs, many individuals continue to experience disability after discharge from inpatient rehabilitation.^{1,5} Thus, there is continued need to improve inpatient stroke rehabilitation outcomes, and reduce long-term disability.

To improve inpatient stroke rehabilitation outcomes, one must examine factors that directly influence them. One such factor is the degree to which individuals actively participate in and follow through with recommended rehabilitation activities – or the level rehabilitation participation.^{6,7} Rehabilitation therapists often judge rehabilitation participation, considering it an indicator of active learning, rehabilitation progress and overall functional prognosis.⁶ In the absence of full active participation, it is unlikely that individuals will receive the full-benefit of stroke rehabilitation intervention, thus increasing their risk for more severe chronic disability. In fact, several studies have shown rehabilitation participation to predict functional outcome at the conclusion of inpatient rehabilitation.^{7–12} However, no studies have examined factors influencing rehabilitation participation among individuals admitted to inpatient stroke rehabilitation.

Several factors may contribute to limited rehabilitation participation after stroke. Cognitive and affective impairments are common sequelae of stroke,^{13–17} and they may reduce participation by limiting the ability to understand or recall instructions, initiate recommended practice, or self-direct their rehabilitation regimen. Cognitive impairments, depressive symptoms and apathy have been associated with poor rehabilitation outcomes in previous studies, and these associations may be due in part to their more immediate impact on rehabilitation participation.^{9,10,14} Yet, no studies have examined associations between these impairments and rehabilitation participation after stroke.

The present study examined whether cognitive or affective impairments predict rehabilitation participation among individuals admitted to inpatient rehabilitation after stroke. By examining predictors of rehabilitation participation, we may be able to identify clinical priorities early in the rehabilitation process that can be targeted to improve rehabilitation participation to reduce overall stroke-related disability.

Methods

Data were collected as part of another study examining the effects of acetylcholinesterase inhibitors on cognitive impairment in older adults after stroke.¹⁸ Participants were recruited from 2 university-affiliated inpatient stroke rehabilitation facilities. Individuals were included if they were age 60 and older, had sustained an ischemic stroke within the prior 30 days, and demonstrated impairment in at least one of three cognitive domains (attention, memory, or executive functions). Cognitive impairment was defined as a score at least one standard deviation below age-adjusted scaled scores on one of three tests: Digit Span - Summary Score from the Wechsler Adult Intelligence Test – III (DS),¹⁹ Hopkins Verbal Learning Test – Trial 4 (HVLT),²⁰ and Executive Interview (EXIT).²¹ Individuals with severe aphasia were excluded.

Severe aphasia was defined as having lesion location typically associated with aphasia and either a Token Test²² Part I score of 8 or less, or a Boston Naming Test²³ score more than one standard deviation below age adjusted norms. Individuals were also excluded if they had

a diagnosis of dementia, major depressive disorder (measured with the PRIME-MD)²⁴ unless treated and in remission, current psychosis or mania (measured with the PRIME-MD), or substance or alcohol abuse or dependence within the prior three months. All participants or designated proxies provided informed consent, and procedures were approved by the university Institutional Review Board.

Intervention

All participants engaged in usual rehabilitation care provided at 2 university-affiliated IRFs. These facilities are overseen by a central medical and administrative leadership, and provide rehabilitation care under the same set of internal clinical practice guidelines (patterned after published clinical practice guidelines for inpatient stroke rehabilitation).²⁵ Thus, rehabilitation care was consistent between these two sites, and comprised a minimum of 3 hours of occupational, physical and speech therapy per day, provided in individual and group treatment sessions. In addition, participants in the parent study received one of two acetylcholinesterase inhibitors or no drug (non-random assignment) at the onset of inpatient rehabilitation, after the completion of all baseline measures.

Measures

Rehabilitation participation was measured with the Pittsburgh Rehabilitation Participation Scale (PRPS) using ratings from occupational and physical therapists providing the rehabilitation care at the inpatient rehabilitation facilities. The PRPS is a valid and reliable criterion-referenced scale developed to rate the degree of active participation in rehabilitation therapy sessions.²⁶ The PRPS requires rehabilitation therapists to characterize a patient's rehabilitation participation during a given rehabilitation session, considering the proportion of prescribed activities in which they actively participated, given levels of interest, effort, direction following, and completion. Each session is scored 1 (no participation, refusal) to 6 (excellent participation). Occupational and physical therapists administering the scale received standardized training using procedures described elsewhere.²⁶ For the present study, each participant's scores were combined for all occupational and physical therapy sessions throughout the rehabilitation length of stay to yield a mean rehabilitation participation score.

Baseline disability was measured with the Functional Independence Measure (FIM)²⁷ at rehabilitation admission and 12 weeks later by a trained occupational therapist who was not part of the rehabilitation team (ES).

We assessed three cognitive domains at rehabilitation admission: attention (measured with the DS), memory (measured with the HVL, Trial 4) and executive functions (measured with the EXIT). We converted DS and HVL (Trial 4) raw scores to scaled scores (adjusted for age), with a score of 10 representative of the population mean with a standard deviation of 3. We modified the administration of the EXIT such that items requiring motor responses were performed with the unaffected upper limb only. For the EXIT, we computed a total raw score (range 0 – 50), with a high score indicating severe impairment.

We also assessed two affective domains at rehabilitation admission: depressive symptoms (measured with the 17-item Hamilton Rating Scale for Depression, HRSD)²⁸ and apathy (measured with the Apathy Evaluation Scale, AES).²⁹ The HRSD assesses frequency and severity of depressive symptoms through structured interview. A total raw score is derived (range 0 – 52), with a high score indicating more frequent and severe symptoms. In the present study, we excluded anyone with a HRSD score of 16 or higher, as this is associated with a diagnosis of Major Depressive Disorder.³⁰ These individuals were referred for full psychiatric evaluation and treatment. The AES assesses level of interest for engaging in daily activities,

also through structured interview. A total raw score is derived (range 0 – 72), with a high score indicating greater apathy.

All of the cognitive and affective measures are valid and reliable and were administered by trained personnel who were not part of the rehabilitation team (supervised by MB, EL, EW). These data were not available to the occupational and physical therapists rating rehabilitation participation.

Data Analyses

We reported baseline demographic and clinical characteristics with descriptive statistics. We then examined the associations between baseline characteristics and rehabilitation participation using zero-order correlations. We subsequently conducted a linear multiple regression analysis in which eligible independent variables (i.e., those with zero-order correlations that were of at least moderate size, $r \geq .30$) were entered simultaneously into the equation.³¹

Results

In the parent study, among 314 individuals were admitted for inpatient rehabilitation, 67 patients consented to this study of which 20 were subsequently excluded in accordance with the protocol and 40 started study medication. An additional 11 subjects were recruited using the same inclusion/exclusion criteria subsequent to completion of the drug study as a control group. For the current report, we conducted analyses with the subset of 44 individuals for whom rehabilitation participation data was available. These 44 individuals did not differ from the remaining 7 participants with respect to age, education, time since stroke onset, or baseline clinical measures (cognitive and affective impairment, disability). Among these 44 participants, 14 participants received donepezil, 20 participants received galantamine, and 10 participants did not receive study medication in the parent study. Analyses revealed that medication assignment was not associated with differences in baseline measures of cognitive and affective impairments, with the exception of apathy (Table 1). Participants who did not receive the study medication had less apathy than participants who received either study medication. Medication assignment had no effect on mean rehabilitation participation scores (Table 1).

The mean age of the sample was 73.6 years, and the mean years of education was 12.4 years. A large percentage of participants were white (85%) and there slightly more men (55%) than women (Table 1). Fifty-one percent of the sample had strokes in the cortical region, compared to 44% in the subcortical region and 5% in the cerebellum. The mean scores on the HVLT and EXIT represent impairment in memory and executive functions, respectively; the mean score on DS does not reflect impairment in attention. In addition, the mean HRSD scores indicated a mild level of depressive symptoms, and the mean AES scores indicated a moderate level of apathy.

Baseline Predictors of Rehabilitation Participation

Days since stroke onset ($r = -.30$, $P = .054$) and baseline disability ($r = .56$, $P < .001$) were significantly correlated with rehabilitation participation. Among baseline measures of cognitive and affective impairment, only executive functions ($r = -.55$, $P < .001$) and depressive symptoms ($r = -.39$, $P = .01$) were significantly correlated with rehabilitation participation and met our criterion for entry into the regression model (Table 2). Age ($r = -.17$, $P = .28$), race ($r = -.19$, $P = .23$), education ($r = .27$, $P = .08$), and stroke location ($V = .70$, $P = .98$) were not reliably correlated with rehabilitation participation.

In the multiple regression model examining days since stroke onset, baseline disability, executive functions, and depressive symptoms, only baseline disability ($\beta=.35$, $P=.02$) and executive functions ($\beta=-.40$, $P=.005$) were significant predictors of rehabilitation participation, $F_{4,32}=9.35$; $R^2=.54$, $P<.001$ (Table 2). Post hoc power analyses suggest we had 99.99% power to detect these differences.

Of note, mean rehabilitation participation scores were significantly correlated with 12 week functional status ($r=.43$, $P=.02$), replicating findings already published.⁷⁻⁹

Discussion

Among individuals with cognitive impairment, days since stroke onset, baseline disability, executive functions and depressive symptoms were all correlated with rehabilitation participation. Nonetheless, only baseline disability and executive functions were independent predictors of rehabilitation participation in this sample. These findings are an important first step toward identifying potentially modifiable clinical factors that contribute to rehabilitation participation, and overall functional outcome.

In the present study, we examined selected baseline clinical factors (i.e., cognitive and affective impairments, baseline disability) associated with rehabilitation participation. Many studies have reported that baseline disability is a robust predictor of functional outcome.^{32,33} For that reason, it is noteworthy that impairment in executive functions was an independent predictor of rehabilitation participation in this sample even after controlling for baseline disability. Individuals with impairment in executive functions have difficulty initiating activities, maintaining consistency of response, inhibiting impulsive behaviors and generalizing instructions to other tasks; hence, individuals with impairment in executive functions may have difficulty internalizing and applying rehabilitation instructions with consistent effort. While level of depressive symptoms was not an independent predictor of rehabilitation participation in this sample, it was strongly correlated with executive functions. Depressive symptoms and impairment in executive functions frequently overlap in late-life³⁴ and after stroke,³⁵ and potentially represent ischemic injury to frontal-subcortical pathways.³⁶ Thus, the findings in the current sample seem plausible, and if validated, may be useful to identify assessment and intervention priorities in inpatient stroke rehabilitation. For example, future studies examining factors contributing to rehabilitation participation may help to identify instances where rehabilitation training is not meeting the needs of selected individuals, and suggest strategies to better tailor rehabilitation training to meet these needs.

We believe these preliminary findings show promise, but should be interpreted with caution. These secondary analyses were conducted using data collected as part of a clinical study examining the effects of acetylcholinesterase inhibitors on cognitive impairment after stroke. As a result, inclusion and exclusion criteria limited the sample to individuals who had selected cognitive deficits and did not have others. Thus, the sample is not necessarily representative of the general inpatient stroke rehabilitation population. In addition, the sample size was sufficient to examine only a few factors that may influence rehabilitation participation. Arguably, there are many additional factors, such as precise stroke location, medical burden, medication regimen, and social support that should be examined in future analyses.

Finally, rehabilitation participation is the product of dynamic interactions between patients and their treating therapists. In the present study, we only examined associations between clinical factors (cognitive and affective impairments) and the treating occupational and physical therapists' perspectives on rehabilitation participation. We did not measure the patients' perspectives on rehabilitation participation. In addition, we did not measure the therapists' perspectives on facilitators or barriers to rehabilitation participation, or the skill of the

therapists' in adapting rehabilitation training to address any perceived barriers. Arguably, all of these factors may facilitate or impede rehabilitation participation and should be measured in future studies examining rehabilitation participation. Despite these limitations, our findings suggest potential predictors of poor rehabilitation participation after stroke that can be tested in future studies.

Conclusions

In summary, rehabilitation participation may be associated with executive functions among adults with cognitive impairment after stroke. Further examination of the determinants and effects of rehabilitation participation may be useful for identifying ways to improve overall functional outcome after stroke.

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Abbreviations

IRF	Inpatient Rehabilitation Facility
DS	Digit Span Summary Score
HVLT	Hopkins Verbal Learning Test, Trial 4
EXIT	Executive Interview
PRPS	Pittsburgh Rehabilitation Participation Scale
FIM	Functional Independence Measure
HRSD	Hamilton Rating Scale for Depression
AES	Apathy Evaluation Scale

References

1. Dombrov ML, Basford JL, Whisnant JP, Bergstralh EJ. Disability and use of rehabilitation services following stroke in Rochester, Minnesota, 1975–1979. *Stroke* 1987;18:830–836. [PubMed: 3629639]
2. Rundek T, Mast H, Hartmann A, Boden-Albala B, Lennihan L, Lin IL, Paik MC, Sacco RL. Predictors of resource use after acute hospitalization. The Northern Manhattan Stroke Study. *Neurology* 2000;55:1180–1187. [PubMed: 11071497]
3. Centers for Disease Control and Prevention. Prevalence of disabilities and associated health conditions among adults: United States. *MMWR* 1999;50:120–125.
4. Centers for Medicare and Medicaid Services, Medicare Program. Inpatient Rehabilitation Facility Prospective Payment System. *Federal Register* 2009 May 6;74(86):21068–21070.
5. Paolucci S, Grasso MG, Antonucci G, Troisi E, Morelli D, Coiro P, Bragoni M. One-year follow up in stroke patients discharged from rehabilitation hospital. *Cerebrovasc Dis* 2000;10:25–32. [PubMed: 10629343]
6. Maclean N, Pound P, Wolfe C, Rudd A. The concept of patient motivation: a qualitative analysis of stroke professionals' attitudes. *Stroke* 2002;33:444–448. [PubMed: 11823650]
7. Lenze EJ, Munin MC, Quear T, Dew MA, Rogers JC, Begley AE, Reynolds CF. The significance of poor patient participation in physical and occupational therapy for functional outcome and length of stay. *Arch Phys Med Rehabil* 2004;85:1599–1601. [PubMed: 15468017]

8. Horn W, Yoels W, Bartolucci A. Factors associated with patients' participation in rehabilitation services: a comparative injury analysis 12 months post-discharge. *Disability Rehabil* 2000;22:358–362.
9. Dorra HH, Lenze EJ, Kim Y, Mulsant BH, Munin MC, Dew MA, Reynolds CF. Clinically relevant behaviors in elderly hip fracture inpatients. *Int J Geriatric Psychiatry* 2002;32:249–259.
10. Lenze EJ, Munin MC, Dew MA, Rogers JC, Seligman K, Mulsant BH, Reynolds CF. Adverse effects of depression and cognitive impairment on rehabilitation participation and recovery from hip fracture. *Int J Geriatric Psychiatry* 2004;19:472–478.
11. Resnick B. Efficacy beliefs in geriatric rehabilitation. *J Gerontol Nurs* 1998;24:34–44. [PubMed: 9801529]
12. Resnick B. Geriatric rehabilitation: the influence of efficacy beliefs and motivation. *Rehabil Nurs* 2002;27:152–159. [PubMed: 12116528]
13. Tatemichi TK, Desmond DW, Stern Y, Paik M, Sano M, Bagiella E. Cognitive impairment after stroke: frequency, patterns, and relationship to functional abilities. *J Neurol Neurosurg Psychiatry* 1994;57:202–207.
14. Heruti RJ, Lusky A, Danker R, Ring H, Dolgopiat M, Barell V, Levenkrohn S, Adunsky A. Rehabilitation outcome of elderly patients after a first stroke: effect of cognitive status at admission on the functional outcome. *Arch Phys Med Rehabil* 2002;83:742–749. [PubMed: 12048650]
15. Pojhasvaara T, Leskela M, Vataja R, Kalska H, Ylikoski R, Hietanen M. Post-stroke depression, executive dysfunction and functional outcome. *Eur J Neurol* 2002;9:269–275. [PubMed: 11985635]
16. Patel M, Coshall C, Rudd AG, Wolfe CD. Natural history of cognitive impairment after stroke and factors associated with its recovery. *Clinical Rehabil* 2003;17:158–166.
17. Brodaty H, Sachdev PS, Withall A, Altendorf A, Valenzuela MJ, Lorentz L. Frequency and clinical neuropsychological and neuroimaging correlates of apathy following stroke – the Sydney Stroke Study. *Psychol Med* 2005;35:1707–1716. [PubMed: 16202190]
18. Whyte EM, Lenze EJ, Butters MA, Skidmore ER, Koenig K, Dew MA, Penrod L, Mulsant BH, Pollock BG, Cabacungan L, Begley A, Reynolds CF III, Munin MC. An open-label pilot study of acetylcholinesterase inhibitors to promote functional recovery in elderly cognitively impaired stroke patients. *Cerebrovasc Dis* 2008;26:317–321. [PubMed: 18667813]
19. Wechsler, D. Wechsler Adult Intelligence Scale III. San Antonio TX: Psychological Corporation Inc; 1997.
20. Shapiro AM, Benedict RH, Schretlen D, Brandt J. Construct and concurrent validity of the Hopkins Verbal Learning Test-Revised. *Clin Neuropsychol* 1999;13:348–358. [PubMed: 10726605]
21. Royall DR, Mahurin RK, Gray KF. Bedside assessment of executive cognitive impairment: the executive interview. *JAGS* 1992;40:1221–1226.
22. Boller F, Vinlogo L. Latent sensory aphasia in hemisphere-damaged patients: an experimental study with the Token Test. *Brain* 1966;89:815–831. [PubMed: 5335067]
23. Kaplan, E.; Goodglass, H.; Weintraub, S. Boston Naming Test. Philadelphia: Lea & Febiger; 1983.
24. Spitzer RL, Williams JB, Kroenke K, Linzer M, deGruy FV, Hahn SR, Brody D, Johnson JG. Utility of a new procedure for diagnosing mental disorders in primary care. The PRIME-MD 1000 study. *JAMA* 1994;272:1749–1756. [PubMed: 7966923]
25. Duncan PW, Zorowitz R, Bates B, Choi JY, Glasberg JJ, Graham GD, Katz RC, Lamberty K, Reker D. Management of adult stroke rehabilitation care: a clinical practice guideline. *Stroke* 2005;36:e100–e143. [PubMed: 16120836]
26. Lenze EJ, Munin MC, Quear T, Dew MA, Rogers JC, Begley AE, Reynolds CF. The Pittsburgh Rehabilitation Participation Scale: reliability and validity of a clinician-rated measure of participation in acute rehabilitation. *Arch Phys Med Rehabil* 2004;85:380–384. [PubMed: 15031821]
27. Stineman MG, Shea JA, Jette A, Tassoni CJ, Ottenbacher KJ, Fiedler R, Granger CV. The Functional Independence Measure: tests of scaling assumptions, structure, and reliability across 20 diverse impairment categories. *Arch Phys Med Rehabil* 1996;77:1101–1108. [PubMed: 8931518]
28. Hamilton M. A rating scale for depression. *J Neurol Neurosurg Psychiatry* 1960;23:56–62.
29. Marin RS, Biedrzycki RC, Firinciogullari S. Reliability and validity of the Apathy Evaluation Scale. *Psychiatry Res* 1991;38:143–162. [PubMed: 1754629]

30. Bagby RM, Ryder AG, Schuller DR, Marshall MB. The Hamilton Depression Rating Scale: has the gold standard become a lead weight? *Am J Psychiatry* 2004;161:2163–2177. [PubMed: 15569884]
31. Tabachnick, BG.; Fidell, LS. *Using Multivariate Statistics*. 5th ed.. Boston: Allyn and Bacon; 2007.
32. Inouye M, Hashimoto H, Mio T, Sumino K. Influence of admission functional status on functional change after stroke rehabilitation. *Am J Phys Med Rehabi* 2001;80:121–125.
33. Ween JE, Alexander MP, D'Esposito M, Roberts M. Factors predictive of stroke outcome in a rehabilitation setting. *Neurology* 1996;47:388–392. [PubMed: 8757009]
34. Alexopoulos GS. The depression-executive dysfunction syndrome of late life: a specific target for D3 agonists. *Am J Geriatric Psychiatry* 2001;9:22–29.
35. Vataja R, Pohjasvaara T, Mantyla R, Ylikoski R, Leskela M, Kalska H, Hietanen M, Juhani Aronen H, Salonen O, Kaste M, Leppavuori A, Erkinjuntti T. Depression-executive dysfunction syndrome in stroke patients. *Am J Geriatric Psychiatry* 2005;13:99–107.
36. Tekin S, Cummings JL. Frontal-subcortical neuronal circuits and clinical neuropsychiatry: an update. *J Psychosom Res* 2002;53:647–654. [PubMed: 12169339]

Table 1

Participants' Demographics and Clinical Characteristics

	Donepezil <i>n</i> =14	Galantamine <i>n</i> =20	No Drug <i>n</i> =10	Test Statistic	Total Sample <i>N</i> = 44
Men, %	43	60	60	$\chi^2_2=1.13, P=.57$	55
Age, years, $\bar{x}$ (<i>SD</i>)	73.0 (7.7)	72.4 (8.0)	76.8 (7.8)	$F_{2,40}=1.12, P=.34$	73.6 (7.9)
Education, years, $\bar{x}$ (<i>SD</i>)	12.3 (3.3)	12.6 (3.5)	12.2 (3.0)	$F_{2,40}= .04, P=.96$	12.4 (3.2)
Ethnicity				$\chi^2_2=4.42, P=.11^{\dagger}$	
White, %	100	75	90		85
Other, %	0	25	10		15
Stroke onset, days, $\bar{x}$ (<i>SD</i>)	9.1 (7.1)	10.7 (11.0)	7.7 (2.9)	$F_{2,38}= .34, P=.72$	9.1 (7.3)
Stroke location				$\chi^2_4=5.68, P=.22$	
Brainstem, %	15	0	0		5
Subcortical only, %	31	45	67		44
Cortical only, %	54	55	33		51
Cognitive and Affective Status					
DS, Baseline, $\bar{x}$ (<i>SD</i>)	13.3 (3.6)	12.1 (3.6)	12.3 (5.4)	$F_{2,39}= .39, P=.68$	12.5 (3.9)
HVLT, Trial 4 Baseline, $\bar{x}$ (<i>SD</i>)	4.9 (3.1)	3.8 (3.0)	3.0 (2.8)	$F_{2,39}=1.10, P=.35$	4.0 (3.0)
EXIT, Baseline, $\bar{x}$ (<i>SD</i>) [*]	17.0 (4.1)	18.5 (5.5)	13.9 (6.9)	$F_{2,39}=2.14, P=.13$	17.1 (5.5)
HRSD, Baseline, $\bar{x}$ (<i>SD</i>) [*]	9.6 (6.0)	8.2 (4.9)	6.7 (5.1)	$F_{2,39}= .84, P=.44$	8.3 (5.3)
AES, Baseline, $\bar{x}$ (<i>SD</i>) [*]	34.9 (10.4)	38.0 (11.5)	26.7 (4.4)	$F_{2,40}=3.91, P=.03$	34.6 (10.8)
Functional Status					
FIM, Baseline, $\bar{x}$ (<i>SD</i>)	75.4 (14.2)	72.7 (14.3)	77.1 (14.2)	$F_{2,38}= .31, P=.74$	75.0 (14.0)
FIM, 12 Week, $\bar{x}$ (<i>SD</i>)	117.0 (16.2)	102.3 (19.2)	105.0 (21.1)	$F_{2,24}=1.82, P=.18$	108.3 (19.0)
Rehabilitation Participation, $\bar{x}$ (<i>SD</i>)	4.92 (1.03)	4.83 (.76)	5.24 (1.05)	$F_{2,41}= .67, P=.52$	4.95 (.91)

* Higher scores indicate worse performance;

[†] All non-white participants were black with the exception of one native American.

DS=Digit Span Summary Score. HVLT=Hopkins Verbal Learning Test. EXIT=Executive Interview. HRSD=Hamilton Rating Scale for Depression. AES=Apathy Evaluation Scale. FIM=Functional Independence Measure

Table 2

Correlates and Predictors of Rehabilitation Participation

Participation (PRPS)										
Predictors										
	DS	HVLT	EXIT	HRSD	AES	FIM,B	r	β	SE	t
DS							-.12	$\frac{.1}{.1}$	$\frac{.1}{.1}$	$\frac{.1}{.1}$
HVLT	.20						.11	$\frac{.1}{.1}$	$\frac{.1}{.1}$	$\frac{.1}{.1}$
EXIT	-.37*	-.39*					-.55 $\frac{.1}{.1}$	-.40 $\frac{.1}{.1}$	.02	-3.05
HRSD	.10	.00	.32*				-.39 $\frac{.1}{.1}$	-.19	.02	-1.47
AES	-.20	-.20	.49 $\frac{.1}{.1}$	.23			-.27	$\frac{.1}{.1}$	$\frac{.1}{.1}$	$\frac{.1}{.1}$
FIM, B	.17	.20	-.20	-.26	-.29		.56 $\frac{.1}{.1}$	.35*	.01	2.55
DAYS	-.04	-.19	.27*	.18	.30*	-.35*	-.30	-.08	.01	-.61
R ² §								.54		

* $P < .05$;

[‡] $P \leq .01$;

[‡] only significant correlates of participation examined in the regression model;

§ $F_{4,32} = 9.35$, $P < .001$.

PRPS=Pittsburgh Rating of Participation Scale. EXIT=Executive Interview. DS=Digit Span Summary Score. HVLT=Hopkins Verbal Learning Test. Trial 4. HRSD=Hamilton Rating Scale for Depression. AES=Apathy Evaluation Scale. FIM, B=Functional Independence Measure, Baseline. DAYS=Days since stroke onset.