Declining financial capacity in mild cognitive impairment

A 1-year longitudinal study

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ABSTRACT

Objective: To investigate 1-year change in financial capacity in relation to conversion from amnesic mild cognitive impairment (MCI) to dementia.

Methods: Seventy-six cognitively healthy older controls, 25 patients with amnesic MCI who converted to Alzheimer-type dementia during the study period (MCI converters), and 62 patients with MCI who did not convert to dementia (MCI nonconverters) were administered the Financial Capacity Instrument (FCI) at baseline and 1-year follow-up. Performance on the FCI domain and global scores was compared within and between groups using multivariate repeated-measures analyses.

Results: At baseline, controls performed better than MCI converters and nonconverters on almost all FCI domains and on both FCI total scores. MCI converters performed below nonconverters on domains of financial concepts, cash transactions, bank statement management, and bill payment and on both FCI total scores. At 1-year follow-up, MCI converters showed significantly greater decline than controls and MCI nonconverters for the domain of checkbook management and for both FCI total scores. The domain of bank statement management showed a strong trend. For both the checkbook and bank statement domains, MCI converters showed declines in procedural skills, such as calculating the correct balance in a checkbook register, but not in conceptual understanding of a checkbook or a bank statement.

Conclusions: Declining financial skills are detectable in patients with mild cognitive impairment (MCI) in the year before their conversion to Alzheimer disease. Clinicians should proactively monitor patients with MCI for declining financial skills and advise patients and families about appropriate interventions. *Neurology*® 2009;73:928-934

GLOSSARY

AD = Alzheimer disease; **ADRC** = Alzheimer's Disease Research Center; **CDR** = Clinical Dementia Rating; **DRS-2** = Dementia Rating Scale, 2nd edition; **DSM-IV** = *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition; **FCI** = Financial Capacity Instrument; **GDS** = Geriatric Depression Scale; **MANCOVA** = multivariate analysis of covariance; **MCI** = mild cognitive impairment; **MMSE** = Mini Mental State Examination; **PFCF** = Prior/Premorbid Financial Capacity Form; **UAB** = University of Alabama at Birmingham.

Financial capacity has emerged as a key instrumental activity of daily living in understanding functional impairment and decline in patients with mild cognitive impairment (MCI) and dementia.¹⁻⁵ Financial capacity comprises a broad range of conceptual, pragmatic, and judgment abilities, ranging from basic skills, such as counting coins, to more complex skills, such as paying bills and managing a checkbook.¹ The capacity to manage one's own financial affairs is critical to success in independent living.⁶ Impairments in financial skills and judgment are often the first functional changes demonstrated by patients with incipient dementia.⁷

Cross-sectional studies have demonstrated impairments in financial skills in patients with MCI. Studies using informant report have found that financial skills are impaired in some individuals with MCI^{4,5,8} and that such impairments can predict subsequent diagnosis of Alzheimer disease (AD).^{4,9} Using a direct assessment approach, our group has found that patients with MCI performed signif-

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icantly below older controls on complex financial domains and overall financial capacity.¹⁰ An outstanding question for the field concerns the longitudinal trajectory of financial capacity decline in MCI.

The present study investigated possible change in financial capacity in relation to conversion from MCI to dementia. We compared changes in financial capacity over a 1-year period in a sample of cognitively healthy controls, patients with MCI who converted to dementia (MCI converters), and patients with MCI who did not convert to dementia (MCI nonconverters). We hypothesized that MCI converters would show greater declines, relative to controls and MCI nonconverters, on complex financial domains and in overall financial capacity.

METHODS Participants. The present study was a cohort study of 76 cognitively healthy older controls and 87 patients with amnesic MCI who were evaluated between June 2004 and October 2008 and diagnostically characterized through the Alzheimer's Disease Research Center (ADRC) at the University of Alabama at Birmingham (UAB) as part of an ongoing longitudinal study of functional change in MCI. The ADRC diagnostic consensus conference team consisted of neurologists, neuropsychologists, a geriatric psychiatrist, and nursing staff. The consensus team was blinded to the results of our financial capacity measure when diagnosing participants. The number of participants with complete initial and 1-year follow-up data determined the sample size.

Control participants were older adult volunteers recruited from the community. Controls underwent neurologic, neuropsychological, and neuroradiologic evaluations and were determined to be free from any medical and psychiatric conditions that could compromise cognition. Their Mini-Mental State Examination (MMSE)¹¹ scores ranged from 25 to 30, and their Dementia Rating Scale, 2nd edition (DRS-2)¹² total scores ranged from 130 to 144.

Participants with MCI either presented for clinical evaluation at the UAB neurology outpatient clinic or volunteered to be in the study. All MCI participants underwent the same examination procedures as controls and met the original Petersen/Mayo criteria for MCI^{13,14}: 1) subjective memory complaint by the patient and/or a knowledgeable informant (e.g., family member), as reported in interview with our neurologists; 2) objective impairment on a memory test (in this study, 1 or more memory test scores falling approximately 1.5 SD below age- and education-appropriate norms); 3) overall preserved general cognitive functioning (using clinical judgment); 4) largely intact functional abilities (based on historic information obtained in the patient and informant interviews, and ratings by an informant on a functional capacity rating form, the Forsyth Functional Capacity Form¹⁵); and 5) absence of dementia at baseline evaluation.¹⁶ Their MMSE scores ranged from 23 to 30, and their DRS-2 total scores ranged from 113 to 142.

MCI subgroups of converters and nonconverters. Of the 87 patients with MCI at baseline, 25 patients (28.7%) met

criteria for mild dementia at 1-year follow-up based on *DSM-IV* criteria¹⁶ (MCI converters). All cases of incident dementia in this sample were determined in diagnostic consensus conference to have possible or probable AD as defined by National Institute of Neurological and Communicative Disease and Stroke-Alzheimer's Disease and Related Disorders Association criteria.¹⁷ There were 62 patients (71.3%) with MCI who did not progress to dementia at 1-year follow-up (MCI nonconverters).

Standard protocol approvals, registrations, and patient consents. Written informed consent was obtained from each study participant. The UAB institutional review board approved the use of human subjects for this study.

Study measures. Financial Capacity Instrument. Financial capacity was directly assessed at baseline and 1-year follow-up using the Financial Capacity Instrument (FCI).¹ The FCI is a standardized psychometric instrument based on a conceptual model that views financial capacity at 3 levels: specific financial abilities (tasks), broader financial activities (domains) important to independent functioning, and overall financial capacity (global scores).¹⁰ Tasks measure simple or complex knowledge or skills. An example of a simple task is counting coins and currency, whereas a complex task is preparing bills for mailing.¹⁰ The FCI has demonstrated high levels of reliability, and content and construct validity, in previous studies of healthy controls and persons with AD and MCI.^{1,10,18} The current version of the FCI directly assesses financial abilities across 20 tasks, 9 domains, and 2 global scores (domains 1–7 total score; domains 1–7 and 9 total score). Trained technicians administer and score the FCI using well-operationalized criteria described elsewhere.¹ In the present study, the primary FCI variables of interest were domain and global level scores. Domain 8 was not analyzed because it is an experimental domain and it requires a collateral source to verify information obtained from the participant, and it is not included in the global scores.

Prior/Premorbid Financial Capacity Form. Because current financial capacity varies across individuals as a function of prior financial experience, we controlled for lack of prior financial experience. The Prior/Premorbid Financial Capacity Form (PFCF) is a patient and informant completed instrument that rates a person's level of experience across all FCI variables.¹⁹ The PFCF was administered to each study participant and also to a knowledgeable collateral source (e.g., family member). The PFCF summary score was used as a covariate in the analyses to control for differences in prior financial experience and ability.

Data analyses. Baseline demographic and clinical variables were compared across groups (controls, MCI nonconverters, MCI converters) using 1-way analysis of variance (for continuous variables) or χ^2 or Fisher exact tests (for categorical variables).

For each participant, FCI data were summarized into domain level performance. In addition, 2 total scores were calculated by summing the scores of domains 1–7, and domains 1–7 and 9. To investigate our specific study hypothesis, we analyzed change on FCI domains 1–7 and 9 and 2 total scores (domains 1–7, domains 1–7 and 9) using a repeated-measures multivariate analysis of covariance (MANCOVA) model that controlled for prior financial experience (dichotomized as 1 = had prior experience and 2 = no prior experience) and any demographic variables differing significantly between groups. Terms of interest were a between-groups term of group (control, MCI nonconverter, MCI converter), a within-subjects term for time (baseline or 1-year follow-up), and an interaction term (group by time). Follow-up repeated-measures 1-way analysis of covariance tests

Table 1 Demographic and clinical characteristics of study participants

	Controls (n = 76)	MCI nonconverters (n = 62)	MCI converters (n = 25)	p Value*	Post hoc*
Age, y	66.7 (8.5)	68.5 (7.5)	74.4 (6.0)	<0.001	MC > MN, C
Female, n (%)	48 (63.2)	34 (54.8)	14 (56.0)	0.583	—
Race, n (%)					
African American	12 (15.8)	13 (21.0)	4 (16.0)		
White	64 (84.2)	48 (77.4)	21 (84.0)	0.661	—
Asian American	0 (0.0)	1 (1.6)	0 (0.0)		
Education	15.0 (2.3)	15.2 (2.8)	14.4 (3.3)	0.437	—
MMSE†	29.4 (1.0)	28.6 (1.4)	27.0 (1.9)	<0.001	C > MN > MC
DRS-2 total score	138.6 (3.4)	134.2 (5.9)	127.4 (5.8)	<0.001	C > MN > MC
CDR-global, n (%)‡					
0.0	75 (100.0)	0 (0)	0		
0.5	0	62 (100.0)	25 (100.0)	<0.001	MC, MN > C
CDR sum of boxes§	0.007 (0.1)	1.2 (0.7)	1.9 (0.6)	<0.001	MC > MN > C
GDS	5.3 (5.1)	7.5 (5.5)	6.0 (4.0)	0.045	—
Months of follow-up	12.3 (1.4)	12.1 (1.4)	12.4 (2.1)	0.545	—

Except for sex, race, and Clinical Dementia Rating (CDR)-global, values are mean (SD).

MC > MN, C = MCI converter mean greater than MCI nonconverter and control means; C > MN > MC = control mean greater than MCI nonconverter and MCI converter means and MCI nonconverter mean greater than MCI converter mean; MC, MN > C = MCI converter and MCI nonconverter means greater than the control mean.

*p value for omnibus test of group differences.

†Subsequent least significant difference post hoc tests or $2 \times 2 \chi^2$ tests ($\alpha \leq 0.01$).

‡Data available for 74 controls, 61 MCI nonconverters, and 25 MCI converters.

§Data available for 75 controls, 62 MCI nonconverters, and 25 MCI converters.

MCI = mild cognitive impairment; MMSE = Mini Mental State Examination; DRS-2 = Dementia Rating Scale, Second Edition; GDS = Geriatric Depression Scale.

were conducted comparing change in performance across groups. The covariates and terms in this analysis were the same as the terms used in the repeated-measures MANCOVA.

All significant omnibus analyses were followed-up with least significant difference post hoc test or subsequent χ^2 tests. Findings with a 2-tailed p value ≤ 0.01 were considered significant. All statistical analyses were performed using SPSS 13.0 (SPSS Inc., Chicago, IL).²⁰

RESULTS Baseline demographic and mental status variables. Table 1 displays the results of the group comparisons on baseline demographic and mental status variables. The MCI converter group was significantly older than the control and MCI nonconverter groups. Consequently, we covaried for age (in years) in all of the FCI analyses. There were no group differences for years of education or for distribution of sex or race. At baseline, MCI converters performed significantly worse than controls and MCI nonconverters on the MMSE and DRS-2, and MCI nonconverters performed worse than controls. As expected, Clinical Dementia Rating (CDR)²¹ scores were higher in the MCI groups but were within the recommended range for MCI.²² There was a trend toward significance on depressive symptoms, with both MCI groups reporting higher levels of depres-

sive symptoms compared with the control group. However, all of the groups' mean scores on the depression scale were within the nondepressed range.

Prior financial experience. Seven controls (9.2%), 8 MCI nonconverters (12.9%), and 7 MCI converters (28.0%) reported having no prior experience performing 1 or more of the 8 FCI domains of interest, which was not different across groups ($\chi^2 = 3.7$, $p = 0.072$).

Baseline differences on the FCI domains and total scores. Table 2 shows the results of the baseline group comparisons on the FCI domains and total scores. After adjusting for group differences in age and prior financial experience, the control group performed significantly better than the MCI nonconverter and converter groups on all FCI domains and on both total scores. The MCI nonconverter group performed better than the MCI converter group on domains of financial conceptual knowledge, cash transactions, bank statement management, bill payment, and both total scores. The MCI converter and MCI nonconverter groups performed equivalently at baseline on domains of basic monetary skills, checkbook management, financial judgment, and investment decision making.

Changes over time in FCI domain and total score performance across groups. In a 2×3 repeated-measures MANCOVA adjusted for age and prior level of financial experience, we compared rates of change on the FCI domains and total scores across groups. Multivariate effects were found for the main effects of group [Wilks $\Lambda = 0.661$, $F(16,302) = 4.3$, $p < 0.001$, multivariate $\eta^2 = 0.19$], but this was qualified by an interaction between group and time [Wilks $\Lambda = 0.771$, $F(16,302) = 2.6$, $p = 0.001$, multivariate $\eta^2 = 0.12$]. This interaction was driven primarily by the differences between the control and MCI converter groups. There was no interaction between prior experience by time [$F(8,151) = 1.0$, $p = 0.453$].

There were univariate group-by-time interactions on domain 4 (checkbook management) [$F(2,158) = 7.2$, $p = 0.001$, $\eta^2 = 0.083$], domains 1–7 total score [$F(2,158) = 6.6$, $p = 0.002$, $\eta^2 = 0.077$], and domains 1–7 and 9 total score [$F(2,158) = 7.2$, $p = 0.001$, $\eta^2 = 0.084$], representing decline for the patients in the MCI converter group and no change for participants in the control and MCI nonconverter groups. The domain of bank statement management showed a trend ($p = 0.021$). The figure displays the 3 trajectories of change for each group on the FCI total score (domains 1–7) and checkbook management (domain 4).

As a subanalysis, we analyzed change on the FCI total score (domains 1–7) in a subgroup of patients with MCI who scored within 1.5 SD of the control mean on

Table 2 One-year change in FCI variables across groups

Task	Range	Controls		MCI nonconverters		MCI converters		Baseline*	Interaction†
		Time 1 (n = 76)	Time 2 (n = 76)	Time 1 (n = 62)	Time 2 (n = 62)	Time 1 (n = 25)	Time 2 (n = 25)		
D1. Basic monetary skills	0-34	32.1 (2.7)	32.7 (2.3)	30.6 (3.8)	30.3 (3.9)	29.2 (4.7)	28.4 (5.6)	<0.001*	0.064
D2. Financial concepts	0-32	29.3 (2.5)	29.9 (2.1)	27.9 (4.0)	27.5 (4.5)	24.9 (5.7)	24.7 (5.6)	<0.001§	0.174
D3. Cash transactions	0-24	21.7 (2.0)	21.7 (2.2)	20.5 (3.0)	19.9 (3.3)	18.7 (4.7)	17.6 (4.7)	<0.001§	0.134
D4. Checkbook management	0-50	48.2 (2.7)	48.2 (2.6)	46.9 (3.6)	47.0 (3.8)	44.6 (6.1)	40.8 (7.9)	<0.001*	0.001¶
D5. Bank statement management	0-39	35.4 (3.1)	34.7 (3.3)	31.9 (5.4)	31.6 (6.0)	28.0 (6.8)	24.9 (9.5)	<0.001§	0.021
D6. Financial judgment	0-16	13.9 (2.4)	14.7 (1.6)	13.9 (2.9)	14.1 (2.9)	12.5 (2.8)	12.4 (3.6)	0.002*	0.190
D7. Bill payment	0-46	44.4 (2.4)	43.9 (4.0)	40.2 (6.2)	41.3 (6.1)	35.8 (9.0)	33.5 (10.6)	<0.001§	0.124
D9. Investment decisions	0-17	14.3 (2.4)	14.5 (2.4)	12.9 (3.1)	12.2 (3.3)	11.6 (4.4)	10.5 (4.4)	<0.001*	0.056
FCI total score, domains 1-7	0-241	225.0 (9.9)	225.9 (11.9)	212.0 (20.9)	211.5 (22.2)	193.7 (29.6)	182.3 (39.0)	<0.001§	0.002¶
FCI total score, domains 1-7 and 9	0-258	239.3 (10.9)	240.4 (13.0)	224.9 (22.8)	223.7 (24.2)	205.3 (32.4)	192.8 (42.3)	<0.001§	0.001¶

*Baseline group comparison on Financial Capacity Instrument (FCI) variables between controls, mild cognitive impairment (MCI) nonconverters, and MCI converters.

†Time × diagnostic group interaction over 1 year on FCI variables between control, MCI nonconverter, and MCI converter groups.

Multivariate analysis of covariance (age entered as covariate) was the statistic used.

*Controls > MCI nonconverters, MCI converters.

§Controls > MCI nonconverters > MCI converters.

¶MCI converters showed greater decline compared with controls and MCI nonconverters.

the FCI total score (domains 1-7). This MCI subgroup obtained an average score of 225.0 (SD = 7.1) at baseline and 222.0 (SD = 14.2) at 1-year follow-up. Although this represented a raw score decline of 3 points, it was not a significant change.

Changes in task and item level performance on checkbook management domain. Because MCI converters showed significant declines on checkbook management (domain 4) compared with controls and MCI nonconverters, we analyzed the task level data for this domain (table 3). Domain 4 consists of 2 tasks: un-

derstanding a checkbook/register (task 4a) requires a participant to conceptually identify and explain parts of a check and check register, and using a checkbook/register (task 4b) requires a participant pragmatically to enter into a simulated transaction, make a payment by check, and record the transaction in a checkbook register.

At baseline, control participants performed significantly better than MCI nonconverter and MCI converter participants on both checkbook management tasks, and MCI nonconverter participants performed

Figure Change over time in FCI total score and domain 4

(A) Change over time in Financial Capacity Instrument (FCI) total score (domains 1-7). (B) Change over time in FCI domain 4 (checkbook management).

Table 3 One-year change in checkbook management tasks across groups

Task	Range	Controls		MCI nonconverters		MCI converters		Baseline*	Interaction†
		Time 1 (n = 76)	Time 2 (n = 76)	Time 1 (n = 62)	Time 2 (n = 62)	Time 1 (n = 25)	Time 2 (n = 25)		
4A. Understanding checkbook/register	0-20	19.0 (1.4)	19.3 (1.0)	18.8 (1.3)	18.8 (1.5)	18.0 (2.1)	17.8 (1.6)	0.001‡	0.748
4B. Using checkbook/register	0-30	29.1 (2.0)	28.9 (2.1)	28.1 (3.0)	28.2 (2.9)	26.5 (4.8)	23.0 (7.5)	<0.001‡	0.001§

*Baseline group comparison on Financial Capacity Instrument (FCI) variables between controls, mild cognitive impairment (MCI) nonconverters, and MCI converters.

†Time × diagnostic group interaction over 1 year on FCI variables between control, MCI nonconverter, and MCI converter groups. Repeated-measures multivariate analysis of covariance (age and prior financial experience entered as covariates) was the statistic used.

‡Controls > MCI nonconverters > MCI converters.

§MCI converters showed greater decline compared with controls and MCI nonconverters.

better than MCI converter participants. Regarding longitudinal change, there was no significant group-by-time interaction effect for task 4a (conceptual understanding). However, there was a significant group-by-time interaction effect on task 4b (pragmatic use), reflecting decline over time for MCI converter participants relative to control and MCI nonconverter participants.

DISCUSSION We used a standardized, psychometrically normed, direct assessment measure of financial capacity to investigate change over time in financial skills in patients with MCI. At baseline, both MCI subgroups showed impairment in financial abilities relative to controls, indicating that decline in financial skills had begun in the MCI group before diagnosis. This finding replicates earlier cross-sectional studies by our group.^{10,18} In addition, MCI nonconverters performed better than MCI converters on several domains, suggesting that the MCI converter subgroup may have undergone greater decline in financial skills than the MCI nonconverters. The progressive loss of financial skills occurring in some patients with MCI is an important area for clinical intervention.

With respect to longitudinal change, the results showed a mixed pattern of functional decline in patients with MCI. Only MCI converters showed significant change in financial capacity over the 1-year study period, with declines emerging in the area of checkbook management skills and in overall financial capacity. A trend for decline in the converter group was found for the domain of bank statement management. MCI nonconverters did not show significant change in financial skills compared with controls over a 1-year period, a finding underscoring the heterogeneous nature of MCI clinical samples regarding cognitive and functional change.

MCI subgroup differences in financial capacity decline seemed to be related to severity of disease. Compared with MCI nonconverters, MCI convert-

ers had more advanced disease as assessed by the MMSE, DRS-2, and CDR sum of boxes (table 1). This finding suggests that patients in the earlier stages of MCI experience slower rates of change compared with patients with MCI who seemed to be further along the continuum to conversion.

Analysis of domain level data revealed a significant group-by-time interaction effect for checkbook management skills (domain 4). On this domain, the MCI converter participants' score was 9% less than the control participants' score at baseline, and decreased an additional 9% during the 1-year study period. In contrast, MCI nonconverter participants' performance on checkbook skills generally remained stable. At the task level, MCI converters showed significant declines on the pragmatic task of using a checkbook/register (task 4b) but stayed the same on the conceptual task of understanding a checkbook/register (task 4a). Task 4b is the more difficult of the 2 tasks, and requires a person to make a payment by check and to accurately record the transaction in a checkbook register. It measures procedural skills that are likely mediated through executive abilities, whereas task 4a measures factual knowledge and is likely mediated by long-term semantic memory. These procedural declines are consistent with the executive function deficits exhibited by patients with amnesic MCI,²³⁻²⁶ and the strong ties between executive function and functional abilities.^{18,27-33}

Checkbook management (domain 4) item responses were further analyzed to describe common errors made by MCI converter participants. Items in task 4b commonly missed by MCI converter participants included writing the correct name on the payee section of the check, writing the correct payment amount in the debit field in the checkbook register, and calculating and writing the correct balance in the checkbook register. For example, one of the patients in the MCI converter group only listed the payee on the checkbook register, but did not record the pay-

ment amount in the debit field or calculate the remaining balance. A different patient in the MCI converter group wrote out the correct payee and payment amount in the register, but did not calculate the balance after making the transaction. Thus, change in checkbook management skills seems to be an early functional change in amnesic MCI patients with incident dementia and may turn out to be an important clinical functional marker for conversion. Further study will be needed to determine this. However, this seems to be an important area of functional status for clinicians to inquire about when evaluating patients with MCI and dementia.³⁴

The interaction effect for bank statement management (domain 5) showed a strong trend ($p = 0.021$), with MCI converters showing greater decline over 1 year than controls or MCI nonconverters. Similar to checkbook management, bank statement management is a cognitively complex financial domain. Visual inspection of task level performance showed that MCI converters declined on the pragmatic task of using a bank statement (task 5b, identifying specific transactions and amounts), but remained stable on the conceptual task of understanding a bank statement (task 5a). Thus, the identified domain trend suggested incipient decline in pragmatic bank statement-related skills in our MCI converter subgroup.

Clinicians should proactively monitor patients with MCI for declining financial skills and advise patients and families about appropriate interventions. Specifically, clinicians can discuss strategies to support, oversee, and protect financial activities of patients with MCI. For example, family members can oversee a patient's checking transactions, contact the patient's bank to detect irregularities such as bills being paid twice, or become cosignatory on a checking account so that joint signature is required for checks above a certain amount. Online banking and bill payment services are additional options for families.

Our amnesic MCI group converted to dementia at a higher rate than typically reported in prior studies. We believe this may be due to a high proportion of patients with more advanced stages of MCI. For example, 69% of our patients with MCI had amnesic plus other cognitive deficits. However, their MMSE, DRS-2, and CDR scores were still within typical range for MCI. Alternatively, it has previously been reported that patients with MCI may be more likely to convert during the first year or two of a study³⁵; longer observation periods are needed to more accurately determine conversion rates.

Some limitations of our study should be noted. Specifically, the relatively small number of participants in our study may have resulted in more conser-

vative estimates of differential rates of change across groups. Secondly, the present study was limited to 1 year of follow-up data. Longer periods of observation will be needed to better understand functional change in MCI nonconverters. Finally, we only included amnesic MCI patients in our study, so it is not clear whether the findings generalize to nonamnesic MCI populations.

AUTHOR CONTRIBUTIONS

Statistical analyses were performed by Dr. Triebel, Department of Neurology, University of Alabama at Birmingham, AL, and statistical consultation was provided by Dr. Bartolucci, Department of Biostatistics, University of Alabama at Birmingham.

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