

Psychometric properties of the self-efficacy for managing mild cognitive impairment scale

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Objectives: We adapted a self-efficacy measure for managing chronic illness to be specific to persons with mild cognitive impairment (pwMCI). The aim of this study was to investigate the psychometric properties of the scale, the self-efficacy for managing MCI scale, for use in research.

Methods: Analyses involved data from pwMCI enrolled in a behavioral intervention study that completed the measure five times from intervention enrollment to 18-month post-intervention. Factor structure, construct validity, internal consistency, and test-retest reliability were analyzed.

Results: Factor analysis identified two factors, related to self-efficacy for daily activities and managing MCI, which corresponded with domains from the original chronic illness self-efficacy scale. Consistent with prior research, construct validity analysis suggested an association between memory-loss self-efficacy and psychosocial distress, but not cognitive or functional ability. Further analyses supported the scale's internal and test-retest reliability.

Conclusions: Currently, no "gold standard" scale of memory-loss self-efficacy for pwMCI exists, despite the positive impact self-efficacy may have on modifiable health behaviors. Overall, results supported the notion that the scale is a valid and reliable measure of memory-loss self-efficacy for pwMCI.

KEYWORDS

memory, mild cognitive impairment, psychometric, self-efficacy, self-report

1 | INTRODUCTION

Self-efficacy reflects a person's confidence in performing or completing a particular task.¹ It is a psychosocial factor that incorporates a person's beliefs on their capacity or ability to exert control over their environment or behavior. Many healthcare fields have applied self-efficacy to behaviors relevant to clinical problems of interest, including smoking cessation, diabetes management, and weight control,

supporting that high efficacy beliefs are associated with better treatment initiation and maintenance, as well as positive lifestyle changes.^{2,3} For example, in cancer patients, greater self-efficacy is associated with higher quality of life (QoL) and decreased psychological distress.⁴⁻⁶ Evidence suggests that interventions to improve self-efficacy can contribute to improved QoL, decreased symptom distress, increased physical activity, and positive health behavior changes.^{5,7,8} Research suggests that self-efficacy is a modifiable

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variable, therefore a potential avenue to improve health-related behaviors and outcomes through applied interventions.

In aging research, self-efficacy, particularly memory self-efficacy (memory-SE), which is defined as a person's evaluation of his/her ability to complete a given memory task with confidence,⁹ are variables of interest in examining factors that may maintain cognitive, functional, and psychosocial integrity in aging. Iteratively, it may impact and be impacted by cognitive training,¹⁰⁻¹³ physical exercise,¹⁴ depression,¹⁵ and QoL.¹⁴ Studies with cognitively impaired older adults show that improving self-efficacy might reduce the impact depressive symptoms has on cognition, supporting self-efficacy as a possible target for interventions.¹⁶ Another study demonstrated that self-efficacy predicted self-rated "capacity to live well" among people with dementia, even when adjusting for covariates such as age, and functional and cognitive ability.¹⁷ Yet there is scant use of measures of self-efficacy in intervention trials for persons diagnosed with memory problems. As of 2018, only 4 of 442 active mild cognitive impairment (MCI) clinical trials included self-efficacy as an outcome.¹⁸ Yet, when persons with MCI (pwMCI) and their caregivers rank outcomes for treatment of MCI, memory-SE appears to be among the important outcomes expected, rated just below QoL and, above cognition and memory function.^{18,19} This, and findings from other healthcare fields that support self-efficacy as a modifiable construct with benefits extending to mood and various health-care outcomes, highlights the necessity and value of including self-efficacy in MCI interventions. Targeting self-efficacy is particularly relevant with pwMCI, considering interventions for reversing or even decelerating cognitive decline are limited.

The disconnect between the number of studies measuring this concept despite its importance to patients and caregivers could relate to the absence of psychometrically sound measures of self-efficacy for managing memory challenges specific to the MCI population. It is important to highlight that one's self-efficacy in achieving a desired outcome is not the same as one's ability or functional ability to achieve a desired outcome. For example, a person may have significant physical limitations that keep them from walking independently, yet their sense of self-efficacy to achieve their daily chores independently is high due to adaptive strategies or devices they know how to use to compensate. In our own research, evidence supported higher self-efficacy attenuated the effect of physical decline on QoL.¹⁴ As part of our efforts to study the impact of MCI behavioral interventions,^{12,13,20,21} we adapted a self-efficacy measure for managing chronic illness²² to be specific to pwMCI. While MCI-related changes do not significantly impede the person's ability to function independently, pwMCI can experience changes to their daily functioning (eg, managing finances, keeping track of appointments), as well as psychological changes and changes in QoL. Thus, we created a self-efficacy scale for activities relevant for MCI-related changes. While various measures exist that require self-appraisal of memory capabilities or meta-memory, this measure specifically contrasts with previous measures by assessing *confidence* to perform a given activity in light of *known* memory difficulties rather than rate the memory difficulty itself. Measuring both memory difficulty and self-efficacy in pwMCI is critical when you consider how compensatory aids and strategies may improve daily function and/or confidence while not improving the memory ability itself.

Key points

- Self-efficacy, or confidence in one's ability to achieve goals despite illness or disability, is a measurable and modifiable health-related outcome.
- Targeting memory-related self-efficacy in persons with mild cognitive impairment (pwMCI) may impact daily function, even if objective memory performance cannot be improved.
- We adapted a health-related self-efficacy measure to assess pwMCI self-reported confidence in performing activities in light of known memory changes.
- This study established the psychometric properties of the SEM-MCI and supports the scale as a reliable and valid tool for use in pwMCI.

We report here on the psychometric properties (ie, validity, reliability) of this adapted scale. We tested construct validity by examining the relationship between memory-SE and measures of pwMCI psychological distress, cognition, and functional ability. There is currently no "gold standard" of memory-SE for pwMCI for use in establishing construct validity of this measure. We believe this measure to be the first of its kind. Still, self-perception of memory-related capabilities has shown to be correlated with psychosocial wellbeing and control.^{15,23,24} Further, there is extensive research on the relationship between self-efficacy and psychosocial wellbeing. We hypothesized, as support for convergent validity, that self-efficacy, a psychosocial construct, would correlate with other psychosocial constructs. We predicted that greater confidence in ability to complete a given memory task in spite of known memory problems would be significantly associated with greater psychosocial well-being. Further, we hypothesized that self-efficacy for managing MCI would not be strongly associated with sex, age, educational attainment, or degree of actual cognitive impairment.

2 | MATERIALS AND METHODS

The present study uses data from the Behavioral Interventions to Prevent or Delay Dementia: Protocol for a Randomized Comparative Effectiveness Study.²⁰ This trial involved a 10-day, group-based, multi-component, behavioral intervention program for pwMCI (ie, study participants), and their support partners. The trial compared the effectiveness of five behavioral interventions: physical exercise, computerized brain fitness, patient and family education, support group, and memory support system training. Note that as a comparative effectiveness study, there were no untreated controls in this protocol. All participants received 4 of 5 interventions with one intervention withheld. Following completion of the intervention, participants and partners were followed-up at 6 to 12 and 18 months. The study protocol was approved by the institutional boards at Mayo Clinic (PR14-000885) and

the University of Washington (#49235). Full details of the study protocol, behavioral interventions, recruitment, and data collection are reported elsewhere.²⁰

2.1 | Participants

Recruitment occurred in neuropsychology clinics and Alzheimer's Disease Research Centers across Mayo Clinic campuses in Minnesota, Arizona, Florida, and the University of Washington. Eligible participants (1) had a clinical diagnosis of aMCI (single or multi-domain)²⁵; (2) had a clinical dementia rating (CDR)²⁶ global score ≤ 0.5 ; (3) were not taking or were stable on nootropic medication for at least three months; and (4) were fluent in English. A neuropsychologist diagnosed each participant with MCI following a review of medical history, symptom profile, physical exam, and neuropsychological testing and based on the National Institute on Aging-Alzheimer Association criteria.²⁵ Exclusion criteria included enrollment in another treatment-related clinical trial and the presence of significant auditory, visual, or motor impairment that would interfere with program participation. All participants signed a written informed consent.

2.2 | Self-efficacy scale

The self-efficacy for managing MCI scale (SEm-MCI) was created from the Chronic Disease Self-Efficacy Scales that has reported internal consistency reliability of $r \geq 0.82$ and test-retest reliability of $r \geq 0.84$.²² The original scale broadly queried respondents' confidence, or self-efficacy, on various tasks based upon their relevant medical condition. The original scale has eight domains that measure different aspects of self-efficacy (https://www.selfmanagementresource.com/docs/pdfs/English_-_chronic_disease_self-efficacy_scales_32.pdf): (1) exercise regularly; (2) obtain help from community, family, friends; (3) communicate with physician; (4) manage disease in general; (5) do chores; (6) do social/recreational activities; (7) manage symptoms; and (8) control/manage depression. The scale was made available for adaptation to specific diseases of interest and permits a condition of interest to be specified into an item, such as "How confident are you that you can get your errands done despite your (illness)." We selected items from manage disease in general, do chores, and social/recreational activities domains based on their relevance to MCI-related challenges. In the end, only nine items with modification were judged relevant to difficulties commonly presented in pwMCI (ie, How confident are you that you can get your errands done despite your memory loss?). The resulting measure requires pwMCI to self-report their confidence in managing memory-related activities, tasks, and emotional distress using a 10-point Likert scale (see Supplemental Table 1). Total scores range from 9 to 90, with higher scores reflecting greater self-efficacy. PwMCI completed the measure at baseline, intervention program completion, and at 6, 12, and 18-month follow-up.

To assess the validity of the SEm-MCI, we examined its association with measures of pwMCI psychological distress, cognition, and function that were completed at baseline.

2.3 | Psychosocial distress

PwMCI completed the following self-report questionnaires: quality of life-Alzheimer's disease (QoL-AD),²⁷ Center For Epidemiological Studies Depression Scale (CES-D),²⁸ and reach anxiety inventory form (Reach AIF).²⁹ Higher scores on the QoL-AD, CES-D, and Reach AIF suggest better QoL, more depressive symptoms, and more anxiety symptoms, respectively. PwMCI was also asked to rate their memory by answering, "On a scale of 1-10, how would you rate your memory?" (1 = having no difficulty to 10 = having extreme difficulty).

2.4 | Cognitive functioning

PwMCI was also administered the Dementia Rating Scale-2³⁰ to obtain a measure of memory and global cognitive functioning. DRS-2 Age-Corrected MOANS Scaled Scores (AMSS) were calculated for the total composite score and the memory subscale. Study partners completed the everyday cognition (ECog)³¹ based off their observations of the pwMCI. Higher ECog scores suggest greater pwMCI in cognitively mediated functioning.

2.5 | Functional status

Study partners completed the Functional Assessment Questionnaire (FAQ)³² based off their observations of the pwMCI. Higher FAQ scores suggest higher pwMCI in instrumental activities of daily living (IADLs).

2.6 | Statistical analysis

The first goal of the study was to investigate the scale's validity. We conducted an exploratory factor analysis (EFA) with principal-axis factor extraction with Promax rotation to determine the scale's factor structure. Model fit was evaluated using Kaiser's criterion of eigenvalues greater than 1.0, square root mean of the residuals (SRMR) < 0.05 , Kaiser-Meyer-Olkin $> .90$,³³ and communalities $> .70$. We examined convergent and discriminant validity using Pearson correlation coefficients between SEm-MCI and baseline cognitive, functional, and psychosocial measures. Partial correlation coefficients derived from simultaneous linear regression analyses adjusted for age (continuous), sex (female/male; reference group = male), and education (continuous) were also calculated to eliminate the influence of sociodemographic variables. With the exception of DRS-2 AMSS, all scores were modeled as unstandardized continuous variables. Bonferroni correction was used to adjust for multiple comparisons.

The scale's reliability was also evaluated. Cronbach's α was used to determine internal consistency for each time point, addressing to what extent individual items on the SEm-MCI are related to one another. We also evaluated changes in Cronbach's α coefficient if we were to delete any one item. Scores' temporal stability over time was obtained using correlations across occasions and subsequent paired-sample t-tests were conducted comparing total score differences across each time point. To assess inter-rater reliability, intraclass correlation coefficient (ICC) estimates were calculated based on an absolute-agreement, two-way mixed effects model. Statistical tests were two-tailed, with significance set at $P < .05$. To account for attrition bias, we used list-wise deletion for all reliability analyses.

All analyses were performed using IBM SPSS Statistics for Windows, Version 25.0 (Armonk, NY) and RStudio.³⁴

3 | RESULTS

Table 1 contains participant characteristics at baseline (N = 258) and for pwMCI who completed the SEm-MCI at all five time points (N = 162). At study completion, 69% of participants had CDR global scores ≤ 0.5 , 29% had scores = 1, and 3% had scores = 2.

3.1 | Validity

3.1.1 | Factor structure

Using Kaiser's criterion of eigenvalues greater than 1.0, a two-factor solution provided the clearest extraction, SRMR = 0.03. The items that clustered on the first and second factor suggested self-efficacy

for "Daily activities" and "Manage disease in general," respectively. Factor loadings are depicted in Figure 1. While these two factors combined accounted for 74% of the total variance, the daily activities factor accounted for most of the variance (64%).

3.1.2 | Construct validity

To evaluate the scale's construct validity, correlations between baseline SEm-MCI and baseline cognitive, functional, and psychosocial measures were calculated (see Table 2). We found significant, strong correlations between SEm-MCI and QoL, depression, and anxiety. Specifically, higher SEm-MCI was associated with higher QoL, and fewer depressive and anxiety symptoms. Further, higher SEm-MCI was significantly and moderately associated with poorer rating of memory difficulties. The association with measures reflecting pwMCI disease severity (cognitive functioning and IADLs) was weak. All measures of disease severity were not meaningfully associated with SEm-MCI scores, with the exception of the ECog. Higher ECog scores were associated with lower scores on the SEm-MCI, although the relationship was weak and attenuated after adjusting for multiple comparisons. Adjustment for age, gender, and education did not meaningfully alter findings.

3.2 | Reliability

3.2.1 | Internal consistency

Cronbach's α indicated high internal consistency across all time points, with α ranging from .925 to .944. At each occasion, deleting any one

TABLE 1 Sample characteristics

	Baseline cohort, N = 258			Longitudinal cohort, N = 162		
	M	SD	Range	M	SD	Range
Age at baseline	75.10	7.60	53-95	74.89	7.53	53-95
Education	16.12	2.82	6-20	16.32	2.96	6-20
Male %	60%			62%		
Race other than white, %	4%			2%		
CES-D	11.92	8.11	0-49	11.37	7.77	0-40
QoL-AD	40.30	5.62	21-52	40.76	5.42	21-51
Reach-AIF	17.66	5.28	10-38	17.56	5.14	10-33
Memory difficulty rating	4.74	1.74	0-8	4.78	1.73	0-8
DRS-2 Total AMSS	7.63	2.81	2-15	7.66	2.72	2-15
DRS-2 Memory AMSS	5.43	3.14	2-14	5.57	3.12	2-14
ECog	74.64	17.54	41-130	74.90	16.55	41-130
FAQ	9.93	5.93	0-30	9.60	5.53	0-30
SEm-MCI	73.94	14.10	19-90	74.64	12.21	33-90

Abbreviations: CES-D, center for epidemiological studies depression scale; QoL-AD, quality of life in Alzheimer's disease; Reach AIF, resources for enhancing Alzheimer's caregiver health; CDR: clinical dementia rating scale; DRS-2, AMSS, dementia rating scale-2, age-corrected MOANS scaled score; ECog, everyday cognition; FAQ, functional assessment questionnaire; SEm-MCI, self-efficacy for managing MCI scale.

item would result in a notable decrease in Cronbach's α , indicating that all items positively contribute to the overall reliability.

3.2.2 | Test-retest reliability

Correlations were significant and moderate across all occasions at each time point ranging from $r = 0.55$ to 0.69 , $P < 0.0001$. Paired-sample tests revealed that relative to all other time points, SEm-MCI was highest at intervention completion ($M = 77.81$, $SD = 11.22$). Memory-SE was significantly lower 18-month post-intervention ($M = 72.21$, $SD = 14.92$) relative to baseline ($M = 74.64$, $SD = 12.21$), intervention completion, and 6-month post-intervention ($M = 74.12$, $SD = 12.47$). There were no significant differences in scores at baseline, 6-month, and 12-month post-intervention ($M = 74.09$, $SD = 13.40$). Similarly, ICC demonstrated a moderate to strong degree of test-retest reliability. The single measure ICC was $.61$ (95% CI:

$.54-.67$), while average measure ICC was $.89$ (95% CI: $.85-.91$), $F(161,644) = 9.161$, $P < 0.001$.

4 | DISCUSSION

The SEm-MCI was developed to assess pwMCI confidence in performing certain activities in light of known memory changes. This study aimed to investigate the reliability and validity of the SEm-MCI in a sample of pwMCI enrolled in a multi-component behavioral intervention program.

Overall, results supported the notion that the scale is a valid measure of memory-SE for pwMCI. A factor analysis indicated a two-factor solution that corresponded with domains from the original Chronic Disease Self-Efficacy Scale.²² Items from the first and strongest factor, "Manage disease in general," corresponded identically with the "Manage disease in general" domain from the original self-efficacy scale. The second factor, "Daily Activities," was derived of items from the "Do Chores" and "Social/Recreational Activities" domains from the original scale. Corresponding with previous data,^{15,23,24} correlation with other baseline measures provided evidence of convergent validity in that lower self-efficacy was strongly associated with psychological distress, including more depressive symptoms, more anxiety symptoms, and lower QoL. A recent study demonstrated that depression and anxiety partially mediated the effects of self-efficacy on QoL in pwMCI and dementia, providing implications for interventions targeting self-efficacy in order to improve QoL.³⁵ In our findings, the temporal ordering between memory-SE and psychosocial functioning cannot be ascertained (ie, is greater self-efficacy resulting in lower psychosocial distress or is higher psychosocial distress resulting in lower self-efficacy?) nor potential mediating or moderating effects. Further research should seek to understand the relationship between these variables for identifying targets for interventions. In addition, the SEm-MCI showed a moderate correlation with self-rating of perceived memory difficulties.

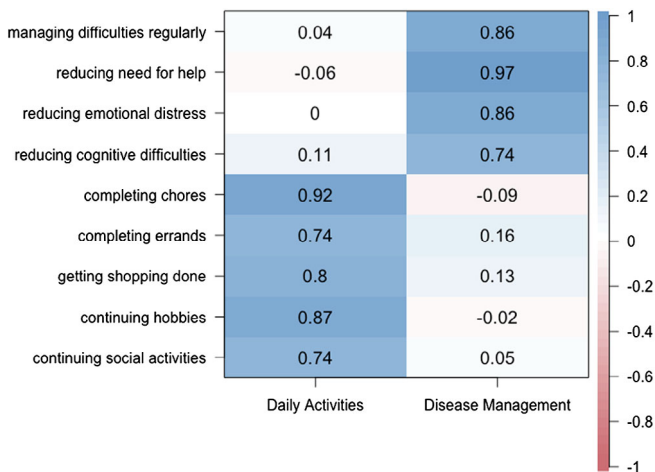


FIGURE 1 Exploratory factor analysis of the two-factor model of the SEm-MCI [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 2 Full correlation matrix for SEm-MCI scale and participant cognitive, functional, and psychosocial variables

	1	2	3	4	5	6	7	8	9
1 CES-D	-	-0.65	0.65	0.15	0.07	0.11	0.18	0.03	-0.54
2 QoL-AD		-	-0.55	-0.24	-0.14	-0.19	-0.23	-0.10	0.63
3 Reach-AIF			-	0.22	0.07	0.12	0.15	-0.02	-0.52
4 Memory rating				-	0.04	0.06	0.09	-0.01	-0.32
5 DRS-2 total					-	0.71	-0.1	-0.19	0.03
6 DRS-2 memory						-	-0.14	-0.15	-0.08
7 ECog							-	0.57	-0.19
8 FAQ								-	-0.09
9 SEm-MCI									-

Abbreviations: CES-D, center for epidemiological studies depression scale; QoL-AD, quality of life in Alzheimer's disease; Reach AIF, resources for enhancing Alzheimer's caregiver health; DRS-2, dementia rating scale-2; ECog, everyday cognition; FAQ, functional assessment questionnaire; SEm-MCI, self-efficacy for managing MCI scale.

Correlation coefficients are above the diagonal.

Though both involve the appraisal of one's capacity and skills, self-efficacy in completing a desired outcome in spite of known memory problems can differ from self-reported memory ratings. For example, a person may view themselves having moderate memory difficulties, yet still feel confident in their ability to engage in social activities or complete tasks to manage their memory difficulties. This may be particularly relevant to our study's sample, which is undoubtedly biased toward people that believed in a philosophy of "functioning as well as possible for as long as possible". While data suggest that memory-SE is associated with negative affect,¹⁵ evidence is mixed on whether self-reported memory complaints are associated with objective memory performance.^{11,36,37} Our results highlight that in a sample of MCI participants engaged in an interventional study, SEm-MCI was not linearly associated with objective disease severity, as the measure did not share substantial variance with the DRS, FAQ, or ECog. These results are promising from an intervention standpoint; regardless of objective memory performance, pwMCI are still able to benefit from interventions targeting self-efficacy.

The SEm-MCI showed unflinching high internal consistency, suggesting that the scale consistently measured the same construct over time. Temporal stability between the five time points was all significant and greater than $r = .5$, which are noteworthy given the 6-month intervals between most retests. Test-retest correlations were largely stable across time, with the exception of, (1) being nominally higher for proximal time points and (2) diminishing with longer inter-test intervals. We observed mean SEm-MCI rise following intervention completion, which corresponds with the intervention's intention of improving memory-SE. We posit that the measure is showing a response to treatment, and thus supports that the SEm-MCI may be useful to detect changes over the course of treatment. Subsequent scores gradually declined, eventually being lowest at 18-month follow up, as the person's cognitive challenges accumulate. The observed changes in SEm-MCI could be attributed to the natural history of MCI, and/or as the effects of the intervention wane. However, the scale's utility to detect and quantify meaningful change goes beyond the scope of the present study and needs to be studied in greater detail.

While we posit that the measure might be sensitive to detect change following intervention participation, we duly acknowledge that the design of the study does not permit for the disentanglement of interventional effects in test-retest reliability analysis between baseline and post-intervention. Comparison of post-intervention to subsequent time points does not contain the influence of intervention but could be affected by the passage of time in months. It could also be argued that the various natural progressions of MCI trajectories (ie, pwMCI may improve, remain stable, or decline) introduces additional difficulties in establishing the reliability and validity of self-reported confidence in one's memory. Second, our sample was predominately white and highly educated, affecting the ability to generalize results with diverse populations. Considering self-efficacy is a psychosocial construct, it would be important to ensure that the scale is reliable and valid to use with diverse groups. Lastly,

considering the sample is comprised of pwMCI, it is plausible to question the validity of a person's rating of their confidence in performing memory-related activities when they themselves have varying insight into these memory difficulties. For instance, recent findings suggest that identifying pwMCI who underestimate their cognitive abilities may serve as a prognostic variable of Alzheimer disease pathology and cognitive severity.³⁸ Yet, confidence in one's ability to complete a task, no matter if it is an overestimation or underestimation of true ability, might be a variable of at least equal interest to measuring cognition objectively.

Self-efficacy continues to gain attention as research demonstrates how confidence in completing a particular task can affect current health-related conditions, influence future health-related change and behavior maintenance, and predict various health-related outcomes. Memory-SE is significantly related to mood and other psychosocial factors, which are often outcomes and/or prognostic factors in interventions with pwMCI.³⁹ In this study, we report on a reliable and valid SEm-MCI measure for pwMCI, specifically relating to a person's confidence in performing activities with known memory changes. Future research focused on improving memory-SE may provide a promising avenue to improve upon treatment and psychosocial-related outcomes among pwMCI.

CONFLICT OF INTERESTS

The authors have no conflicts.

DATA AVAILABILITY STATEMENT

The mechanism of data sharing will entail written request for data to be reviewed by the principal investigators for approval. The de-identified data will then be uploaded to an electronic file (spreadsheet or text file) and transferred to the requestor. The overall goal is to share data with others in as timely a fashion as possible. The criteria for providing access to data will include the scientific merit of the proposed work as described in the application and the ability of the investigators to successfully carry out the proposed work. Review is expected to occur within 2 weeks of receipt of application, with time to provide data mainly dependent on the quality and completeness of the applications. An applicant will be informed of the decision on an application, and any necessary revisions specified. Data will be provided electronically. Extensive documentation will also be provided. Study personnel will be available for questions. It is expected that most requests will involve questions, as the data are complex and most work will involve analysis of repeated measurements. With regard to institutional review board involvement, all outside requests for data sharing will need to be approved by our institutional review boards and governed by a Data Use Agreement, an agreement between our institutions and the recipient of protected health information. The process of data sharing will continue after funding ends with the contact principal investigator as the contact person.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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