

RESEARCH ARTICLE

Emotional characteristics of socially isolated older adults with MCI using tablet administered NIH toolbox: I-CONNECT study

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Abstract

Introduction: Examining the emotional functioning of individuals with mild cognitive impairment (MCI) could help describe their cognitive status and inform the development of interventions. This study compared the emotional characteristics of socially isolated older adults with and without MCI.

Methods: We used baseline data from the Internet-based Conversational Engagement Clinical Trial. Emotional characteristics were assessed with the National Institutes of Health Toolbox Emotion Battery (NIHTB-EB). MCI status was determined with a consensus clinical diagnosis.

Results: This study included 163 participants (mean age = 81.2 years, non-Hispanic Black = 20.7%, MCI = 52.8%). MCI was associated with higher negative affect and lower psychological well-being. Non-Hispanic Black participants scored lower in sadness, higher in positive affect, and higher in meaning and purpose than non-Hispanic White participants.

Conclusion: Older adults with MCI experience more negative emotions and worse psychological well-being than those with normal cognition. The NIHTB-EB appears to be a sensitive tool to detect emotional characteristics associated with cognitive decline.

KEYWORDS

cognitive aging, emotion battery, epidemiology, minority aging, psychosocial

1 | BACKGROUND

It is estimated that more than 6 million adults in the United States are living with Alzheimer's disease (AD) in 2021, and the number is expected to markedly increase with population aging.¹ Mild cognitive impairment (MCI) is an early stage of memory loss or other cognitive ability loss (e.g., executive function, attention, and language) in individuals who maintain the ability to independently perform most activities of daily living.^{2,3} Individuals with MCI are at a high risk of develop-

ing Alzheimer's disease and related dementias (ADRD).^{4,5} Although the cognitive and behavioral changes associated with an MCI diagnosis have been widely reported in the literature,⁶ emotional states related to MCI have been less examined.⁷ Emotional states refer to one's strong feelings, which can be either positive or negative.^{8,9} The concept differs from neuropsychiatric symptoms (NPS) as it does not define psychiatric disorders. Scrutinizing both positive and negative emotional characteristics of individuals with MCI can inform early detection of MCI with frequent monitoring and self-reported tools,

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and inform the development of behavioral health interventions for individuals with early stages of cognitive decline.⁷

Neuropsychiatric symptoms, such as changes in emotion and behavior, are early indicators of subsequent cognitive decline.¹⁰ Those with a diagnosis of MCI have been found to have changes in emotional well-being and social relationships.⁶ Socially isolated older adults, who often experience loneliness and psychological distress, are at greater risk of cognitive decline.¹¹ Racial disparities in MCI and subsequent cognitive decline have also been widely acknowledged empirically.¹² Compared to their non-Hispanic White counterparts, non-Hispanic Black older adults with MCI had a faster decline in cognitive functioning 3 years after an MCI diagnosis.¹² Better understanding of the emotional states of socially isolated individuals, especially within a racially diverse sample, could inform research and clinical practice for preventing further cognitive decline.

The National Institutes of Health Toolbox for Assessment of Neurological and Behavioral Function (NIH Toolbox) Emotion Battery (NIHTB-EB) is an assessment of emotional states that is administered with iPads.⁹ It was designed as a “common currency” for easy comparison of the findings of different studies of different racial/ethnic populations and age groups.⁸ As NIHTB-EB includes comprehensive measures of both positive and negative aspects of emotion, it could be more sensitive to changes in the early stage of MCI compared to other commonly used neuropsychiatric scales, such as the Geriatric Depression Scale (GDS) and the Mild Behavioral Impairment (MBI) assessments. The existing literature has not yet reported any empirical study that examines the associations between NIHTB-EB outcomes and MCI status, let alone among socially isolated older adults or by their racial identities. Racial/ethnic background can affect one's experience and expression of emotion.^{13,14} For instance, compared to their non-Hispanic White counterparts, Black older adults reported less COVID-19 related emotional distress while Hispanic older adults reported more emotional distress during the pandemic.¹⁴ The relationships between emotional function and MCI diagnosis among racial/ethnic diverse older adults is largely unknown. It is of practical and clinical importance to investigate the emotional characteristics of racial/ethnic minority older adults with and without MCI. Using a study sample of non-Hispanic White and non-Hispanic Black socially isolated participants, this study aims to compare the emotional characteristics among older adults with MCI and with normal cognition as measured by NIHTB-EB.

2 | METHODS

2.1 | Participants and recruitment

This cross-sectional study uses baseline data from the Internet-based Conversational Engagement Clinical Trial (I-CONNECT, ClinicalTrials.gov: NCT02871921). The sample included 162 participants who completed the baseline emotion battery assessment between July 2018 and January 2021. The I-CONNECT trial protocol has been documented in detail elsewhere.¹⁵ The study procedures were reviewed

RESEARCH IN CONTEXT

- 1. Systematic Review:** The authors conducted a literature review of the emotion characteristics of older adults with mild cognitive impairment (MCI) using PubMed and PsychINFO. Non-cognitive symptoms, such as changes in emotion and behavior, could be early indicators of subsequent cognitive decline. Using technology-facilitated screening tools could increase access to a larger population to identify those at high risk of cognitive decline. These relevant citations are appropriately cited.
- 2. Interpretation:** Among socially isolated older old adults recruited from communities, we found that participants with MCI experienced more negative emotions and worse psychological well-being than their cognitively intact counterparts. The iPad-administered National Institutes of Health Toolbox Emotion Battery (NIHTB-EB) could be used as a supplementary assessment tool for detecting MCI.
- 3. Future Directions:** More studies need to be conducted to further understand the emotional characteristics associated with cognitive decline. Future directions include (a) confirming the study findings with a larger and racially diverse study sample and (b) investigating the within-person trajectories of changes in NIHTB-EB associated with changes in cognitive function over time using longitudinal data.

and approved by the institutional review board (IRB) at Oregon Health & Science University (OHSU IRB STUDY00015937).

Briefly, participants were eligible if they were age 75 or older and socially isolated. The participants were considered socially isolated if they met any one of the following three criteria: (1) scoring <12 on the 6-item Lubben Social Network Scale (LSNS-6),¹⁶ (2) engaging in conversations lasting 30 minutes \leq twice per week, or (3) answering “often” to at least one question of the three-item UCLA Loneliness Scale.¹⁷ Exclusion criteria for participating in the I-CONNECT study included having dementia, severe depressive symptoms operationally defined as a 15-item GDS (GDS-15) score > 7, current alcohol or substance abuse, unstable medical conditions, active systemic cancer within 5 years of the screening visit, or surgery that required full sedation with intubation within 6 months of screening. Participants were recruited from the metropolitan areas of Portland, Oregon, and Detroit, Michigan. Potential participants were identified in collaboration with the Meals on Wheels program, Area Agency on Aging (AAA), the Healthier Black Elders Registry, and other community partners as well as through mass mailing using voter registration lists. The research team contacted potential participants using telephone calls, direct mail, distribution of recruitment flyers, and social media (e.g.,

Facebook). The study is an extension of a previously conducted pilot study, which showed promising results.^{18,19}

2.2 | Measurements

NIH Toolbox Emotion Battery (NIHTB-EB). Based on NIHTB scoring instructions, three domain scores were calculated from 17 subscale emotion measures. The three emotion domains, previously identified with confirmatory factor analysis, are negative affect, social satisfaction, and psychological well-being.²⁰ The NIHTB app automatically generated the subscale emotion raw scores. The domain scores were calculated with subscale raw scores weighted by their confirmatory factor loading.⁹ The general population mean was standardized to be centered on 50 with a standard deviation (SD) of 10.⁹ The negative affect domain includes subscale measurements of anger affect, anger hostility, sadness, fear affect, and perceived stress. The social satisfaction domain includes subscales of friendship, loneliness, emotional support, instrumental support, and perceived rejection. The perceived rejection subscale was reverse coded so that its direction is consistent with the other subscales within the social satisfaction domain. The psychological well-being domain includes subscale measurements of general satisfaction, meaning and purpose, and positive affect.

MCI status was determined based on the consensus clinical diagnosis between neurologists and neuropsychologists using the National Alzheimer's Coordinating Center Uniform Data Set Version 3 (UDS V3),^{2,21-23} including amnesic MCI (aMCI) with impairment in a single domain and multiple domains, and non-amnesic MCI (naMCI) with impairment in a single domain and multiple domains. The MCI type was dichotomously coded as amnesic versus non-amnesic MCI regardless of the number of impairment domains. Individuals with aMCI had impairment in memory while those with naMCI had decreased abilities in other cognitive domains, such as executive functioning, and visuospatial and language abilities.²⁴ The participants were blinded to their MCI diagnosis.

Covariates. The analytical models controlled for age, sex, race (non-Hispanic White vs. non-Hispanic Black participants), years of education, marital status ("married/partnered" vs. "not married or partnered"), and presence of depressive symptoms operationalized as scored GDS-15 ≥ 5 on the 15-item GDS.²⁵

2.3 | Data analysis

All statistical analyses and data management were conducted using Stata 15 SE.²⁶ The sample characteristics were compared by MCI diagnosis, including covariates described above as well as Montreal Cognitive Assessment (MoCA) scores as an indicator of global cognition function. Separate linear regression analyses were used to evaluate the relationship between MCI status and the three NIHTB-EB domain scores with adjustment with all the covariates discussed in the previous section. The three domain scores were analyzed in separate models because the correlations among them were high ($r > 0.6$; see

Table S1 in supporting information). For any significant domains, linear regression models were run to identify specific items that drove the association between NIHTB-EB and MCI status. We performed post hoc analyses by subtypes of MCI (aMCI and naMCI), comparing their NIHTB-EB domain and subscale scores with those of participants with normal cognition. The NIHTB-EB domain and subscale outcomes were also compared within the MCI participants between these two subtypes. The same types of linear regression models were run for the post hoc analyses, controlling for age, sex, race, years of education, marital status, and depressive symptoms. Due to the exploratory nature of this study with a small sample size, we used a type I error rate of 0.05 as a cut point ($P < .05$) to determine statistical significance, but we noted the multiple comparisons adjusted *P*-values in the footnote of tables so that readers can interpret our results with caution.

3 | RESULTS

The sample included 163 I-CONNECT participants who completed NIHTB-EB assessments at baseline before the intervention started. Sample characteristics are summarized in Table 1. Eighty-six (52.8%) of the participants were diagnosed with MCI, and 77 (47.2%) participants had normal cognition. The sample's mean age was 81.2 (SD = 4.7) years. On average, the participants with MCI were about 2.5 years older than the subgroup with normal cognition ($t = 3.62, P < .001$). Approximately 71.0% of the sample was female, with an average of 15.3 (SD = 2.34) years of education. More than two thirds (78.7%) of the study sample self-identified as non-Hispanic White, and $\approx 20.1\%$ self-identified as non-Hispanic Black. For MoCA scores collected either in person,²⁷ or over phone calls (see the footnote in Table 1),²⁸ individuals with MCI scored significantly lower than those with normal cognition ($P < .001$), as expected. GDS scores ranged from 0 to 15 with the sample mean being 2.3 (SD = 1.75). Approximately 10.5% of the participants had depressive symptoms as defined by having a GDS score of 5 or greater. The mean score of LSNS-6 was 13.3 (SD = 5.0). The total sample's average negative affect, psychological well-being, and social satisfaction were 46.8, 46.2, and 41.2, respectively. NIHTB-EB set the population mean for these three domain scores to be 50 with an SD of 10. The social satisfaction mean score was almost 1 SD below the population mean. The subgroups with and without MCI did not differ significantly in sex, education level, depressive symptoms, the extent of social isolation, and the three NIHTB-EB domains in bivariate analyses.

Table 2A shows the linear regression model results that compare the three NIHTB-EB domain scores by MCI status. Table 2 presents the coefficients of MCI status and race after adjusting other covariates. Regression coefficients of other covariates including age, sex, education, depressive symptoms, and marital status, are shown in Table S2 in supporting information. Once age, sex, race, education, marital status, and depressive symptoms were controlled, a MCI diagnosis was associated with having a higher negative affect ($B = 2.836$; 95% confidence interval [CI], 0.241, 5.430; $P = .032$) and a lower psychological well-being score ($B = -2.974$; 95% CI, -5.376, -0.212; $P = .034$). Social satisfaction was not associated with MCI status ($P = .152$, see

TABLE 1 Sample characteristics by MCI status

	Total sample N = 163		MCI ^a n = 86		Normal cognition n = 77		χ^2 /t-test	P	P(adjusted) ^b
	n/mean	%/SD	n/mean	%/SD	n/mean	%/SD			
Age ^c	81.22	4.65	82.41	4.99	79.86	3.84	3.62	.000	-
Sex: female	115	70.99%	56	65.12%	59	77.63%	-3.07	.080	-
Race							3.57	.168	-
Non-Hispanic White	129	78.66%	64	74.42%	65	83.33%			
Non-Hispanic Black	34	20.73%	22	25.58%	12	15.38%			
Years of education	15.30	2.34	15.28	2.28	15.33	2.42	-0.13	.893	-
Married/partnered	35	21.34%	20	23.26%	15	19.23%	0.39	.530	-
MoCA ^d									
In-person MoCA (n = 127)	23.46	3.58	21.86	3.31	25.44	2.85	6.45	.000	-
Telephone MoCA (n = 36)	18.14	2.26	16.56	1.86	19.40	1.70	4.77	.000	-
GDS ^e >= 5	17	10.49%	9	10.49%	8	10.53%	0.00	.990	-
Lubben Social Network Scale ^f	13.29	4.97	12.80	4.61	13.84	5.32	-1.33	.184	.128
NIHTB-EB domains									
Negative affect	46.73	8.64	47.47	8.76	45.91	8.49	1.15	.253	.032
Psychological well-being	46.24	9.04	45.44	9.35	47.14	8.64	-1.21	.230	.034
Social satisfaction	41.23	9.63	40.78	9.51	41.73	9.80	-0.62	.538	.152

Notes: The general population means for negative affect, psychological well-being, and social satisfaction are 50, and the SD is 10.

^aThere were 41 participants diagnosed with non-amnesic MCI, and 45 participants diagnosed with amnesic MCI.

^bControlling for age, sex, race, education, marital status, and depressive symptoms.

^cAge range 75–94.

^dAfter the onset of the COVID-19 pandemic, I-CONNECT's data collection modality changed. The research team used the telephone MoCA because we could not conduct the assessment in person. The possible scale range for in-person MoCA is 0–30, and for telephone MoCA is 0–22. A higher MoCA score indicates better global cognition. Of the 127 participants who had in-person MoCA assessments, 70 were diagnosed with MCI, and 57 had normal cognition. Among the 36 participants who had MoCA test over phone calls, 16 had MCI, and 20 had normal cognition.

^eGDS possible scale range 0–15, sample score range 0–7.

^fLubben Social Network Scale (LSNS-6) score possible scale range 0–30, sample score range 3–29.

Abbreviations: GDS, Geriatric Depression Scale; MCI, mild cognitive impairment; MoCA, Montreal Cognitive Assessment; SD, standard deviation.

Table 2A). Compared to their non-Hispanic White counterparts, the non-Hispanic Black participants on average scored 7.9 points higher on social satisfaction ($B = 7.915$; 95% CI, 4.349 to 11.481; $P < .001$) and 5.7 points higher on psychological well-being ($B = 5.670$; 95% CI, 2.531 to 8.810; $P < .001$) domains.

To further explore which subscales in the negative affect and psychological well-being domains contributed to the relationship, we conducted exploratory analyses using the subscales in the negative affect (Table 2B) and psychological well-being domains (Table 2C). Within the negative affect domain, MCI status was related to experiencing more sadness ($B = 4.410$; 95% CI, 1.211 to 7.609; $P = .007$), fear affect ($B = 3.766$; 95% CI, 0.538 to 6.994; $P = .023$), and perceived stress ($B = 3.046$; 95% CI, 0.301 to 5.790; $P = .030$; Table 2B). Non-Hispanic Black participants scored about 5.39 points lower in sadness than non-Hispanic White participants ($B = -5.394$; 95% CI, -9.284 to -1.504; $P = .007$). Within the psychological well-being domain, individuals with MCI had lower meaning and purpose scores than the cognitively normal participants ($B = -2.567$, 95% CI, -5.089 to -0.044; $P = .046$). Non-Hispanic Black participants had higher positive affect ($B = 4.742$; 95% CI, 1.620 to 7.863; $P = .003$) and meaning and pur-

pose scores ($B = 7.698$; 95% CI, 4.631 to 10.765; $P < .001$) than Non-Hispanic White participants.

3.1 | Post-hoc analysis

The post-hoc analysis results are summarized in Table 3. Participants with naMCI scored lower than participants with normal cognition ($B = -3.175$, standard error [SE] = 1.563, $P = .044$) in psychological well-being, but the two groups did not differ in the other two domain scores (i.e., negative affect and social satisfaction) of NIHTB-EB. Individuals with aMCI did not differ from those with normal cognition in all three domain scores. In terms of subscale scores, individuals with aMCI had a higher fear score than the normal cognition group ($B = 4.482$, SE = 2.014, $P = .028$). Participants with naMCI had a higher level of sadness ($B = 4.770$, SE = 1.937, $P = .015$) and lower self-efficacy ($B = -3.590$, SE = 1.707, $P = .037$) compared to those with normal cognition. In a comparison between the two subtypes of MCI (amnesic vs. non-amnesic), no difference in either the domain scores or subscales was detected, possibly due to a small sample size.

TABLE 2 Linear regression results that compare NIH toolbox emotion battery domain scores by MCI status (N = 163)

	Coefficient	SE	P	95% CI	
A. Three domains of NIHTB-EB					
Negative affect					
MCI ^a	2.836	1.313	.032*	0.241	5.430
Non-Hispanic Black ^b	-2.573	1.597	.109	-5.728	0.582
Psychological well-being					
MCI	-2.794	1.307	.034*	-5.376	-0.212
Non-Hispanic Black	5.670	1.589	.000***	2.531	8.810
Social satisfaction					
MCI	-2.122	1.473	.152	-5.033	0.789
Non-Hispanic Black	7.915	1.804	.000***	4.349	11.481
B. Subscales of the negative affect domain					
Anger affect					
MCI	0.662	1.344	.623	-1.992	3.317
Non-Hispanic Black	-2.195	1.634	.181	-5.424	1.033
Anger hostility					
MCI	-0.385	1.340	.774	-3.033	2.262
Non-Hispanic Black	-0.432	1.630	.791	-3.651	2.788
Sadness					
MCI	4.410	1.619	.007**	1.211	7.609
Non-Hispanic Black	-5.394	1.969	.007**	-9.283	-1.504
Fear affect					
MCI	3.766	1.634	.023*	0.538	6.994
Non-Hispanic Black	-1.749	1.987	.380	-5.674	2.176
Perceived stress					
MCI	3.046	1.389	.030*	0.301	5.790
Non-Hispanic Black	-1.245	1.689	.462	-4.582	2.092
C. Subscales of the psychological well-being domain					
Positive affect					
MCI	-2.436	1.300	.063	-5.003	0.131
Non-Hispanic Black	4.742	1.580	.003**	1.620	7.863
Meaning and purpose					
MCI	-2.567	1.277	.046*	-5.089	-0.044
Non-Hispanic Black	7.698	1.553	.000***	4.631	10.765
General satisfaction					
MCI	-1.834	1.478	.216	-4.753	1.085
Non-Hispanic Black	1.606	1.797	.373	-1.943	5.156

Abbreviations: CI, confidence interval; MCI, mild cognitive impairment; NIH, National Institutes of Health; NIHTB-EB, National Institutes of Health Toolbox Emotion Battery; SE, standard error.

Note: All models controlled for age, sex, race, education, marital status and depressive symptoms. Bonferroni Adjusted P value for Table 2A is .016, for Table 2B is .01, for Table 2C is .016.

^aReference group: participants with normal cognition.

^bReference group: non-Hispanic White participants.

*P < .05.

**P < .01.

***P < .001.

TABLE 3 Post-hoc analysis: Comparing participants' NIHTB-EB scores for those with amnesic MCI and non-amnesic MCI to the reference group with normal cognition

	Coefficient	SE	P	95% CI	
Psychological well-being					
Non-amnesic MCI ^a	-3.175*	1.563	.044	-6.262	-0.088
Amnesic MCI ^a	-2.374	1.612	.143	-5.558	0.810
Age	0.084	0.144	.560	-0.201	0.369
Female	-0.366	1.488	.806	-3.305	2.573
Years of education	0.649*	0.275	.020	0.106	1.193
Severe depressive symptoms	-10.767***	2.006	.000	-14.730	-6.804
Married/partnered	2.823	1.631	.085	-0.398	6.045
Non-Hispanic Black ^b	5.600**	1.601	.001	2.437	8.763
Fear affect					
Non-amnesic MCI ^a	3.118	1.953	.112	-0.740	6.975
Amnesic MCI ^a	4.482*	2.014	.028	0.502	8.461
Age	-0.360*	0.180	.048	-0.716	-0.004
Female	1.216	1.859	.514	-2.456	4.889
Years of education	-0.121	0.344	.725	-0.801	0.558
Severe depressive symptoms	8.576**	2.507	.001	3.624	13.529
Married/partnered	-3.691	2.038	.072	-7.716	0.335
Non-Hispanic Black ^b	-1.869	2.001	.352	-5.821	2.084
Sadness					
Non-amnesic MCI ^a	4.770*	1.937	.015	0.944	8.596
Amnesic MCI ^a	4.013*	1.998	.046	0.067	7.960
Age	-0.220	0.179	.220	-0.573	0.133
Female	-0.238	1.844	.898	-3.880	3.405
Years of education	-0.358	0.341	.296	-1.032	0.317
Severe depressive symptoms	11.847***	2.486	.000	6.935	16.758
Married/partnered	-0.601	2.021	.767	-4.593	3.391
Non-Hispanic Black ^b	-5.327**	1.984	.008	-9.247	-1.407
Self-efficacy					
Non-amnesic MCI ^a	-3.590*	1.707	.037	-6.963	-0.218
Amnesic MCI ^a	-2.103	1.761	.234	-5.582	1.376
Age	-0.059	0.158	.711	-0.370	0.253
Female	0.296	1.625	.856	-2.915	3.507
Years of education	0.612*	0.301	.044	0.018	1.206
Severe depressive symptoms	-2.971	2.192	.177	-7.302	1.359
Married/partnered	1.793	1.782	.316	-1.727	5.312
Non-Hispanic Black ^b	1.836	1.749	.296	-1.620	5.291

Abbreviations: CI, confidence interval; MCI, mild cognitive impairment; NIHTB-EB, National Institutes of Health Toolbox Emotion Battery; SE, standard error. Note: Only the coefficients of MCI status and racial groups were presented in this table. All models controlled for age, sex, race, education, marital status, and depressive symptoms. Insignificant findings were omitted from this table.

^aReference group: participants with normal cognition.

^bReference group: non-Hispanic White participants.

* $P < .05$.

** $P < .01$.

*** $P < .001$.

4 | DISCUSSION

The study's findings indicate that socially isolated older adults with MCI had more negative affect and lower psychological well-being than cognitively normal older adults. Within the negative affect domain, sadness, fear, and perceived stress were significantly associated with the MCI diagnosis. Participants with MCI scored lower in the meaning and purpose subscale in the psychological well-being domain. However, the participants with MCI did not differ from their cognitively normal counterparts in the social satisfaction domain. In this study sample, non-Hispanic Black participants had more positive emotions than the non-Hispanic White participants. For example, the non-Hispanic Black participants had higher positive affect, meaning, and purpose, and less perceived stress.

I-CONNECT recruited socially isolated older adults age 75 and above. With a general population sample recruited using a stratifying sample strategy from 10 sites (1036 English-speaking and 408 Spanish-speaking adults aged between 18 and 85), the general population's mean score of the NIHTB-EB outcomes was set to 50.⁹ Compared to the population mean, participants in the current study had slightly lower averaged scores of negative affect (46.73), psychological well-being (46.24), and a much lower mean score of social satisfaction (41.23). Given that the participants were socially isolated, it is expected their perceived social satisfaction and psychological well-being would be lower than the general population. The socioemotional selectivity theory posits that older adults pay more attention to more positive events and could experience lower negative affect than younger individuals.²⁹ Our findings also showed that individuals aged 75 and above had a lower negative affect. These descriptive results contribute to the existing literature by applying the NIHTB-EB measurements to a racially diverse, socially isolated older old study sample.

Few previous studies have used NIHTB-EB to examine the association between emotional function and cognitive status. Nonetheless, existing literature reports an association between negative affect and cognitive decline using other types of measurements of emotions, such as the negative emotionality scale and GDS. A longitudinal 23-year follow-up study with cognitively normal community-dwelling adults (mean age 59.8) found negative affect was associated with greater cognitive decline and the relationships between cognitive decline and negative affect were bidirectional.³⁰ Negative affect was found to be a signal of inflammation and increased kynurenine metabolism among a mixed sample with cognitively normal, MCI, and AD patients.³¹ Using the NIHTB-EB measures, the current study also found that individuals with MCI had higher negative affect and lower psychological well-being, which is consistent with existing evidence. However, perhaps because the current study participants share similar levels of loneliness or social isolation, we did not identify significant differences in social satisfaction between participants with and without MCI.

Although the I-CONNECT study had a larger percentage of the non-Hispanic Black participants than most clinical trials,³² non-Hispanic Blacks represent only about 20% of the study sample. The research team collaborated with the Healthier Black Elders Registry in Detroit,

sent invitational mailings using contact information from the voters' registry, and conducted community outreach in senior housing, yet found it to be particularly challenging to recruit socially isolated non-Hispanic Black older adults. Among racial minority groups, those who agreed to participate in a research project may be healthier and happier than their peers who declined the opportunity. The findings of the current study, that non-Hispanic Black participants reported more positive emotions and less stress than non-Hispanic White participants, might reflected a selection bias, that is, minority older adults who agreed to participate were in a better emotional state to begin with. Recruiting minority populations requires significant time and effort in building relationships with the community prior to the start of recruitment. Future studies with more racially diverse participants are much needed.

In the post-hoc analysis, we identified different patterns in emotional characteristics associated with subtypes of MCI. Participants with aMCI reported more fear affect, while individuals with naMCI had higher scores in sadness and lower scores in self-efficacy compared to those with normal cognition. The aMCI subtype is considered to be a common prodromal stage of AD,³³ while naMCI is associated with higher risks of developing other dementias, including Lewy body dementia, Parkinson's disease, and frontotemporal dementia.²⁴ Findings of the current study might help to shed light on the early emotional characteristics associated with subtypes of dementias. Previous research documented that, compared to their cognitively healthy counterparts, individuals with aMCI had more difficulties in identifying emotions in facial expressions, suggesting deficits in social cognition ability.^{34,35} However, we did not find previous research contrasting the emotional characteristics of individuals with the two subtypes of MCIs to individuals with normal cognition. Although our post hoc analysis is exploratory, the findings add to the knowledge of self-reported emotional characteristics among people with amnesic and non-amnesic MCI.

This study explores the possibility of using the iPad-administered NIHTB-EB to compare the emotional characteristics of individuals with and without MCI within a socially isolated sample, which could be of practical importance given that older adults living in isolation or experiencing frequent loneliness could be at higher risk of developing ADRD.¹¹ Our study did not find the more traditional emotion measures, such as GDS, to be sensitive enough to detect the differences in emotional characteristics between individuals with normal cognition and MCI. Nonetheless, this statement is true only within the group free from severe depressive symptoms as defined in the study's inclusion criteria, which may lessen its predictive value as it was administered to a sample far more homogeneous than the general population. With more comprehensive items and an adaptive testing mode made possible by using mobile technology, the NIHTB-EB might be uniquely equipped to detect the change in emotional characteristics associated with MCI. The concept of MBI was developed to describe sustained and impactful NPS and behavioral changes associated with predementia risk states.³⁶⁻³⁸ However, MBI does not necessarily encompass comprehensive aspects of emotion in later life. For instance, MBI criteria do not include positive emotional experiences. Assessing NIHTB-EB

among older adults at risk of cognitive decline might add new perspectives to the research of MBI and help to better understand the neuropsychiatric pathways of dementia development.

Strengths of this study include examining emotional status among the socially isolated and a smaller number of racial minority older old subjects who are rarely included in clinical trials. Additionally, the MCI clinical diagnosis was based on the standardized criteria. There are some limitations in this study. The study is exploratory and with a relatively small sample. Future research with a larger sample size and in different populations would increase the generalizability of the results. The study findings are also limited by the cross-sectional nature of the data. Future studies with longitudinal follow-up might examine the within-person trajectories of changes in NIHTB-EB before and after incident MCI. The current study did not examine associations between NIHTB-EB outcomes and biomarkers, and therefore, underlying biological mechanisms of the found association are yet to be examined in future studies.

In conclusion, we found MCI status was associated with increased negative affect and less psychological well-being. The participants with and without MCI were not different in their social satisfaction possibly due to the fact that we recruited those experiencing social isolation. In this study sample, non-Hispanic Black participants had more positive affect, meaning, and purpose and less perceived sadness. Understanding the emotional characteristics of older adults with MCI, especially with racially diverse participants, could inform the development of targeted and effective interventions for improving quality of life. NIHTB-EB may be a more sensitive tool to detect emotional change than traditional assessments, such as GDS. The results suggest that NIHTB-EB could be used as a supplementary assessment tool for evaluating the emotional variances of patients challenged with cognitive concerns.

AUTHOR CONTRIBUTIONS

Kexin Yu and Hiroko H. Dodge contributed to conception of the study, and drafting and editing of the full manuscript. Kexin Yu conducted data analysis. Hiroko H. Dodge received the funding for the I-CONNECT study. Katherine Wild, N. Maritza Dowling, Jeffrey A. Kaye, and Lisa C. Silbert provided reviews, and theoretical and analytical suggestions. All authors contributed to manuscript revision, and reading and approval of the submitted version.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose. Author disclosures are available in the supporting information.

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The sponsor had no role in planning of the current manuscript, study design data analysis, and the interpretation of the research findings.

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SUPPORTING INFORMATION

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

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