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Cognitive Impairment no Dementia and Associations with Health Literacy, Self-Management Skills, and Functional Health Status

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Abstract

Objectives: To determine the prevalence of cognitive impairment no dementia (CIND) among a diverse, community-based population, and establish associations between CIND and health literacy, chronic disease self-management and functional health status.

Methods: 863 primary care adults without dementia aged 55–74. Adjusted logistic and linear regressions were used to assess associations between CIND (None, Mild, Moderate/Severe) and outcomes.

Results: 36% participants exhibited CIND. It was strongly associated with limited health literacy (Newest Vital Signs: Mild [OR 3.25; 95% CI 1.93, 5.49], Moderate/Severe [OR 6.45; 95% CI 3.16, 13.2]; Test of Functional Health Literacy in Adults: Mild [OR 3.46; 95% CI 2.08, 5.75], Moderate/Severe [OR 8.82; 95% CI 4.87, 16.0]; all p's < 0.001) and poor chronic disease self-management (Mild [B = −11.2; 95% CI −13.5, −8.90], Moderate/Severe CI [B = −21.0; 95% CI −23.6, −18.4]; both p's < 0.001). Associations between CIND and functional health status were nonsignificant.

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Author Contributions

Dr. Lovett and Dr. Wolf devised the main conceptual ideas, with contribution from Dr. Griffith and Dr. Persell. Dr. Lovett, Ms. Curtis, and Dr. Cobia conceptualized and conducted the norming analysis. Dr. Lovett conducted the primary statistical analysis and wrote the study manuscript. All authors provided critical interpretation and feedback on the results, and were involved in manuscript preparation and final approval.

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Conclusions: CIND was prevalent in this cohort, and strongly associated with requisite skills for managing everyday health needs.

Practice Implications: Attention to subtle declines in chronic disease self-care may assist with CIND identification and care management within this population. When CIND is observed, clinicians should also expect and address difficulties with self-management.

1. INTRODUCTION

Cognitive impairment no dementia (CIND) broadly refers to impairment in cognition above that which is seen in normal age-related decline, but which is not severe enough to qualify for dementia diagnosis [1]. An estimated 22% of Americans ≥ 65 live with CIND, with rising prevalence as age increases [2]. As the U.S. population continues to grow older, rates of CIND are expected to increase due to changes in both life expectancy and a growing proportion of older adults. This increase is likely to have a dramatic impact on individuals and their families, as well as the healthcare system. Extensive research has demonstrated that older adults with CIND have poorer physical and mental health [3–6], higher rates of disability [7], and increased morbidity/mortality [8–9], translating to greater healthcare utilization and costs [10]. These outcomes may be more prevalent among individuals with subtle or undiagnosed impairments not readily detected by their medical providers [11,12].

It is increasingly recognized that cognitive factors may negatively influence health in part by reducing one’s health literacy skills and ability to independently self-manage illness and chronic disease [13]. While investigations have found support for this pathway among cognitively-normal older adults or those with expected age-related declines [14–19], this relationship is less studied among individuals with CIND. Older adults with cognitive deficits experience high rates of multimorbidity, resulting in greater complexity of care and demand for healthcare services [20]. Multimorbidity itself is also known to increase risk of progression of cognitive decline [21]. Adequate understanding of health information and effective navigation of healthcare systems, including engagement with multiple clinicians, participating in treatment decisions, and managing complex medication regimens, is therefore essential to adequately manage both physical and cognitive health. Yet, these healthcare tasks may pose difficulty for those with CIND due to their cognitive demands.

Emerging research has demonstrated associations between CIND with low health literacy or numeracy skills [22,23], as well as patient behaviors associated with these skillsets such as poor medication adherence [24]. However, investigations that include comprehensive, ecologically valid assessments of health literacy and self-management skills among diverse, community-based cohorts are lacking, despite these areas being highlighted as important areas of research within this population [25,26]. Evidence currently remains inconclusive for strategies to prevent or delay progression of CIND [26], and no curative treatment yet exists for more severe forms of impairment such as dementia. Thus, strategies to better manage CIND once established remain the primary means of intervention available. An enhanced understanding of how CIND impacts illness self-care may assist in case identification, as well as inform patient and health system-based approaches to reduce self-care burden and improve health outcomes among this population.

The objectives of the present study were to 1) assess the prevalence of CIND among a diverse, community-based cohort of older adults, and 2) determine associations between CIND with health literacy and healthcare-related self-management skills, as well as measures of functional health status. We hypothesized that older adults with CIND will be at greater risk for poor performance on these measures as compared to their cognitively-normal counterparts, with those with more significant impairments demonstrating the greatest risk.

2. METHODS

The study cohort and methods have been described previously [19], and are also briefly detailed below.

2.1 Sample

This secondary analysis uses baseline data from the ongoing ‘Literacy and Cognitive Function among Older Adults’ (i.e., LitCog) longitudinal cohort study. Data collection for the baseline phase occurred from 2008 to 2015. Participants were recruited from one academic medical center and from five federally-qualified health centers in Chicago, Illinois. Participant inclusion criteria for the original LitCog study included: 1) English-speaking, 2) aged 55–74, 3) actively connected to a clinic physician (≥ 2 visits within 2 years of the baseline interview), and 4) non-demented [27]. A younger age range was purposefully targeted, as a primary goal of the LitCog study was to obtain a sample of independent, community-dwelling adults without severe cognitive impairment at baseline and observe cognitive changes over time. A total of 900 individuals consented and participated in the larger study. Only those completing cognitive assessments were included in this analysis, resulting in a final sample of 863 participants.

2.2 Procedure

Participants completed two baseline interviews, spaced 7–10 days apart. Day 1 assessments included self-reported basic demographics, functional health status, health literacy, and performance-based chronic disease self-management measures. Day 2 interviews consisted of a comprehensive cognitive battery. Northwestern University’s Institutional Review Board approved the study.

2.3 Main Measures

2.3.1 Cognitive Function.—Thirteen cognitive tests were used to measure performance in five cognitive domains: processing speed (Digit Comparison [28], Pattern Comparison [29], Symbol Digit Modalities [30]), working memory (CANTAB Spatial Span Length – Reverse [31], CANTAB Spatial Working Memory, Size Judgment Span [32]), delayed memory (CANTAB Delayed Verbal Memory [31], New York Paragraph – Delayed [33]), executive function (ETS Letter Sets [34], CANTAB Stockings of Cambridge [31], Ravens Progressive Matrices [35]), and language (CANTAB Graded Naming Test [31], Shipley Institute of Living – Vocabulary [36]). Premorbid cognitive function was assessed using the American Version of the National Reading Test (AMNART) [37].

We defined CIND broadly to include patients who may have acute impairments that are reversible, as well as more progressive impairments including but not limited to mild cognitive impairment (MCI) [1]. To obtain our CIND variable, raw cognitive scores were normed using a modified regression-based method initially proposed by Shirk et al. for circumstances in which cognitive assessments have been adapted for practical use and/or when reliable norms are not available for a given population of interest [38]. Following this method, we first obtained regression coefficients for each cognitive test from a linear model among a subset of ‘normal’ patients with average premorbid functioning (±1 SD on the AMNART), no diagnosis of MCI/dementia or stroke within one year of their baseline interview as identified via retrospective chart review or self-report, and statistically controlling for age, sex, and education. Using these regression coefficients, we then estimated predicted population means in the full sample for each participant on each test. Finally, individual test z-scores were calculated using participants’ raw tests scores, the predicted population means, and root mean square errors from the original regression models.

Using these z-scores, patients were classified as having either mild (−1 to −1.49), moderate (−1.5 to −1.99), or severe (<−2) impairment if their performance on two or more tests within at least one cognitive domain met these thresholds (with higher domain severities superseding lower domain severities). This classification is closely aligned to methods proposed by Jak/Bondi, in which both a cut-off score and number of impaired tests in a domain are considered to balance both sensitivity and specificity [39]. Participants with moderate and severe impairments were combined into one category due to the relatively small cell sizes within each group. This resulted in a final CIND variable with three levels (None, Mild, Moderate/Severe).

2.3.2 Health Literacy & Self-Management Skills.—We measured health literacy using the Newest Vital Sign (NVS) and the Test of Functional Health Literacy in Adults (TOFHLA). The NVS uses a nutrition label to assess basic health understanding and numeracy [40]. Scores range from 0–6, and were dichotomized into limited (0–3) and adequate literacy (4–6). The TOFHLA measures both reading fluency and numeracy using actual health-related materials [41]. Scores range from 0–100, and were categorized as limited (<75) or adequate (75–100).

We used the Comprehensive Health Activities Scale (CHAS) to measure health-related self-management skills, which was validated in the original LitCog sample [15]. This scale measures performance on various health scenarios designed specifically for older adults, and assesses comprehension of oral and written communications, recall of video-based health education, and complex medication dosing. The CHAS consists of 45 items and raw scores (0–45) are transformed to a 0–100 scale, with higher scores indicating better performance.

2.3.3 Functional Health Status.—We obtained self-reported measures of physical and mental health using Patient Reported Outcomes Measurement Information System (PROMIS) depression, anxiety, and physical function short-form subscales [42]. All PROMIS tests have a mean of 50 (± 10) by definition and are normed against the US population. For the subscales measuring mental health, higher scores indicate more symptomatology, whereas for the physical function subscale higher scores represent greater function.

2.4 Analysis Plan

We first conducted descriptive statistics on our overall sample. The prevalence of CIND was then determined, and its associations with patient characteristics using a combination of chi-square tests and analysis of variance (ANOVA). For bivariate analyses, we compared CIND by health literacy level using chi-square tests, while ANOVA was used to compare mean performance on self-management tasks and functional health status by each CIND group. Non-parametic Kruskal-Wallace H tests were used for continuous outcomes violating assumptions of normality. We conducted separate multivariable logistic and linear regression models to assess associations between CIND and outcomes of interest, controlling for demographic characteristics (age, race/ethnicity, education, income) and number of self-reported chronic conditions. To obtain effect sizes, odds ratios (OR) were calculated when the primary predictor of interest was categorical and unstandardized beta coefficients (B) were used for continuous primary predictors. We used post-hoc pairwise comparisons with Bonferroni adjusted alpha level of $p = 0.0167$ (.05/3) to assess for significant differences between CIND severity levels. All analyses were performed using STATA 15.0 (College Station, TX, USA).

3. RESULTS

3.1 Patient Characteristics

Patient characteristics are listed in Table 1. On average, participants were 63.1 years old (standard deviation (SD) 5.4), the majority were female, and non-White. Over half of participants had less than a college degree, and an annual household income of < $50,000. Participants reported an average of 2.7 chronic conditions (SD 1.8). Overall, 36% of our sample exhibited CIND (n = 306). Of these, just over one-half (51%) demonstrated mild impairments, while the remainder had moderate/severe impairments. Individuals with CIND significantly differed by race/ethnicity, education, income, study site, and by number of chronic conditions.

3.2 Main Outcomes

3.1.1 Health Literacy.—In bivariate analyses, health literacy level significantly differed by CIND for both the NVS and the TOFHLA (both p's < 0.001) (Table 2). In adjusted multivariable models controlling for relevant covariates (Table 3), CIND was strongly associated with limited health literacy for both measures (NVS: Mild [OR 3.25; 95% CI 1.93, 5.49], Moderate/Severe [OR 6.45; 95% CI 3.16, 13.2]; TOFHLA: Mild [OR 3.46; 95% CI 2.08, 5.75], Moderate/Severe [OR 8.82; 95% CI 4.87, 16.0]; all p's < 0.001). On post-hoc comparisons, participants with Moderate/Severe CIND demonstrated greater risk for limited health literacy than those with Mild CIND on only the TOFHLA (OR 2.55; 95% CI 1.17, 5.54, p = 0.012); there were no significant differences between CIND severities for the NVS in adjusted models.

3.1.2 Self-Management Skills.—Table 2 lists mean performance on self-care tasks, which significantly differed by CIND for the overall CHAS score ($p < 0.001$). In adjusted multivariable analyses (Table 3), both Mild [B = −11.2; 95% CI −13.5, −8.90] and Moderate/Severe CIND [B = −21.0; 95% CI −23.6, −18.4] were strongly associated with a lower overall CHAS score (both p's < 0.001). On post-hoc testing, participants with Moderate/Severe CIND demonstrated lower overall CHAS scores than the Mild CIND group (B = −9.79; 95% CI −13.2, −6.37, $p < 0.001$).

When broken down by CHAS subtest, participants with CIND had lower mean scores than the cognitively-normal group (all p's < 0.001) (Table 2). CIND was also associated with poorer performance on all CHAS subtests in adjusted multivariable models (Print: Mild [B = −10.6; 95% CI −13.4, −7.68], Moderate/Severe [B = −23.8; 95% CI −27.0, −20.5]; Spoken: Mild [B = −10.1; 95% CI −13.6, −6.49], Moderate/Severe [B = −17.1; 95% CI −21.1, −13.1]; Multimedia: Mild [B = −12.3; 95% CI −16.6, −8.04], Moderate/Severe [B = −16.1; 95% CI −20.8, −11.3]; Medication Dosing: Mild [B = −11.3; 95% CI −14.6, −7.98], Moderate/Severe [B = −20.1; 95% CI −23.7, −16.4]; all p's < 0.001) (Table 3). For each CHAS subtest except the Multimedia task, the Moderate/Severe CIND group demonstrated worse performance compared to the Mild CIND group when analyzed using post-hoc comparison tests (Print: [B = −13.2; 95% CI −17.5, −8.94], $p < 0.001$; Spoken: [B = −7.09; 95% CI −12.4, −1.79], $p = 0.004$; Medication Dosing: [B = −8.81; 95% CI −13.7, −3.93], $p < 0.001$).

3.1.3 Functional Health Status.—Mean physical function scores significantly differed by CIND in bivariate analysis ($p < 0.001$) (Table 2). Associations between CIND and physical function scores in multivariable models were not statistically significant after controlling for relevant covariates (Table 3). Depression ($p < 0.001$) and anxiety ($p = 0.01$) were significantly associated with CIND in bivariate analysis (Table 2). In multivariable analyses (Table 3), all adjusted associations between CIND and depression and anxiety scores were not statistically significant.

4. DISCUSSION AND CONCLUSION

4.1 Discussion

Among our community-based sample of older adults, over a third (36%) had CIND. Of these participants, approximately half were determined to have mild impairments, while the remainder demonstrated more significant deficits. Notably, our overall CIND sample estimate is higher than other published prevalence rates [2,43]. This is not surprising, as the LitCog sample was recruited from primary care settings in socioeconomically diverse communities; all participants were health-seeking with a high prevalence of not just one but multiple chronic conditions.

CIND was also strongly associated with more limited health literacy and self-management skills. While two previous studies have found a relationship between CIND and low health literacy [21,22], those investigations did not use common, validated health literacy measures. Furthermore, our study is the first to our knowledge to examine associations between CIND and performance on a variety of everyday healthcare-related self-management behaviors, such as dosing complex medication regimens and navigating healthcare information presented in verbal, written, or multimedia formats. This association with decreased self-management skills is especially relevant because most operational criteria for subtle cognitive impairment commonly used in both research and clinical settings require little to no impact on more instrumental daily activities [1,44,45].

Furthermore, our findings also shed light on how differing severities within the continuum of CIND may impact various self-management tasks. As expected, individuals with more significant impairments performed worse than those with milder deficits on the majority of health literacy measures and self-care activities. The only exceptions to this trend were for the NVS health literacy tool and the CHAS Multimedia subtest, in which both Mild and Moderate/Severe CIND participants demonstrated similar poor performance. This might suggest a possible threshold effect of CIND for the skillsets examined on these measures. For example, the NVS relies heavily on numeracy skills, while the Multimedia subtest requires the user to navigate health information presented in a technology-based format. These tasks may be more cognitively demanding than others, such as retrieving information from a print document or recalling spoken instructions [46, 47]. We should also emphasize that the threshold for our CIND group is purposefully based on a lower cutoff score than is frequently utilized in the literature (−1.0 SD versus −1.5 SD below normative expectations) [45]. This could suggest that more subtle cognitive impairments than what has previously been proposed might still impact an individual’s ability to manage their personal health. Given the present lack of a clear clinical signal for the early detection of even modest cognitive impairments in ambulatory settings, such functional self-care deficits may not be captured by the healthcare system [48]. Our findings offer an alternative means for detection by routinely assessing and monitoring whether patients are experiencing difficulty implementing commonplace self-care tasks, such as organizing and dosing their medication regimen, or recalling spoken medical guidance, among other responsibilities.

Contrary to expectations, we found no significant associations between CIND and measures of physical function or mental health after statistically controlling for relevant covariates. It is plausible that our functional status measures lacked the precision to detect the types of impairments more commonly seen in those with CIND. For instance, task performance speed may be one method that is more indicative of functional change than the self-report measures of physical function utilized in this study [49]. It is also possible that the self-report nature of these measures itself, which are subject to recall or desirability biases, influenced our negative findings. Such concerns may be especially relevant among adults with CIND who may be experiencing deficits in memory, or lack insight into their current level of functioning [50]. Additionally, the relatively young age of our sample may have been another factor that limited our ability to observe associations among CIND and mental health. Research has demonstrated that older adults experience a decline in depressive and anxiety symptoms beginning in middle adulthood, before rising again in their 70’s [51,52]. Prior studies demonstrating associations between poor mental health and CIND have mostly been performed among adults 70 and older [4,5]. Thus, any differences by CIND on our mental health measures may have been masked by this overall age effect.

Despite the strengths of this study, our study has limitations. Foremost, this was a cross-sectional, secondary analysis from a larger cohort study, which limits our ability to infer causation. A priori, longitudinal investigations aimed at understanding the pathways proposed here are necessary to fully capture the impact of CIND on these outcomes. Future studies examining differences between types or number of cognitive domains affected may also assist in greater understanding of associations between varying presentations of CIND and performance on specific self-management tasks. While socioeconomically diverse, our sample was also English-speaking only and primarily female, thereby limiting generalizability. Furthermore, while the health literacy assessments and CHAS measure used in our study are based on many ‘real world’ scenarios older adults in particular might encounter in a healthcare setting, it should be expected that participants would have varying levels of experience with the task demands. Familiarity with and/or perceived importance of the task based on personal health experiences may have impacted performance. Lastly, our CIND classification was not verified by subjective experiences of cognitive change, which has been standard practice [45]. However, recent studies have questioned the utility of subjective complaints in case identification [53], and argued for the use of primarily neuropsychological-based methods [39], possibly tempering this critique.

4.2 Conclusion

This investigation demonstrates that cognitive impairment not attributable to dementia is prevalent among a diverse, community-based cohort, and associated with reduced competencies related to navigating healthcare systems and self-managing health. The magnitude of these impairments are likely large enough to have important clinical consequences.

4.3 Practice Implications

Moving forward, limited or declining health literacy and/or self-care abilities should be considered as a possible marker of impaired cognition, leading to further screening or testing, or be targeted for intervention itself. Addressing these self-care difficulties may be a feasible approach for managing physical and cognitive health in this population. Conversely, when cognitive impairment is suspected, self-management behaviors related to health and chronic disease should also be routinely assessed and addressed. Lastly, healthcare systems, clinicians, and researchers should also consider ways to best tailor healthcare and support materials for patients with relatively modest impairments in cognition.

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Highlights

- CIND may be more prevalent than expected in diverse, primary care settings.
- CIND is associated with reduced ability to independently self-manage health.
- Self-care difficulty may be an indirect means of detecting early cognitive changes.
- Targeting self-care may be a practical approach to manage health in CIND adults.

Table 1.

Participant Characteristics, Overall and by CIND

	Cognitive Impairment				
Variable	**Overall (N=863)**	**None (n=557)**	**Mild (n=156)**	**Moderate/Severe (n=150)**	***P value***
Age, mean (SD)	63.1 (5.4)	63.0 (5.3)	63.2 (5.8)	63.0 (5.5)	0.92
Age, n (%)					
55–59	269 (31.2)	175 (31.4)	53 (34.0)	41 (27.3)	0.19
60–64	277 (32.1)	177 (31.8)	41 (26.3)	59 (39.3)	
65+	317 (36.7)	205 (36.8)	62 (39.7)	50 (33.3)	
Gender, n (%)					0.16
Female	597 (69.2)	382 (68.6)	117 (75.0)	98 (65.3)	
Race, n (%)					<0.001
Black	401 (46.6)	176 (31.8)	107 (68.6)	118 (78.7)	
White	402 (46.7)	349 (63.0)	38 (24.4)	15 (10.0)	
Other	57 (6.6)	29 (5.2)	11 (7.1)	17 (11.3)	
Education, n (%)					<0.001
HS or less	251 (29.1)	99 (17.8)	69 (44.2)	83 (55.3)	
Some College	195 (22.6)	128 (23.0)	38 (24.4)	29 (19.3)	
≥College	417 (48.3)	330 (59.3)	49 (31.4)	38 (25.3)	
Income, n (%)					<0.001
<$10,000	112 (13.8)	42 (7.8)	32 (21.3)	38 (29.9)	
$10,000-$24,999	176 (21.7)	73 (13.6)	58 (38.7)	45 (35.4)	
$25,000-$49,999	129 (15.9)	82 (15.3)	24 (16.0)	23 (18.1)	
>$50,000	396 (48.7)	339 (63.3)	36 (24.0)	21 (16.5)	
Site Type, n (%)					<0.001
AMC	600 (69.5)	457 (82.1)	83 (53.2)	60 (40.0)	
FQHC	263 (30.5)	100 (17.9)	73 (46.8)	90 (60.0)	
# Conditions, mean (SD)	2.7 (1.8)	2.3 (1.5)	3.4 (2.1)	3.6 (1.9)	<0.001

CIND = Cognitive Impairment no Dementia; AMC = Academic Medical Center; FQHC = Federally-Qualified Health Center

Table 2.

Performance on Health Literacy Measures, Health-Related Tasks and Functional Health Status by CIND

	Cognitive Impairment				
	Overall (N=863)	**None (n=557)**	**Mild (n=156)**	**Moderate/Severe (n=150)**	***P value***
Health Literacy, n (%)					
NVS					<0.001
Adequate	398 (46.2)	354 (63.6)	32 (20.5)	12 (8.1)	
Limited	464 (53.8)	203 (36.4)	124 (79.5)	137 (92.0)	
TOFHLA					<0.001
Adequate	583 (68.5)	478 (86.8)	71 (46.4)	34 (23.1)	
Limited	268 (31.5)	73 (13.3)	82 (53.6)	113 (76.9)	
CHAS Self-Management Skills, mean (SD)					
Overall	61.2 (21.6)	71.4 (15.1)	49.3 (17.8)	35.3 (17.7)	<0.001
Print	65.6 (24.6)	76.5 (17.3)	53.6 (21.2)	35.8 (21.1)	<0.001
Spoken	69.0 (23.2)	77.2 (18.9)	58.6 (22.1)	47.7 (21.7)	<0.001
Multimedia	42.7 (26.9)	52.1 (24.7)	29.6 (22.4)	21.6 (20.6)	<0.001
Medication Dosing	61.8 (24.5)	71.7 (18.5)	49.6 (23.1)	36.3 (22.3)	<0.001
PROMIS Functional Health Status, mean (SD)					
Physical Function	47.6 (9.0)	49.2 (8.5)	45.6 (9.3)	43.7 (8.9)	<0.001
Depression	47.7 (9.0)	46.4 (8.2)	49.6 (9.8)	50.6 (10.0)	<0.001
Anxiety	53.2 (8.9)	52.5 (8.6)	54.3 (9.5)	54.4 (9.1)	0.02

CIND = Cognitive Impairment no Dementia; NVS = Newest Vital Sign; TOFHLA = Test of Functional Health Literacy in Adults; CHAS = Comprehensive Health Activities Scale; PROMIS = Patient-Reported Outcomes Measurement Information System

Table 3.

Adjusted Logistic and Linear Regression Estimates for Limited Health Literacy, Health-Related Task Performance and Functional Health Status by CIND

Outcome	Cognitive Impairment			
	Mild (n = 156)		Moderate/Severe (n = 150)	
	Summary Value	***P value***	**Summary Value**	***P value***
Limited Health Literacy (OR, 95% CI)				
NVS	3.25 (1.93, 5.49)	<0.001	6.45 (3.16, 13.2)	<0.001
TOFHLA	3.46 (2.08, 5.75)	<0.001	8.82 (4.87, 16.0)	<0.001
CHAS Self-Management Skills (B, 95% CI)				
Overall	−11.2 (−13.5, −8.90)	<0.001	−21.0 (−23.6, −18.4)	<0.001
Print	−10.6 (−13.4, −7.68)	<0.001	−23.8 (−27.0, −20.5)	<0.001
Spoken	−10.1 (−13.6, −6.49)	<0.001	−17.1 (−21.1, −13.1)	<0.001
Multimedia	−12.3 (−16.6, −8.04)	<0.001	−16.1 (−20.8, −11.3)	<0.001
Medication Dosing	−11.3 (−14.6, −7.98)	<0.001	−20.1 (−23.7, −16.4)	<0.001
PROMIS Functional Health Status (B, 95% CI)				
Physical Health	1.26 (−0.16, 2.68)	0.08	0.12 (−1.46, 1.70)	0.88
Depression	0.50 (−1.14, 2.13)	0.55	0.89 (−0.93, 2.72)	0.34
Anxiety	−0.09 (−1.76, 1.59)	0.92	0.23 (−2.10, 1.64)	0.81

CIND = Cognitive Impairment not Dementia; NVS = Newest Vital Sign; TOFHLA = Test of Functional Health Literacy in Adults; CHAS = Comprehensive Health Activities Scale; PROMIS = Patient-Reported Outcomes Measurement Information System.

Separate regressions were conducted for each outcome. Each model controlled for age, race/ethnicity, education, income, and # chronic conditions. Reference categories: Cognitive Impairment (None), Health Literacy (Adequate).