Evaluating PROMIS Physical Function Measures in Older Adults at Risk for Alzheimer's Disease

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Abstract

Activities of daily living can be affected by cognitive decline. Self-report measurement of functioning is attractive due to ease of data collection, low cost, and accessibility via technology-assisted means, and for understanding patient perspective. A concern is with reliability of such measurement as cognitive decline occurs. We compared a widely used, self-report "legacy" measure of functioning, Lawton and Brody's Instrumental Activities of Daily Living Scale (IADLS), with a subset of physical functioning items from the Patient-Reported Outcomes Measurement Information System (PROMIS). The study sample consisted of 304 individuals of varying cognitive status: normal, mild cognitive impairment (MCI), or early dementia. An expert consensus method was used to select PROMIS functional items most relevant to neurocognitive disorder and to identify major functional sub-domains. Selected PROMIS functional subscales and the IADLS were then evaluated with respect to cognitive status. Few PROMIS functional items were useful in identifying MCI, while we reaffirmed the utility of the IADLS. Also, even mild depression levels were found to have negative effects on functioning according to both PROMIS and IADLS.

Keywords

PROMIS, dementia, MCI, physical functioning, self-report measurement

Introduction

Physical function decline is known to be associated with dementing conditions such as Alzheimer's disease (AD; Auyeung et al., 2008). Physical frailty, weaker grip strength, and slower chair stand test have all been associated with cognitive decline (Auyeung, Lee, Kwok, & Woo, 2011). Functional indicators of neurocognitive decline that can be seen in persons with AD are important because timely identification of these deficits can potentially help inform planning and care approaches that optimize longer term health outcomes and quality of life. Given the need for early treatment planning, it is of particular interest to determine if elderly people with mild cognitive impairment (MCI) report subtle functional deficits that may help predict conversion to dementia.

Several tools are used in routine clinical practice to evaluate both cognitively intact and impaired geriatric patients (Sajatovic & Ramirez, 2015). Unfortunately, no single measure has proven ideal for all patients, and certain Activities of Daily Living Scales have proven less reliable when used in people with dementia (Bucks, Ashworth, Wilcock, & Siegfried, 1996). Moreover, many commonly used scales are long or cumbersome to use and need trained raters to administer, thus being impractical for use in typical clinical settings.

The National Institute of Health (NIH) funded the Patient-Reported Outcomes Measurement Information System (PROMIS) that measures seven common health domains, including emotional distress (depression), anxiety, pain, fatigue, sleep disturbance, physical functioning, and social participation. Advantages are that these brief measures are completed by patients and can be accessed via computer through a centralized testing system (Cella et al., 2007). There have been numerous reports on PROMIS measures, including more than 100 in 2014 alone. PROMIS has been demonstrated to be a valid and reliable source of information from patients across multiple ethnic and age groups (Jensen et al., 2015) and in a

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variety of health conditions, including rheumatoid arthritis (Orbai & Bingham, 2015), cirrhosis (Bajaj et al., 2011), depression (Irwin et al., 2010), and fatigue (American Psychiatric Association, 2013).

In spite of wide use of PROMIS, we are not aware of PROMIS measures being tested in patients with cognitive impairment, except for a report on the PROMIS depression measure by our own study team (Bavelloni, Piazzi, Raffini, Faenza, & Blalock, 2015). This analysis is from an NIH-funded prospective study to assess the use of PROMIS self-report measurement in a range of domains and across varying cognitive status levels in aging adults. It is expected that shorter batteries than the full set of PROMIS items are likely to be administered in clinical practice settings, and so an objective of this study was to identify relevant subsets of PROMIS items that are potentially sensitive to mild cognitive deficit. We compared a selected set of PROMIS items with a widely used "legacy" measure of functioning, the Instrumental Activities of Daily Living Scale (IADLS; Lawton & Brody, 1969). We expected that scores on PROMIS items deemed relevant to functional status in older people would differ depending on whether individuals had early dementia, MCI, or were cognitively normal elderly.

Method

Overall Design and Study Sample

Data for this analysis were drawn from a prospective cohort study to psychometrically assess PROMIS and Legacy scales in an elderly sample. Study methods from the larger study are described in detail elsewhere (Bavelloni et al., 2015). The University Hospitals Institutional Review Board evaluated our proposal (No. 09-10-13) for participant risk and ethical concerns and confirmed that all study procedures were in accordance with the Helsinki Declaration of 1975 (revised in 1983). This analysis included only cross-sectional baseline assessment. The study sample consisted of 307 individuals of varying cognitive status: normal, MCI, or early dementia as categorized by the Saint Louis University Mental Status Exam (SLUMS), an 11-item screening tool used to evaluate cognitive status in adults. The SLUMS has the advantage of identifying individuals with MCI (Tariq, Tumosa, Chibnall, Perry, & Morley, 2006), accounts for level of education, and has been found to be highly sensitive in both highly and poorly educated individuals (Tariq et al., 2006). For those with high school education, SLUMS cutoff scores for normal, MCI, and dementia were 27-30, 21-26, and 1-20. For those with less than high school education, the respective cutoffs were 25-30, 20-24, and 1-19. We considered a score in the dementia range as "Early dementia," as subjects had not been formally diagnosed.

We used an expert consensus, nominal group process method to select from the extensive PROMIS battery those items that would be most likely to tap functional

impairment due to changes in cognition and group those items into major functional sub-domains. The selected PROMIS functional items and the IADLS were then evaluated with respect to cognitive status, and the PROMIS subscales were modeled as dependent variables in regression analyses. Other covariates such as age, gender, depression severity, and medical comorbidities were included in the regression models (Charlson, Pompei, Ales, & MacKenzie, 1987; Yesavage et al., 1982).

Specific Procedures

In a two-step process, nominal group process was completed to select a PROMIS functional status subset that may be sensitive to cognitive decline. In Step 1, prior to assessment, an expert panel identified 62 items out of 125 in the PROMIS physical function item battery most likely to be affected by cognitive decline. An expert panel of six clinicians and researchers with direct experience in the care or study of elderly persons with cognitive impairment selected the items using the Nominal Group technique (Jones & Hunter, 1995). In Step 2, we further aggregated items into four subcategories. This stage also was done by expert review and discussion among research team members. Four subscales were identified, and associated with the following domains: physical functioning (P), fine motor functioning (F), physical functioning with cognitive component (PC), and fine motor functioning with cognitive component (FC). An item was deemed to have a cognitive component if it involved significant planning, sustained attention, or working memory likely to be affected in a typical person with MCI. See Table 1 for the list of items and the subscale breakdown. The items with exact response choice wording can be found on the original PROMIS forms.

Legacy Scale. The Legacy Scale was the self-rated version of the IADL (IADLS) consisting of nine functional domains including money management, shopping, travel, telephoning, medication use, housekeeping, meal preparation, handyman work, and laundry (Lawton & Brody, 1969). The IADLS typically takes 10 to 15 min to administer.

Comorbidity. Comorbidity was identified with the self-rated Geriatric Depression Scale (GDS; Yesavage et al., 1982) and total number of medical comorbidities with the Charlson comorbidity index (Charlson et al., 1987).

Data Analysis

We estimated Spearman correlations of the IADLS among the four PROMIS functional subscales, as well as with the SLUMS total score. In addition, we correlated SLUMS with each of the functioning subscales and IADLS. Finally, we modeled the PROMIS subscales and IADLS as dependent variables in regression models. Besides cognitive status, other covariate information was

Table 1. PROMIS Functional Status Subset and Subscale.

Category	Items (PROMIS functioning)
Physically activity only (P)	1, 2, 4, 5, 7, 10, 12, 15, 16, 18, 23, 27, 28, 30, 33, 38, 47, 48, 50-59, 62
1. Does your health now limit you in doing vigorous activities, such as running, lifting heavy objects, and participating in strenuous sports? 2. Does your health now limit you in doing heavy work around the house like scrubbing floors, or lifting or moving heavy furniture? 4. How much do physical health problems now limit your usual physical activities (such as walking or climbing stairs)? 5. Are you able to stand for 1 hour? 7. Are you able to exercise for an hour? 10. Are you able to run or jog for 2 miles? 12. Are you able to go up and down stairs at a normal pace? 15. Are you able to exercise hard for a half an hour? 16. Are you able to run at a fast pace for 2 miles? 18. Are you able to carry a laundry basket up a flight of stairs? 23. Are you able to run errands and shop? 27. Does your health now limit you in putting a trash bag outside? 28. Does your health now limit you in hiking a couple of miles on uneven surfaces, including hills? 30. Are you able to carry two bags of groceries 100 yards? 33. Are you able to take a tub bath? 38. Are you able to run a short distance, such as to catch a bus? 47. Does your health now limit you in taking a shower? 48. How much difficulty do you have doing your daily physical activities because of your health? 50. Does your health now limit you in going OUTSIDE the home, for example, to shop or visit a doctor's office? 51. Are you able to run five miles? 52. Does your health now limit you in climbing several flights of stairs? 53. Does your health now limit you in doing 2 hours of physical labor? 54. Are you able to run 100 yards? 55. Are you able to climb up 5 flights of stairs? 56. Are you able to run 10 miles? 57. Does your health now limit you in doing 8 hours of physical labor? 58. Does your health now limit you in walking more than a mile? 59. Are you able to walk at a normal speed? 62. Does your health now limit you in getting in and out of the bathtub?	
Fine Motor Skills only (F)	3, 9, 11, 17, 19, 20, 21, 25, 31, 34, 36, 37, 41, 42, 43, 44, 61
3. Does your health now limit you in bathing or dressing yourself? 9. Are you able to use a hammer to pound a nail? 11. Are you able to cut your food using eating utensils? 17. Are you able to turn a key in a lock? 19. Are you able to write with a pen or a pencil? 20. Are you able to put on a shirt or blouse? 21. Are you able to peel fruit? 25. Are you able to wash and dry your body? 31. Are you able to wash dishes, pots, and utensils by hand while standing at a sink? 34. Are you able to change the bulb in a table lamp? 36. Are you able to cut a piece of paper with scissors? 37. Are you able to hold a plate full of food? 41. Are you able to open a new milk carton? 42. Are you able to change a light bulb overhead? 43. Are you able to turn faucets on and off? 44. Are you able to trim your fingernails? 61. Are you able to wipe yourself after using the toilet?	
Physical and Cognitive (PC)	6, 13, 26, 29, 46, 49
6. Are you able to do chores such as vacuuming or yard work? 13. Are you able to do yard work like raking leaves, weeding, or pushing a lawn mower? 26. Does your health now limit you in doing moderate work around the house like vacuuming, sweeping floors, or carrying groceries? 29. Does your health now limit you in doing strenuous activities such as backpacking, skiing, playing tennis, bicycling, or jogging? 46. Does your health now limit you in doing moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf? 49. Does your health now limit you in participating in active sports such as swimming, tennis, or basketball?	
Fine Motor and Cognitive (FC)	6, 8, 14, 22, 24, 32, 35, 39, 40, 45, 46, 60
6. Are you able to do chores such as vacuuming or yard work? 8. Are you able to dress yourself, including tying shoelaces and doing buttons? 14. Are you able to open a can with a hand can opener? 22. Are you able to tie your shoelaces? 24. Are you able to button your shirt? 32. Are you able to make a bed, including spreading and tucking in bed sheets? 35. Are you able to shave (men) or apply makeup (women)? 39. Are you able to shampoo your hair? 40. Are you able to tie a knot or a bow? 45. Does your health now limit you in taking care of your personal needs (dress, comb hair, toilet, eat, or bathe)? 46. Does your health now limit you in doing moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf? 60. Are you able to use your hands, such as for turning faucets, using kitchen gadgets, or sewing?	

Note. PROMIS = Patient-Reported Outcomes Measurement Information System.

included, such as age, gender, GDS, and Charlson index. For the PROMIS FC scale, presence of arthritis condition was used instead of total number of medical conditions, because this medical condition was viewed as having the most direct impact on these items.

For the PROMIS P and PC subscales, we fit linear multivariate regression models. For the F and FC subscales, we used ordinal regression with ordered categorical outcomes, due to apparent lack of normality in the subscale scores. Predominantly high functioning occurred

across items, so that a strong degree of skewness was present in these score distributions. Ordinal regression allows for ordered categorical outcomes, as opposed to normally distributed scores, while still allowing for regression modeling. The data for F and FC subscales were binned into three distinct groups: normal, impaired, and severely impaired. A fair majority of the patients were placed in the normal group, while some were impaired, and fewer were deemed severely impaired. If an individual only reported mild difficulty in relation to one or a few items, they were still considered normal. As the number of items an individual reported difficulty with increased, or if they reported serious problems in relation to a few items, they were placed in the impaired category. If the individual reported difficulty throughout the items or reported severe difficulty with multiple items, they were deemed severely impaired.

Results

Summary Findings

Table 2 summarizes key demographic and clinical variables of the sample. Higher scores in SLUMS and IADLS reflect higher levels of functioning, while lower scores in GDS indicate lower depression levels. For the PROMIS items and subscales, lower scores indicate higher functioning.

Correlations Between PROMIS and the IADLS

Table 3 shows the moderate Spearman correlations between each of the PROMIS subscale scores and IADLS total scores ($p < .01$). Negative correlations are noted between PROMIS and IADLS because higher scores for IADLS indicate better functioning. Moreover, the correlation between SLUMS total score and IADLS was significant ($\rho = 0.20$, two-sided p value = .001, $n = 271$), but were close to 0 in value with the PROMIS subscales, thus indicating the lack of correlation between SLUMS and PROMIS.

Functional Associations With Cognitive Status

As noted in Table 4, the item-level analysis of PROMIS found only one item (Item 37) with cognitive group difference p value < .01. Overall, there were no differences between the three cognitive groups and even some fluctuation in the expected ordering of the observed group-level mean values.

In regression analyses, depression level and age effects appeared to be significant across the three cognitive groups. GDS and age were associated with significantly poorer functioning across all four PROMIS subscales (either t tests or Wald's tests). When adjusting for covariates, cognitive status generally did not have a significant effect on PROMIS subscale scores, with the exception of the FC subscale. The FC subscale is comprised of items

Table 2. Sample Demographic and Clinical Variables.

Characteristic	M (SD; n)
Age in years	78.3 (5.7; 278)
Conditions count	3.8 (2.3; 277)
SLUMS total score	22.1 (4.8; 278)
GDS total score	5.3 (5.1; 271)
IADLS total score	24.8 (2.3; 271)

	% (n)
Education level	
<high school	11.1 (34)
High school graduate	25.0 (76)
Some college	22.7 (69)
College grad	22.4 (68)
Graduate degree	18.8 (57)
Female	71.1 (216)
Race	
Caucasian	78.3 (238)
African American	19.1 (58)
Other	2.6 (8)
Hispanic	1.0 (3)
Cognitive status	
Normal	21.2 (59)
MCI	46.1 (128)
Early dementia	32.7 (91)

Note. SLUMS = Saint Louis University Mental Status Exam; GDS = Geriatric Depression Scale; IADLS = Instrumental Activities of Daily Living Scale; MCI = mild cognitive impairment.

deemed to have a cognitive component and requiring fine motor skills. On the FC subscale, the MCI and early dementia subgroups were significantly different, with the MCI group having higher FC functioning ($p = 0.002$). Early dementia and normal groups were not significantly different, however, and surprisingly had similar estimated effects. Given the possibility that the MCI and normal groups may not be clearly differentiated by the SLUMS criteria, we then combined normal and MCI groups and compared the combined group with those with early dementia. The same respective regression models for FC subscale and IADLS were then fit. For the FC subscale, the two-level cognitive status variable was not significant ($p = .10$).

As a comparison, we conducted similar regression analyses with the IADLS. In contrast with the PROMIS FC subscale, those with early dementia had significantly lower levels of functioning according to IADLS than MCI ($p = .002$) and nearly significant lower levels than with normal ($p = .099$). Combining normal/MCI versus early dementia within an IADLS regression, the p value was .003.

Discussion

This cross-sectional evaluation of well-characterized elderly individuals with varying cognitive status compared a widely used legacy measure of functioning (the IADL)

Table 3. Correlations Between PROMIS Physical Functioning Subscales and IADLS.

	Spearman's ρ correlations				
	IADLS	Scale P	Scale F	Scale PC	Scale FC
IADLS					
Correlation coefficient	1.000	−.539**	−.609**	−.566**	−.505**
Significance (2-tailed)		.000	.000	.000	.000
n	271	240	266	254	266
Scale P					
Correlation coefficient	−.539**	1.000	.707**	.926**	.662**
Significance (2-tailed)	.000		.000	.000	.000
n	240	246	241	242	243
Scale F					
Correlation coefficient	−.609**	.707**	1.000	.714**	.676**
Significance (2-tailed)	.000	.000		.000	.000
n	266	241	271	254	266
Scale PC					
Correlation coefficient	−.566**	.926**	.714**	1.000	.641**
Significance (2-tailed)	.000	.000	.000		.000
n	254	242	254	261	258
Scale FC					
Correlation coefficient	−.505**	.662**	.676**	.641**	1.000
Significance (2-tailed)	.000	.000	.000	.000	
n	266	243	266	258	272

Note. PROMIS = Patient-Reported Outcomes Measurement Information System; IADLS = Instrumental Activities of Daily Living Scale; P = physical functioning; F = fine motor functioning; PC = physical functioning with cognitive component; FC = fine motor functioning with cognitive component.
**Correlation is significant at the .01 level (two-tailed).

with an expert-selected subset of PROMIS functional measures and evaluated each instrument's ability to differentiate groups with normal cognition, MCI, and early dementia. While a selected PROMIS physical functioning battery chosen by expert consensus correlated moderately well with the IADLS and the PROMIS functional items were able to distinguish those with early dementia versus a normal/MCI group, the PROMIS items did not differentiate MCI from individuals with normal cognitive status.

It is known that self-report measurements become less reliable as a person becomes more cognitively impaired (Edmonds, Delano-Wood, Galasko, Salmon, Bondi, & AD Neuroimaging Initiative, 2014). Anosognosia, the inability to recognize a clinically evident disorder, is prevalent in those with AD (Mak, Chin, Ng, Yeo, & Hameed, 2015). As recently pointed out by Rodakowski and colleagues (2014), there are no established standards for measuring preclinical disability in performance of activities of daily living in individuals with MCI or mild neurocognitive disorder. In the analysis presented here, all the PROMIS functioning subscales were moderately correlated with IADLS, suggesting that the PROMIS functioning scales are measuring similar constructs. If one compares the content of the eight IADLS items and the 62 PROMIS items, some similarities are apparent. Overlapping domains include food preparation, and housekeeping. Areas with less overlap include using the telephone, doing laundry, transportation logistics, taking mediation, and handling finances.

With respect to the relationship between the legacy IADLS and cognitive status, we found a natural ordering of functional levels by cognitive status, with the dementia group having significantly worse functioning than MCI. The IADLS instrument has been related to cognitive status in elderly individuals in other research (Peres et al., 2006). Some studies suggest that the IADLS can be used as screen for dementia, but there is also a need for further validation to draw definite conclusions, as results have been mixed (Castilla-Rilo et al., 2007; Iavarone et al., 2007; Jefferson et al., 2008; Juva et al., 1997; Mariani et al., 2008; Pedrosa et al., 2010). Our own findings support the assertion that IADL might help discriminate dementia status through assessment of functioning. The significant correlation with SLUMS total score, in contrast to the lack of significant correlation between SLUMS and the PROMIS subscales, also gives indication of the relative sensitivity of IADLS to cognitive status.

In contrast with our original expectation, we did not find differences for PROMIS functioning at the item level across cognitive groupings. Three of the four subscales within the PROMIS battery that assess different major functional domains were not differentiated by cognitive status. The exception was the subscale that focused on fine motor activity with a cognitive component. Fine motor functioning that involves both fine motor skills and focused attention or planning may be an area where self-report reflects differences in cognitive status. This could

Table 4. PROMIS Physical Functioning Item Comparisons Between Cognitive Groups.

| Scale | Question No. | M (SD), median (minimum, maximum), n | | | p value |
		Normal	MCI	Dementia	
Physical Activity Only	15	2.97 (1.50) 3 (1, 5) 59	2.92 (1.45) 3 (1, 5) 126	2.82 (1.56) 2 (1, 5) 89	.015
	16	4.65 (0.90) 5 (1, 5) 57	4.45 (0.96) 5 (1, 5) 125	4.16 (1.24) 5 (1, 5) 90	.109
	23	1.32 (0.75) 1 (1, 5) 59	1.23 (0.65) 1 (1, 5) 128	1.56 (1.18) 1 (1, 5) 91	.117
	33	2.39 (1.73) 1 (1, 5) 59	1.77 (1.40) 1 (1, 5) 124	1.79 (1.43) 1 (1, 5) 89	.030
	50	1.36 (0.78) 1 (1, 4) 59	1.16 (0.42) 1 (1, 3) 128	1.48 (0.95) 1 (1, 5) 91	.078
	62	2.47 (1.56) 2 (1, 5) 59	1.94 (1.26) 1 (1, 5) 124	1.83 (1.13) 1 (1, 5) 90	.030
Fine Motor Skills Only	9	1.42 (0.93) 1 (1, 5) 59	1.26 (0.69) 1 (1, 5) 127	1.58 (1.17) 1 (1, 5) 91	.108
	17	1.14 (0.43) 1 (1, 3) 59	1.05 (0.29) 1 (1, 3) 128	1.13 (0.40) 1 (1, 3) 91	.018
	20	1.08 (0.34) 1 (1, 3) 59	1.05 (0.25) 1 (1, 3) 128	1.12 (0.33) 1 (1, 2) 91	.075
	21	1.14 (0.57) 1 (1, 5) 59	1.09 (0.33) 1 (1, 3) 128	1.23 (0.62) 1 (1, 4) 91	.108
	34	1.03 (0.18) 1 (1, 2) 59	1.06 (0.30) 1 (1, 3) 127	1.18 (0.61) 1 (1, 5) 89	.150
	37	1.20 (0.52) 1 (1, 3) 59	1.06 (0.29) 1 (1, 3) 127	1.20 (0.50) 1 (1, 4) 91	.005
	44	1.20 (0.69) 1 (1, 5) 59	1.09 (0.33) 1 (1, 3) 127	1.26 (0.76) 1 (1, 5) 91	.056
Physical and Cognitive	13	2.61 (1.65) 2 (1, 5) 59	2.67 (1.63) 2 (1, 5) 124	2.85 (1.64) 3 (1, 5) 85	.135
	29	4.28 (1.15) 5 (1, 5) 57	3.97 (1.26) 4 (1, 5) 125	3.94 (1.38) 5 (1, 5) 87	.113
	49	3.45 (1.54) 4 (1, 5) 55	3.47 (1.52) 4 (1, 5) 120	3.41 (1.66) 4 (1, 5) 85	.027
Fine Motor Skills and Cognitive	35	1.05 (0.22) 1 (1, 2) 58	(0.09) 1 (1, 2) 128	1.11 (0.38) 1 (1, 3) 90	.014
	40	1.17 (0.53) 1 (1, 4) 59	1.15 (0.49) 1 (1, 4) 128	1.17 (0.40) 1 (1, 3) 90	.135

Note. PROMIS = Patient-Reported Outcomes Measurement Information System; MCI = mild cognitive impairment.

have practical implications, by identifying a functioning domain where perceived impact may be different for early dementia subjects relative to non-dementia.

Perhaps another reason for the general lack of significant cognitive effects on the PROMIS functional subscales is the generality of the functioning being assessed. Rodakowski and colleagues (2014) used the Performance Assessment of Self-Care Skills (PASS; Rogers & Holm, 1989), an observation-based assessment that evaluates basic and instrumental ADL performance through standardized, criterion-referenced observations in an individual's home. The study by Rodakowski et al. (2014) found that two tasks (shopping and checkbook balancing) were the most discriminating (area under curve 0.80, $p < .001$) in being able to differentiate cognitively normal elderly versus those with MCI. Perhaps the PROMIS functional assessment might have been more likely to identify differing cognitive ability if these domains were assessed more specifically.

It must be noted that in our sample, most participants had at most only mild depression. In this analysis, both the PROMIS and the IADLS appeared sensitive even to mild levels of depression. Similar findings have been published on this phenomenon regarding the IADLS (Channon & Green, 1999). Others have also noted the negative effects of depression on functioning among older adults (Austin, Mitchell, & Goodwin, 2001; Fitz & Teri, 1994).

Our study had a number of limitations including the sample size, limited numbers of minorities, and the fact that most individuals were well educated. It has been suggested that individuals with greater education have more cognitive reserve and may have functional compensation in spite of neurocognitive decline (Amieva et al., 2014). Also, our subset of PROMIS functional items was not tailored to assess cognitive-related decline, but rather more focused on physical functioning. Finally, it should be pointed out that the SLUMS-based cognitive groupings were not validated by a more extensive clinical review. Hence, there may be some imprecision in how the cognitive groups were identified.

Conclusion

In conclusion, in this well-characterized sample of older people, selected PROMIS physical functioning batteries correlated with the IADLS, a widely used legacy measured. However, overall the PROMIS items and corresponding proposed subscales were not sensitive to cognitive groupings across the spectrum from early AD to normal status. Our findings reaffirmed the utility of the self-report IADLS in identifying functional differences of cognitive grouping, particularly for early dementia. Self-reported measures have the advantage of being low-cost, low-burden, and accessible via technology-assisted means. Additional studies using self-rated measures of functioning in older people with minor neurocognitive disorders may thus help in developing care approaches that are pre-emptive and practical, as well as being useful in helping to detect cognitive change itself. From our findings, such self-reported measures of functioning should assess activities with more direct cognitive involvement than the physically-oriented PROMIS items analyzed here.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Amieva, H., Mokri, H., Le Goff, M., Meillon, C., Jacqmin-Gadda, H., Foubert-Samier, A., . . . Dartigues, J. F. (2014). Compensatory mechanisms in higher-educated subjects with Alzheimer's disease: A study of 20 years of cognitive decline. *Brain*, *137* (Pt. 4), 1167-1175. doi:10.1093/brain/awu035

Austin, M. P., Mitchell, P., & Goodwin, G. M. (2001). Cognitive deficits in depression: Possible implications for functional neuropathology. *British Journal of Psychiatry*, *178*, 200-206. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11230029

Auyeung, T. W., Kwok, T., Lee, J., Leung, P. C., Leung, J., & Woo, J. (2008). Functional decline in cognitive impairment—The relationship between physical and cognitive function. *Neuroepidemiology*, *31*, 167-173. doi:10.1159/000154929.

Auyeung, T. W., Lee, J. S., Kwok, T., & Woo, J. (2011). Physicalfrailty predicts future cognitive decline - a four-year prospective study in 2737 cognitively normal older adults. *The journal of nutrition, health and aging*, *15*, 690-694.

Bajaj, J. S., Thacker, L. R., Wade, J. B., Sanyal, A. J., Heuman, D. M., Sterling, R. K., . . . Revicki, D. A. (2011). PROMIS

computerised adaptive tests are dynamic instruments to measure health-related quality of life in patients with cirrhosis. *Alimentary Pharmacology and Therapeutics*, *34*, 1123-1132. doi:10.1111/j.1365-2036.2011.04842.x

Bavelloni, A., Piazzi, M., Raffini, M., Faenza, I., & Blalock, W. L. (2015). Prohibitin 2: At a communications crossroads. *IUBMB Life*, *67*, 239-254. doi:10.1002/iub.1366

Bucks, R. S., Ashworth, D. L., Wilcock, G. K., & Siegfried, K. (1996). Assessment of activities of daily living in dementia: Development of the Bristol Activities of Daily Living Scale. *Age and Ageing*, 25, 113-120. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/8670538

Castilla-Rilo, J., Lopez-Arrieta, J., Bermejo-Pareja, F., Ruiz, M., Sanchez-Sanchez, F., & Trincado, R. (2007). Instrumental activities of daily living in the screening of dementia in population studies: A systematic review and meta-analysis. *International Journal of Geriatric Psychiatry*, *22*, 829-836. doi:10.1002/gps.1747

Cella, D., Yount, S., Rothrock, N., Gershon, R., Cook, K., Reeve, B., . . . Rose, M. (2007). The Patient-Reported Outcomes Measurement Information System (PROMIS): Progress of an NIH Roadmap Cooperative Group During Its First Two Years. *Medical Care, 45*, S3-S11.

Channon, S., & Green, P. S. (1999). Executive function in depression: The role of performance strategies in aiding depressed and non-depressed participants. *Journal of Neurology, Neurosurgery & Psychiatry*, *66*, 162-171. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10071094

Charlson, M. E., Pompei, P., Ales, K. L., & MacKenzie, C. R. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases*, *4*, 373-383. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/3558716

Edmonds, E. C., Delano-Wood, L., Galasko, D. R., Salmon, D. P., & Bondi, M. W., & Alzheimer's Disease Neuroimaging Initiative. (2014). Subjective cognitive complaints contribute to misdiagnosis of mild cognitive impairment. *Journal of the International Neuropsychological Society*, *20*, 836-847. doi:10.1017/S135561771400068X

Fitz, A. G., & Teri, L. (1994). Depression, cognition, and functional ability in patients with Alzheimer's disease. *Journal of the American Geriatrics Society*, *42*, 186-191. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/8126334

Iavarone, A., Milan, G., Vargas, G., Lamenza, F., De Falco, C., Gallotta, G., & Postiglione, A. (2007). Role of functional performance in diagnosis of dementia in elderly people with low educational level living in Southern Italy. *Aging Clinical and Experimental Research*, *19*, 104-109. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/17446720

Irwin, D. E., Stucky, B., Langer, M. M., Thissen, D., Dewitt, E. M., Lai, J. S., . . . DeWalt, D. A. (2010). An item response analysis of the pediatric PROMIS anxiety and depressive symptoms scales. *Quality of Life Research*, *19*, 595-607. doi:10.1007/s11136-010-9619-3

Jefferson, A. L., Byerly, L. K., Vanderhill, S., Lambe, S., Wong, S., Ozonoff, A., & Karlawish, J. H. (2008). Characterization of activities of daily living in individuals with mild cognitive impairment. *American Journal of Geriatric Psychiatry*, *16*, 375-383. doi:10.1097/JGP.0b013e318162f197

Jensen, R. E., Potosky, A. L., Reeve, B. B., Hahn, E., Cella, D., Fries, J., . . . Moinpour, C. M. (2015). Validation of the PROMIS physical function measures in a diverse US population-based cohort of cancer patients. *Quality of Life Research*, *24*, 2333-2344. doi:10.1007/s11136-015-0992-9

Jones, J., & Hunter, D. (1995). Consensus methods for medical and health services research. *British Medical Journal*, *311*, 376-380. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/7640549

Juva, K., Makela, M., Erkinjuntti, T., Sulkava, R., Ylikoski, R., Valvanne, J., & Tilvis, R. (1997). Functional assessment scales in detecting dementia. *Age and Ageing*, *26*, 393-400. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9351484

Mak, E., Chin, R., Ng, L. T., Yeo, D., & Hameed, S. (2015). Clinical associations of anosognosia in mild cognitive impairment and Alzheimer's disease. *International Journal of Geriatric Psychiatry*, *30*, 1207-1214. doi:10.1002/gps.4275

Mariani, E., Monastero, R., Ercolani, S., Rinaldi, P., Mangialasche, F., Costanzi, E., . . . ReGAI Study Group (2008). Influence of comorbidity and cognitive status on instrumental activities of daily living in amnestic mild cognitive impairment: Results from the ReGAl project. *International Journal of Geriatric Psychiatry*, *23*, 523-530. doi:10.1002/gps.1932

Orbai, A. M., & Bingham, C. O., III. (2015). Patient reported outcomes in rheumatoid arthritis clinical trials. *Current Rheumatology Reports*, *17*(4), Article 28. doi:10.1007/s11926-015-0501-8

Pedrosa, H., De Sa, A., Guerreiro, M., Maroco, J., Simoes, M. R., Galasko, D., & de Mendonca, A. (2010). Functional evaluation distinguishes MCI patients from healthy elderly people—The ADCS/MCI/ADL scale. *The Journal of Nutrition Health & Aging*, *14*, 703-709. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/20922349

Peres, K., Chrysostome, V., Fabrigoule, C., Orgogozo, J. M., Dartigues, J. F., & Barberger-Gateau, P. (2006). Restriction in complex activities of daily living in MCI: Impact on outcome. *Neurology*, *67*, 461-466. doi:10.1212/01.wnl.0000228228.70065.f1

Lawton, M. P., & Brody, E. M. (1969). Assessment of older people: Self-maintaining and instrumental activities of daily living. *The Gerontologist*, *9*, 179-186. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/5349366

Rodakowski, J., Skidmore, E. R., Reynolds, C. F., III., Dew, M. A., Butters, M. A., Holm, M. B., . . . Rogers, J. C. (2014). Can performance on daily activities discriminate between older adults with normal cognitive function and those with mild cognitive impairment? *Journal of the American Geriatrics Society*, *62*, 1347-1352. doi:10.1111/jgs.12878

Rogers, J. C., & Holm, M. B. (1989). *Performance Assessment of Self-Care Skills* (Version 3.1). Pittsburgh, PA: Rogers & Holm.

Sajatovic, M., & Ramirez, L. (2015). *Rating scales in mental health* (3rd ed.). Baltimore, MD: Johns Hopkins University Press.

Tariq, S. H., Tumosa, N., Chibnall, J. T., Perry, M. H., III, & Morley, J. E. (2006). Comparison of the Saint Louis University Mental Status examination and the mini-mental state examination for detecting dementia and mild neurocognitive disorder—A pilot study. *American Journal of Geriatric Psychiatry*, *14*, 900-910. doi:10.1097/01.JGP.0000221510.33817.86

Yesavage, J. A., Brink, T. L., Rose, T. L., Lum, O., Huang, V., Adey, M., & Leirer, V. O. (1982). Development and validation of a geriatric depression screening scale: A preliminary report. *Journal of Psychiatric Research*, *17*, 37-49. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/7183759