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EPIDEMIOLOGY

Differences in the measurement of cognition for the assessment of dementia across geographic contexts: Recommendations for cross-national research

Emma Nichols[1] | Jennifer A Deal[1] | Kenneth M Langa[2] | Derek Ng[1] | Alden L Gross[1]

[1]Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

[2]University of Michigan, Ann Arbor, MI, USA

Correspondence
Emma Nichols, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA.
Email: enicho30@jh.edu

Abstract

Background: Although 71% of individuals with dementia are projected to live and low- and middle-income countries by 2050, most dementia research to-date has been conducted in high-income countries. Cross-national studies are needed to understand how the causes and consequences of dementia may differ by country. However, factors such as urbanicity, language of administration or race/ethnicity, which vary across countries, affect the measurement of cognition. A better understanding of which cognitive items perform well across countries or within specific countries will allow researchers to optimize dementia measurement in future cross-national and international studies.

Method: We used data from the Harmonized Cognitive Assessment Protocol surveys in the US, Mexico, India, England, and South Africa (combined N = 11,364). To define cognitive impairment consistently across countries, we compared participants' cognitive performance with robust neuropsychological norms within each country. For each HCAP country, we assessed item performance by estimating associations between each cognitive item and cognitive impairment using logistic regression models, controlling for age and gender. We avoided circularity in the analysis by using an iterative quasi-leave-one-out approach. We compared patterns of associations across countries using median odds ratios, and visually, using heatmaps.

Result: The associations between cognitive items and cognitive impairment were stronger in the US (Median Odds Ratio [OR] = 0.17) and England (Median OR = 0.19), in comparison to South Africa (Median OR = 0.23), India (Median OR = 0.29), and Mexico (Median OR = 0.28). Memory items, notably delayed recall tasks, had the most consistent associations of the largest magnitudes across countries. In comparison, there was variability in performance between settings for many language items (e.g. naming a hammer). Items requiring numeracy, including the Trail-making test, did not perform well in countries with low educational attainment.

Conclusion: The performance of cognitive items for the classification of cognitive impairment was not consistent across countries. Although items performing well in a

single country could be used to improve measurement precision in specific settings, transporting items between countries without prior validation warrants caution. However, we did identify items that performed well across a range of countries (i.e. delayed recall, animal naming); these items may be of particular utility in future cross-national research.

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Table 1. Cognitive items administered in each of the US, England, South Africa, India, and Mexico Harmonized Cognitive Assessment Protocol (HCAP) samples

Cognitive Item	Domain	United States	England	South Africa	India	Mexico
Orientation						
Day Of The Week	Orientation	X	X	X	X	X
Day Of Month	Orientation	X	X		X	X
Month	Orientation	X	X		X	X
What Season Is It	Orientation	X	X	X	X	
Year	Orientation	X	X		X	X
What Time Is It	Orientation					X
Where Are We	Orientation					X
What City Are We In	Orientation	X	X	X	X	
What County Are We In	Orientation	X	X			
What Province Are We In	Orientation	X		X	X	X
What Country Are We In	Orientation		X			X
What Floor Are We On	Orientation	X			X	
What Street Are We On	Orientation		X			
What Building Are We In	Orientation		X		X	
What Address Are We At	Orientation	X			X	
Memory						
CERAD Immediate Sum Of 3 Trials	Memory	X	X	X	X	X
CERAD Word List Delay	Memory	X	X	X	X	X
CERAD Recognition	Memory	X	X	X	X	X
Logical Memory Immediate	Memory	X	X	X	X	X
Logical Memory Delay	Memory	X	X	X	X	X
Logical Memory Recognition	Memory	X	X	X	X	
Brave Man Delay	Memory	X	X		X	X
Brave Man Immediate	Memory	X	X		X	X
CERAD Constructional Praxis Delay	Memory	X	X	X	X	X
MMSE 3-Word Immediate	Memory	X	X		X	X
MMSE 3-Word Delay	Memory	X	X		X	X
Executive Functioning						
Symbol/Letter Cancellation	Executive	X	X	X	X	X
Symbol Digit Modalities Test	Executive	X	X	X		X
Serial Threes	Executive					X
Serial Sevens	Executive		X		X	X
MMSE Spelling Backwards	Executive	X				
Backward Day Naming	Executive			X	X	
Backward Counting	Executive	X	X	X		
Backward Counting From 20	Executive					X
Hrs Number Series	Executive	X	X			
Digit Span Forward	Executive				X	
Digit Span Backward	Executive				X	
Trails A Time	Executive	X	X	X		
Trails B Time	Executive	X	X	X		
Ravens Progressive Matrices	Executive	X	X	X	X	
Go-No-Go	Executive				X	X
Token Test	Executive				X	
Similarities	Executive				X	X
Problem Solving	Executive				X	
Language						
Animal Fluency	Language	X	X	X	X	X
TICS Name Cactus	Language	X	X			
TICS Name Coconut	Language				X	
TICS Name Scissors	Language	X	X	X	X	X
TICS Name Prime Minister	Language	X	X	X	X	
TICS Name Deputy President	Language			X		
1066 Name Elbow	Language	X	X	X	X	X
1066 Do With A Hammer	Language	X	X	X	X	X
1066 Following Instructions	Language	X	X	X	X	X
1066 Where Is The Local Market?	Language	X	X	X	X	X
Define Bridge	Language					X
MMSE Naming (Watch)	Language	X	X		X	
MMSE Naming (Pencil)	Language	X	X		X	X
MMSE Naming (Shoe)	Language					X
MMSE Write/Say A Sentence	Language	X	X		X	X
MMSE Read And Follow Command	Language	X	X		X	X
MMSE Repetition Of Phrase	Language	X	X		X	X
MMSE Following Instructions 3 Step (Paper)	Language	X	X		X	X
Visuospatial Functioning						
CERAD Constructional Praxis (Copy 4 Figures)	Visuospatial	X	X	X	X	X
MMSE Polygons (Copy 1 Figure)	Visuospatial	X			X	X
Clock Drawing	Visuospatial				X	

*CERAD = Consortium to Establish a Registry for Alzheimer's Disease, MMSE = Mini-Mental State Examination, HRS = Health and Retirement Study, TICS = Telephone Interview for Cognitive Status

Table 2. Characteristics of the US, England, South Africa, India, and Mexico Harmonized Cognitive Assessment Protocol (HCAP) samples

	United States	England	South Africa	India	Mexico
Number of Participants (N)	3329	1255	560	4095	2011
Years of Data Collection	2016-2017	2018	2016-2017	2017-2019	2015
Age (Mean [SD])	75.8 (7.5)	75.9 (7.1)	69.2 (11.1)	69.0 (7.6)	68.1 (9.0)
Percent Female (N)	60.5% (2014)	54.9% (689)	56.2% (315)	53.9% (2207)	59.3% (1193)
No education - primary education (% [N])	18.2% (607)	33.1% (416)	92.7% (519)	75.3% (3085)	72.9% (1467)
Some secondary - completed secondary education (% [N])	53.0% (1766)	53.9% (676)	5.4% (30)	20.6% (845)	20.8% (419)
Post-secondary education (% [N])	28.7% (956)	13.0% (163)	2.0% (11)	4.0% (165)	6.2% (125)
White race (% [N])	78.9% (2627)				
Black race (% [N])	16.0% (533)				
Other race (% [N])	5.1% (169)				
Percent Hispanic (N)	10.8% (360)				
Percent Rural (N)				62.0% (2539)	28.3% (569)
Percent Illiterate (N)			58.6% (328)	56.6% (2319)	

*SD = standard deviation

Figure 1. Associations between each cognitive test item and cognitive impairment by domain for each Harmonized Cognitive Assessment Protocol Study (HCAP) from logistic regression models, controlling for age and gender. Odds ratios are displayed for significant associations. Color scale shows differences in associations on the log odds scale.

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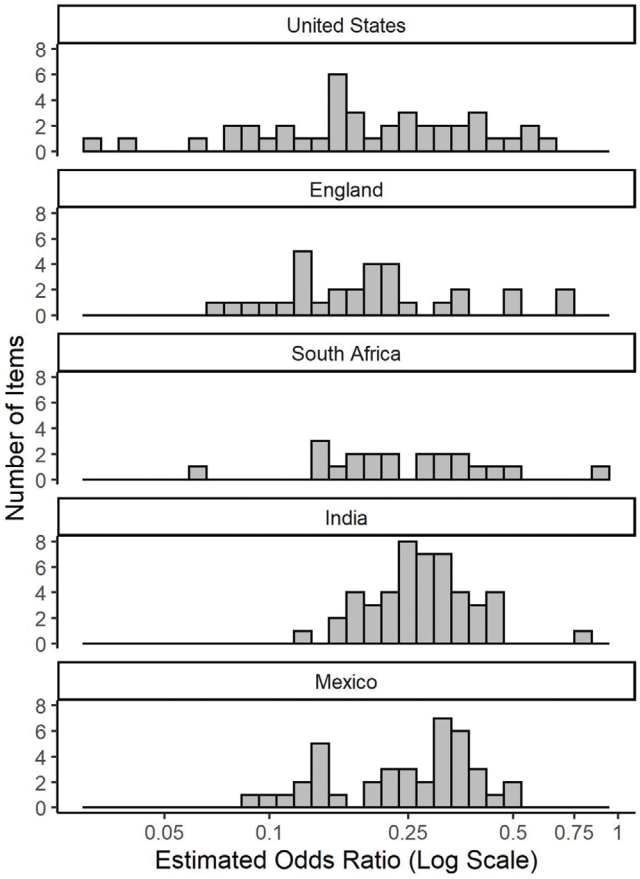

Figure 2. Distributions of estimated odds ratios describing the association between items on cognition and cognitive impairment across Harmonized Cognitive Assessment Protocol Study (HCAP) from logistic regression models, controlling for age and gender.