MCI Classification in the Longitudinal Aging Study in India Diagnostic Assessment of Dementia (LASI-DAD)

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Background

- There is strong interest in comparing prevalence of cognitive impairment across countries around the world
- HRS leads a family of international partner studies, however deep cognitive phenotyping is lacking
- Harmonized Cognitive Assessment Protocol (HCAP) projects are designed to facilitate collaborative efforts aimed at cross-national comparisons
- To date, HCAP surveys have been completed in India, Mexico, England, China, EU, and S. Africa
- LASI-DAD (N=4,096) is a substudy of the Indian LASI study (N~70,000)
Outline

• Establish **algorithmic criteria** for MCI based on available information in LASI-DAD
  • Apply an approach based on comprehensive neuropsychological criteria using robust norms developed for MexCog

• We have studied 30 adaptations of Petersen’s original and revised criteria (Petersen, 2004) to LASI-DAD
  • Not the focus of this talk
Adjudication did not work well for MCI

• Thus, we are interested in algorithmic approaches
• Clinicians rated LASI-DAD participants on a CDR using an online website
  • Dementia assignment corresponds with in-person clinical assessment, kappa=0.76 (Lee et al., in review)

<table>
<thead>
<tr>
<th>Final CDR rating</th>
<th>Freq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>748</td>
</tr>
<tr>
<td>.5</td>
<td>1,537</td>
</tr>
<tr>
<td>1</td>
<td>161</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

1537/2476 cases (62%) with CDR=0.5
Believable? Probably not.
Challenges to Online Diagnosis

Insufficient information, e.g.,
• Nature and severity of physical disability which might explain some of the functional deficits that might otherwise be cognitive in origin;
• Underlying medical conditions and how they may affect cognition

Inconsistent information, e.g.,
• Participant performs perfectly on brief memory test but reports subjective difficulties
• Participant and informant provide contradictory information
• Informant provides inconsistent information on different scales

Illiterate participants
When memory is intact but other domains are impaired
Different language than interviewer
High scores on depression scale
### Information available in LASI-DAD

#### Figure 2. LASI-DAD Protocol

**Cognitive Tests**

| 1. Hindi Mental State Exam
| 2. HRS TICS*
| 3. Word learning: immediate recall*
| 4. Digital span forward and backward
| 5. Symbol cancellation
| 6. Word list delayed recall*
| 7. Word list recognition
| 8. Logical memory: immediate recall
| 9. Constructional praxis: copy*
| 10. Logical memory delayed recall
| 11. Logical memory recognition
| 12. Retrieval fluency*
| 13. Constructional praxis recall
| 14. Backward count (Phase 1 only)
| 15. Hand sequencing (Phase 2|3 only)
| 16. Token test (Phase 2|3 only)
| 17. Judgment (Phase 2|3 only)
| 18. Serial 7s*
| 19. CSI-D*
| 20. Raven’s matrices
| 21. Go-No Go

**Informant Interview**

| 1. Informant’s relationship with R
| 2. Jorm’s IQCODE*
| 3. Blessed Dementia Rating Scale
| 4. CSID Cognitive Activities Questionnaire
| 5. 10/66 Informant Questionnaire

BLUE font indicates a modification from the HCAP protocol

* Indicates tests also administered in the main LASI
Factor structure of cognition in LASI-DAD

Measurement and Structure of Cognition in the Longitudinal Aging Study in India–Diagnostic Assessment of Dementia

Alden Gross, PhD, MHS; Pranali Y. Khobragade, MD; Erik Meijer, PhD; and Judith A. Saxon, PhD

CONCLUSION: We demonstrated configural factorial invariance of a cognitive battery in the Indian LASI-DAD using CHC theory. Broad domain factors may be used in future research to rank individuals with respect to cognitive performance and classify cognitive impairment. J Am Geriatr Soc 00:1-9, 2020.

Objectives: To test whether a relatively complex model of human cognitive abilities based on Cattell-Horn-Carroll (CHC) theory, developed mainly in English-speaking samples, adequately describes correlations among tests in the Longitudinal Aging Study in India–Diagnostic Assessment of Dementia (LASI-DAD), and to develop accurate measures of cognition for older individuals in India.

Keywords: Harmonized Cognitive Assessment Protocol;
How to operationalize MCI criteria in LASI-DAD?

Adaptation of Petersen’s original and revised criteria (Petersen, 2004)
- We have studied 30 adaptations to LASI-DAD

Comprehensive neuropsychological criteria using robust norms (Arce et al., in review)
- We followed procedures set forth by MexCog researchers
How to operationalize MCI criteria in LASI-DAD?

• Comprehensive neuropsychological criteria using robust norms
  • Identified a robust normative group (N=403, 10% of sample)
    • No cognitive impairment, no history of stroke, low depressive symptom count, no informant-reported functional decline or impairment based on CSID, no evidence of functional decline based on 10/66 items
  • In the robust subsample, regress domain-specific cognitive factors on age, sex, education
  • Estimated residuals
  • MCI defined as 1.5 SD below the mean of any domain-specific residual
Identifying a normative group: Work in progress

- No history of dementia or low cognition
  - Leverage data from the parent LASI study
- No history of stroke
  - Easy to implement
- Low depressive symptom count
  - Difficult! Translation problem for some items?
- No informant/self-reported functional decline
  - Only asked in phases 2,3, not phase 1
- No impairment based on CSID
  - Complicated
- No evidence of functional decline based on 10/66 items
  - Easy to implement (problems handling money; stopped hobbies)
Next step: regress domain-specific cognitive factors

We’ll just use factor scores directly from that published hierarchical CFA!

Right?

Gross et al., JAGS, 2020
Prevalence of MCI, based on factors from hierarchical CFA

- Domain-specific prevalences of MCI are similar, but overall prevalence of any MCI is much lower in LASI-DAD
  - How?
    - The factor scores are all correlated at r>0.9
- Let’s look back at the hierarchical CFA and its assumptions

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<th>LASI-DAD</th>
<th>MexCog</th>
</tr>
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<tbody>
<tr>
<td>Any</td>
<td>12.5</td>
<td>34.4</td>
</tr>
<tr>
<td>orientation</td>
<td>6.3</td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td>5.7</td>
<td>5.9</td>
</tr>
<tr>
<td>Language</td>
<td>6.1</td>
<td>4.3</td>
</tr>
<tr>
<td>Visuospatial</td>
<td>6.5</td>
<td>7.7</td>
</tr>
<tr>
<td>Executive</td>
<td>5.8</td>
<td>4.2</td>
</tr>
<tr>
<td>Multiple domain, not memory</td>
<td>6.8</td>
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Confirmatory factor analysis

- This is a single common factor model for a specific domain
- Latent variables in circles, represent common covariation among the observed indicators, in boxes
Confirmatory factor analysis

- A single common factor model could be estimated for a particular domain, or for general cognition
- The latter does not give us domain scores
We can augment this second model with narrow domains. Such a hierarchical model is nested within the common factor model. However, latent variables for narrow domains from the hierarchical common factor model are not the same as those at far left - unless we force the residual variance of the narrow factors to be 0 and for the loadings on the broad general cognition factor to be 1 (perfect relationship).
Confirmatory factor analysis

• That is to say, if we assume that
  • (1) the loadings of the broad “General cognition” factor in each narrow factor was 1,
  • (2) the residual variance of the narrow factors was 0,
  • (3) the loadings and thresholds of indicators are the same as those in domain-specific single common factor models
• Then the single common factor model and the hierarchical common factor model would be identical.
• We typically would not impose such restrictions; to go to such lengths would return us to domain-specific single common factor models.
• So why don’t we just use the single factor model
# Prevalence of MCI

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<th>LASI-DAD - single domain factors</th>
<th>MexCog</th>
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Conclusions

Main conclusions
• Hierarchical factor analysis is useful for describing the factor structure of a test battery
  • Conforms to CHC theory of human cognitive abilities
• BUT, for empirical estimation of factor scores, use domain-specific single domain models

Other
• Much still needs to be done in developing cross-nationally comparable algorithms to compare MCI
Conclusions

• Ultimately, any approach will have advantages and disadvantages
• Our overall strategy will be to evaluate a variety of methods using data for criterion validation from future study waves
Acknowledgements

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  • LASI-DAD team

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