HEALTHY BIRTH, GROWTH & DEVELOPMENT

A Case Study in Comparing Cognitive Development Across Populations

POSTER #I-12

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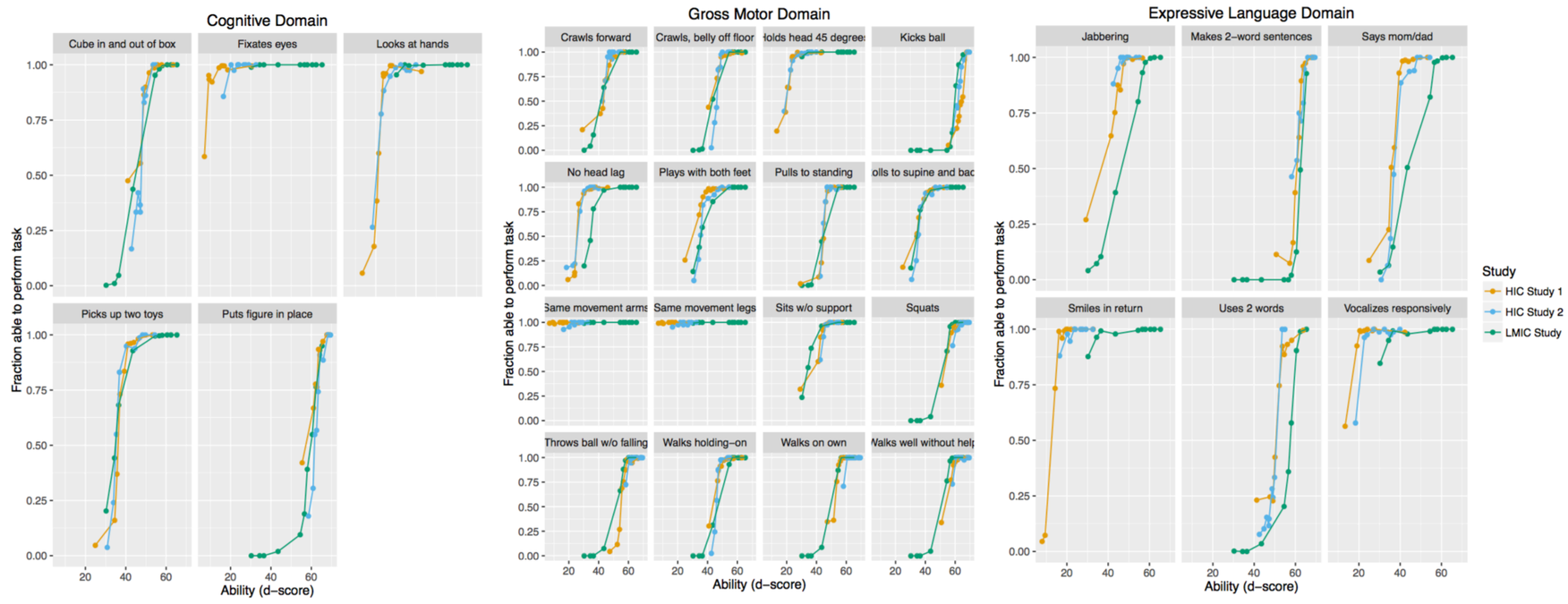
Objectives

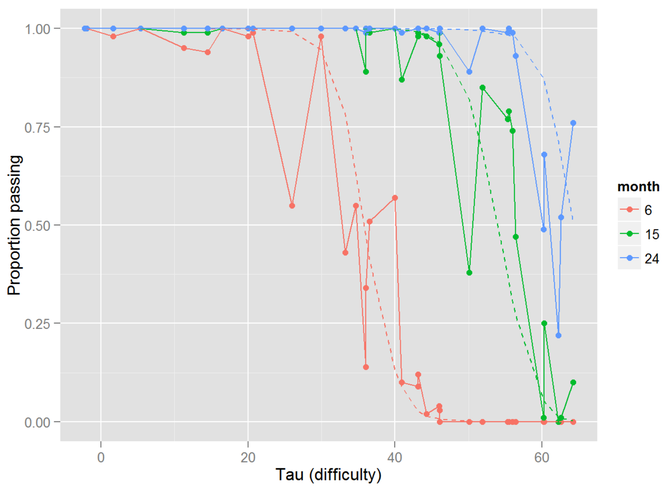
- **Assessment of neurocognitive development during the first 1000 days after birth is important, particularly in children in low- and middle-income countries (LMIC).**
- **Various instruments are used for these assessments, mostly based on a defined set of tasks for the child to perform.**
- **Tasks typically are scored as a set of ordered categories.**
- **Development score (D-score) may integrate data collected using different scales and across different populations.[1,2]**
- **The purpose of this work was:**

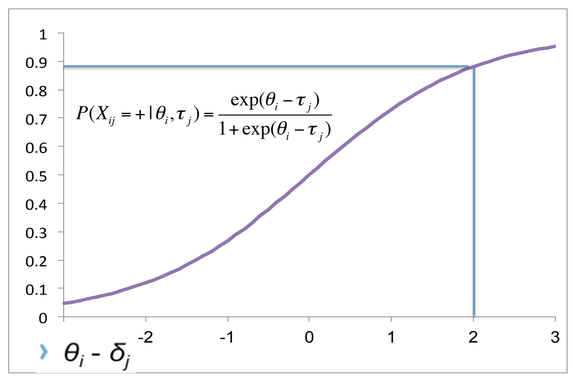
(1) To evaluate the assumptions underlying the D-score using data from an LMIC population, and

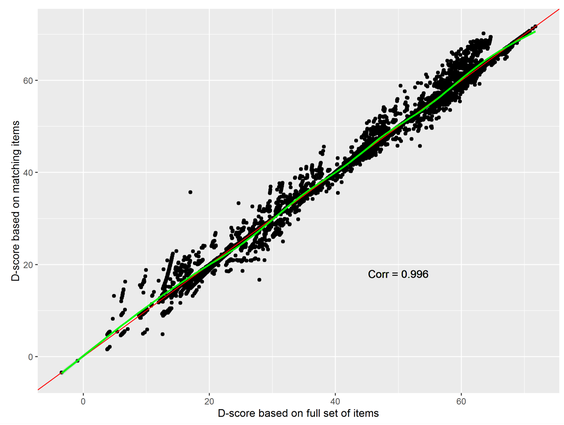
(2) To assess whether the D-score can be used for between-population comparisons.

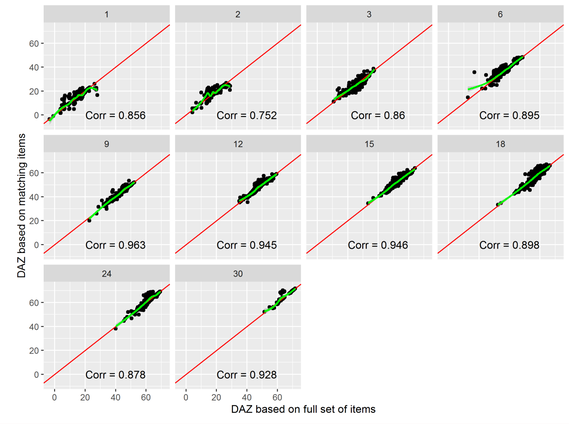
Discrimination Plots for a Sample of Items

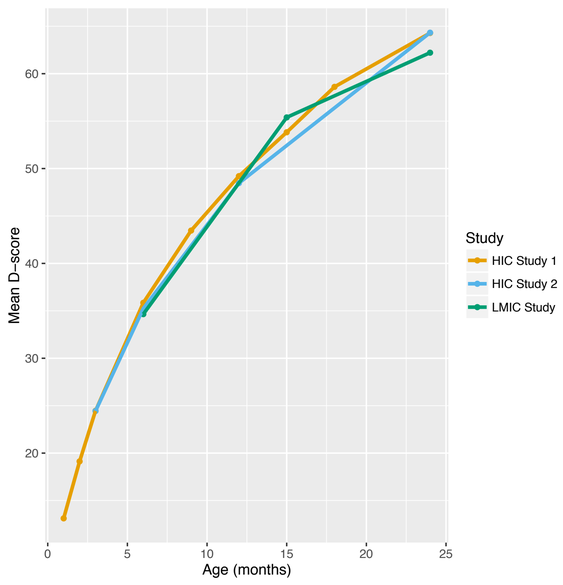












Methods

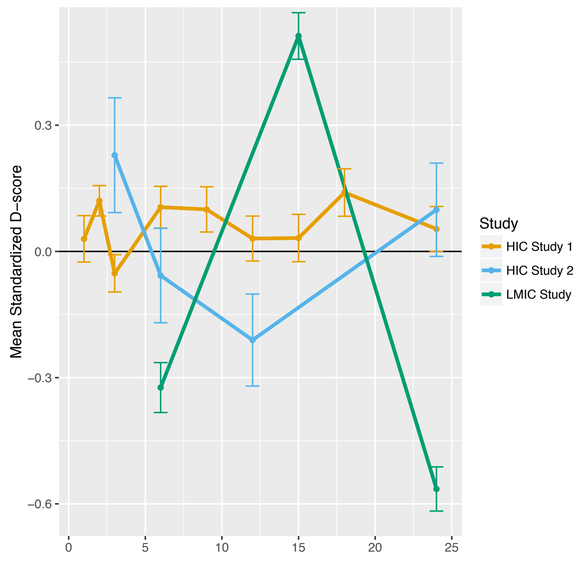
- Child's D-score was connected to observed longitudinal outcomes through Rasch model[1] (an item-response theory model).
- Probability of a positive response modeled to each item (X_{ij}) as a function of the difference between a child's ability (θ_i) and an item-level difficulty (τ_j).
- D-score was a translation of θ_i to an interpretable scale.

Data:

- 2 studies in high income countries (HIC): ~2000 and ~500 children.
- 1 study in an LMIC : ~1900 children.
- All 3 studies: birth to age 2 y.
- Instruments for assessing neurocognitive development differed between studies.
- 35 items matched between studies.
- HIC data: item-level difficulty values were previously estimated.[1,2]

Rasch model assumptions:

- (1) Invariance to the set of items used.
- (2) Common item-level difficulty across populations.
- Assumption of parameter invariance evaluated by comparing estimated D-score based on full set of items and matching items in LMIC study instrument.
- Discrimination plots made to compare item difficulty and item discrimination across studies.
- Longitudinal D-scores compared between study populations.



Results

- Comparison of the D-score (based on full- and matched-set of items in HIC studies): high correlations both overall and by age, indicating that the D-score may be invariant to the full and reduced set of items.
- Discrimination plots:
  - Item-level difficulty similar across these HIC and LMIC populations for most items.
  - Some difficulty parameters may differ (items relating to language and motor skills).
  - D-scores in all 3 studies increased consistently as children matured.
- Average standardized scores were lower at 6 and 24 mo and higher at 15 mo in LMIC than HIC.
- This pattern of development may be accurate or due to incorrect assumptions of the Rasch model.

Conclusions

- D-score shows promise for facilitating comparisons across populations.
- D-score has not been clearly validated for this purpose.
- D-score was invariant to choice of items, but item-level difficulties may depend on the population and/or instrument used.
- Additional work is needed to further evaluate D-score, including comparisons using additional populations and neurocognitive development instruments.

Acknowledgments

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References

1. Jacobusse G, van Buuren S, Verkerk PH. An interval scale for development of children aged 0-2 years. *Stat Med.* 2006;35(13):2272-2283.
2. van Buuren S. Growth charts of human development. *Stat Methods Med Res.* 2014;23(4):346-368.

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