Introduction to the Pediatric Evaluation of Disability Inventory Computerized Adaptive Test (PEDI-CAT) and the PEDI-CAT for Children with Cerebral Palsy and Developmental Delay

A New Option for Measuring Function in Daily Activities, Mobility, Social/Cognitive and Responsibility

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Objectives

- Describe the transition from the Pediatric Evaluation of Disability Inventory (PEDI) to the Pediatric Evaluation of Disability Inventory Computer Adaptive Test (PEDI-CAT)
- Introduce the PEDI-CAT: including intended populations, domains, test items, response scales, administration procedures, and scoring
- Discuss results of PEDI-CAT in a population of children with CP
- Demonstrate use of the PEDI-CAT and PEDI-CAT: through case presentations

Pediatric Evaluation of Disability Inventory (PEDI)

- Developed by Stephen M. Haley PT, Ph.D, Wendy J. Coster PhD, OTR/L, Larry H. Ludlow PhD, Jane Haltiwanger PhD, Peter Andrellos PhD
- Published in 1992
- First pediatric measure to assess function rather than development

Pediatric Evaluation of Disability Inventory Computer Adaptive Test (PEDI-CAT)

“Paper/pencil” assessment

Still available through Pearson Publishing

(Score software later available-not used much)
Pediatric Evaluation of Disability Inventory (PEDI)
- Administered via observation and/or caregiver report
- Measures: Capability [Functional Skills (FS) scale] and Level of independence [Caregiver Assistance (CA) scale]
- 3 Functional Domains:
  - Self-care (73 FS + 8 CA items)
  - Mobility (59 FS items + 7 CA items)
  - Social Function (65 FS + 5 CA items)

Applications of the PEDI
- Most commonly used to:
  - Document functional delay
  - Document changes in functional abilities over time in response to therapeutic intervention

PEDI Scoring
- Scoring: Raw Scores added and transformed using table in manual
- Normative scores for children 6 months to 7.5 years
- Scaled scores
  - 0-100 scale
  - Intended for those children with reduced levels of function

PEDI – Psychometric Properties
- Reliability-inter & intra-rater (Berg 2004; Nichols 1996)
- Validity:
  - Content/Construct (Melbourne-Bourke-Taylor 2003; COPM-Verkerk 2006)
  - Concurrent (WeeFIM-Ziviani 2001)
  - Discriminant Validity by Diagnosis subtypes: (Cerebral Palsy = Voorman 2006; Oeffinger 2007)

PEDI-Responsiveness
- Inpatient hospital treatment (Dumas 2002; Choksi 2010; Haley 2001)
- Early Intervention services (Eigsti 2010)
- Surgical interventions - Dorsal Rhizotomy (Nordmark 2000; Dudley, 2013)
- Pharmacological interventions (Baclofen-Awaad 2003; Botox-Keren-Capelovitch 2010; Dudley 2013)
- Hippotherapy (Casady 2004)
- Group therapy (Sorsdahl 2010)
- Aquatic Therapy (Fragala-Pinkham 2009)
- Constraint Induced Movement Therapy (CIMT) (Martin 2008)

PEDI: The Positives
- Document functional delay or changes in functional abilities after therapeutic interventions
- Program evaluation to document functional status in groups of children and changes over time
- Document functional skill acquisition in clinical populations and the importance of recognizing cultural differences
- Minimal training, low cost to administer
**PEDI: The Criticisms**

- Lengthy administration time (60min)
- Skills are at the lower end of the continuum
- Items focused primarily on home-based activities, which creates difficulties for therapists to answer questions without parent input
- Original standardization sample had some sampling error due to a lack of geographical representation and small numbers in each age group, which can affect the validity of interpretations made using norm-referenced scores

**Pediatric Evaluation of Disability Inventory-Computer Adaptive Test**

- For children and youth ages 0 - 20 years
- Can be used across all diagnoses, conditions and settings
- Focuses on activities and participation in life tasks
- Can be completed by a parent independently
- Brief yet precise

**From PEDI → PEDI-CAT**

- 2003 - transition to computer adaptive testing began
- Pompe PEDI (expanded self-care and mobility domains adding items on both ends of the easy to hard continuum – normed to age 15 years)
- PEDI-MCAT (M=multi-dimensional; Pompe PEDI but use of both self-care and mobility simultaneously for item administration)
- Today’s final PEDI-CAT - released October, 2012

**What is Computer Adaptive Testing (CAT)?**

- Administered only on the computer
  - No ‘paper and pencil’ version available!
- Uses artificial intelligence to select only most relevant items from a ‘pool’ of validated items
- Each item in the ‘pool’ represents a different amount of ‘difficulty,’ from most easy to most difficult to perform

**What is CAT? Item Banks**

- Set of calibrated items that describe one domain (item banks)
- Not every item needs to be answered to get a score
- For each domain, all respondents begin with the same question in the middle of the scoring range
- Depending on the initial response will dictate if a harder or easier item will be administered next
How does item selection occur?

Starting Question: Stands alone for a few minutes

4 (Easy) → High → Select a “High” question

3 (A Little Hard) → Medium → Select a “Medium” question

1 (Unable) or 2 (Hard) → Low → Select a “Low” question

Starting Question:

1. How does item selection occur?
2. High
3. Medium
4. Low

Computer Adaptive Testing

- CATs used as measure in community reintegration, behavioral health, quality of life, headaches, behavioral health and more……
- PEDICAT
  - Accurate & Precise
  - Increased efficiency
  - Reduced respondent burden
- PEDI-CAT is available for iPads & PCs
- Each download includes English & Spanish versions

PEDI-CAT Features

- Age, gender and mobility device filters prevent irrelevant items from being presented
- Items worded using everyday language & clear examples
- Can be completed by the child’s caregiver(s) or by the child’s therapist/clinician
- Equations available to link previous PEDI Functional Skills Self-care, Mobility and Social Function scores to the PEDI-CAT so that clinicians may continue to track a child’s changes over time

PEDI-CAT

Intended Population:
- Children and youth (birth through 20 years of age) with physical and/or behavioral conditions

Applications:
- Identification of functional delay
- Examination of improvement for an individual child after intervention
- Evaluation and monitoring of group progress in program evaluation and research

Administration of the PEDI-CAT

- No special environment, materials or activities necessary
- Focuses on typical performance at the present time
- Can be used on multiple occasions for the same child (e.g. initial, interim, discharge and follow-up)
- No minimum time must pass between assessments
- Recommendation: review of the PEDI-CAT Manual prior to administration to familiarize self with administration procedures, instrument content, item intent, response scales and score interpretation
Domains of the PEDI-CAT

4 Domains:
- Daily Activities
- Mobility
- Social/Cognitive
- Responsibility

- Each domain is self-contained and can be used separately or with other domains
- Illustrations of Daily Activities and Mobility items are included to facilitate understanding of the item intent

PEDI-CAT Domains

- 3 domains aligned with ICF Activity dimension, i.e. the execution of discrete tasks
  - Daily Activities
  - Social/ Cognitive
  - Mobility
- One domain aligned with ICF participation dimension, i.e. involvement in a life situation
  - Responsibility

The ICF as a conceptual framework

For Daily Activities, Mobility and Social/Cognitive:
- Unable
- A Little Hard
- Hard
- Easy
- I don’t know

5-point Responsibility Scale:
- Range from:
  - Adult/caregiver has full responsibility & child does not take responsibility
  - Child takes full responsibility without any direction, supervision or guidance from an adult/caregiver

PEDI-CAT = Response Scales

Daily Activities

68 items in Item Pool
- 4 Content Areas:
  - Getting Dressed
  - Keeping Clean
  - Home Tasks
  - Eating & Mealtime

Sample Item:
Ties Shoelaces (Getting Dressed content area)

Mobility

75 items in Item Pool
- 5 Content areas:
  - Basic Movement & Transfers
  - Standing & Walking
  - Steps & Inclines
  - Running & Playing
- Additional 22 items for children who use mobility devices (walking aids (canes, crutches, walkers) &/or wheelchairs)

Sample Item:
Gets on and off a public bus or school bus (Steps & Inclines content area)
Social/Cognitive

60 items in Item Pool (No Pictures)
- 4 Content areas:
  - Interaction
  - Communication
  - Everyday Cognition
  - Self Management

Sample Items:
- Communicates ideas in a 2-3 page written assignment or report (Everyday Cognition)
- Uses single words, gestures or signs to show what he/she wants (Communication)

Responsibility

51 items in Item Pool (4 Content areas)
- Organization & Planning
- Taking Care of Daily Needs
- Health Management
- Staying Safe

* Items require children to use several functional skills in combination to carry out life tasks

Sample Item: Keeping track of time throughout the day
* Includes: Arriving on time to scheduled activities or appointments; Coming back home at planned time; Ending an activity on time to stay on schedule

Versions of the PEDI-CAT

**Speedy (<15 items)**
- Fastest way to get an accurate and precise score

**Content-Balanced (up to 30 items)**
- Program will choose items from all content areas within a domain
- Example-for Daily Activities will get items from all 4 content areas: Getting Dressed, Keeping Clean, Home Tasks, and Eating & Mealtime

PEDI-CAT Scoring

**Normative scores**
- Provided as age percentiles and T-scores
- Based on a child’s chronological age
- Intended for use by clinicians so that they may interpret a particular child’s functioning relative to other children of comparable age

Test Scores-Normative Standard

**Age Percentile** = indicates percent of the total frequency scored below that score

**T Score** = Mean of 50 SD of 10
**PEDI-CAT Scoring**

*Scaled scores*
- 20-80 metric
- Provide a way to look at a child's current functional skills and progress in these skills over time
- Helpful in documenting improvements in functional skills for children not expected to exhibit or regain normative levels of functioning

*Item Maps* - generated with Content-Balanced PEDI-CAT; represent location of item ratings along the continuum of difficulty measured in that domain

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**Daily Activities Item Map**
- *daily activities item map.pdf*

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**Mobility Device Item Map**
- *Mobility Device item map.pdf*
Social/Cognitive Item
• social cognitive item map.pdf

Responsibility
• responsibility item map.pdf

Recent Research within CP
• Prospect cross sectional cohort of children with CP
• Study aims:
  1. Evaluate discriminant validity (Sensitivity) of the PEDI-CAT according to GMFCS
  2. Evaluate convergent validity of the PEDI-CAT with PedsQL (CP module), CP CHILD and FMS
  3. Perform a validation analysis of the crosswalk that links the new PEDI-CAT scores with original PEDI scores.
  4. Measure test, re-test reliability of the PEDI-CAT.

PEDI-CAT and CP
• 101 Children presenting to BCH (June 2013- May 2014)
• 54 boys (53%)
• Mean age was 11.9 (SD=2.7 years)
Aim 1: Sensitivity
- All 4 domains of PEDI-CAT were able to differentiate across GMFCS (p<0.001)
- PEDI-CAT Mobility was able to differentiate between all levels of GMFCS
  - Except between GMFCS I & II (P=0.09) and II & III (P=0.12)

<table>
<thead>
<tr>
<th>GMFCS LEVEL</th>
<th>PEDI-CAT Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>67.0±3.79</td>
</tr>
<tr>
<td>II</td>
<td>62.6±4.19</td>
</tr>
<tr>
<td>III</td>
<td>58.2±5.32</td>
</tr>
<tr>
<td>IV</td>
<td>49.9±7.67</td>
</tr>
<tr>
<td>V</td>
<td>39.4±9.54</td>
</tr>
</tbody>
</table>

Aim 2: Convergent Validity
- Tested against
  - PedsQL (GMFCS I-III)
  - CPCHILD (GMFCS IV & V)
  - Functional Mobility Scale
- 4 Domains of PEDI-CAT tested individually against individual domains of PedsQL & CPCHILD

<table>
<thead>
<tr>
<th>MACS LEVEL</th>
<th>PEDI-CAT Daily Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>57.7±5.59</td>
</tr>
<tr>
<td>II</td>
<td>57.4±5.01</td>
</tr>
<tr>
<td>III</td>
<td>56.1±5.73</td>
</tr>
<tr>
<td>IV</td>
<td>44.4±7.76</td>
</tr>
<tr>
<td>V</td>
<td>34.3±8.84</td>
</tr>
</tbody>
</table>

Aim 2: PEDI-CAT vs FMS
- Mobility domain demonstrated highest correlation with FMS levels

<table>
<thead>
<tr>
<th>FMS</th>
<th>Mobility</th>
<th>Daily Activities</th>
<th>Social Function</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>5m</td>
<td>0.85*</td>
<td>0.69*</td>
<td>0.43*</td>
<td>0.46*</td>
</tr>
<tr>
<td>50m</td>
<td>0.84*</td>
<td>0.69*</td>
<td>0.41*</td>
<td>0.43*</td>
</tr>
<tr>
<td>500m</td>
<td>0.76*</td>
<td>0.58*</td>
<td>0.35*</td>
<td>0.41*</td>
</tr>
</tbody>
</table>

Aim 2: PEDI-CAT vs PedsQL
- Daily activities domain had highest correlation with daily activities (r=0.85, p<0.001) & eating activities (r=0.76, p<0.001)

<table>
<thead>
<tr>
<th>PedsQL</th>
<th>Mobility</th>
<th>Daily Activities</th>
<th>Social Function</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Activities</td>
<td>0.63*</td>
<td>0.85*</td>
<td>0.70*</td>
<td>0.66*</td>
</tr>
<tr>
<td>School Activities</td>
<td>0.38*</td>
<td>0.62*</td>
<td>0.51*</td>
<td>0.47*</td>
</tr>
<tr>
<td>Eating Activities</td>
<td>0.45*</td>
<td>0.76*</td>
<td>0.57*</td>
<td>0.49*</td>
</tr>
<tr>
<td>Movement &amp; Balance</td>
<td>0.45*</td>
<td>0.59*</td>
<td>0.29*</td>
<td>0.25*</td>
</tr>
<tr>
<td>Fatigue</td>
<td>0.43*</td>
<td>0.28*</td>
<td>0.19</td>
<td>0.19</td>
</tr>
<tr>
<td>Communication</td>
<td>0.24*</td>
<td>0.49*</td>
<td>0.42*</td>
<td>0.24</td>
</tr>
<tr>
<td>Pain &amp; Hurt</td>
<td>0.14</td>
<td>0.01</td>
<td>0.15</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Aim 2: PEDI-CAT vs CPCHILD
- Strongest correlations were found between Mobility & Positioning, Daily Activities & Health and Social Function & Health

<table>
<thead>
<tr>
<th>CPCHILD</th>
<th>Mobility</th>
<th>Daily Activities</th>
<th>Social Function</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Care</td>
<td>0.45*</td>
<td>0.44*</td>
<td>0.38*</td>
<td>0.29</td>
</tr>
<tr>
<td>Positioning</td>
<td>0.65*</td>
<td>0.56*</td>
<td>0.46*</td>
<td>0.36*</td>
</tr>
<tr>
<td>Comfort</td>
<td>0.34*</td>
<td>0.40*</td>
<td>0.31*</td>
<td>0.16</td>
</tr>
<tr>
<td>Communication</td>
<td>0.38*</td>
<td>0.54*</td>
<td>0.64*</td>
<td>0.37*</td>
</tr>
<tr>
<td>Health</td>
<td>0.40*</td>
<td>0.60*</td>
<td>0.60*</td>
<td>0.53*</td>
</tr>
<tr>
<td>Quality of Life</td>
<td>0.13</td>
<td>0.12</td>
<td>0.30</td>
<td>-0.07</td>
</tr>
<tr>
<td>Total Score</td>
<td>0.53</td>
<td>0.61</td>
<td>0.56</td>
<td>0.40</td>
</tr>
</tbody>
</table>
Aim 3: Validity of PEDI vs PEDI-CAT

- Pearson's correlations with 95% CI demonstrated excellent concurrent validity across all PEDI domains
  - Mobility ICC = 0.91
  - Daily Activities ICC = 0.95
  - Social/Cognitive ICC = 0.84

Future research directions

- Diagnostic Specific
  - Spinal Muscular Atrophy module (Dr. Darras/SMA team – Boston Children's Hospital; PNCR network)

- Setting Specific
  - Hospital-items (Franciscan Hospital for Children – Dumas, 2010)

Aim 4: Retest Reliability

- A 17 patient subset completed the PEDI-CAT @ 2 separate time points (avg 25 days, range 6-44 days)
- Test retest reliability was excellent across all domains
- ICC = 0.96-0.99 (p<0.001)

PEDI-CAT-ASD: Changes to Test Format

- Expanded rating scale directions through a pop up “help” button.
- Specific guidance regarding performance variability to help parents make consistent rating decisions.

Comparing PEDI-CAT ASD & PEDI-CAT

- Compared to the relative difficulty of items from the original PEDI-CAT validation sample:

<table>
<thead>
<tr>
<th>Domain</th>
<th>Total # of Items</th>
<th># Items Significantly Different</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Activities</td>
<td>76</td>
<td>4</td>
</tr>
<tr>
<td>Social/ Cognitive</td>
<td>68</td>
<td>31</td>
</tr>
<tr>
<td>Responsibility</td>
<td>58</td>
<td>4</td>
</tr>
</tbody>
</table>
PEDI-CAT-ASD Scoring

* Normative scores (T-scores, percentiles) that are exactly the same as the PEDI-CAT-ASD.

* Scaled score is adjusted to better reflect the way that children and youth with ASDs perform functional activities.

* Score remains comparable to scores produced using the PEDI-CAT.

Mobility Subscale Test Information Function: SMA

Correlation: Type-I

Correlation: Type-II

Case Example

PEDI-CAT Demonstration: Speedy
PEDI-CAT
Demonstration: Content-Balanced

www.pedicat.com

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- How-to videos
- Contact and Ordering Information

- Other Cases
- iPad demo
- Questions