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To link to this article: http://dx.doi.org/10.3109/17518423.2013.827755
Development and validity of the early clinical assessment of balance for young children with cerebral palsy

Sarah W. McCoy¹, Doreen J. Bartlett², Allison Yocum³, Lynn Jeffries⁴, Alyssa L. Fiss⁵, Lisa Chiarello⁶, & Robert J. Palisano⁶

¹Department of Rehabilitation Medicine, University of Washington, Seattle, WA, USA, ²School of Physical Therapy, Faculty of Health Sciences, Western University, Hamilton, Ontario, Canada, ³Waypoint Pediatric Therapies, Issaquah, WA, USA, ⁴Department of Rehabilitation Sciences, University of Oklahoma Health Sciences Center, Oklahoma City, OK, USA, ⁵Department of Physical Therapy, Mercer University, Atlanta, GA, USA, and ⁶Programs in Physical Therapy and Rehabilitation Sciences, Drexel University, Philadelphia, PA, USA

Abstract

Objectives: Validity of the Early Clinical Assessment of Balance (ECAB), to monitor postural stability in children with cerebral palsy (CP), was evaluated.

Methods: 410 children with CP, 1.5 to 5 years old, participated. Physical therapists scored children on the Movement Assessment of Infants Automatic Reactions section and Pediatric Balance Scale. Through consensus, researchers selected items from both measures to create the ECAB. Content and construct validity were examined through item correlations, comparison of ECAB scores among motor ability, age and gender groups and correlations with the Gross Motor Function Measure 66 basal and ceiling (GMFM-66-B&C).

Results: Internal consistency was high (Cronbach’s alpha = 0.92). ECAB differed significantly among motor ability, children <31 months old scored lower than older children, but there was no difference between boys and girls. ECAB and GMFM-66-B&C scores correlated strongly (r = 0.97).

Conclusion: Validity of the ECAB was supported. Reliability and responsiveness need study.

Introduction

Postural stability is defined as the ability to control the body’s center of mass in relationship to the person’s base of support for maintenance of balance [1]. Impairments in postural stability have been documented in children with cerebral palsy (CP) during both static (maintaining a posture) and dynamic (changing positions and moving through the environment) activities [2–5]. Depending on the type of CP (spastic, dystonic, ataxic), children may show primary impairments in postural stability due to variations in biomechanical alignment and musculoskeletal structures [6], sensory cueing for postural adjustments [1] and temporal and spatial aspects of motor coordination patterns triggered to control posture [7–9]. Balancing difficulty can also be observed among children with CP in the control of the head alone [10], the head and trunk for sitting activities [11] or the head, trunk and legs for standing and walking activities [2, 5].

The relationship between postural stability or balancing ability (used as a synonymous term) and gross motor ability in children with CP has been demonstrated in many research studies [1, 2, 10]. Given the importance of balance ability for functional movement in children with CP, a valid, reliable and clinically feasible measurement of impairments in postural stability is important for describing when and how postural stability is impaired and monitoring change in children’s balance across time. This should lead to amelioration as much as possible via specific interventions.

For a larger study to identify determinants of gross motor function, self-care and play in young children with CP (entitled Move & PLAY: Movement and Participation in Life Activities of Young Children) [12, 13], we wanted a clinically feasible measure of balance ability from pre-sitting to standing and walking that is valid for young children with CP across all Gross Motor Function Classification System (GMFCS) [14–16] levels. Available clinical measures of balance for young children with CP that include early balance ability of the head, the trunk in sitting and standing balance are sections of developmental diagnostic motor tests such as the Peabody Developmental Motor Scales, 2nd edition (PDMS-2) [17] and Movement Assessment of Infants (MAI) [18], and tests focused specifically on sitting and standing balance such as the Pediatric Reach Test (PRT) [19] and the Pediatric Balance Scale (PBS) [20]. Each of these tests was reviewed from the perspective of our research purpose with the following conclusions.

The PDMS-2 has been shown to have high test–retest and inter-rater reliability on children 17 months and younger [17] and on 4–10-year-old children with CP [21] (correlations or ICCs > 0.80). The stationary sub-test has a limited number of...
items related to balance ability development, making it potentially unresponsive to small changes in functional balance [17]. The MAI [18] has one section (Automatic Reactions section) devoted to equilibrium development, which offers a detailed and systematic way to examine and monitor emerging balance ability of the head and trunk in supine, prone and sitting. Psychometrics on the MAI have been completed in infants with positive results (inter-rater reliability $r = 0.72$, test–retest reliability $r = 0.76$, significant predictive validity for early MAI to assessment 1–2 years later) [22–24] but have not been completed on young children with CP or on the Automatic Reactions Section. Our assumption, however, was that these items were clearly written and could conceivably be measured reliably.

The PRT assesses the distance a child can reach from a sitting and/or standing posture [19] and was developed so it could be used with children with CP across all GMFCS levels. However, it is limited to a measurement of balance due to an internal perturbation (reaching) and does not encompass balance in response to external perturbations (reactive postural adjustments) or sensory perturbations (altered vision or support surface). The PBS [20], adapted from the Berg Balance Scale (BBS) [25], includes static, dynamic and anticipatory balance items that are considered integral parts of everyday functional tasks. The PBS presents as a more comprehensive postural stability test for children’s sitting and standing balance. Reliability was found to be high (inter-rater ICC = 0.997; test–retest ICC = 0.998) in a mixed group of children with mild to moderate motor impairments, many of whom had a diagnosis of CP [20]. Validity has been demonstrated via verification of increased scores as children age and differences in scores of children with and without disability [26].

Based on our review, we did not find one measure that adequately examined balance for head control through body control during static (prone, sitting, standing) and dynamic (moving while sitting and standing) activities. Therefore, within the Move & PLAY study, we collected data using several balance measures. We chose to use the items and scoring mechanism within the Automatic Reactions section of the MAI to measure balance ability within the head and trunk during lying and sitting in children with CP who had limited functional movement (GMFCS levels III–V) and we used the PBS to measure balance during more challenging sitting and standing activities in children with CP who had greater functional movement ability (GMFCS levels I and II and potentially III). Our research team combined items from the two measures to represent the continuum of balance ability from head control in prone and supported sitting to whole body control in standing while moving through space to create the Early Clinical Assessment of Balance (ECAB). The ECAB is a 13-item test that estimates postural stability and is intended for children with CP across all levels of functional ability. Ease of administration in clinical practice and low burden on the child were high priorities during the development of the test.

The purpose of this study was to describe the creation of the ECAB and our examination of content and construct validity [27] within our Move & PLAY sample of young children with CP. The primary research questions and our hypotheses were:

1. Does the ECAB have content validity (internal consistency of test items)?

We hypothesized that internal consistency would be $\geq 0.80$, indicating that items are measuring similar types of balance behaviors.

2. Does the ECAB demonstrate construct validity?

   a. Using a “known groups method”:

      i. Do ECAB scores differ among children with CP by GMFCS level? We hypothesized that ECAB scores would differ based on children’s GMFCS level; children with higher gross motor function would demonstrate higher ECAB scores demonstrating better balance ability.

      ii. Do ECAB scores differ among children with CP by age? We hypothesized that older children would have higher ECAB scores than younger children (children older than 42 months > children 31–42 months > children less than 31 months).

      iii. Do ECAB scores differ among children with CP by gender? While the conclusion by many is that postural control matures earlier in girls than in boys in typically developing children younger than 10 years [28–32], we could find no research that had examined this within young children with CP. We therefore hypothesized that there would be no differences between boys and girls.

   b. Does the ECAB correlate with the Gross Motor Function Measure 66 basal & ceiling version (GMFM-66-B&C) [33] in children with CP? We hypothesized correlations of moderate to high magnitude ($r = 0.60–0.80$) between ECAB and GMFM-66-B&C scores, given that the GMFM-66-B&C reports on overall gross motor activity, not just balance ability, but does include assessment of pre-sitting to standing gross motor movements.

**Methods**

**Design**

For content validity, an informal consensus process and a correlation design was employed. To evaluate construct validity of the ECAB, a known groups and correlation design was used [34].

**Participants**

A convenience sample of 410 children with CP who participated in the Move & PLAY study across all GMFCS levels, age 1.5–5 years, was recruited through therapist referral and word of mouth from four regions across the United States (Greater Seattle, WA; Greater Philadelphia, PA; Greater Oklahoma City, OK; Greater Atlanta, GA) and six provinces across Canada (British Columbia, Saskatchewan, Manitoba, Ontario, Nova Scotia, and Newfoundland and Labrador). Institutional Review Boards at all participating institutions approved the study. Parents provided informed consent for their children’s participation in the study.

The children included 231 boys and 179 girls (mean age 38 mo, SD 11 mo): 9 children with monoplegia, 90 with hemiplegia, 97 with diplegia, 24 with triplegia, and 188 with quadriplegia, ($n = 2$ unclassified). For age comparisons, the
children were divided into three age groups: <31 months; 31–42 months; >42 months. These age divisions were chosen to divide the sample into three relatively equal groups of ~2 years old, ~3 years old and ~4–5 years old. Table I summarizes the characteristics of the children who participated in the study.

### Instrumentation

**Gross Motor Function Classification System (GMFCS)**

The GMFCS is a 5-level system used to classify children with CP on present abilities and limitations in motor function with emphasis on sitting and walking [14]. The GMFCS has evidence of reliability and validity [14, 15] and has been used in many studies [16].

**Movement Assessment of Infants – Automatic Reactions section (MAI-AR)**

The Movement Assessment of Infants (MAI) is a criterion-referenced tool used to evaluate infants at risk for developmental delay [18]. Test items used within our study included the eight items within the MAI’s Automatic Reactions section, including assessment of reactive postural adjustments of the head to tilting, trunk reactions when rolling, trunk balance reactions in sitting and reactions to fast perturbations (protective extension) in sitting [18]. Inter-rater reliability of the MAI items used was assessed on 16 children within the Move & PLAY study. One of the study raters administered and scored the test while a second study rater or investigator observed and scored. Inter-rater reliability was found to be high, ICC(2,1) = 0.96, (95% CI: 0.90–0.99), p < 0.001.

**Pediatric Balance Scale (PBS)**

The PBS is a 14-item criterion referenced screening tool for functional balance in children age 3–6 years that assesses static, dynamic and anticipatory balance [20]. The PBS starts with bench sitting balance ability and then moves to more difficult standing balance tasks such as standing with eyes closed and completing dynamic tasks in standing such as alternately tapping feet on a 6” step [20]. Adequate test–retest, inter-rater and intra-rater reliability have been established and beginning norms have been compiled [20, 28]. Convergent validity of the BBS [25] (same items as PBS, but directions are not modified for children) to the GMFM-66-B&C, walking speed and 10-second sit-to-stand test has been demonstrated in children with CP [35].

**Gross Motor Function Measure 66 basal & ceiling (GMFM-66-B&C)**

The basal and ceiling approach of the GMFM-66-B&C was used to measure motor function in as succinct a manner as appropriate to reduce the burden of testing on the children and because our sample age matched previous research that validated this procedure [33]. The GMFM-66-B&C is based on sequencing the 66 items in terms of difficulty level, established using Rasch analysis [36]. The 66 items are the same as the GMFM-66, in which each item is graded on a 4-point ordinal scale (from 0 ‘‘does not initiate’’ to 3 ‘‘completes’’). Using the basal and ceiling version of the GMFM, therapists can obtain a very accurate estimate of the GMFM-66 score with as few as 15 items. An adapted score sheet provides an entry point for testing children based on their GMFCS level and age, and therapists need to score items that fall between a basal level of three consecutive scores of ‘‘3’’ and a ceiling of three consecutive scores of ‘‘0’’. The second version of the Gross Motor Ability Estimator (GMAE) is used to calculate a GMFM-66 score using the basal and ceiling approach (available at www.canchild.ca – search GMAE-2 – for a free download of the software). Concurrent validity is supported with strong correlations between the GMFM-66-B&C and the GMFM-66 (ICC = 0.987; 95% CI: 0.972–0.994) and test–retest reliability is also high (ICC = 0.994; 95% CI: 0.987–0.997 [33].

### Procedures

**Rater training**

As a part of the Move & PLAY study, 61 licensed, practicing, pediatric physical and occupational therapists attended one-day training courses held in each data collection site. During the training, investigators used the same presentations to explain the study and the tests. Within the training, therapists achieved 80% agreement on rating of the GMFCS using video segments of children with CP. After the course, therapists observed and scored MAI, PBS and GMFM-66-B&C items from videotapes of children. Before testing any children in the study, the therapists had to reach 80% agreement with investigators’ scores for the videotaped children on all tests.

**Data collection**

Therapists collected data during home or clinic visits, dependent upon families’ preferences. Within a single test session, the therapists scored the children on the GMFM-66-B&C and the MAI and/or PBS and established the children’s GMFCS level. Children in GMFCS levels I–III were scored on all items from the PBS. Children in GMFCS levels III–V were scored on the Automatic Reactions section of the MAI. Intentionally, children in GMFCS level III were assessed using both tools because it was thought that their balance ability would potentially fall between the two scales.
Construction of the Early Clinical Assessment of Balance (ECAB)

After collection of the MAI and PBS data, we reviewed the eight items from the MAI and 14 items from the PBS in order to merge the items into one comprehensive test of balance, the ECAB. Consensus between two researchers (SWM, DJB: pediatric physical therapists with greater than 30 years experience) and approval of the Move & PLAY study team was conducted to: (1) reduce clinician and respondent burden by decreasing the number of items, (2) maintain items which measured postural stability due to internal, external and sensory perturbations and (3) cover balance of the child’s head, trunk in sitting and overall body in standing to allow measurement of all functional levels among children with CP.

Seven items from the MAI and six from the PBS were retained for the ECAB. (Table II lists the test items.) One item was dropped from the MAI, forward protection response, due to the reported difficulty administering this item with larger children. Also, therapists demonstrated uncertainty in scoring the item; because as the child is quickly lowered toward the floor to score this item, the arms can extend slightly due to gravity. Eight items were dropped on the PBS for the following reasons: (1) problems with test administration and measurement in the young children as reported by therapist raters (turn to look behind, reaching forward while standing), (2) redundancy in type of balance tested and desire for reducing burden of testing (stand to sit, stand unsupported, pick up object from floor), (3) requirement of specified equipment (transfers, the need for an appropriate size chair to stand), (4) two dynamic standing items to 0–16 points. Therefore, the maximum score for this section of the ECAB is 36. The written scoring criteria for the six items originally from the PBS, which ranged from 0 (unable to complete task) to 4 (able to complete task at the noted criterion level) were retained. However, the points awarded for these items were changed based on the fact that we had more early items (12) and our judgment that there were small increments of postural stability difficulty item-to-item reflected in the early measurements of head and trunk postural stability. Also, there were larger increments of difficulty between items, that is, greater changes in postural stability required for accomplishing these later test items. We changed the points for the sitting items to 0–6 points, the static standing items to 0–10 points and the dynamic standing items to 0–16 points. Therefore, the maximum score for this section of the ECAB is 64. The full ECAB is available on the Move & PLAY website: http://www.canchild.ca/en/ourresearch/moveplay.asp.

Data analysis

The Statistical Package for the Social Sciences (SPSS) (PASW, Version 18; IBM Corporation, Somers, NY) was used for data analyses. The total ECAB test score was used for all data analyses, except item scores were used for examination of internal consistency. Descriptive statistics of each comparison group were run within SPSS to examine data distributions (skewness and kurtosis). The distribution of ECAB total scores was relatively normally distributed among...
all groupings (GMFCS levels, age groups and gender groups) except one (ECAB score for GMFCS level II). Given this, and the fact that the ECAB items are scored on ordinal scales, the decision was made to use non-parametric statistics. The alpha value used for all analyses was 0.05.

Content validity was analyzed by examining the bivariate Spearman correlations between test items and Cronbach’s alpha to determine overall internal consistency. Construct validity was first analyzed using the known groups method. Kruskal–Wallis ANOVA tests were used to determine if ECAB scores differed among the five GMFCS levels and among the three age groups of children. Post-hoc comparisons between GMFCS levels and age groups were performed using Mann–Whitney U tests. Differences between the ECAB scores among girls and boys were analyzed using the Mann–Whitney U test. As a second test of construct validity, the ECAB and the GMFM-66-B&C total scores were compared using Spearman’s correlation coefficients.

Results

Descriptive data on the ECAB and the GMFM-66-B&C for children with CP, grouped by GMFCS level are presented in Table III, grouped by age in Table IV and grouped by gender in Table V.

Table III. Summary of scores on the Early Clinical Assessment of Balance for children with cerebral palsy across gross motor function classification levels.

<table>
<thead>
<tr>
<th>GMFCS</th>
<th>Mean (SD)</th>
<th>Median (min/max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>80.3 (17.2)</td>
<td>46.7 (7.7)</td>
</tr>
<tr>
<td>II</td>
<td>85.8 (43.5/100)</td>
<td>43.5 (37.5/83.0)</td>
</tr>
<tr>
<td>III</td>
<td>67.8 (7.8)</td>
<td>50.5 (5.1)</td>
</tr>
<tr>
<td>IV</td>
<td>66.7 (47.5/100)</td>
<td>50.9 (39.5/63.6)</td>
</tr>
<tr>
<td>V</td>
<td>70.3 (22.2)</td>
<td>44.2 (27.3/56.9)</td>
</tr>
</tbody>
</table>

Table IV. Summary of scores for the Early Clinical Assessment of Balance for children with cerebral palsy grouped by age.

<table>
<thead>
<tr>
<th>Age</th>
<th>GMFCS level</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>18–31 Months</td>
<td>Mean score (SD)</td>
</tr>
<tr>
<td>Mean score</td>
<td>61.4 (13.5)</td>
</tr>
<tr>
<td>Median</td>
<td>58.5</td>
</tr>
<tr>
<td>(min/max)</td>
<td>(43.5/92.0)</td>
</tr>
<tr>
<td>(n)</td>
<td>28</td>
</tr>
<tr>
<td>32–42 Months</td>
<td>Mean score (SD)</td>
</tr>
<tr>
<td>Mean score</td>
<td>81.0 (14.2)</td>
</tr>
<tr>
<td>Median</td>
<td>85.8</td>
</tr>
<tr>
<td>(min/max)</td>
<td>(46.5/100)</td>
</tr>
<tr>
<td>(n)</td>
<td>48</td>
</tr>
<tr>
<td>43–60 Months</td>
<td>Mean score (SD)</td>
</tr>
<tr>
<td>Mean score</td>
<td>88.4 (13.9)</td>
</tr>
<tr>
<td>Median</td>
<td>95.0</td>
</tr>
<tr>
<td>(min/max)</td>
<td>(46/100)</td>
</tr>
<tr>
<td>(n)</td>
<td>62</td>
</tr>
</tbody>
</table>

GMFCS = Gross Motor Function Classification System; CP = cerebral palsy; SD = standard deviation.

All bivariate correlations between test items were statistically significant ($p < 0.001$) and varied in magnitude from $r_s = 0.32–0.94$ (Table VI). Cronbach’s alpha was 0.92, indicating statistically, a high overall internal item consistency.

Construct validity (known groups method)

For comparisons among GMFCS levels, Kruskal–Wallis ANOVA results were statistically significant (Chi-square = 365.11, $p < 0.001$) (Figure 1 and Table III). Mann–Whitney U pairwise analyses indicated that median ECAB scores differed significantly among children in all GMFCS levels ($p < 0.001$). Children with GMFCS level I had the highest median ECAB score, while children in level V had the lowest median score.

For comparisons among the three age groups, Kruskal–Wallis ANOVA results were statistically significant (Chi-square = 9.42, $p = 0.009$). Children with CP who were less than 31 months of age had lower median balance scores than children 31–42 months of age ($p = 0.01$) and children 43–60 months of age ($p = 0.006$). Median balance scores did not differ between children 31–42 and 43–60 months of age ($p = 0.51$) (Table IV).

Table IV. Summary of scores for the Early Clinical Assessment of Balance for children with cerebral palsy grouped by age.

<table>
<thead>
<tr>
<th>Age</th>
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<tr>
<td>18–31 Months</td>
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<td>III</td>
<td>50.5 (5.1)</td>
</tr>
<tr>
<td>IV</td>
<td>66.7 (47.5/100)</td>
</tr>
<tr>
<td>V</td>
<td>80.3 (17.2)</td>
</tr>
<tr>
<td>Difference among GMFCS groups</td>
<td>$p &lt; 0.001$</td>
</tr>
</tbody>
</table>

GMFCS = Gross Motor Function Classification System; CP = cerebral palsy; SD = standard deviation.
For comparisons between genders, there was no significant effect of gender (Mann–Whitney \( U = 19,684.0, \ p = 0.41 \) (Table V).

### Construct validity (correlation method)

The Spearman correlation between the ECAB and GMFM-66-B&C was 0.97 (\( p < 0.001 \)). The explained variance between ECAB and GMFM-66-B&C scores (\( R^2 \)) was 94.1%.

### Discussion

#### Content validity

Content validity was supported by the high internal consistency of the items. The bivariate correlations indicate that while all items were significantly related, there were differences in the magnitude of the relationships between individual items. The lowest correlations were between the first four items (head control laterally to right and left and in flexion and extension) and the last two items (turning 360 degree in standing and alternate toe tapping on a step). We suggest this supports that the items cover different aspects of postural stability.
Construct validity

The ECAB was significantly different across gross motor function levels of children with CP, which provides evidence of the construct validity of the test. As gross motor function increased, balance ability increased. Children with the highest motor ability, GMFCS level I, had the highest balance ability among children with CP; on average their scores were 72% higher than the scores for children in GMFCS level II. This finding, that children in GMFCS level I stand apart compared to children with CP in other GMFCS levels, is consistent with previous research in older children on participation in leisure and recreation activities and impairments [37]. However, it should be noted that children in level I also had the highest variability in their balance scores, in part due to age variability within the sample.

We hypothesized that ECAB scores of children with CP < 31 months, 31–42 months, and 43–60 months of age would be higher for each age group based on the assumption of age related changes in postural stability during early development [38]. We found that children < 31 months had the lowest median score, but the median scores of children in the two older groups did not differ from each other. To explore the interaction of age and GMFCS level, we ran a 2-way (Age × GMFCS) ANOVA. We found an interaction in age and GMFCS level (Figure 2). The mean ECAB scores of children in GMFCS level I differed significantly for each age group, whereas there were smaller differences among children in levels II and III by age group and no significant differences at GMFCS levels IV and V. In studies of children with typical development, postural control, motor coordination patterns and sensory integration during balancing were different between 18 month to 3 years old and 4 to 6 years old [38, 39]. Further analysis of ECAB scores after collection of a larger sample including older children (6 years old) with re-grouping into two similar age levels (18 months–3 years and 4–6 years) may yield similar age differences on the ECAB. Alternatively, improvement in postural stability behaviors in children with CP has been shown to take longer to develop [1, 10, 40, 41], which may be affecting our age differences results as compared to those from children with typical development.

Although research on children with typical development shows gender differences in young children [28–32], we could not find reports of gender differences in balance in young children with CP. Therefore, we hypothesized that there would not be a significant difference in ECAB scores between the young boys and girls in our study. Our results substantiated this hypothesis. It is interesting to note, however, that for every GMFCS level except level V, girls mean scores were higher than boys.

The correlation between ECAB (a measure of body functions) and GMFM-66-B&C (a measure of gross motor activity) scores ($r = 0.97$) was higher than anticipated. We hypothesized a correlation of 0.60 to 0.80 based on the perspective that although many items on the ECAB and GMFM are similar, items on the ECAB were selected specifically to assess postural stability. In retrospect, perhaps this is not surprising, given the inclusion of some postural control tasks within the GMFM-66-B&C items (e.g. prone, lifts head upright; supine, pulls self to sitting with head control) and the focus of measuring postural stability using motor functions in the PBS that are also in the GMFM (e.g. sitting on a bench or moving from sitting to standing). Although the correlation is very strong, we propose that the ECAB focuses specifically on functional balance tasks, whereas the GMFM is a global measure of gross motor function. In addition, the ECAB includes items for head and trunk postural stability, specific balance reactions in sitting and a dynamic standing balance task, which are not addressed by the GMFM-66-B&C items. Given the reduced time to administer the GMFM-66-B&C, therapists might consider using both the ECAB and GMFM-66-B&C to identify strengths and areas for improvement and intervention planning. Research is recommended to determine if the ECAB and GMFM-66-B&C differ in measuring change over time.

Benefits of the ECAB

The ECAB provides an easy, inexpensive and low-burden way to measure postural stability or balance in young children with CP at all GMFCS levels. To our knowledge there are no other tests for young children with CP across all functional levels in this age range that are specific to balance ability. The ECAB can be completed within approximately 15 minutes, making the burden of administration low for therapists and researchers. It includes a broad and comprehensive range of balance abilities, from early head and trunk balancing to balance in standing while doing a dynamic activity. As the intent of the ECAB is to succinctly measure overall postural stability, it cannot be broken down into subscales associated with aspects of postural control, but should direct implementation of physical therapy interventions. Utilization of the ECAB with families of young children with CP should also facilitate opportunities for discussion about the child’s abilities across time and the importance of balance within development of movement ability.
Limitations of the ECAB

Within our study, we acknowledge the limitations of the assumptions we made in creating the test, the lack of complete normal distribution and the different sample sizes within some of the groupings for functional ability and age. Future studies should include the use of different and larger samples of children with CP to assist with statistical analysis (i.e. Rasch analysis) to determine whether items represent a univariate construct and to assess the difficulty of each item. This will help substantiate or refute the scoring system and determine the interval nature of the items. Reliability, comparison of the ECAB with other measures of postural stability and sensitivity-to-change also need to be completed. An examination of the responsiveness of the ECAB in children with CP after interventions focusing on improving balance would be beneficial prior to the test being used as an outcome measure. This analysis is in progress. Following children over time will also facilitate the development of reference percentile curves across GMFCS levels for monitoring of developmental progression of postural stability and recommendations for interventions for children with CP. Finally, research on this test in children with other medical diagnoses or motor disabilities is warranted.

Conclusion

The ECAB provides clinicians and researchers with a clinically feasible test of balance or postural stability for 1.5- to 5-year-old children with CP across all GMFCS levels. Content and construct validity of the ECAB are supported for children with CP. Further research examining test reliability, the potential interval nature of the test items, describing developmental trajectories of postural stability of children with CP and examination of responsiveness (ability to detect change) of the ECAB in the context of effective interventions is needed prior to use as an outcome measure in clinical trials and as an evaluative measure in clinical practice.

Acknowledgments

We wish to express our appreciation to all the children and their families who participated in this study. We also want to acknowledge all the rest of the Move & PLAY research team including Peter Rosenbaum, MD; Barbara Stokof, RN, MHSc; Audrey Wood, PT, MS; Barbara Sieck Taylor, parent consultant; Tina Hjorngaard, parent consultant; and all the therapist assessors and interviewers from the United States and Canadian test sites.

Declaration of interest

The authors report no declarations of interest.

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