Reliability of The Thai Kids-Balance Evaluation Systems Test (Kids-BESTest-Th) in Children with Cerebral Palsy

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Abstract

Cerebral palsy normally showed impairment of movement and postural control, thus, a standard or specific tool for evaluating the postural control problem is an important issue in planning suitable treatment for patients. This study aims to translate the Kids Balance Evaluation System Test (Kids-BESTest) from the original version to the Thai version (Kids-BESTest-Th) and study the reliability of the Kids-BESTest-Th in cerebral palsy patients. The translation processes in this study were forward and backward translation. The Kids-BESTest was translated by a professional English linguist and physical therapist. Subsequently, the content validity ratio (CVR) was measured in the Kids-BESTest-Th by the physical therapists and lecturers who have expertise in children with cerebral palsy. After that, two physical therapists had applied the Kids-BESTest-Th to evaluate the balance systems in ten children with cerebral palsy. The Balance system was measured at 2 periods a week apart. Statistical analysis was the intraclass correlation coefficient (ICC) for calculating the inter- and intra-rater reliability. The study showed excellent inter - and intra-rater reliability (ICC > 0.94) of The Kids-BESTest-Th in both total and section scores. To conclude, the Kids-BESTest-Th showed excellent reliability, which can apply to evaluating the balance systems in cerebral palsy. The concurrent validity of the Kids-BESTest-Th would be a suggestion for further study.

Keywords*: *Cerebral palsy, Balance, Kids-BESTest, Reliability

1. Introduction

The incidence of cerebral palsy (CP) was 2 to 3.5 of 1,000 people and caused by brain disorders (Singer, Mink, Gilbert, & Jankovic, 2016). All of the children with CP showed delay and abnormality of motor development from infancy to early childhood such as a position of sitting or standing, a transition from sitting to standing, and locomotion by crawling or walking (Kent, 2013; Richards & Malouin, 2013). The main impairment of cerebral palsy were symptoms of muscle spasticity, muscle weakness, and abnormal postural balance. Other common problems are abnormal sensation, perception, cognition, communication, behavior, and epilepsy (Ackman et al., 2005; Degelaen et al., 2013; Dewar, Love, & Johnston, 2015; Shumway-Cook & Woollacott, 2012). Children with CP had been reported to display postural control deficits across all system approach components such as anticipatory, reactive postural adjustments, and sensory and biomechanical constraints (Dewar et al., 2015; Shumway-Cook & Woollacott, 2012). Treatments of postural balance in cerebral palsy are different among the patients, depending on the causes of the disorders. Therefore, medical, physical therapy, surgery, and using the assistive device were alternative treatments for improving postural control in children with cerebral palsy (Ackman et al., 2005; Degelaen et al., 2013; Dewar et al., 2015; Shumway-Cook & Woollacott, 2012). The Balance Evaluation Systems Test (BESTest) is an assessment tool of postural control that covers all system approach components. The BESTest had been applied in neurological patients such as subacute, chronic stroke, and elderly, and the results showed good to excellent intra- and inter-rater reliability, including a validity with the Berg balance scale (BBS) (Chinsongkram et al., 2014; Marques et al., 2016; Potter et al., 2018; Rodrigues, Marques, Barros, & Michaelsen, 2014). The BESTest had been developed to Mini-BESTest which was a short version and contained specific items of dynamic balance, functional mobility, and gait. BESTest and the Mini-BESTest had been applied in typical school-aged children, of which the results showed excellent reliability of the total scores. However, a previous study suggested that some items of BESTest or Mini-BESTest showed unsuitable protocol with school-aged children (Dewar, Claus, Tucker, Ware, & Johnston, 2017). Therefore, the BESTest has been modified to the Kids-BESTest for more proper use with children. For example, the Kids-BESTest

has changed item 13 of the BESTest, which is standing and lifting 2.5 kilograms weight, to lifting a 1-kilogram weight instead. The Kids-BESTest had been applied in children with cerebral palsy aged between 8 and 17 years. The results from the patients of this age range showed excellent intra-rater reliability in the total score (ICC=0.99) and section scores (ICC=0.92-0.98). Seven systems approach components, namely neuromuscular synergies, musculoskeletal components, adaptive mechanisms, internal representations, anticipatory mechanisms, sensory strategies, and individual sensory systems, should be assessed for detecting abnormality of postural balance in children with cerebral palsy. Even though Gross Motor Function Measure (GMFM) and Pediatric Balance Scale (PBS) have generally used as standard measurements in typical and atypical children, evaluations have covered only 4 out of 7 systems approach components; anticipatory mechanisms, sensory strategies, sensory systems, and internal representations (Franjoine, Gunther, & Taylor, 2003; Kim, 2013). The Kids-BESTest is an assessment that can completely evaluate 7 systems approach components of the postural balance. (Dewar, Claus, Tucker, Ware, & Johnston, 2019). The original version of Kids-BESTest had been launched in 2019 and translated into the Turkish language in 2020 (Oruç & Candan, 2020). This study would be the second translation of the Kids-BESTest, this time into the Thai language. Therefore, the Kids-BESTest may be a new standard assessment for evaluating the problem of atypical children who have several problems of postural balance and functional activities in Thailand. The Thai version of Kids-BESTest may be easy to use for Thai physical therapists to interpret the postural balance problems in children with cerebral palsy, leading to an appropriate treatment setting. Therefore, this study aims to translate the Kids-BESTest from the original to the Thai version and examine the psychometric properties in terms of reliability in children with cerebral palsy.

2. Objectives

1) To translate the Kids-Balance Evaluation Systems Test (Kids-BESTest) from English to Thai.

2) To assess the inter - and intra - rater reliability of Kids-BESTest-Th in children with cerebral palsy.

3. Materials and Methods

3.1 Research Design

This study was an observational study of the reliability of the Kids-BESTest-Th. Ethical approval was granted by the Ethical Review Committee for Research Involving Human Subjects and/or Use of Animal in Research, Queen Sirikit National Institute of Child Health, Bangkok, Thailand, and the Ethical Review Committee for Research Involving Human Subjects and/or Use of Animal in Research, Srinakharinwirot University.

3.2 Sample size

The sample size was calculated using the formula of $N=[(Z\alpha+Z\beta)/(C(r))]^2 + 3$, which $Z\alpha = 1.96$, $Z\beta = 0.84$, and $C = 0.5 \times \ln[(1+r)/(1-r)]$ where $r = 0.9$ (Dewar, Claus, Tucker, Ware, & Johnston, 2019). The sample was ten for the reliability study.

3.3 Participants

Ten children with cerebral palsy were recruited from the Queen Sirikit National Institute of Child Health, Bangkok, Thailand. Participants were aged between 7-18 years. They would be eligible for inclusion should they had been diagnosed with CP by a physician and were able to 1) walk 6 meters independently with or without assistive devices (Gross Motor Function Classification System I-III) (Palisano, Rosenbaum, Bartlett, & Livingston, 2007) and 2) understand the instructions of the Kids-BESTest-Th. The participants would be excluded should they had a history of 1) orthopedic or neurological surgery that the physicians did not allow them to stand, 2) uncontrolled seizures, and 3) intellectual or behavioral disability that limits the perception of assessment.

3.4 Outcome Measures

3.4.1 The Thai Kids-Balance Evaluation Systems Test (Kids-BESTest-Th)

The Kids-BESTest-Th consisted of 36 items from 6 balance systems, namely, (1) Biomechanical constraints, (2) Stability limits/verticality, (3) Reactive postural responses, (4) Anticipatory postural adjustments; (5) Sensory orientation, and (6) Stability in gait. An item of Kids-BESTest-Th has 4 points of ordinal scales from 0 (severe impairment) to 3 (no impairment). The total scores of The Kids-BESTest-Th were 108. The total time for testing and scoring was approximately 30-35 minutes (Dewar et al., 2017; Horak, Wrisley & Frank, 2009).

3.5 Testing procedures

3.5.1 Procedure of translation

The Kids-BESTest was translated from the original vision (English) to the Thai version by 2 persons (forward translation). The first person is a professional English language translator (T1), and the second person is a physical therapist (T2). The Thai version of the Kids-BESTest from the first (T1) and the second (T2) translators had been compiled to be a Thai version by three experienced physical therapy lecturers. For backward translation, another professional English language translator (T3), who was blinded to the original version, translated the Thai version of Kids-BESTest into the English version. After that, both versions from original and back-translated documents were compared for accuracy by 2 physical therapists (T4 and T5). If there were items with disagreement, those items would be identified and re-translated by another translator. This process was repeated until the meaning of the translated document is mutually agreed upon. The final version of the Kids-BESTest-Th was measured in its content validity ratio by 4 physical therapists and a lecturer in the pediatric subject of a physical therapy program (T6-T10). All raters (T6-T10) have experience in the pediatric subject for at least 5 years. The content validity ratio (CVR) has 3 scores of essential (1), useful but not essential (0), and not necessary (-1). Items in the Kids-BESTest-Th were accepted in an agreement at the CVR of equal to 0.99 and over (Lawshe, 1975; Wilson, Pan, & Schumsky, 2012; Zamanzadeh et al., 2015). If some items in the Kids-BESTest-Th were not equal to 0.99. Those items would be re-evaluated by different physical therapist experts for their necessity. Lastly, the Thai version of Kids-BESTest-Th was ready for reliability.

3.5.2 Procedure of measurements

Before the measurement, the participants were asked to take off shoes and socks and wear comfortable clothes that are easy for movement. The participants were evaluated by the Kids-BESTest-Th. The participants were measured once, and they can rest during the test to avoid exhaustion. If the participants could not complete all assessments within one day, the assessments would be continued next time within 7 days. During the process of the measurement, all participants were commanded with the same standard verbal instructions and were recorded by a video camera in the front and side views. The reliability of the Kids-BESTest-Th was examined in 10 CP at the Queen Sirikit National Institute of Child Health, Bangkok, Thailand. The reliability was evaluated by 2 raters, both of which were physical therapists who have experience in clinical training in children with cerebral palsy for at least 1 year. The first (R1) and the second raters (R2) were trained to use the Kids-BESTest-Th before gathering data (Horak, 2008). The first rater (R1) measured and scored the Kids-BESTest-Th real-time while the second rater (R2) scored simultaneously with the first rater (R1). Approximately 1 week later, both raters repeatedly scored the Kids-BESTest-Th (R1, R2) from videos recorded. Scoring from the videos recorded could protect a confounding factor from changing postural balance after 1 week of children with cerebral palsy. Scores by the same rater from real-time and the videos were calculated as intra-rater reliability of the Kids-BESTest-Th, while real-time scores from the first and second raters (R1, R2) were calculated as inter-rater reliability of the Kids-BESTest-Th.

3.6 Data analysis

Descriptive statistical analyses of mean, standard deviation, percent, and the number of subjects were presented as characteristics of the participants. For the reliability, the scores of Kids-BESTest-Th in

real-time from the first and the second raters (R1, R2) were used for calculating inter-rater reliability. Besides, the scores by each rater, comparing real-time and from the videos recorded, were used for calculating intra-rater reliability. The reliability was calculated by the intraclass correlation coefficient (ICC). The 95% confidence intervals (95% CI) were also calculated using the analysis of variance models. The intraclass correlation coefficient model (ICC) 2, 1 and 3, 1 were used for the inter-rater and intra-rater reliability respectively. The ICC values > 0.90 were considered as excellent, 0.75–0.90 as good, and <0.75 as poor to moderate reliability (Portney & Watkins, 2009).

4. Results and Discussion

The content validity ratio (CVR) of the Thai Kids-Balance Evaluation Systems Test (Kids-BESTest-Th) showed equivalence of 0.99 in all items (Table 1). Therefore, the Thai version of Kids-BESTest-Th was ready for reliability and validity testing.

Table 1 Summary of the measurement for quantification of content validity in the Thai Kids-Balance Evaluation Systems Test (Kids-BESTest-Th) by 4 physical therapists and one lecturer (T6-T10)

Item	Essential (1)	useful but not essential (0)	Not necessary (-1)	CVR = (Ne - N/2) / (N/2)
Item 1	√			0.99
Item 2	√			0.99
Item 3	√			0.99
Item 4	√			0.99
Item 5	√			0.99
Item 6	√			0.99
Item 7	√			0.99
Item 8	√			0.99
Item 9	√			0.99
Item 10	√			0.99
Item 11	√			0.99
Item 12	√			0.99
Item 13	√			0.99
Item 14	√			0.99
Item 15	√			0.99
Item 16	√			0.99
Item 17	√			0.99
Item 18	√			0.99
Item 19	√			0.99
Item 20	√			0.99
Item 21	√			0.99
Item 22	√			0.99
Item 23	√			0.99
Item 24	√			0.99
Item 25	√			0.99
Item 26	√			0.99
Item 27	√			0.99

4.1 Demographics and characteristics of participants

Ten children with cerebral palsy (5 males and 5 females) aged between 9-18 years old were recruited in this study. The characteristics of the participants which consisted of age, gender, type of cerebral palsy, weight, height, and GMFCS level were shown in Table 2.

Table 2 Demographic and characteristic of participants

Characteristics	All Participants (N = 10)
Age (years: Mean ± SD)	10.43 ± 1.17
Gender (Male: Female)	5 : 5
Weight (kg: Mean ± SD)	34.2 ± 14.48
Height (cm: Mean ± SD)	134.7 ± 9.89
Type of cerebral palsy	
Diplegia (n, %)	7, 70%
Right hemiplegia (n, %)	2, 20%
Ataxia (n, %)	1, 10%
GMFCS-E&R level	
I (n, %)	6, 60%
II (n, %)	1, 10%
III (n, %)	3, 30%
Gait aids	
Independent walking (n, %)	8, 80%
Posterior walker (n, %)	2, 20%

Note: *GMFCS-E&R level, Gross Motor Function Classification Expanded & Revised level

4.2 Reliability

The ICC of Kids-BESTest-Th from the first (R1) and the second raters (R2) showed in Table 3. The results showed excellent inter and intra-rater reliability of the total scores and section scores (ICC > 0.94).

Table 3 Reliability of the Kids-BESTest-Th (n=10)

Kids-BESTest-Th	Inter-rater (ICC2, 1)	95 %CI	Intra-rater (ICC3, 1) (Rater 1)	95 %CI	Intra-rater (ICC3, 1) (Rater 2)	95 %CI
1. Biomechanical constraints	0.98	0.923-0.995	0.97	0.886-0.993	0.944	0.792-0.986
2. Stability limits/verticality	0.947	0.804-0.987	0.988	0.952-0.997	0.963	0.859-0.991
3. Reactive postural responses	0.993	0.973-998	0.989	0.958-0.997	0.989	0.955-0.997
4. Anticipatory postural adjustments	0.982	0.929-995	0.997	0.988-0.999	0.986	0.945-0.996
5. Sensory orientation	0.996	0.985-0.999	0.997	0.989-0.999	0.998	0.992-0.999
6. Stability in gait	0.993	0.972-0.998	0.99	0.959-0.997	0.974	0.9-0.974
Total score	0.999	0.995-1.000	0.999	0.998-1.00	0.998	0.99-0.999

ICC – intraclass correlation coefficient; CI – confidence interval; Kids-BESTest-Th – Thai Kids-Balance Evaluation Systems Test

4.3 Discussion

The purpose of the study was to translate the Kids-BESTest-Th from the original (English) into Thai version and measure the psychometric property of the reliability before adoption by physical therapists in Thailand. The Kids-BESTest was a notable measurement that would be different from other standard measurements such as Gross Motor Function Measure (GMFM) and Pediatric Balance Scale (PBS) (Franjoine, Gunther, & Taylor, 2003; Kim, 2013). While PBS and GMFM measured only static and dynamic balance and functional activity in CP, the Kids-BESTest can be used to assess the complex motor problem in children with cerebral palsy which covers many aspects of postural control such as biomechanical constraints, reactive postural responses, and sensory orientation. The Kids-BESTest-Th had measured postural balance in CP without floor and ceiling effects (Dewar et al., 2019; Rutka & Pałac, 2020). The Kids-BESTest had recently translated into the Turkish language in 2020 and has been translated into the Thai language in this study (Oruç & Candan, 2020). The original version found good to excellent intra-rater and inter-rater reliability of the total score and section scores (ICC=0.70-0.99) when measured in school-aged with cerebral palsy (Dewar et al., 2019). This study also showed excellent inter-rater reliability in the total (ICC 0.999) and section scores (ICC 0.947 to 0.996) and excellent intra-rater reliability in the total (ICC 0.998 to 0.999) and section scores (ICC 0.944 to 0.998) conform to a previous study (Dewar et al., 2019). The other previous study also showed excellent reliability of the Kids-BESTest (ICC 0.95 to 0.97) and Kids-Mini-BESTest (ICC 0.87 to 0.99) in children with down syndrome (Rutka & Pałac, 2020). The results implied that the Kids-BESTest-Th can be adopted for assessing postural balance in cerebral palsy. The excellent reliability could be explained by a clear instruction and scoring system of the Kids-BESTest, of which almost all items were quantitative measurements, leading to scoring without a subjective decision. According to the protocol of the study, assessors who would score using the Kid-BESTest had to understand the Kids-BESTest before applying it (Dewar et al., 2019; Rutka & Pałac, 2020). In this study, the raters had also been prepared by reading the instruction and trained to score from video samples before performing with cerebral palsy. Consequently, understanding the Kid-BESTest-Th would be the main factor that contributed to the excellent reliability. Therefore, the study recommended that the raters should study the instruction and rehearsed scoring with the Kids-BESTest-Th before actually using it. The other suggestion for using the Kids-BESTest-Th will be the characteristics of the children. Regarding the subjects of the study, the Kids-BESTest-Th will be suggested to apply in school-aged children to adolescence who can understand and follow the instructions. They should be able to walk as diplegia and hemiplegia. Even though the study showed excellent reliability of the Kids-BESTest-Th, the rather small number of the participants and types of cerebral palsy that were not diverse, only spastic diplegia and hemiplegia, were limitations of this study. Suggestions for further study might be to increase the number of subjects and recruit various types of cerebral palsy.

Because of the excellent reliability, the Kids-BESTest may be suggested as a new balance measurement for physical therapists in Thailand. It can evaluate balance problems and detect impairment of the balance systems in cerebral palsy. The Thai version of Kids-BESTest might be easier for Thai physical therapists for evaluating the postural balance problem in children with cerebral palsy. An obvious evaluation from the Kids-BESTest-Th can guide the physical therapists to create an appropriate treatment and detect the responsiveness of treatment in children with cerebral palsy. Increasing the sample size and recruiting more types of cerebral palsy will be recommended for further study. Furthermore, the psychometric properties of concurrent validity and responsiveness should be the next study of the Kids-BESTest-Th.

5. Conclusion

The Kids-BESTest was translated from the original (English) to the Thai version (Kids-BESTest-Th) for evaluating the balance systems of cerebral palsy in Thailand. The psychometric property of the reliability was examined in the Kids-BESTest-Th and showed excellent results in both total and section scores (ICC = 0.94). Therefore, the Kids-BESTest-Th is reliable for the physical therapists to apply for assessing balance systems in school-age children and adolescence with cerebral palsy. However, the study recommended the physical therapists learn the instruction and try to understand the Kid-BESTest-Th before applying it with the patients. Concurrent validity and responsiveness were suggested for further study.

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