OCCUPATIONAL THERAPY INTERNATIONAL
Occup. Ther. Int. (2009)
Published online in Wiley InterScience
(www.interscience.wiley.com) **DOI:** *10.1002/oti.281*

Development of the Chinese language paediatric daily occupation scale in Taiwan

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ABSTRACT: *The aim of this study was to describe the development of the paediatric daily occupation scale (PDOS) that was validated with Taiwanese children aged from birth to 72 months. Item–scale correlation coefficient was also used to select items. The psychometric properties of PDOS were examined based on the results of 957 children who participated in the study. The Chinese child development inventory (CCDI) was used as a standard to examine the concurrent validity of PDOS on two different samples.*

The PDOS, completed by parents, contains 340 items with good internal consistency (Cronbach's $\alpha = 0.99$*), test–retest reliability* ($r = 0.99$) *and concurrent validity* ($r = 0.88$ *between PDOS and CCDI). The sensitivity of PDOS (83%) in detecting children with developmental problems was much higher than CCDI (33%).*

Because the PDOS is developed and examined on children from greater Taipei area, when using the PDOS with children from different socio-cultural environments, the results need to be interpreted cautiously. Further research of the PDOS to justify its use as a screening tool for early detecting of children with developmental problems is suggested. Copyright © 2009 John Wiley & Sons, Ltd.

Key words: child developmental scale, daily occupation, paediatric occupational therapy

Introduction

Learning to perform functional activities in a variety of environments or contexts is essential to an individual's survival (Bruner, 1972). Although a child

has a wide repertoire of potential abilities, only those abilities that meet environmental demands are most likely to develop and eventually be maintained (Kellegrew, 1998). Furthermore, according to Gibson's theory of affordances (Gibson, 1977), the environment and objects in it that are meaningful to the child are more easily to elicit his/her action than an artificially designed situation. Therefore, the effectiveness of a child's interaction with his/her environment should be the indicator of the soundness of child development. However, most of the developmental assessment tools, such as the Battelle Developmental Inventory (BDI) (Newborg et al., 1988) and the Bayley scales of infant development (Bayley, 1993), examine a child's performance skills or abilities such as fine motor, gross motor, cognitive, social and communication by using standardized method with specific modalities rather than collecting information on a child's performance in his/her natural environment. Separate assessment of performance skills or abilities, respectively, often results in a fragmented representation of a child and has limited power to predict future functioning (Thelen, 1995; Diamond, 2000; Magnusson, 2000; American Academy of Pediatrics, 2001). Because of this consideration, the third edition of the Bayley scales of infant and toddler development added new test items which use a caregiver's or parent's involvement to allow more input to be gathered from the child's natural environment to assess a child's social–emotional and adaptive behavior (Bayley, 2005). However, its three major components – cognitive, language and motor – are still tested with the child directly by an examiner.

The International Classification of Functioning, Disability, and Health (ICF) published by the World Health Organization (2001) emphasizes how individuals interact with their environment and the capacity of the individual to live a full life in society. Consistent with this concept, the Assessment, Evaluation, and Programming System (AEPS) for infants and children (Bricker, 2002) was developed as an activity-based child development assessment tool. In AEPS, information is gathered by observing a child during his/her typical daily routines. However, in order to link assessment, goal development and intervention together, AEPS focuses on a child's skills and abilities in different developmental areas rather than on the efficacy of a child's functional performance itself. The short child occupational profile (Bowyer et al., 2005) is designed according to the model of human occupation (MOHO) (Kielhofner, 2002) to assess children's occupational functioning according to information gathered from formal or informal observation and interviewing. However, the components of MOHO such as volition, habituation, communication/interaction skills, process skills, motor skills and the environment are used as the constructs rather than the occupational performance itself.

It is believed that engaging in occupations structures everyday life and contributes to health and well-being (American Occupational Therapy Association, 2008). For young children, occupational participation and performance should be the ultimate goal of development. In order to gather information on a child's occupational participation and performance, an occupation-based,

DOI: 10.1002/oti

naturalistic, context-driven assessment model is more pertinent than an ability-based design. Parents are the ones who observe their children in the context of daily occupations. There is evidence that parental reports of a child's abilities are predictive of developmental delays (DDs) (Bricker and Squires, 1989; Diamond, 1993; Doig et al., 1999). Parents may even detect abnormalities in a child's development much earlier than a clinical diagnosis can be made (Ei-Hazmi, 1997). In addition, using parental reports is the most cost-effective method to collect data (Glascoe et al., 1997). The child development inventory (CDI) (Ireton, 1992; Ireton and Glascoe, 1995) is one of the very few developmental assessment tools that use parental reports. However, it is focused on measuring a child's performance skills and abilities rather than occupational performance. To date, there isn't any comprehensive context-driven occupational participation and performance assessment tool designed for young children (Mulligan, 2003).

The purpose of this study was to develop and examine the psychometric properties of an assessment tool using parental reports to gather information on young children's occupational performance in everyday life, the paediatric daily occupation scale (PDOS) in Taiwan. The items of the PDOS are occupation-based behaviours observable in children's daily lives. Occupation here is defined as goal-directed pursuits that children engage in throughout their daily lives to fulfill their time and give life meaning (American Occupational Therapy Association, 2008). Occupation-based behaviours are actions that have specific meaning to children and support children's health and participation in daily life (American Occupational Therapy Association, 2008). An occupation can be composed of a set of small unit activities including repetitive or exploratory behaviours, but the ultimate goal of the action is to consciously fulfill specific physical, psychological or spiritual needs. For example, behaviours such as 'children may use a spoon to feed themselves' or 'children may bang a spoon on a table and enjoy the effect of the action' are both considered to be occupations for a young child. The child's performance as well as the real-life settings that support or deter development are considered. The scope of the activities and participation section of the ICF–children provides a comprehensive reference structure for the composition of PDOS (World Health Organization, n.d.). According to the definition of occupation and occupation-based behaviour, occupational performance is a unified action of all the bio–psycho-social functions of the environment (Kielhofner, 2002). Therefore, although the PDOS covers different occupation categories, it is essentially a unidimensional scale.

Method

Scale development

The items of the PDOS were mainly identified from two sources: (1) items of developmental scales designed for children less than 6 years old that met the

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definition of occupation for this study were identified and then translated into Chinese by a research assistant; and (2) 15 children aged less than 6 were observed and videotaped for two whole days (one week day and one weekend), and the videotapes were later transcribed into descriptions by two research assistants trained by the principal investigator (PI). The two research assistants were occupational therapy graduate students with 2 years working experience in paediatric occupational therapy. The PI identified occupations from these transcriptions thereafter. Items from the two sources were then pooled together and sequenced according to their developmental ages, and then discussed by the PI and the two research assistants one by one. Each item has to be a purposeful behaviour in a specific context to meet the definition of occupation for this study, and item descriptions have to be easily understood by laypersons. For example, 'opens door by turning knob' in BDI (Newborg et al., 1988) was modified to 'opens and closes door by turning knob repetitively for fun', and 'gives detailed information about self' in the preschool developmental profile (PDP) of the developmental programming for infants and young children (Brown et al., 1981) was modified to 'tells own experience sequentially such as the experience of going to a zoo'. Similar items were integrated.

The first draft of the PDOS was filled out by parents of 350 children after signing a consent form. Items that were difficult to understand or observe were modified or deleted according to the parents' feedback on the scale items. Because the PDOS was designed as an occupational framework for children less than 6 years old, only occupations typical for regular children were included. Thus, the sample subjects were divided into 18 different age groups: children less than 3 years were grouped by 3-month intervals, while children aged from 3 to 5 years were grouped by 6-month intervals. For each item, the passing percentage was calculated for children in each age group. Items with a passing percentage lower than 75 in all the age groups indicating that they may not be typical occupations for regular children were deleted. The remaining items were sequenced by the highest passing age to create the second version of the PDOS.

Parents of children in the 27 public nursery schools in Taipei city were invited by the teachers to participate in this study, and 1341 of them filled out the PDOS after they signed a consent form. Among them, 209 parents of children from four nursery schools were invited to fill out the PDOS twice with a 2-week interval in between for analyzing the test–retest reliability of it. Meanwhile, the PDOSs were collected continuously at a paediatric health clinic and from colleagues of the PI for children under 3 until all the PDOSs were returned from the schools. The 350 children's first draft PDOSs were recoded according to the second version of the PDOS, and then combined with the PDOSs collected later for a total of 2064 PDOSs.

Then, the Rasch analysis was used to calibrate the items of the second version of PDOS for goodness-of-fit test (Wright and Stone, 1979). The WINSTEPS Rasch measurement software (Rasch Measurement Software and Pub-

DOI: 10.1002/oti

lications, 2002) was used with a criterion of OUTFIT MNSQ 0.7–1.3. Values of outfit MNSQ statistics that fall within the range indicate that the child or item fits a Rasch rating scale model reasonably well (Smith, 1999). On the other hand, values outside the range suggest possible misfit of a child or item to a Rasch rating scale model. Thus, any children or items outside the range were deleted. Moreover, item–scale correlation coefficients were calculated afterwards, and items with an $r < 0.30$ were further deleted. All items remaining were constructed into the final version of PDOS. The percentile score of the PDOS for each age group was calculated as the norm.

Participants

A convenience sample of 15 Taiwanese children less than 6 years of age were recruited from colleagues and neighbours to initially develop the PDOS. The sample consisted of three children under 1, three 1-year olds, four 2-year olds, one 3-year old, two 4-year olds and two 5-year olds. Their daily occupations were observed and videotaped.

Another sample of 350 children in Taiwan (166 boys, 184 girls), aged from birth to 72 months without any clinical diagnoses, was used to examine the usefulness of the occupational items in the first draft of the PDOS. Among them, 252 children were recruited from the paediatric health clinic in a hospital, 92 children were randomly selected from two nursery schools and one kindergarten in Taipei County and six were children of co-workers of the PI.

For examining the psychometric quality of the PDOS, 2064 Taiwanese children aged from 0 to 72 months participated in the study. They included 1341 children recruited from all 27 public nursery schools in Taipei City (25% of the total enrolled children), 362 children (mainly under 3 years of age) recruited from the paediatric health clinic in a hospital, 11 recruited from colleagues and 350 from the earlier stage. Among them, 957 children's PDOSs meet the criteria of the goodness-of-fit test and were used to develop the norms of PDOS and for further psychometric analyses.

The average age of the 957 children (494 boys and 463 girls) was 40.6 months (SD = 23.3). The average ages of the 957 children's mothers and fathers in years were 33.9 (SD = 4.7) and 37.0 (SD = 5.5). Caregivers and parents had an average of 12.6 years of education (SD = 3.4; 21% were college graduates).

In addition, another two groups of children were recruited to examine the validity of PDOS: (1) 512 children from 39 private nursery schools in the 12 district areas of Taipei City, 250 boys and 262 girls, age ranged from 6 to 71 months; and (2) 119 children who had been diagnosed as developmentally delayed or disabled, and receiving occupational therapy service in a teaching hospital, 81 boys and 38 girls, age ranged from 9 to 72 months. A summary of the participants is displayed in Table 1.

TABLE 1: Participants in different stages of the developmental process of the paediatric daily occupation scale

Purpose	Participant
Scale development	
Item generating	A convenience sample of 15 children
Usefulness examination	A convenience sample of 350 children: 252 from the paediatric health clinic in a teaching hospital, 92 from two nursery schools and one kindergarten and six from colleagues
Psychometric property examination	
Rasch analysis	2064 children: 1341 from 27 public nursery schools in Taipei City, 362 from the paediatric health clinic of a teaching hospital, 11 from colleagues and 350 from the second stage
Reliability analyses	957 of the 2064 children filtered in by using Rasch analysis
Validity analyses	(1) 957 of the 2064 children filtered in by using Rasch analysis (2) 512 children from 39 private nursery schools in Taipei City (3) 119 children from the occupational therapy department of a teaching hospital

Measure

The Chinese child development inventory (CCDI) (Hsu et al., 1978) was used as a criterion to investigate the PDOS's concurrent validity. The CCDI was revised from the Minnesota child development inventory (MCDI, the first edition of CDI) (Ireton, 1972; Ireton and Glascoe, 1995) and has been standardized locally on children from 6 to 78 months (Hsu et al., 1978). It is one of the most popular developmental scales currently used for screening children with developmental problems in Taiwan. The CCDI, a parent-reported scale, contains 320 yes/no observable behavioural items grouped into eight subscales: gross motor, fine motor, expressive language, concept comprehension, situational comprehension, self-help, personal–social and general development. Developmental age is provided for each subscale as the norm. A developmental quotient (DQ), calculated by dividing the developmental age by a child's chronological age and then multiplied by 100, lower than 70 indicates a marked DD. Adequate concurrent validity was reported between CCDI and the Denver developmental screening test ($r = 0.64$–0.84 for different domains), the draw-a-person test ($r = 0.69$) and the Chinese version of revised Stanford–Binet intelligence scale ($r = 0.64$) (Hsu et al., 1978). However, the sensitivity rate of CCDI was not reported, and that of MCDI was low (56%) (Shoemaker et al., 1993).

Data analysis

Internal consistency and test–retest reliability of the final version of PDOS were analysed by computing Cronbach's coefficient α and intra-class correlation (ICC) (Bartko, 1966; Shrout and Fleiss, 1979), respectively. The validity of the PDOS was determined by three methods. The first was to compare the mean scores on the PDOS of the 18 age groups of children. A developmental scale should be able to discriminate among children in different age groups. That is, the mean scores of PDOS in later age groups should significantly increase, and limited score variability within each age group was expected. In this way, comparable children who fall below the normal range can be identified with reasonable confidence as developing behind age expectations. Thus, the mean scores on the PDOS of the 18 age groups of children were compared by using analysis of variance (ANOVA). If a significant difference was found, Tukey's post hoc tests would be used thereafter to compare the means of each two consecutive age groups.

Second, the correlation between PDOS and CCDI was investigated. Parents of 512 children of the 39 private nursery schools were invited to fill out the PDOS and CCDI for their children, respectively, with a 2-week interval in between. Three methods of analyses were used: (1) the Spearman rank-order correlation coefficient was calculated between PDOS and CCDI scores; (2) independent *t*-tests were used to compare the PDOS percentile scores of children whose GD subscale scores on the CCDI were in the upper one-third and the lower one-third range of the group; and (3) two expectancy tables were calculated to divide children by standard deviation intervals and into quartiles using their PDOS and the GD scores of the CCDI. Next, the concordant and discordant values of the two expectancy tables were compared.

Third, the sensitivity rates of PDOS and CCDI were investigated. Parents of children who were receiving occupational therapy in a teaching hospital for DD or disabilities were invited to participate in this study. The PDOS and CCDI were filled out by the parents in a counterbalanced sequence with a 1-week interval in between. For calculating the sensitivity rates, a percentile score of 15 was used as the cut-off point for PDOS, and a DQ of 70 for the GD subscale was used as the cut-off point for CCDI.

Results

Scale development

The first draft of the PDOS contained 895 items; 339 items derived from developmental scales and 556 items from field observation. Based on the feedback of 350 parents, 86 items that were unclear or difficult to identify were deleted. Of the remaining 809 items, 627 items with a 75% or higher passing rate for at least one age group were selected and sequenced by the earliest passing age to develop the second version of the PDOS.

DOI: 10.1002/oti

Next, using Rasch logistic model with a criterion of OUTFIT MNSQ = 0.7–1.3 for goodness-of-fit test, 64 of the 2064 children's PDOSs with a 100% passing rate were first deleted by the model. Then, 1043 children's PDOSs which did not meet the criterion were further deleted. With the remaining 957 children's PDOSs, again using the criterion of OUTFIT MNSQ = 0.7–1.3 to check the items, 275 of the 627 items that misfit a Rasch rating scale model were deleted. Finally, 12 items with an item–scale correlation coefficient $r < 0.30$ were also deleted. The remaining 340 items with a coefficient r from 0.31 to 0.93 were constructed as the final version of the PDOS. Among them, 129 items were derived from four developmental scales: the BDI (Newborg et al., 1988), *Developmental Programming for Infants and Young Children – Preschool Developmental Profile* (Brown et al., 1981), the *Southern California Ordinal Scales of Development – Development Scale of Practical Abilities* (Ashurst et al., 1985) and the early learning accomplishment profile for young children: birth to 36 months (Glover et al., 1995), and the other 211 items are from observation. Table 2 shows some sample items from the final version of the PDOS. The percentile scores of the PDOS for 18 age groups were calculated as the norms based on the scores of the 957 children.

Reliability analysis

Reliability analysis found that the Cronbach's coefficient $\alpha = 0.99$ ($n = 957$), indicating that the PDOS has high internal consistency. Seventy-seven of the 957 subjects completed the PDOS twice with a 2-week interval in between. The ICC for test–retest scores of the PDOS was 0.99, indicating that the PDOS has very high 2-week test–retest reliability.

Validity analysis

Comparison between age groups

By using ANOVA, a significant difference was found among the means of the PDOSs of the 18 groups of children [F (17, 939) = 12067.74, $p < 0.001$] (Table 3). Further, using Tukey's post hoc tests to compare the means of each two consecutive age groups, significant differences were found for test scores between all age groups ($p < 0.05$) except three: the 25- to 27-month and 28- to 30-month, 31- to 33-month and 34- to 36-month, and 61- to 66-month and 67- to 72-month age groups.

Correlations between PDOS and CCDI

A high correlation coefficient ($r = 0.88$, $p < 0.001$, $n = 512$) was found between PDOS and CCDI scores. Further, children who scored in the upper one-third

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TABLE 2: Sample items of the paediatric daily occupation scale

Item no.	Occupation category	Content	Source
126	Mobility	Climbs up onto an adult-sized chair to sit without assistance	Observation
128	Community, social and civic life	Plays ball with others such as throwing and catching the ball or picking up the ball when missed or dropped	Observation
145	Learning and applying knowledge	Uses different ways to look at a book, such as upright, upside down or close to the face	Observation
153	Domestic life	Helps with chores actively such as throwing away a wet diaper	SCOSD-PA
160	General tasks and demands	Replaces toys or books correctly as requested	Observation
161	Self-care	Tells an adult actively where there is pain to get caring or comfort	Observation
166	Interpersonal interactions and relationships	Brings a storybook to someone and ask for storytelling	Observation
281	Communication	Tells own experience sequentially such as the experience of going to a zoo	PDP
290	Major life areas	Follows command to finish three different tasks in sequence, such as 'put the toys away, brush teeth and go to bed'	PDP

PDP = *Preschool Developmental Profile of the Developmental Programming for Infants and Young Children*; SCOSD-PA = *Southern California Ordinal Scales of Development – Development Scale of Practical Abilities*.

range of the GD scores on the CCDI had significantly higher PDOS percentile scores than children in the lower one-third range ($t = 4.99$, $p < 0.001$). In addition, for the two expectancy tables, significant concordances were found between the PDOS and GD scores with $\gamma = 0.97$ and 0.91 ($p < 0.001$), respectively. The details of the validity study have been published elsewhere (Chiu and Lo, 2005).

Sensitivity rates of the PDOS

Of the 119 children with DD, 83.2% had a PDOS percentile score below 15, indicating the sensitivity rate of the PDOS is 83.2%. On the other hand, only

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TABLE 3: Mean values and standard deviations of paediatric daily occupation scale for the 18 age groups

Age (month)	*N*	Mean	SD
0–3	92	8.85	4.06
4–6	70	28.97	7.91
7–9	18	51.22	12.22
10–12	7	78.71	13.72
13–15	16	113.25	23.10
16–18	12	139.83	22.28
19–21	19	170.37	14.35
22–24	10	187.30	12.29
25–27	24	219.71	13.20
28–30	22	222.27	15.13
31–33	35	248.14	10.40
34–36	66	253.35	9.67
37–42	56	267.23	5.55
43–48	88	281.55	4.36
49–54	79	313.62	6.86
55–60	101	324.60	6.24
61–66	94	335.93	3.00
67–72	148	337.05	2.71

32.8% of the children had a DQ of GD below 70, indicating the sensitivity rate of the CCDI is low. The results indicate that the PDOS is more sensitive than the CCDI in identifying children with DD.

Discussion

The purpose of this study was to develop an occupation-based child developmental scale that reflects the child's occupational performance in everyday life, which is different from traditional developmental scales measuring domains of performance skills and abilities. The PDOS was designed as a unidimensional scale; scope of the activities and participation section of the ICF-children were used as a reference for its construct. By using Rasch logistic model, the PDOS was developed as a sample-independent objective scale. When using PDOS to measure a child's occupational performance, item difficulty is taken into account.

For children less than 6 years old, the PDOS takes 25–35 min for parents to complete. It has good internal consistency and test–retest reliability. Percentile scores for 18 age groups are provided as the norm. However, because the differences of the means of three consecutive age group pairs (the 25- to 27-month

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and 28- to 30-month, 31- to 33-month and 34- to 36-month, and 61- to 66-month and 67- to 72-month age groups) did not reach significant levels, the discrimination ability between these three age group pairs is not adequate. The results suggested that for 2-year olds, grouping by 6-month intervals may be more appropriate than 3-month intervals; while for 5-year olds, 1-year intervals may be better than 6-month intervals. However, continuing research is needed to provide solid evidence for making this conclusion.

The high correlations between PDOS and CCDI indicated that the PDOS well represented children's developmental level. But, it might also suggest that the two scales are very similar. However, when using the two scales to identify children with DD, the sensitivity rate of PDOS is much higher than that of CCDI (83.2 vs. 32.8%). The results indicated that the performance skills and abilities as measured by CCDI might not predict a child's everyday occupational performance as measured by PDOS.

The layout of the PDOS provides information of a repertoire of typical children's daily occupations. By using the PDOS, health professionals might gain more insight into children's performance and participation in everyday occupations and contexts. The assessment results of the PDOS provide an occupational framework for the child's strengths and limitations in interactions with the environment. These results can be effectively utilized to formulate developmentally appropriate occupational goals for the child in order to develop a top-down, occupation-based intervention programme. The PDOS can also be used to monitor a child's progress.

In 2008, for children less than 6 years old, only 1.00% of them were identified as DD in Taiwan (Child Welfare Bureau, Ministry of the Interior, n.d.; Department of Statistics, Ministry of the Interior, n.d.). It is less than one-third of that in the United States (Simpson et al., 2003). The PDOS might help the parents and public health personnel to early identify children with or at risk of DD. The information obtained through the PDOS can remind parents to notice their children's repertoire of daily occupations and provide a more effective framework for them to facilitate their children's development.

Limitations and recommendations for further research

The PDOS is an occupation-based scale developed according to the information collected from children less than 6 years old of average families in the Chinese-speaking, greater Taipei area (including rural, suburban and urban areas). However, because occupations are context bound and may be influenced by socio-cultural factors, when using the PDOS with children from different socio-cultural environments, the results need to be interpreted cautiously. However, the scope of the PDOS is the same as that of the activities and participation section of ICF, which is intended to be universal for children. So, the PDOS should still provide parents and health professionals an occupational framework of young children. Another potential limitation is that for parents who do not

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pay much attention to their children's daily occupations, using the PDOS might underestimate the children's performance. However, by using PDOS, the parents can be encouraged to be attentive to their children's daily occupations. In addition, the PDOS takes about 25–35 min for parents to finish and this may be somewhat laborious to some parents. A shorter version would be easier for the parents to complete. Furthermore, for children of the 25- to 27-month and 28- to 30-month, 31- to 33-month and 34- to 36-month, and 61- to 66-month and 67- to 72-month age groups, the discrimination ability of the PDOS is not as adequate as it is for the other age groups.

Further study of the efficacy of the PDOS in identifying children with DD, such as studies of sensitivity, specificity, positive and negative predictive values and accuracy, might justify its use as a screening tool for early detecting children with developmental problems in terms of occupational participation.

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