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Validity of the Family-Rated Kinder Infant Development Scale (KIDS) for Children

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Abstract

Background: Our objective was to test the validity of the Kinder Infant Development Scale (KIDS) rated by families of children.

Methods: A total of 317 children (151 healthy children and 166 disabled patients) participated in this prospective study. To prove the validity of the family-rated KIDS, period of gestation, birth weight, diagnosis, age, and results of the family-rated Ages & Stages Questionnaires, Third Edition (ASQ-3), family-rated Ability for Basic Movement Scale for Children (ABMS-C) and Ability for Basic Movement Scale for Children type T (ABMS-CT), and staff-rated Functional Independence Measure for Children (WeeFIM) were recorded.

Results: Developmental age and quotient on the 9 subscales of the family-rated KIDS had appropriate internal consistency (Cronbach's α=0.969, 0.942). The total developmental age assessed with KIDS correlated with age, the total scores for the ABMS-C and ABMS-CT, the motor and cognitive WeeFIM (r=0.839-0.894, p<0.01). The total developmental quotient by KIDS was correlated with the period of gestation and birth weight of the children by low correlation coefficient (r=0.353, 0.299, p<0.01).

Conclusions: This study provides evidence for the validity of the family-rated KIDS for assessing the developmental age of children in early childhood.

Keywords: Children; Kinder Infant Development Scale (KIDS); Development; Functional ability

Introduction

The Kinder Infant Development Scale (KIDS), which was developed by the Center of Developmental Education and Research in Japan, is convenient and easy to use and can be easily administered by parents. This test was standardized in 1988 and 1989 using 6000 children aged 0 to 6 years [1]. However, the validity of the family-rated KIDS for healthy and disabled children has been rarely evaluated [2]. The objective of this study was to test the validity of the family-rated KIDS by assessing the relationship between the family-rated KIDS score and scores for developmental status by the Ages & Stages Questionnaires (ASQ), Third Edition (ASQ-3), Ability for Basic Movement Scale for Children (ABMS-C), and Ability for Basic Movement Scale for Children type T (ABMS-CT), and scores for activities of daily life as assessed by the Functional Independence Measure for Children (WeeFIM).

The ASQ is a screening system that was developed by the University of Oregon's Center on Human Development [3-5]. The ASQ is comprised of 21 age-specific questionnaires to be completed by parents of children in the age range of 1 to 66 months (21 questionnaires and scoring sheets for use at 2, 4, 6, 8, 9, 10, 12, 14, 16, 18, 20, 22, 24, 27, 30, 33, 36, 42, 48, 54, and 60 months of age) with a third edition recently published (Squires J, Bricker D et al, 2009). The ASQ was developed as a parent-completed screening method of monitoring children who are at risk for developmental delay [3]. This structured questionnaire involving five domains of development has been shown to be cross-culturally valid in the United States and other Western countries [6-7].

In 1987, the Functional Independence Measure (FIM) was adapted for use in pediatric patients by a multidisciplinary team of physicians, nurses, and therapists [8]. The resultant scale, known as the WeeFIM, is a measure of functional abilities and the need for assistance that is associated with various levels of disability in children aged 6 months to 7 years. It can also be used in children much older than 7 years if delays in functional performance are evident. The WeeFIM is widely used in the field of pediatric rehabilitation medicine.

The ABMS is a scale for assessing the ability for gross motor function in early childhood [9-10]. Therefore, in assessing the validity of the family-rated KIDS, we determined whether the results of the family-rated KIDS, ASQ-3, ABMS-C, and ABMS-CT and the staff-rated WeeFIM were comparable.

This study was supported by the Japan Environment and Children's Study (JECS). JECS is a birth cohort study involving 100,000 parent-child pairs, was launched in 2011 to evaluate the impact of various environmental factors on children's health and development. The concept plan of JECS was published in March 2010 after three years of development within expert groups and public discussions about the research hypotheses and aims. Pilot studies started in 2008 at four universities and samples from two preceding cohorts (Hokkaido and

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Tohoku) were used to establish exposure measurement protocols. Recruitment of pregnant women started in January 2011 and will continue until 2013. Health outcomes and exposure measurements will continue until the participating children become 13 years old [11]. Our institute, the National Center for Child Health and Development, supports this study from the medical aspect as the Medical Support Center. One of our jobs is to develop appropriate questionnaires to evaluate the development of participants and ensure their validity and reliability.

Study Population and Methods

To develop appropriate questionnaires to evaluate the development of participants and ensure their validity and reliability in The Japan Environment and Children's Study (JECS). We recruited participating children and their families from January to November 2012, 151 apparently healthy children and 166 pediatric patients with motor impairment, cognitive impairment, or both were assessed for developmental status at Nico Children's Clinic and the National Center for Child Health and Development, Tokyo, Japan. The subjects were 169 boys and 148 girls with a median age of 20.00 months, median 2.00 years old (range, 2 to 69 months, zero to 5 years old). Of the 166 patients, 9 had cerebral palsy, 10 spinal bifida, 3 hypoxic encephalopathy, 4 chromosomal abnormality, 28 motor retardation, 6 mental retardation, 5 delayed language, 26 developmental disorders, 4 hearing disorder, 7 hydrocephalus, 6 Chiari malformation, 4 encephalitis, 2 osteogenesis imperfecta, 2 epilepsy, 15 small for gestational age, 3 craniosynostosis, 4 hypothyroidism, 6 metabolic disorders, and 22 had other conditions (Table 1).

Tests

All study participants underwent an examination to evaluate their developmental status. We screened the developmental age and quotient by KIDS, developmental and social-emotional status using the ASQ-3, gross motor function by ABMS-C and ABMS-CT, and activities of daily life by the WeeFIM in the healthy subjects at Nico Children's Clinic and in the disabled patients at National Center for Child Health and Development. KIDS, ASQ-3, ABMS-C and ABM-CT were conducted by their families (mother or father of the subject). WeeFIM was rated by medical staffs (clinical psychologist, medical clerk, or occupational therapist).

	Median	Range
Age, mo	20.00	2-69
Period of gestation, w	38.00	23-42
Birth weight, g	2892.00	476-4170
gender	169 boys	148 girls
diagnosis	number	
cerebral palsy	9	
spinal bifida	10	
hypoxic encephalopathy	3	
chromosomal abnormality	4	
motor retardation	28	
mental retardation	6	
delayed language	5	
developmental disorders	26	
hearing disorder	4	
hydrocephalus	7	
Chiari malformation	6	
encephalitis	4	
osteogenesis imperfecta	2	
epilepsy	2	
small for gestational age	15	
craniosynostosis	3	
hypothyroidism	4	
metabolic disorders	6	
other conditions	22	
apparently healthy children	151	

Table 1: Profile of study participants.

The KIDS consists of 9 subscales for behavior: "physical motor," "manipulation," "receptive language," "expressive language," "language concepts," "social relationships with children," "social relationships with adults," "discipline," and "feeding". In each subscale, behaviors that can be performed by the child are checked. Using the 9 areas of development, this test produces a clear profile of the developmental age and developmental quotient of the child. Miyake et al. [1] reported that the KIDS had a reliability coefficient of 0.95 and a correlation coefficient with the Stanford-Binet Intelligence Scales of 0.856 and with the Wechsler Preschool and Primary Scale of Intelligence of 0.653. They concluded that the KIDS is valuable for diagnosing developmental disorders because the level of development can be established in 9 areas [1].

Figure 1 shows examples of behaviors in the "physical motor" subscale of the KIDS. The KIDS is an extremely simple scale that elicits information on various kinds of activities that young children can or cannot perform. The developmental age is rated by counting the number of behaviors that a child can perform. And developmental quotient is calculated by dividing developmental age by one's chronological age. Although the KIDS has four different types of questionnaires (A, B, C, and T), we used the KIDS type A for healthy subjects from 1 to 11 months of age, type B for those from 12 months to 35 months of age, and type C for those from 3 years to 6 years and 11 months of age. We used KIDS type T for the disabled patients.

Before the study, the parents of all subjects gave informed consent to participate in the research. This study was approved by the Ethics Committee of the National Center for Child Health and Development. There was no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Data Analysis

The internal consistency of the 9 subscales for developmental age and quotient comprising the KIDS for behavior: "physical motor," "manipulation," "receptive language," "expressive language," "language concepts," "social relationships with children," "social relationships with adults," "discipline," and "feeding" was checked by Cronbach's coefficient alpha (Cronbach's α). Using Spearman's rank correlation coefficients, we examined the strength of the association between the developmental age and developmental quotient of the KIDS with each score for the ASQ-3 and total scores for ABMS-C and ABMS-CT and with the total scores of the motor WeeFIM and cognitive WeeFIM as determined in all children. Data were analyzed with the software package IBM SPSS Statistics 12.0 J (IBM Japan Ltd., Tokyo, Japan).

Results

Each developmental age and quotient by the 9 subscales of the KIDS had appropriate internal consistency (Cronbach's α=0.969 and 0.942, respectively). Both of the total developmental age and quotient assessed with KIDS were correlated with age (month) (Table 2). The

Instructions: Please answer the questions as to what your child can or cannot do.

	Yes O	No ×	The child ….	Age of month
1	○	×	Turns his head while watching a moving object according to the movement of the object.	<1>
2	○	×	Can lift his/her head while he/she is in the prone position.	<2>
3	○	×	Can lift his/her chest and head using both arms while he/she is in the prone position.	<3>
4	○	×	Can maintain a sitting position if supported.	<4>
5	○	×	Kicks his/her legs when he/she is lifted off the ground.	<5>
6	○	×	Can maintain a standing position if supported under his/her arms.	<6>
7	○	×	Can roll over.	<7>
8	○	×	Can stand up if holding onto something with both hands.	<8>
9	○	×	Can crawl.	<9>
10	○	×	Can maintain a standing posture by himself/herself for a short period of time.	<10>
11	○	×	Can bend forward.	<11>
12	○	×	Can maintain a standing posture by himself/herself without support for several seconds.	<12>
13	○	×	Moves his/her body in rhythm.	<14>
14	○	×	Can climb the stairs if someone holds his/her hand.	<15>
15	○	×	Can walk about 200 meters by himself/herself.	<16>
16	○	×	Can walk while pushing a tricycle or the like.	<17>
17	○	×	Can throw a ball overhand.	<18>
18	○	×	Can walk backwards without holding onto anything.	<19>
19	○	×	Can stand on tiptoes.	<20>
20	○	×	Can hang from a horizontal bar.	<22>
21	○	×	Can climb the stairs using one leg after the other.	<25>
22	○	×	Tries to hop on one foot.	<28>
23	○	×	Can ride a tricycle or a bicycle with training wheels.	<33>
24	○	×	Can stand on a swing by himself/herself.	<36>
25	○	×	Can grab a rolling ball.	<38>
26	○	×	Can hop on one foot.	<39>
27	○	×	Can run smoothly at full speed for approximately 20 meters.	<40>
28	○	×	Can climb the jungle gym at the park to the top.	<42>
29	○	×	Can walk backwards on tiptoes.	<45>
30	○	×	Can stand on a swing.	<46>
31	○	×	Can skip.	<49>
32	○	×	Can enjoy a relay race with other children.	<60>
33	○	×	Can dribble a ball about three times.	<61>
34	○	×	Can chase other children on the jungle gym without touching his/her feet to the ground.	<63>
35	○	×	Can swing very high while standing on the swing.	<65>
36	○	×	Can jump rope by himself/herself.	<68>
37	○	×	Can ride a bicycle without training wheels.	<77>

Figure 1: List of 37 behaviors in the "physical motor" subscale of the Kinder Infant Development Scale (KIDS) Type T. The age at which a normal child is expected to be able to perform each behavior is shown in brackets.

total developmental age assessed with KIDS correlated with the total scores on ABMS-C and ABMS-CT, the motor and cognitive WeeFIM (r=0.839-0.894, p<0.01). On the other hand, the total developmental age by KIDS did not correlated strongly with scores of the "communication," "gross motor," "fine motor," "problem solving," and "personal-social" items on the ASQ-3 (r=0.417-0.663, p<0.01) (Table 2). And the total developmental quotient assessed by KIDS was correlated with the period of gestation and birth weight of the children by low correlation coefficient (r=0.353 and 0.299, respectively, p<0.01) (Table 1).

Discussion

In the field of developmental pediatrics, the Bayley Scales of Infant Development III (BSID-III), Wechsler Intelligence Scale for Children IV (WISC-IV), Wee-FIM, and Pediatric Evaluation of Disability Inventory (PEDI) are very well known scales that have been developed to assess the motor and cognitive functions of children. On the other hand, it is difficult for parents to use the rather specialized scales such as PEDI, WICS-IV, etc., to assess the development of their children. Interest is growing in developing simpler, less expensive, and less time-consuming ways of ascertaining a child's development, such as questionnaires filled out by parents. Studies have shown that most parents can correctly judge their children's performance and that their concerns are appropriate [12–15]. Therefore, the development of a questionnaire that would allow parents to record the developmental age and quotient score with good discriminatory power for the neurodevelopmental outcome of their children is of prime importance. Few parental questionnaires have shown significant agreement with standardized developmental test scores for children born preterm [16–19].

We evaluated the KIDS to determine if it could be used to easily assess a child's physical and mental development in daily life. One advantage of the KIDS in comparison with other scales, such as the BSID-III and PEDI, is that families can easily record the child's ability to perform various behaviors in 9 different areas of development and, thereafter, can monitor the progress of that child's ability to perform each individual motor and cognitive skill from the ages of 1 month to 6 years 11 months. In the present study we found significant correlations between the developmental age on the family-rated KIDS with gross motor function (ABMS-C, ABMS-CT), and the motor and cognitive

							Spearman's rank correlation coefficients			**P<0.01, *P<0.05
						with ASQ-3 (n=240)				
						communication	gross motor	fine motor	problem solving	personal-social
Variable		**Median**	**Range**	**Internal consisstency of dev. age**	**Internal consisstency of dev. quotient**	r	r	r	r	r
Family-rated KIDS				Cronbach's α	Cronbach's α					
total	dev. age, mo	16.50	1-63			0.428**	0.663**	0.417**	0.450**	0.600**
	dev. quotient	100.00	4.76-300			0.445**	0.318**	0.311**	0.319**	0.316**
physical motor	dev. age, mo	16.00	1-72			0.363**	0.667**	0.387**	0.387**	0.568**
	dev. quotient	91.30	1-63			0.361**	0.529**	0.373**	0.303**	0.411**
manipulation	dev. age, mo	18.00	1-63			0.401**	0.646**	0.416**	0.447**	0.599**
	dev. quotient	100.00	3.17-250			0.445**	0.388**	0.420**	0.380**	0.417**
eceptive language	dev. age, mo	18.00	1-82			0.403**	0.621**	0.362**	0.407**	0.538**
	dev. quotient	108.33	4.76-400			0.432**	0.211**	0.155**	0.254**	0.214**
expressive language	dev. age, mo	15.00	2-70			0.478**	0.637**	0.396**	0.467**	0.570**
	dev. quotient	97.84	8.7-450			0.437**	0.197**	0.185**	0.271**	0.193**
language concepts	dev. age, mo	16.00	15-78			0.528**	0.251**	0.056	0.349**	0.402**
	dev. quotient	104.76	23.81-184.62	0.969	0.942	0.290**	0.371**	0.343	0.247**	0.265**
social relationships with children	dev. age, mo	21.00	12-73			0.520**	0.277**	0.134	0.434**	0.408**
	dev. quotient	88.46	19.05-176.92			0.314**	0.409**	0.462**	0.345**	0.334**
social relationships with adults	dev. age, mo	17.00	2-69			0.394**	0.613**	0.374**	0.386**	0.552**
	dev. quotient	100.00	3.17-250.00			0.385**	0.304*	0.274**	0.237**	0.290**
discipline	dev. age, mo	27.00	16-74			0.401**	0.152	0.025	0.226**	0.368**
	dev. quotient	101.82	25.4-194.44			0.056	0.233**	0.341**	0.049	0.215**
feeding	dev. age, mo	13.00	1-36			0.417**	0.692**	0.448**	0.463**	0.612**
	dev. quotient	84.13	1.59-200			0.327**	0.304**	0.313**	0.277**	0.291**
		with ABMS		with WeeFIM (n=233)						
		ABMS-C (n=212)	**ABMS-CT (n=213)**	**motor**	**cognitive**	**Age, mo (n=307)**	**Period of gestation, w (n=291)**	**Birth weight, g (n=297)**		
Variable		r	r	r	r	r	r	r		
Family-rated KIDS										
total	dev. age, mo	**0.878****	**0.863****	**0.891****	**0.894****	**0.839****	0.126	0.116		
	dev. quotient	0.041	0.062	−0.169 **	**−0.146***	−0.395**	0.353**	0.299**		
physical motor	dev. age, mo	**0.908****	**0.849****	**0.885****	**0.845****	**0.788****	0.096	0.109		
	dev. quotient	0.305**	0.236**	0.041	0.038	−0.197**	0.256**	0.287**		
manipulation	dev. age, mo	**0.857****	**0.857****	0.880**	**0.887****	**0.810****	0.123*	0.109		
	dev. quotient	0.138*	0.206**	−0.039	−0.006	−0.224**	0.315**	0.281**		
eceptive language	dev. age, mo	**0.846****	**0.831****	**0.861****	**0.877****	**0.803****	0.109	0.090		
	dev. quotient	0.033	0.113	−0.119	−0.084	−0.311**	0.267**	0.240**		
expressive language	dev. age, mo	**0.783****	**0.817****	**0.803****	**0.847****	**0.749****	0.131*	0.119*		
	dev. quotient	−0.048	0.045	−0.198**	−0.128	−0.361**	0.269**	0.239**		
language concepts	dev. age, mo	0.507**	**0.802****	**0.806****	**0.787****	0.643**	0.178*	0.107		
	dev. quotient	0.133	0.114	−0.059	0.036	−0.426**	0.221**	0.207**		
social relationships with children	dev. age, mo	0.540**	**0.799****	**0.785****	**0.803****	0.623**	0.230**	0.118		
	dev. quotient	0.237**	0.267**	0.088	0.199*	−0.262**	0.200*	0.161*		
social relationships with adults	dev. age, mo	**0.841****	**0.836****	**0.859****	**0.881****	**0.788****	0.093	0.082		
	dev. quotient	0.161*	0.160*	−0.013	0.037	−0.250**	0.250**	0.220**		
discipline	dev. age, mo	0.539**	**0.804***	**0.846****	**0.799****	0.664**	0.156*	0.081		
	dev. quotient	0.162	0.087	−0.027	0.001	−0.477**	0.163*	0.178*		
feeding	dev. age, mo	**0.837****	**0.819****	**0.859****	**0.848****	**0.729****	0.129*	0.120*		
	dev. quotient	−0.135*	−0.169*	−0.310**	−0.284**	−0.531**	0.223**	0.252**		

KIDS= Kinder Infant Development Scale, SAQ-3= Ages & Stages Questionnaires, Third Edition, ABMS-C=Ability for Basic Movement Scale for Children, ABMS-CT=Ability for Basic Movement Scale for Children type T, Wee FIM=Functional Independence Measure for Children

Table 2: Correlations among the KIDS scores, other scales, age, period of gestation, and birth weight.

WeeFIM scores (Table 1). On the basis of the results, we believe that the KIDS as rated by families can be used to evaluate the abilities of children. On the other hand, significant correlation by high correlation coefficient between developmental age and scores as assessed with ASQ-3 was not admitted. One of the reasons of this result is that ASQ-3 is the screening tool for developmental delay, which does not calculate developmental age or quotient. And the low grade correlation among the developmental quotient by KIDS, period of gestation, and birth weight of the children was established.

This result may be important even if they are small statistical significance. We should follow up small for gestational age infants for long time and explore which patient group has a greater or worse correlation to the reference tools (typical children vs. delayed children vs. premature children) in next research.

Several limitations of this study should be mentioned. First, the number of study subjects was too small (317) to draw any conclusions as to the validity of the KIDS even though the correlation with other instruments was significant. Second, there was no proof that these 317 children were representative of infants and young children in Japan. These children were those who visited either a single clinic and a hospital, and just being healthy or disabled did not ensure that they represented children in either category. In other words, possible selection bias could not be ruled out completely. Last, in order to assess validity, we need a better description of the populations (e.g. maternal age & education, socioeconomic status, gestational age, birth weight etc) and more detailed evaluation by gold standard test of development such as Bayley or WISC. Therefore, future research with a large sample in national-wide survey to confirm the real validity of the KIDS is desirable.

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