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The Psychometric Properties of Newsha Developmental Scale: an Integrated Test for Persian Speaking Children

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Abstract

Objective: The term 'child development' is used to describe the skills acquired by children between birth and the age of 6 years. Development is rather an integrated process and impairment in one developmental milestone can affect other areas too. The goal of the present study was preparation and determination of validity and reliability of the "Newsha Developmental Scale" as an integrated scale for assessing developmental skills of Persian speaking children up to the age of six years.

Methods: The Newsha developmental scale was created to thoroughly evaluate seven developmental domains in 13 age groups from birth to 72 months. It was based on the concerns of parents and nursery teachers about child development. In order to obtain the scores of normal population, 593 children in nurseries and health centers of Tehran were assessed. The children had no medical concern or confirmed disorders. With consideration of the age of each child, the score of minimum or higher in each developmental milestone was considered as the normal range. The test-retest reliability and inter-rater reliability were measured. In addition, the content validity was assessed by ideas taken from 10 specialists in the field of child development and the content validity Index (CVI) was calculated. Also construct validity was considered by establishing the effect of age on test results.

Findings: A correlation of more than 95% was shown in both test-retest and inter-rater reliabilities (P<0.001). The CVI of various skills of the age groups was between 0.8 and 1, and construct validity revealed the effect of age on the test results. The gender difference was shown only in 6 items among 646 items of the scale (P<0.02).

Conclusion: The "Newsha Developmental Scale" is an integrated and comprehensive scale for evaluating the developmental process of children and identification of any probable delay in developmental abilities of children with Persian language up to 6 years of age.

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Key Words: Development; Scale; Hearing; Language; Speech; Cognition; Motor Skills

Introduction

The continuous sequential physiologic and psychological maturing of an individual from birth is given the title of development. Development during infancy forms the basis for the child's subsequent development and is influenced by both biological and environmental factors [1]. In the general pediatric population, about 6-9% of children aged 0-6 years may have developmental delays which require early intervention [2,3]. It has been demonstrated that pre-kindergarten

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intervention leads to substantial economic, academic and social benefits, and helps conserve social resources [4]. Therefore, assessing development in general is common practice in pediatric care worldwide [5].

A medical professional cannot rely solely on clinical judgment for identification of developmental problems since less than half of the cases of mild mental retardation or emotional/behavioral disorders are identified through such methods [6,7]. It appears reasonable to suggest, therefore, that diagnostic accuracy can be increased by the use of standardized developmental screening tools at periodic intervals [8]. With the aid of information obtained from a developmental diagnostic test, the positive predictive value of pediatric diagnosis, in terms of later school performance, increases [6].

Developmental process includes at least the domains of cognition, fine and gross motor skills, speech, language and social-emotional development and a comprehensive examination of young children should include coverage of this spectrum [9]. Although there are some developmental assessment tools, most of them assess limited domains of child development and are designed for certain ages or disease conditions [10-24]. Some of these tools can be completed by parents or caregivers. On the other hand, the appropriateness of using developmental tools established for use in a different country has always been an issue for debate. Hence, creation of tests and even reference data for any specific country can help families and practitioners in that country for better assessing child development.

Since we had no culture-friendly, multi-dimensional and easy to use instrument for assessing child development in Iran, we created a developmental scale entitled as "The Newsha Developmental Scale" for assessing Persian speaking children and evaluated its reliability, validity and its norms in different age groups.

Subjects and Methods

Study Type and Sample

This cross sectional study was performed on 593 Persian-speaking children in age range up to 72 months consisting of 298 (50.25 %) girls and 295 (49.75 %) boys, from July 2006 to August 2007 in Tehran, Iran. Age ranges were classified in 13 levels: 0-3 months (level 1), 4-6 months (level 2), 7-9 months (level 3), 10-12 months (level 4), 13-15 months (level 5), 16-18 months (level 6), 19-24 months (level 7), 25-30 months (level 8), 31-36 months (level 9), 37-42 months (level 10), 43-48 months (level 11), 49-60 months (level 12), 61-72 months (level 13). Cluster sampling was used in nurseries in 22 municipality regions of Tehran. Children were selected randomly from nurseries. Because of small number of children under 2 years in kindergartens, selection was done in infants' vaccination centers in Tehran. In each age group, at least 43 children were selected. All children in this study were healthy according to their medical records and statement of their parents and nursery teachers, and none of them had developmental delay or other diseases and disorders. The study was approved by the Ethics Committee of Tehran University of Medical Sciences.

Creation of the Scale: Its Psychometric Properties and Norms Amounts

The Newsha Developmental Scale was created for Persian-speaking children and its reliability and validity were assessed in the following steps.

Step 1: *Resource collection, preliminary study and creation of primary scale*

To create the primary Newsha Developmental Scale which assesses seven skills (hearing, speech, receptive language, expressive language, cognition, social communication, and motor) in 0-6 year-old children, we reviewed all available resources on child growth and development [13-17]. Also because of the lack of a continuous integrated developmental scale in these resources, some developmental scales were bought and ideas and opinions of researchers and specialists in this area obtained. Finally, the primary version of the Newsha Developmental Scale was created. This version had 13 developmental tables (each table for one age group) for the seven various skills, which inquire the ideas of parents and nursery teachers about each child's developmental status.

Step 2: *Testing the primary version of the Newsha Developmental Scale*

In this step, two interviewers were selected among a group of speech therapy students and were trained on the aims of the study and completion of tables of skills. Five children from each age group were interviewed (65 children) in one month. After reception of interviewer' comments, minor revision in writing pattern and number of some items were done and so the final version of the Newsha Developmental Scale was created. This version contains 646 items for various skills for all age groups. The number of items for each age group varies from 38 to 64. Each question has two responses: Yes or No. The score of the child in each skill is calculated by the total sum of "Yes" responses to the items of that skill. The scale is filled through interviews by parents and nursery teachers. With respect to child's age, the minimum, or higher, score of each developmental milestone is considered as normal range.

Step 3: *Assessment of validity and reliability of the final version of Newsha Developmental Scale*

Two types of validity were considered:

1. Content Validity: For assessment of this type of validity, we asked 10 experts in the field of child development to rate the items of each skill of age groups based on four choices of Likert scale (1 Items are not representative of the skill, 2 Items need major revisions to be representative of the skill, 3 Items need minor revisions to be representative of the skill, 4 Items is representative of the skill) [25]. Content Validity Index (CVI) was calculated based on the Likert scale. The CVI conducted by counting the number of participants who rated the skill items as a 3 or 4 and divided by the number of participants. A CVI equal or greater than 0.8 for the skill is desired to consider the skill to have adequate content validity.

2. Construct validity: This type of validity was assessed by one logical hypothesis: "Effect of child age on the skills score". According to this hypothesis, children with normal growth and development can get an acceptable score range in skills of their age range while can get no score or complete score in skills of upper and lower age range. Hence, we completed skills of upper, lower and own age range for 30 children 0-6 years of age.

In addition, 2 types of reliability were calculated:

3. Inter-Rater Reliability: In this reliability type, percent of agreement and correlation between scores of the two interviewers for 150 children were calculated. Completion interval between the two raters was one week.

4. Test-Retest Reliability: Correlation between the scores of completion of the Newsha Developmental Scale for 156 children by one rater with a one-week interval was considered.

Step4: *Normalization of the final version of Newsha Developmental Scale for various age groups*

For determining norms, the Newsha Developmental Scale was completed for a total of 593 children (295 boys and 298 girls).

Data Analysis

SPSS for Windows 13 was used for data analysis. Mean (SD) and Frequency (percentage) was used for description. Statistical tests for assessment of test-retest reliability and Inter-Rater Reliability were paired with t test, independent sample t test and Pearson correlation coefficient. A *P*-value of <0.05 was considered to be significant.

Findings

There were no differences between the results of various skills scores assessed by two raters and scores of each rater were correlated with another (Pearson correlation coefficient 0.950-0.995, *P*<0.001) (Table 1, Inter-rater reliability).

In addition, there was no meaningful difference between assessment results of various skills of one rater (Table 2, test-retest reliability).

The CVI of various skills of each age group was between 0.8 and 1. Construct validity scores were good and all 30 children gained full scores in skills of their lower age group and gained no or low scores in skills of their upper age group. Table 3 illustrates the norms of various skills of each age group in the Newsha Developmental Scale.

There were no significant differences between boys and girls in majority of items except in the following:

Two items in speech in the 7-9 months group (boys higher), 1 item in speech in the 10-12 months group (girls higher), 1 item in cognition in

Table 1: Inter-rater reliability of skills of age groups in the Newsha Developmental Scale (n=150)

No	Skill	Independent sample t test		Correlation	
		t value	P value	Pearson Correlation Coefficient	P value
1	Hearing	0	1.000	0.995	< 0.001
2	Receptive Language	-0.255	0.799	0.986	< 0.001
3	Expressive Language	-0.103	0.915	0.968	< 0.001
4	Speech	-0.954	0.345	0.975	< 0.001
5	Cognition	-0.222	0.824	0.987	< 0.001
6	Social Communication	-0.026	0.979	0.964	< 0.001
7	Motor	-0.059	0.953	0.950	< 0.001

the 7-9 months group (boys higher), 1 item in cognition in the 37-42 months group (girls higher), 1 item in social communication in the 31-36 months group (girls higher) and 1 item in social communication in the 37-42 months group (girls higher)

Discussion

The main advantage of the Newsha Developmental Scale in comparison with other scales is that it is a multidimensional scale for assessing development of Persian speaking children. It assesses seven developmental domains: hearing, speech, receptive language, expressive language, cognition, social communication, and motor skills.

The scale is based on ideas of parents and nursery teachers about child development and has acceptable validity and reliability.

There are plenty of questionnaires, tools and instruments for assessing child development worldwide[22]. Some of these can be completed by parents and caregivers. Although some of these instruments evaluate multiple domains of development ((e.g. The Ages & Stages Questionnaire (ASQ)[22,24], Child Development Inventories (CDIs)[22,23], Kent Inventory of Developmental Skills – 3rd Edition (KIDS)[22] and Parents' Evaluations of Developmental Status (PEDS)[22])), others evaluate limited domains (e.g. The Cottage Acquisition Scales for Language, Listening, and Learning (CASLLS)[13], The Preschool Language Scale, 4th Edition (PLS-4)[14] and the Ski Hi Language Development Scale (Ski Hi LDS)[18])). In comparison of these instruments, our scale covers seven domains of child development. In addition, the mentioned instruments evaluate various child age ranges. ASQ[22,24], CDI[22, 23], PEDS[22], PLS-4[14] and Ski Hi LDS[18] evaluate wide child age range from birth to a maximum of 8 years while KIDS for example assesses children from birth through to 15 months. In concordance with these instruments, The Newsha Developmental Scale studies birth to 6 year-old children.

Based on our knowledge, the ASQ has good psychometric properties, although it has no nationally representative norm data[22,24]. CDI has been highly correlated with mental ages obtained during formal psychometric evaluation[22,23]. The reliability of the developmental domains of KIDS

Table 2: Test-retest reliability of skills of age groups in the Newsha Developmental Scale (n=156)

No	Skill	Paired sample t test		Correlation	
		t value	P value	Pearson Correlation Coefficient	P value
1	Hearing	1.016	0.311	0.993	< 0.001
2	Receptive Language	-1.726	0.086	0.980	< 0.001
3	Expressive Language	0.377	0.707	0.961	< 0.001
4	Speech	-1.233	0.219	0.960	< 0.001
5	Cognition	-1.273	0.205	0.983	< 0.001
6	Social Communication	0.000	1.000	0.965	< 0.001
7	Motor	0.774	0.440	0.950	< 0.001

Table 3: Norms of skills of age groups in the Newsha Developmental Scale (n=593)

	boy	girl	Hearing		Receptive Language		Expressive Language		Speech		Cognition		Social Communication		Motor	
			Range	Mean(SD)	Range	Mean(SD)	Range	Mean(SD)	Range	Mean(SD)	Range	Mean(SD)	Range	Mean(SD)	Range	Mean(SD)
1	19	25	12-18	17.2 (1.2)	2-4	3.89 (0.49)	2-3	2.93 (0.25)	2-2	2 (0)	2-4	3.79 (0.56)	3-4	3.91 (0.29)	4-6	5.84 (0.43)
2	24	21	17-19	18.12 (0.28)	2-4	3.82 (0.44)	5-6	5.96 (0.21)	6-8	7.78 (0.4)	2-4	3.69 (0.06)	4-6	5.67 (0.52)	4-7	6.02 (0.81)
3	27	17	11-13	11.2 (0.29)	4-8	7.44 (0.8)	5-8	7.58 (0.79)	3-7	5.84 (1.53)	5-9	7.98 (0.94)	7-10	9.63 (0.77)	4-9	7.8 (1.02)
4	24	23	9-11	10.91 (0.36)	3-7	6.76 (0.77)	4-6	5.76 (0.52)	2-5	4.24 (1.01)	2-5	4 (1.14)	7-10	9.57 (0.69)	2-5	4.24 (0.87)
5	23	20	4-5	4.73 (0.18)	6-8	7.56 (0.62)	3-6	5.63 (0.71)	2-6	5.62 (1.05)	2-7	6 (1.24)	3-5	4.93 (0.34)	4-8	6.86 (1.32)
6	24	19	5-7	6.6 (0.54)	4-6	5.56 (0.69)	2-4	3.48 (0.73)	1-3	2.58 (0.71)	5-7	6.22 (0.72)	2-5	4.49 (0.52)	3-6	5.4 (0.08)
7	20	25	8-10	9.82 (0.44)	5-8	7.76 (0.61)	2-8	6.65 (1.89)	2-5	4.1 (1.02)	4-9	8.11 (1.37)	2-7	6.47 (1.1)	5-8	7.44 (0.79)
8	23	23	3-6	5.84 (0.57)	3-7	6.44 (0.41)	3-8	6.94 (1.65)	4-9	7.65 (1.44)	2-8	7.21 (1.3)	2-7	6.26 (1.21)	4-8	7.03 (1.21)
9	23	25	4-6	5.83 (0.43)	8-11	10.76 (0.65)	7-11	10.38 (1.11)	3-6	5.42 (1.06)	5-11	10.53 (1.14)	3-6	5.27 (1.03)	2-5	4.61 (0.62)
10	21	27	4-5	4.95 (0.22)	6-7	6.83 (0.38)	6-7	6.9 (0.03)	1-2	1.57 (0.59)	5-6	5.86 (0.35)	4-6	5.74 (0.05)	3-5	4.83 (0.44)
11	21	26	9-11	10.83 (0.48)	9-12	11.72 (0.68)	6-9	8.79 (0.55)	2-6	5.65 (1.02)	5-8	7.89 (0.52)	3-5	4.89 (0.37)	4-6	5.83 (0.43)
12	25	21	5-6	5.91 (0.28)	10-12	11.6 (0.69)	3-5	4.79 (0.45)	1-3	2.48 (0.79)	12-17	16.28 (1.2)	2-3	2.98 (0.15)	3-6	5.6 (0.66)
13	28	19	2-3	2.98 (0.15)	3-7	6.46 (1.04)	2-3	2.96 (0.29)	2-3	2.89 (0.31)	6-12	10.94 (1.18)	1-3	2.85 (0.32)	5-12	11.04 (1.32)
	295	298														

SD: Standard Deviation

are particularly high for infants between 2 and 12 months, but for those older than 12 months, the Motor and Self-Help domains are relatively less reliable. Its Test-retest reliability was between 0.86 and 0.98 and scale validity was 0.95 for the full scale and somewhat lower for the five domains (between 0.80 and 0.88)[22]. In addition, although PEDS has acceptable high to strong inter-rater reliability, its concurrent validity is moderate and it is not nationally representative[22]. In receptive language and expressive domains, Ski Hi LDS has an inter-rater reliability of 0.82 and 0.68, respectively. In addition, test-retest reliability of these skills is 0.70 and 0.76, respectively[18]. The Newsha scale has more than 95% correlation in both test-retest and inter-rater reliabilities that presents good psychometric properties in comparison with similar non-Persian scales. This high reliability results may be due to good cooperation of the interviewer and nursery teachers and efforts to complete the scale in similar conditions. However, we had two interviewers in comparison to some other studies. This can be a reason for higher reliability results than for example the Ski Hi LDS, in which the number of interviewers for inter-rater and test-retest reliabilities was 24 and 7, respectively[18]. Moreover, content validity that was assessed according to ideas taken from specialists showed good results. The results of our logical hypothesis showed that skills that are designed to assess each given age group is suitable for assessing the developmental status of children in that age group.

The present scale has a simple scoring method in contrast to other scales. Additionally, if a child had a score lower or higher than norms of its age appropriate category, we recommended completion of lower or upper level items of that skill for estimating the exact developmental age. The ASQ has different scoring for various age groups[22]. PEDS reveals high, moderate, and low risk children for developmental and behavioral/mental health problems. In Ski Hi LDS, obtaining more than 50% of the age appropriate score is considered as suitable developmental progress[18].

There were no significant differences between girls and boys in the majority of the items except in some items of communicational skills (speech, cognition and social communication). Male and female development and maturation occur at consistently different rates and in different sequences. Areas of the brain involved in language and fine motor skills mature up to six years earlier in girls. Areas of the brain involved in targeting and spatial memory mature up to four years earlier in boys[26]. In addition, some studies showed that speech fluency is better in girls while speech recognition ability is better in boys[27]. In one study on learning ability of 3-12 year-old girls and boys, girls had more rapid learning ability and fewer faults than boys did and also girls could complete the test more than boys did[28].

Although our scale is based on the concerns of parents and nursery teachers and this can be a limitation for the study, it must be mentioned that parents and teachers can help the professionals for better assessing the child's developmental process[29]. Another limitation of our study was that we performed our study in nurseries and health centers in Tehran, the capital city of Iran. Although children who live in Tehran may be different from children who live in other cities or rural areas, it seems that there are no prominent differences in the development of children between urban and rural areas in Iran

Conclusion

The Newsha Developmental Scale is the first multidimensional instrument that can assess developmental process of Persian speaking children. It can be used as a reference for future studies and in monitoring of treatment strategies for disabled children. Furthermore, assessment of its sensitivity, specificity and positive predictive value can prepare grounds for it to become a preschool screening tool.

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Conflict of Interest: None

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