Original Article

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Correlation of Language Assessment Batteries of Toddlers With Developmental Language Delay

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Objective To analyze the correlation between standardized language assessment batteries of toddlers and developmental language delays.

Methods A total of 319 children with suspected language developmental delays were enrolled in this study retrospectively. They underwent the Receptive and Expressive Vocabulary Test (REVT) for vocabulary development assessment and at least one of two language assessment batteries: The Sequenced Language Scale for Infants (SELSI) or the Preschool Receptive-Expressive Language Scale (PRES) for language development assessment. The correlation of the results for receptive and expressive language between the scales were analyzed.

Results The participants were divided into two groups: SELSI and REVT (n=45) and PRES and REVT (n=273). When the children's results were classified into groups (average, mild delay, and delay), receptive and expressive scores were significantly correlated with each other in both SELSI-REVT and PRES-REVT groups. In addition, the correlation of mean developmental age between tests are analyzed. In the SELSI-REVT group, there was weak correlation of mean developmental age between tests for receptive and expressive language. In the PRES-REVT group, there was a strong positive correlation of mean developmental age for receptive and expressive language in children aged >36 months. Attention deficits during the test was found to be the statistically significant factor affecting the differences between the tests. The odds ratios for receptive and expressive language were 2.60 (95% confidence interval,1.15–5.84) and 1.94 (95% confidence interval, 1.15–3.27), respectively.

Conclusion This study examined the correlations and influencing factors between language development evaluation tools for toddlers. An integrated interpretation of comprehensive language and vocabulary evaluation tools may be possible in children older than 3 years of language developmental age.

Keywords Child language, Developmental language disorders, Language tests

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INTRODUCTION

Language development is critical for children's normal communication and learning abilities. Nevertheless, the prevalence of language delay in preschool children was reported as between 3.1% and 10.1% [1-3]. Children with delayed language development may require interventions such as speech therapy. In some cases, their language development may not reach a normal level, and various verbal and non-verbal problems may persist, thus increasing the risk of difficulties in reading and learning even after entering school [4,5]. In the case of specific language impairment (SLI), treatment is relatively effective if there are no significant problems in areas other than language; thus, proper attention must be paid to distinguish such patients [6]. Additionally, cases of developmental language disorder (DLD) have different prognoses because they are accompanied by cognitive impairment and developmental behavioral disorders. Therefore, it is important to evaluate and differentiate delays in language development early [7,8]. The most widely used language and vocabulary development screening tools for preschool toddlers are the Sequenced Language Scale for Infants (SELSI) [9], the Preschool Receptive-Expressive Language Scale (PRES) [10], and the Receptive and Expressive Vocabulary Test (REVT) [11]. The SELSI and PRES tests have demonstrated high internal consistency and reliability among children in Korea and included questions that evaluate the degree of development in receptive and expressive language in terms of semantics, syntax, and pragmatics. Two of these tests can be performed on children aged ≥2 years, and SELSI can also be performed on younger children [9,10]. REVT differs from the previous two tests as it evaluates children's receptive and expressive vocabulary capabilities [11]. Due to differences in the tests and their scoring methods, it is common to perform two or more tests when evaluating language function. Since SELSI and PRES assess the comprehensive language area overall, and REVT focuses on vocabulary, similar results may not be derived from these tests. Thus, the correlation between these tests must be identified to clinically analyze the derived results and use the appropriate medical approaches based on the child's language abilities. Furthermore, identifying the factors that may affect the analysis results is considered pragmatic given their complementary use as synergistically comprehensive diagnostic tests. To our knowledge, no such research has been conducted to date. Therefore, this study aimed to analyze the correlation between language and vocabulary development evaluation tools and confirm the factors affecting the difference in results. Ultimately, the study aimed to promote an objective evaluation of language function in Korean toddlers.

MATERIALS AND METHODS

Children aged 24–87 months with suspected language developmental delay who visited the Department of Rehabilitation Medicine at Pusan National University Hospital between March 2016 and June 2021 were enrolled in the study retrospectively. Exclusion criteria for the study were as follows: (1) children who did not take the PRES or SELSI for comprehensive language evaluation, (2) those who did not undergo the REVT for their vocabulary test, and (3) those whose equivalent age of expressive or receptive language was not derived because of poor cooperation. All tests were performed on the same day to compare results under the same conditions. A reliable speech therapist with over 15 years of experience evaluated language development according to the manual guidelines. The participants were evaluated using REVT and either SELSI or PRES and were subsequently divided into two groups: SELSI and REVT (n=45) and PRES and REVT (n=273). The PRES and REVT groups were then further divided into five subgroups according to age for subgroup analysis. The developmental age of receptive and expressive languages was derived in each test, and the raw scores of the tests were classified into scaled scores following standard guidelines: average, within -1 standard deviation (SD) of the mean; mild delay, up to -2 SD; and delay >-2 SDs below the mean for SELSI and REVT [9,11]. In PRES, a child is considered average if the combined language age shows a difference of less than one year with their chronological age. If the combined language age is 1–2 years below their actual age, they are considered to have a mild delay, and if the difference is more than 2 years, they are considered to have a delay [10].

In addition, the factors affecting the differences between the tests were analyzed. The decrease in the two factors of "interaction" and "concentration" was evaluated based on the evaluator's description during the

evaluation. Autistic propensity, IQ, and sociality were analyzed based on the results of 41 cases in whom the Childhood Autism Rating Scale (CARS) was used [12], and the Full-Scale Intelligence Quotient (FSIQ) [13] and social quotient (SQ) were evaluated for 112 cases. This retrospective study was approved by Institutional Review Board, which waived the requirement for written consent (IRB No. 2210-011-119).

Statistical analysis values are presented as mean±SD or percentage, where appropriate. Spearman correlation and Kendall's tau-b method were used to assess the linear-by-linear association of the language assessment batteries. Multivariate logistic regression analysis was used to study the factors affecting the differences between tests. All statistical analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA).

RESULTS

The average age and sex distribution of each test is shown in Table 1. The average age of the children at their first visit was 45.4±20.1 months, and the most common age group was 37–48 months. The distribution and comparison of language test scores among the tests are shown in Tables 2 and 3. When the children's results were classified into groups (average, mild delay, and delay), receptive and expressive scores were significantly correlated with each other in both SELSI-REVT and PRES-REVT groups (Tables 2, 3). The correlation of mean developmental age between tests are described in Tables 4 and 5. In the SELSI-REVT group, there was weak correlation between SELSI and REVT for both receptive (r=0.348) and expressive (r=0.258) language (Table 4). In the PRES-REVT group, there was weak correlation between PRES

Table 1. Age and sex distribution of the children

Age (mo)	SELSI (n=55)		PRES (n=274)		REVT (n=303)		Total (n=632)	
	Male	Female	Male	Female	Male	Female	Male	Female
24–36	24 (3.8)	13 (2.0)	21 (3.3)	5 (0.8)	36 (5.7)	18 (2.9)	81 (12.8)	36 (5.7)
37–48	7 (1.1)	6 (0.9)	53 (8.4)	28 (4.4)	48 (7.6)	32 (5.1)	108 (17.1)	66 (10.4)
49–60	3 (0.5)	0 (0)	58 (9.2)	26 (4.1)	58 (9.2)	26 (4.1)	119 (18.8)	52 (8.2)
61–72	0 (0)	0 (0)	28 (4.4)	19 (3.0)	28 (4.4)	20 (3.2)	56 (8.9)	40 (6.3)
73–87	0 (0)	0 (0)	21 (3.3)	15 (2.4)	21 (3.3)	16 (2.5)	42 (6.7)	32 (5.1)

Numbers in parentheses denote a percentage of the total number.
SELSI, Sequenced Language Scale for Infant; PRES, Preschool Receptive-Expressive Language Scale; REVT, Receptive and Expressive Vocabulary Test.

Table 2. Comparison of language test scores among SELSI and REVT

		SELSI receptive score				
		Average	Mild delay	Delay	Total	p-value
REVT Receptive score	Average	2 (4.4)	0 (0)	0 (0)	2 (4.4)	<0.001*
	Mild delay	5 (11.1)	6 (13.3)	2 (4.4)	13 (28.9)	
	Delay	5 (11.1)	10 (22.2)	15 (33.3)	30 (66.7)	
	Total	12 (26.7)	16 (35.6)	17 (37.7)	45 (100)	
		SELSI expressive score				
REVT Expressive score	Average	0 (0)	1 (2.2)	0 (0)	1 (2.2)	<0.001*
	Mild delay	0 (0)	0 (0)	1 (2.2)	1 (2.2)	
	Delay	1 (2.2)	1 (2.2)	41 (91.1)	43 (95.6)	
	Total	1 (2.2)	2 (4.4)	42 (93.3)	45 (100)	

Values are presented as number (%).
SELSI, Sequenced Language Scale for Infant; REVT, Receptive and Expressive Vocabulary Test.
*p<0.001 by Spearman correlation and Kendall's tau-b.

Table 3. Comparison of language test scores among PRES and REVT

		PRES receptive score				
		Average	Mild delay	Delay	Total	p-value
REVT Receptive score	Average	82 (30.0)	56 (20.5)	26 (9.5)	164 (60.0)	<0.001*
	Mild delay	19 (7.0)	24 (8.8)	26 (9.5)	69 (25.3)	
	Delay	0 (0)	4 (1.5)	36 (13.2)	40 (14.7)	
	Total	101 (37.0)	84 (30.8)	88 (32.2)	273 (100)	
		PRES expressive score				
REVT Expressive score	Average	58 (21.4)	29 (10.6)	29 (10.6)	116 (42.5)	<0.001*
	Mild delay	15 (5.5)	24 (8.8)	44 (16.1)	83 (30.4)	
	Delay	5 (1.8)	4 (1.5)	65 (23.8)	74 (27.1)	
	Total	78 (28.6)	57 (20.9)	138 (50.5)	273 (100)	

Values are presented as number (%).
PRES, Preschool Receptive-Expressive Language Scale; REVT, Receptive and Expressive Vocabulary Test.
*p<0.001 by Spearman correlation and Kendall's tau-b.

Table 4. Correlation analysis of mean developmental age between SELSI and REVT (n=45)

SELSI & REVT receptive language		SELSI & REVT expressive language	
r	p-value	r	p-value
0.348	0.019	0.258	0.087

SELSI, Sequenced Language Scale for Infant; REVT, Receptive and Expressive Vocabulary Test.
*p<0.001 by Spearman correlation and Kendall's tau-b.

Table 5. Correlation analysis of mean developmental age between PRES and REVT (n=273)

Age (mo)	n	PRES & REVT receptive language		PRES & REVT expressive language	
		r	p-value	r	p-value
24–36	25	0.265	0.078	0.454	0.002
37–48	72	0.703	0.000	0.780	0.000*
49–60	88	0.770	0.000	0.820	0.000*
61–72	52	0.899	0.000	0.898	0.000*
73–87	36	0.894	0.000	0.895	0.000*

PRES, Preschool Receptive-Expressive Language Scale; REVT, Receptive and Expressive Vocabulary Test.
*p<0.001 by Spearman correlation and Kendall's tau-b.

Table 6. Related factors affecting the difference between PRES and REVT

	Receptive language			Expressive language		
	n	Adjusted OR (95% CI)	p-value	n	Adjusted OR (95% CI)	p-value
Interaction deficit	273	2.72 (0.51–14.36)	0.237	273	2.02 (0.94–4.31)	0.069
Attention deficit	273	2.60 (1.15–5.84)	0.021	273	1.94 (1.15–3.27)	0.012
CARS ≥30	41	1.70 (0.54–5.35)	0.361	41	1.60 (0.27–9.49)	0.605
FSIQ <70	112	0.37 (0.06–2.30)	0.290	112	0.78 (0.33–1.81)	0.563
SQ <70	112	0.72 (0.31–1.69)	0.459	112	1.25 (0.52–2.98)	0.615

CARS, Childhood Autism Rating Scale; FSIQ, Full-Scale Intelligence Quotient; SQ, social quotient.

and REVT for both receptive (r=0.265) and expressive (r=0.454) language in young children aged 24–36 months. Otherwise, there was a strong positive correlation for both receptive and expressive language in children aged >36 months (Table 5).

When determining the factors affecting in the difference between PRES and REVT results, attention deficits during the test was found to be the statistically significant factor affecting the differences between the tests. The odds ratios (OR) for receptive and expressive language were 2.60 (95% confidence interval [CI], 1.15–5.84) and 1.94 (95% CI, 1.15–3.27), respectively (Table 6).

DISCUSSION

In this study, we analyzed the correlation between the SELSI, PRES, and REVT tests, among children with suspected language development delay in Korea and demonstrated differences in the content and interpretation of the results. Additionally, we identified factors that may induce the gaps between the tests. Using these language assessment batteries, it is possible to evaluate receptive and expressive language evaluation scores and comprehensive domains, such as meaning-cognitive, phonological, syntactic, pragmatic, and vocabulary abilities, allowing for appropriate treatment when vocabulary or comprehension ability begins to increase rapidly [14,15]. Thus, children usually undergo two or more tests rather than a single test for a more objective assessment. However, to the best of our knowledge, no study has been conducted on how to interpret the results complementarily. In addition, because early treatment of SLI [16] is as important as differential diagnosis and the integrated evaluation of cognitive, behavioral, and social development [17], interpreting these results appropriately between tests is very important.

SELSI and PRES have been designed considering the semantic, syntactic, and pragmatic aspects of language [18], whereas REVT, focuses solely on vocabulary and is conducted using pictures and drawing answers [11]. REVT is mainly conducted in children from children aged 30 months, whereas SELSI is often conducted in children aged <36 months. Therefore, we believe it is important to verify the correlation between tests by age in months through comparing the results of other tests within the overlapping range of both language age and actual age. We observed a weak correlation of mean developmental age between SELSI and REVT across both receptive and expressive language domains. The possible reason for this result is that during SELSI, parental reports or behavioral observations are often used when the child's developmental age is too young to perform structured tests or when it is difficult to perform the test because of other disabilities.

For PRES and REVT, although a significant correlation was verified in a previous study using 33 toddlers [19], in this study, we performed a subgroup analysis divided by age in 273 toddlers. The results showed strong positive correlation of mean developmental age between receptive and expressive language across age groups >36 months. Thus, we were able to verify that language and vocabulary development within this age group are at a similar level in terms of semantics, syntax, and pragmatics. However, REVT should be interpreted separately from SELSI and PRES until the age at which both semantics and vocabulary have developed to a measurable level. In our study, weak correlation was demonstrated in children aged <36 months who underwent SELSI or REVT. Each test has been validated as a language and vocabulary development evaluation method for all applicable age groups [20]. However, the validation study for REVT was conducted on children under the school-age range (4–6 years old). To our knowledge, no preceding studies validated the test with age groups <36 months, which is the minimum age at which this test can be conducted. This study, which identified whether the two test results across all age groups could be linearly analyzed, confirmed that comprehensive language evaluation and vocabulary levels might not be linear in age groups <36 months. Therefore, it will be meaningful to review the validity of the tests for children aged <36 months and confirm the correlation between tests that were conducted on a more significant number of children.

An analysis of the five factors that may produce differences in the results between PRES and REVT for the largest number of children, confirmed that attention deficit at the time of the test was significant. Therefore, it is necessary to carefully observe and describe children's concentration during the examination. As mentioned in previous studies, it is difficult to differentiate between SLI and DLD based on a simple linguistic profile [21]. For clinical or language evaluation, we believe that a comple-

mentary interpretation of two or more test results may influence test reliability.

This study has some limitations. First, as this was a retrospective study, it was difficult to collect sufficient data because all factors affecting the test results were based on language evaluation papers and intelligence tests performed at approximately the same time. Second, this study was conducted in children aged ≥24 months; however, the youngest group, which shows a gap between the actual age and the language developmental age, may show a floor effect when the language development is less than 19 months, which is the minimum age recorded in the PRES evaluation. To minimize this effect, subgroup evaluation was conducted according to age (in months), and the PRES-REVT group was further analyzed the results by age group. Third, the interaction and concentration at the time of the test are described by the evaluator's subjective judgment during the evaluation. This data has limitations in that it is a retrospective study and is not evaluated as an objective score. However, an attempt was made to identify that the child's cooperative level at the time of evaluation is a possible factor causing the difference between the two test results. Therefore, this study suggests that the cooperative level during evaluation has the potential to cause differences between the two test results.

In conclusion, this study examined the correlations and influencing factors between language development evaluation tools for toddlers. An integrated interpretation of comprehensive language and vocabulary evaluation tools seems possible in children older than three years of language developmental age. In addition, if the results of the two evaluations differ in children aged three years or older, it is necessary to closely observe the concomitant symptoms of the children.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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AUTHOR CONTRIBUTION

Conceptualization: Yoon JA, Shin YB. Methodology: Yoon JA, Shin YB. Formal analysis: Yoon JA, Shin YB. Project administration: Yoon JA, An SW, Choi YS, Seo JS, Yoon SJ, Kim SY, Shin YB. Visualization: Yoon JA, An SW, Choi YS, Seo JS, Yoon SJ, Kim SY, Shin YB. Writing – original draft: Yoon JA. Writing – review and editing: Yoon JA, Shin YB. Approval of final manuscript: all authors.

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