

A Comparative Analysis of Clinical Screening Test and Language Specific Test in Language Delay Children

Na Ra Lee¹, So Hee Chung¹, Mi Kyoung Song¹, Young Hwa Kong¹, Chan Uhng Joo¹, and Sun Jun Kim^{1,2,3,*}

¹Department of Pediatrics, Chonbuk National University Medical School, ²Research Institute of Clinical Medicine, Chonbuk National University, ³Biomedical Research Institute of Chonbuk National University Medical School, Jeonju, Korea

The aim of this study was to investigate the usefulness of a clinical screening test [the Korean Infant and Child Developmental Test (KICDT)] compared to language specific tests: the sequenced language scale for infant (SELSI) and the Preschool Receptive-Expressive language Scale (PRES) in children with delayed language development. A retrospective chart review was conducted on 615 children who visited the Department of Pediatrics at Chonbuk National University Hospital from January 2013 to December 2016. All patients were evaluated with KICDT as a clinical screening test and SELSI or PRES as a language specific test. Language Developmental Quotients (LDQs) from the KICDT were compared with the Receptive Language Quotient (RLQ) and expressive language quotient (ELQ) from the SELSI or PRES. The sensitivity, specificity and predictive values of LDQ of KICDT were calculated by comparing with SELSI/PRES. Language DQs from the KICDT were significantly correlated with the RLQ ($r=0.706$), ELQ ($r=0.768$), and total language quotient (TLQ) ($r=0.766$) from the SELSI/ PRES ($p<0.05$). In cross tabulation, the patients belonging to the retardation groups in both KICDT and SELSI/ PRES were 417 (67.8%). Otherwise, patients belonging to the normal group in KICDT but not in SELSI/ PRES were 151 (24.6%). Sensitivity and specificity of LDQ of KICDT relative to SELSI/PRES were 72.3% and 92.2% respectively ($p<0.05$). Our data suggests that clinical screening tests alone, not cumbersome language specific tests, can determine language developmental delays in children.

Key Words: *Infant; Language Tests; Language Development; Child Development*

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Article History:

Received August 27, 2019
Revised October 3, 2019
Accepted October 4, 2019

Corresponding Author:

Sun Jun Kim
Department of Pediatrics, Chonbuk National University, Medical School, 20 Geonji-ro, Duckjin-gu, Jeonju 54907, Korea
Tel: +82-63-250-1799
Fax: +82-63-250-1464
E-mail: sunjun@jbnu.ac.kr

INTRODUCTION

Children with delayed language development are frequently encountered by pediatricians, but their parents have a lot of anxiety. Several studies have shown that the prevalence of language delay in preschool children is known to be 2-19%.¹⁻⁵ Law et al.⁶ also reported a high prevalence rate of 2-15% in children two to five years old in the United Kingdom.

Language performance in early childhood is highly related to school age cognitive ability and educational performance as well as predicting verbal and nonverbal language ability after growth.^{7,8} It is very important to diagnose this condition early with proper language screening

tests because through early language intervention of children with language impairment language function can be expected to show improvement.

Language specific tests, such as the Sequenced Language Scale for Infant (SELSI), the Preschool Receptive-Expressive language Scale (PRES), and the Receptive and Expressive Vocabulary Test (REVT) are usually used as standardized tests for language ability evaluation in the pediatric age group. However, it is difficult to use in pediatric clinics because these tests require well-trained language therapists and take more than 40 minutes per test. On the other hand, clinical screening tests such as the Korean Infant and Child Developmental Test (KICDT) take less time and are relatively simple to be used by pedia-

tricians in primary medical institutions.

The KICDT is designed to assess a child's developmental age in 5 functional domains, 1) gross motor, 2) fine motor, 3) social-personal, 4) language, and 5) cognitive-adaptive skills.⁹ The language domain of the KICDT can be used to quickly screen children for developmental language delays.

This study aims to investigate the usefulness of the clinical screening test (KICDT) compared to language specific tests such as SELSI and PRES in language evaluation. Here, we compare and analyze the relationship between the language domain Developmental Quotients (DQs) of the KICDT and SELSI/ PRES in children aged 8-60 months.

MATERIALS AND METHODS

The participants were 615 children (M:F=459:156, mean age=35.3±11.6 months) with developmental delays who visited the Department of Pediatrics at Chonbuk National University Hospital from January 2013 to December 2016. This study was performed with approval from the Institutional Review Board of Chonbuk National University Research Council (CUH 2018-08-030).

All participants underwent the KICDT and SELSI or PRES at the same time, and the test results were acquired through a retrospective chart review. All patients were divided into two groups according to their age. 340 children aged 8-36 months underwent KICDT and SELSI, and 275

children aged 37-60 months were tested using the KICDT and PRES at the same time.

The language DQ of KICDT which is obtained from each patient was compared with the DQs of SELSI or PRES of the patient. The DQs of SELSI or PRES include receptive language quotient (RLQ), expressive language quotient (ELQ) and total language quotient (TLQ). The sum of the RLQ and ELQ is defined as the total language quotient (TLQ).^{10,11}

Each developmental quotient of SELSI or PRES was converted into percentile ratio of the age equivalent so that the language developmental status (normal, borderline, or delay) can be suggested through the ratio. Then the agreement between suggested language developmental status from SELSI or PRES and LDQ of KICDT was checked. In KICDT a cut-off value is indicated with a language developmental quotient (LDQ). $LDQ \geq 115$ is advanced, $85 \leq LDQ < 114$ is normal, $70 \leq LDQ < 85$ is borderline, and $LDQ < 70$ is delay in KICDT. In SELSI or PRES a cut-off value is indicated with a percentile ratio of DQ. Percentile ratio of DQ (P. ratio of DQ) ≥ 84 is advanced, $16 \leq P. \text{ ratio of DQ} < 84$ is normal, $2.3 \leq P. \text{ ratio of DQ} < 16$ is borderline, and P. ratio of DQ < 2.3 is delay in SELSI and PRES.

According to the two kinds of cut-off values, all participants were divided into two groups: the normal group and the retardation group. We estimated the sensitivity, specificity, and predictive values of LDQ of KICDT relative to

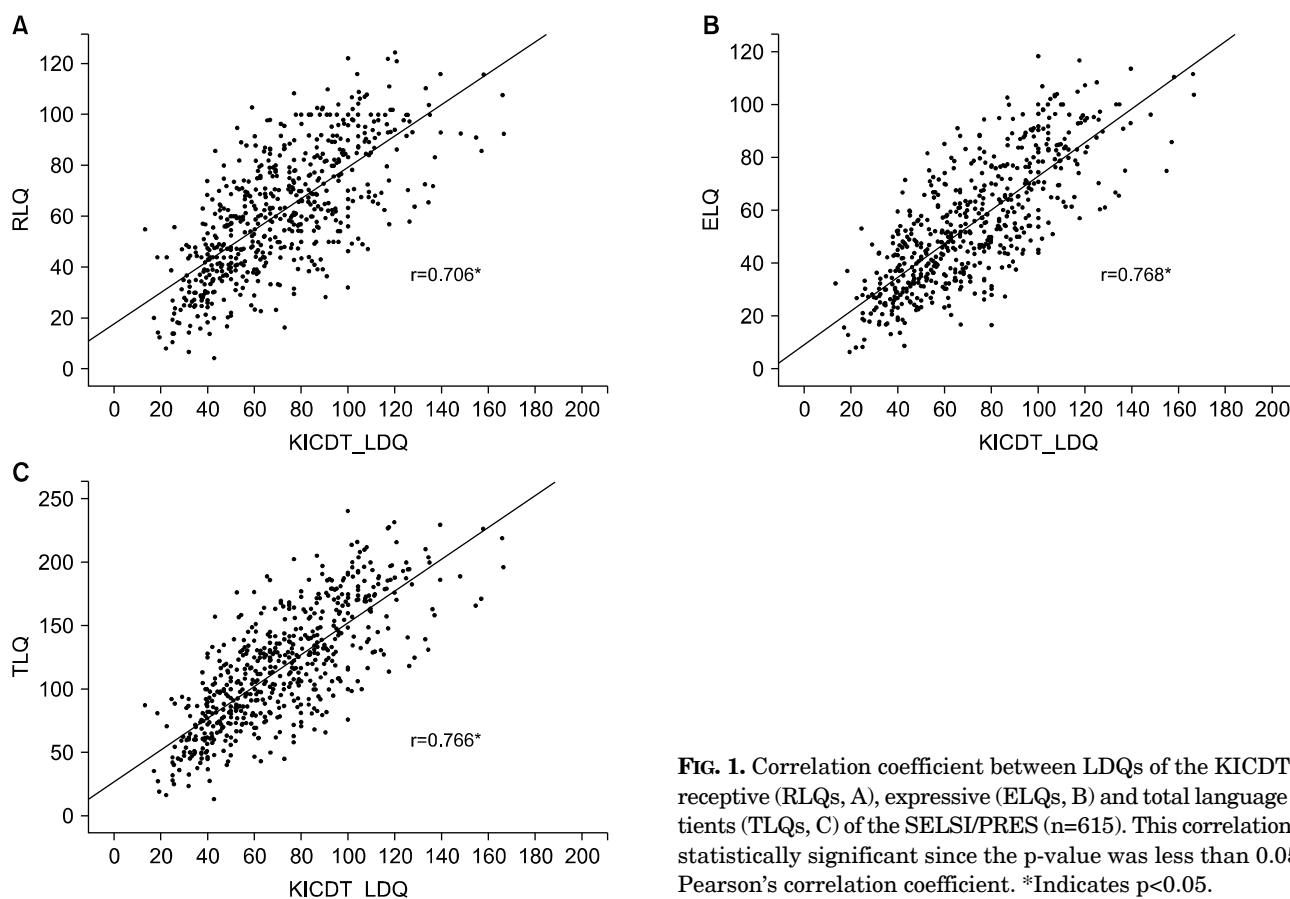


FIG. 1. Correlation coefficient between LDQs of the KICDT and receptive (RLQs, A), expressive (ELQs, B) and total language quotients (TLQs, C) of the SELSI/PRES (n=615). This correlation was statistically significant since the p-value was less than 0.05. r= Pearson's correlation coefficient. *Indicates $p < 0.05$.

SELSI/PRES based on the cut-off values of the LDQ (85) and the percentile ratio of DQ (16).¹⁰⁻¹²

We used Pearson’s correlation coefficient to analyze the relationship between the LDQs of the KICDT and the RLQ and ELQ of the SELSI or PRES. We also used a Chi-square test to cross analyze the correlation between language developmental status from LDQs in KICDT and from the percentile ratio of DQ in SELSI/ PRES. All statistical evaluations were completed with PASW Statistics 18, and a $p < 0.05$ was considered significant.

RESULTS

Among the 615 participants who were assessed with the KICDT and SELSI/PRES, 459 (74.6%) were male and 156 (25.4%) were female, and their mean age is 35.3 ± 11.6 months (8-60 months).

The group that performed KICDT and SELSI was composed of 340 children aged 8-36 (mean age, 26.6 ± 6.1) months. 247 (40.2%) were male and 93 (15.1%) were female of them. The other group performed KICDT and PRES was composed of 275 children aged 37-60 (mean age, 46.1 ± 6.6) months. Among them, there were 212 (34.5%) males and 63 (10.2%) females.

For the 615 participants, the correlation coefficients between the LDQs of the KICDT and the RLQs ($r=0.706$), ELQs ($r=0.768$), and TLQs ($r=0.766$) from the SELSI/PRES

were indicated in Fig. 1A-C. On the other hand, among the 340 participants less than or equal to 36 months old, the correlation coefficient between LDQs of the KICDT and the RLQs ($r=0.674$), ELQs ($r=0.737$), and TLQs ($r=0.746$) from the SELSI were indicated in Fig. 2A-C. Also, among the 275 participants greater than or equal to 37 months old, the correlation coefficient between LDQs of the KICDT and the RLQs ($r=0.729$), ELQs ($r=0.786$), and TLQs ($r=0.773$) from the PRES were indicated in Fig. 3A-C. Statistically, there was a positive correlation between the RLQs, ELQs, and TLQs of the SELSI/PRES and the LDQs of the KICDT ($p < 0.05$).

In cross tabulation, the patients belonging to the retardation groups in both KICDT and SELSI/ PRES numbered 417 (67.8%). Otherwise, patients belonging to the normal groups in KICDT but not in SELSI/ PRES were 151 (24.6%). We derived sensitivity (73.4%), specificity (93.6%), positive predictive value (99.3%), and negative predictive value (22.6%) from the cut-off value of LDQ (85) in KICDT. Calculated χ^2 value was 90.1 which was greater than the critical χ^2 value (14.9). Based on the results, we can state a significant association between language developmental status from LDQs in KICDT and from percentile ratio of DQ in SELSI/ PRES (Table 1).

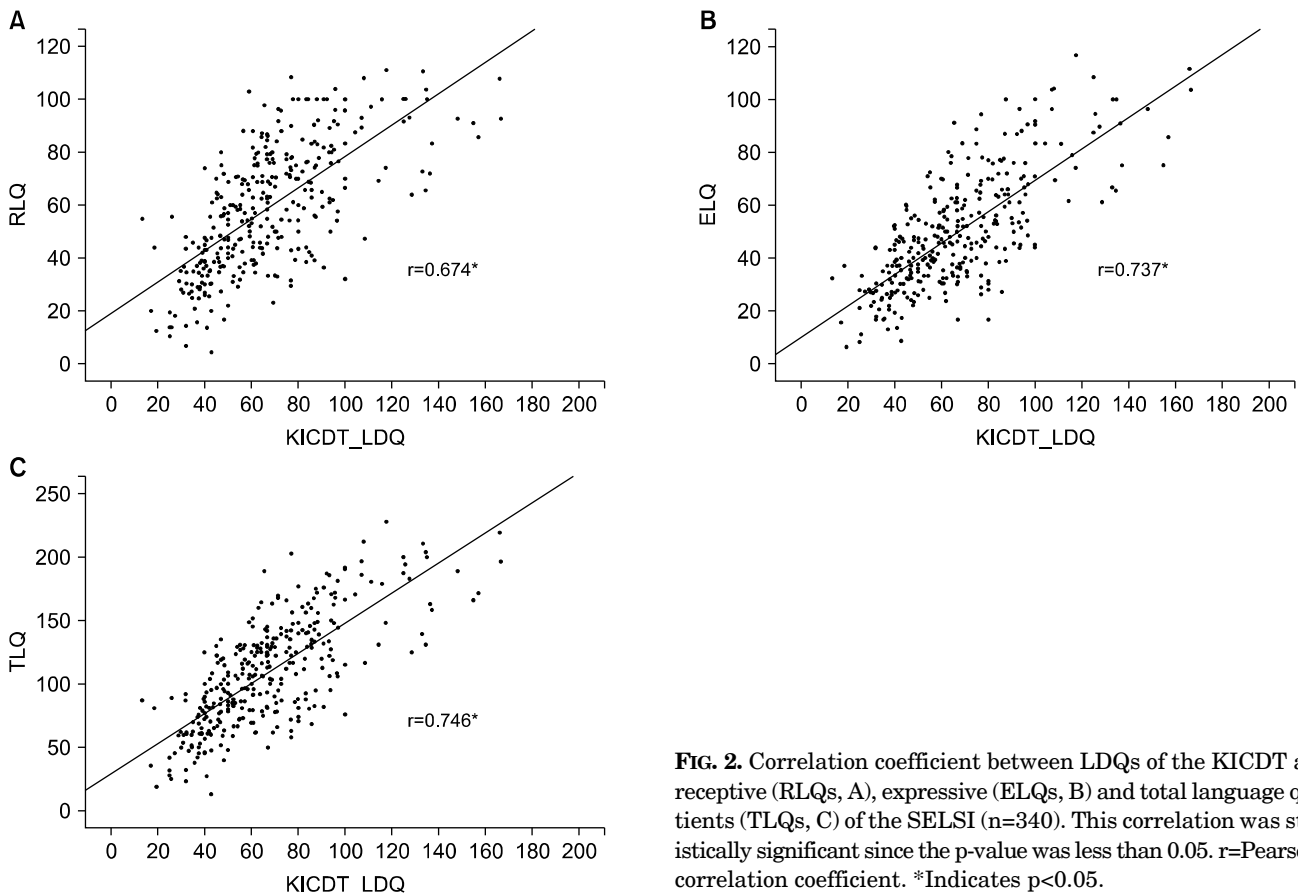


FIG. 2. Correlation coefficient between LDQs of the KICDT and receptive (RLQs, A), expressive (ELQs, B) and total language quotients (TLQs, C) of the SELSI (n=340). This correlation was statistically significant since the p-value was less than 0.05. r=Pearson’s correlation coefficient. *Indicates $p < 0.05$.

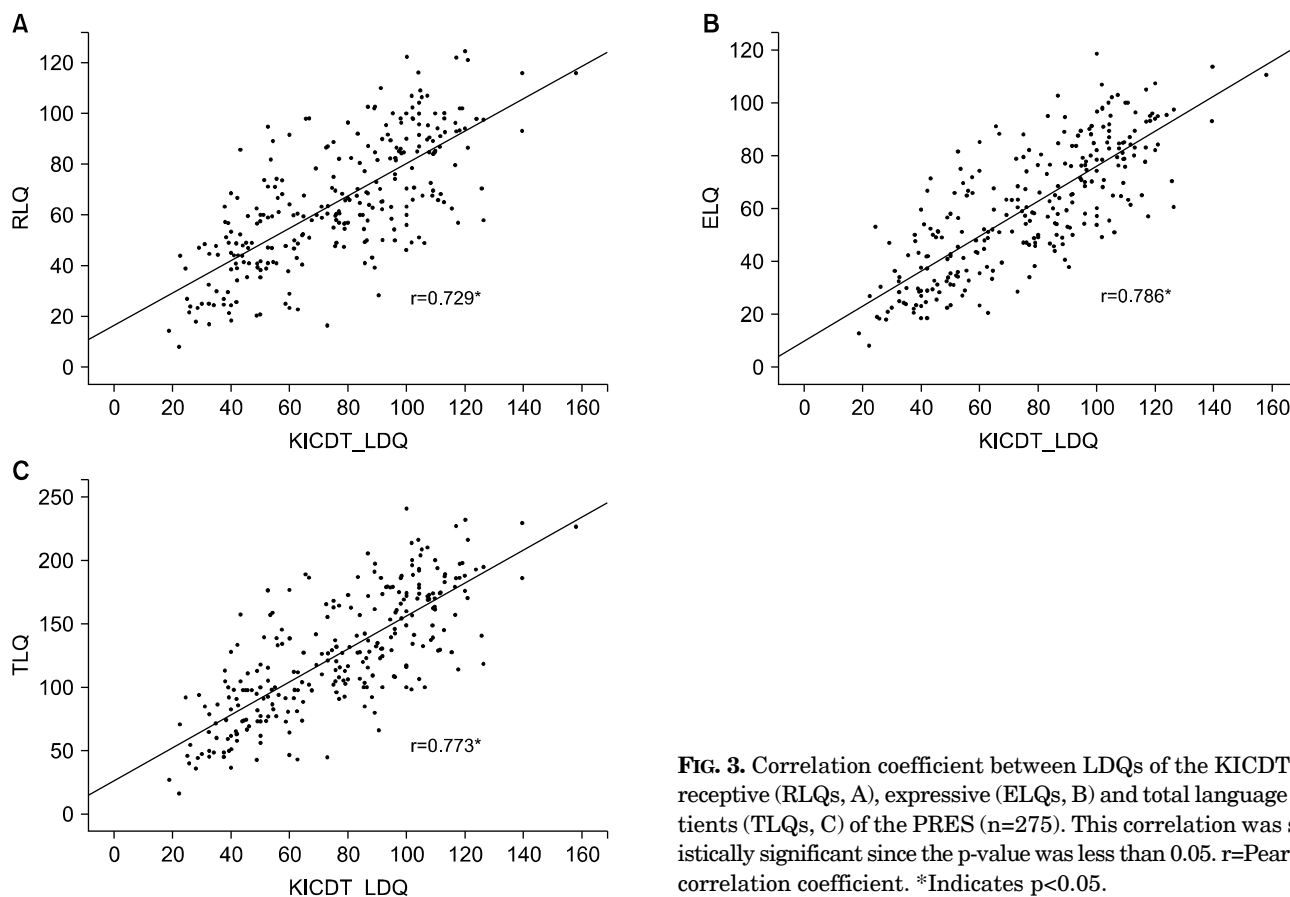


FIG. 3. Correlation coefficient between LDQs of the KICDT and receptive (RLQs, A), expressive (ELQs, B) and total language quotients (TLQs, C) of the PRES (n=275). This correlation was statistically significant since the p-value was less than 0.05. r=Pearson's correlation coefficient. *Indicates $p < 0.05$.

TABLE 1. Language developmental status in the KICDT and SELSI/PRES (n=615)

	Percentile ratio <16 in SELSI/PRES	Percentile ratio \geq 16 in SELSI/PRES	Total
LDQ <85 in KICDT	417 (67.8%)	3 (0.5%)	455 (68.3%)
LDQ \geq 85 in KICDT	151 (24.6%)	44 (7.1%)	195 (31.7%)
Total	568 (92.4%)	47 (7.6%)	615 (100%)

KICDT: Korean Infant and Child Developmental Test, SELSI: Sequenced Language Scale for Infants, PRES: Preschool Receptive-Expressive Language Scale, LDQ: Language Developmental Quotient, LQ: Language Quotient.

DISCUSSION

Speech and language issues are the most common problems seen in children with developmental delays. About 20% of these children learn to talk or use words later than other children of their age.¹³ Although some of the delays might be spontaneously resolved, early detection and treatment are required because early language intervention has a positive impact on linguistic functioning.⁸ Therefore, developmental screening tests are very important for the early diagnosis of developmental delay.^{12,14,15}

Currently, the SELSI and PRES are the language devel-

opmental screening tools most commonly used in Korea. Children under 36 months old are primarily evaluated with the SELSI; whereas, children over 36 months old are assessed with the PRES. The SELSI evaluates children with a total of 112 questions; 56 questions refer to receptive language, and 56 refer to expressive language skills. For children under 36 months old, their caregivers respond to the questionnaires.¹⁰ The PRES has a total of 90 questions, in which 45 refer to receptive language and 45 to expressive language. Three questions are selected for children aged 2-3 years every 3 months of development and for those aged 4-6 years every 6 months of development. The PRES uses various methods, such as pictures, objects, instructions, and interviews to examine semantics, syntax, and pragmatics. The results estimate the language developmental age (receptive language age, expressive language age, and combined language age) through the chronological age.¹¹

The SELSI and PRES are useful for evaluating overall language, but they are very time consuming to administer in primary clinics. However, the clinical screening test such as the KICDT takes less time and is relatively simple to administer. KICDT is a developmental screening test for infants under the age of 5 years and was developed at the Korean Pediatric Society in 2002. This test is subdivided into 5 sub-domains (gross motor, fine motor, personal-social, language, cognitive-adaptive) and each domain consists of 28 items. The KICDT takes only 10-15 minutes and its

scores are described with developmental quotients.¹⁶⁻¹⁸

Therefore, here we investigated whether the language development category of the KICDT had a close relationship with the SELSI/PRES. Our results suggest that the language development category of the KICDT could be used for screening language developmental delays. Indeed, we found that the LDQs of the KICDT were strongly correlated with the ELQs of the SELSI/PRES. Also, we found the correlation between language developmental status from LDQs in KICDT and from percentile ratios of DQ in SELSI/PRES. The sensitivity, specificity, positive predictive values of LDQ of KICDT relative to SELSI/PRES showed that KICDT was a valid screening test for children with language developmental delay.

The KICDT might hold some practical advantages over the SELSI/PRES, including being less time consuming and relatively easier to use. This is very important for pediatricians. The administration requires a language voucher certificate or a language disability certificate to be provided with a diagnostic language test such as SELSI or PRES when supporting language therapy. However, most pediatricians cannot do this in the outpatient clinic. Under these circumstances, pediatricians are excluded because they cannot perform language tests.

In this study, KICDT was discussed among various screening tests, but what we focused on is the usefulness of screening tests that could be used for patients with language delay. However, most of the previous studies have analyzed the correlations with the Korean Bayley Scales of Infant Development, Social Maturity Scale, Korean-Wechsler Preschool and Primary Scale of Intelligence to confirm the usefulness of KICDT as a screening test in the overall development evaluation.^{9,19,20}

The significance of this study is that we did not confine patients in our study to a specific disease group such as epilepsy or autism spectrum disease, but involved more than 600 patients who had developmental delays with or without other diseases for 4 years from January 2013 to December 2016. In addition, the sensitivity, specificity and predictive values derived from LDQ of KICDT relative to SELSI/PRES were used to confirm the validity of KICDT as a screening test.

There are several limitations to the current study. First, this study was based on retrospective data and conducted in a single center. Second, since our hospital is a tertiary hospital, most of the patients are transferred from the primary clinic and their chief complaints were developmental delay, so there is a sample bias in which this study contains very few normal children. As shown in Table 1, the number of patients with language delay was 12 times higher than normal children. Third, this study was not conducted with a new screening test. The Korean Developmental Screening Test (K-DST) is a new screening test, revised in 2017 and has replaced previous developmental screening tests. Since this study included developmental screening tests conducted from 2013 to 2016, new screening tools were not available. Finally, we also need to examine data from nor-

mal control groups to determine the accuracy of this investigation.

The KICDT is a relatively simple appropriate screening that can be performed easily in primary clinics. Further, it is not surprising that the KICDT shows a strong correlation with the SELSI/PRES, as it originated from these instruments. Overall, the LDQ of the KICDT has such a strong correlation with the SELSI/PRES that it could be a useful screening tool for detecting language development delay. Importantly, it can be administered relatively quickly by clinicians.

ACKNOWLEDGEMENTS

This study was performed with approval from the Institutional Review Board of Chonbuk National University Research Council (CUH 2018-08-030).

Lee NR and Kim SJ wrote the first draft of this paper.

There are no prior publications or submissions with any overlapping information, including studies or patients.

This manuscript has not been and will not be submitted to any other journal while it is under consideration by the Chonnam Medical Journal.

CONFLICT OF INTEREST STATEMENT

None declared.

REFERENCES

- Burden V, Stott CM, Forge J, Goodyer I. The Cambridge Language and Speech Project (CLASP). I. Detection of language difficulties at 36 to 39 months. *Dev Med Child Neurol* 1996;38:613-31.
- Stevenson J, Richman N. The prevalence of language delay in a population of three-year-old children and its association with general retardation. *Dev Med Child Neurol* 1976;18:431-41.
- Silva PA, McGee R, Williams SM. Developmental language delay from three to seven years and its significance for low intelligence and reading difficulties at age seven. *Dev Med Child Neurol* 1983; 25:783-93.
- Rescorla L. The Language Development Survey: a screening tool for delayed language in toddlers. *J Speech Hear Disord* 1989;54: 587-99.
- Wong V, Lee PW, Lieh-Mak F, Yeung CY, Leung PW, Luk SL, et al. Language screening in preschool Chinese children. *Eur J Disord Commun* 1992;27:247-64.
- Law J, Boyle J, Harris F, Harkness A, Nye C. Prevalence and natural history of primary speech and language delay: findings from a systematic review of the literature. *Int J Lang Commun Disord* 2000;35:165-88.
- Hohm E, Jennen-Steinmetz C, Schmidt MH, Laucht M. Language development at ten months. Predictive of language outcome and school achievement ten years later? *Eur Child Adolesc Psychiatry* 2007;16:149-56.
- Robertson SB, Ellis Weismer S. Effects of treatment on linguistic and social skills in toddlers with delayed language development. *J Speech Lang Hear Res* 1999;42:1234-48.

9. Kim JH, Yum MS, Jeong SJ, Ko TS. Assessment of children with developmental delay: Korean infant and child development test (KICDT) and Korean Bayley scale of infant development-II (K-BSID-II). *Korean J Pediatr* 2009;52:772-7.
10. Kim YT. Content and reliability analyses of the Sequenced Language Scale for Infants (SELSI). *Commun Sci Disord* 2002;7:1-23.
11. Kim YT. Content and reliability analyses of the Preschool Receptive - Expressive Language Scale (PRES). *Commun Sci Disord* 2000;5:1-25.
12. Kamhi AG. Trying to make sense of developmental language disorders. *Lang Speech Hear Serv Sch* 1998;29:35-44.
13. Moreno MA. Speech and language delays in young children. *JAMA Pediatr* 2015;169:796.
14. Eun BL, Chung HJ, Cho S, Kim JK, Shin SM, Lee JH, et al. The appropriateness of the items of Korean Ages and Stages Questionnaires (K-ASQ) developmental screening test in Korean infants and children. *J Korean Child Neurol Soc* 2014;22:29-41.
15. Im SH, Han EY, Song J. Clinical application of neurodevelopmental assessment for infants and toddlers. *J Korean Acad Child Adolesc Psychiatry* 2012;23:175-80.
16. Sung MH, Choi JM, Yoo JH, Lee YS, Hwang KG, Lee YA. Developmental quotient of very low birth weight infants assessed by Korean infant development screening test. *J Korean Soc Neonatol* 2004;11:152-9.
17. Shin DH, Lee HS, Lee JY, Choi BM, Eun BL, Hong YS, et al. Usefulness of Korean infant developmental screening test in premature infants. *Korean J Pediatr* 2005;48:1337-41.
18. Choi HW, Jeong MH, Lee EH, Jeong SJ, Yum MS, Ko TS. Korean Infant and Child Developmental Test (KICDT) in children with epilepsy. *J Korean Child Neurol Soc* 2010;18:40-8.
19. Kim SG, Kim NC, Lee IK, Oh MH, Kim YC, Lee HJ. Comparative study between Bayley scales of infant development-II and Korean infant and child developmental test in infants younger than 12 months. *J Korean Child Neurol Soc* 2005;13:48-56.
20. Chung HJ, Eun BL, Kim HS, Kim JK, Shin SM, Lee JH, et al. The validity of Korean Ages and Stages Questionnaires (K-ASQ) in Korean infants and children. *J Korean Child Neurol Soc* 2014;22:1-11.