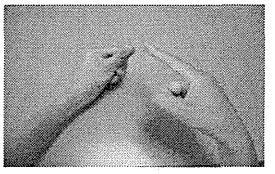
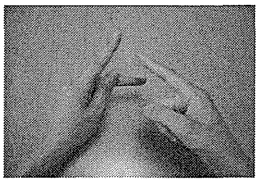
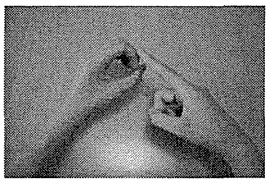
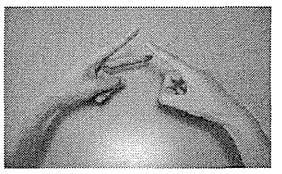
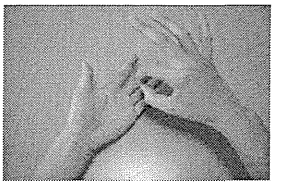
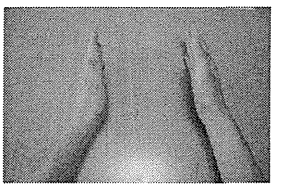
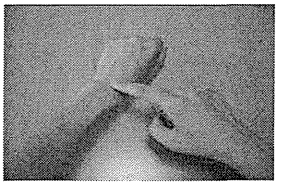
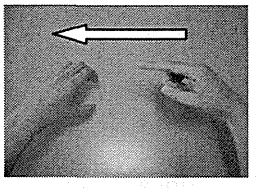
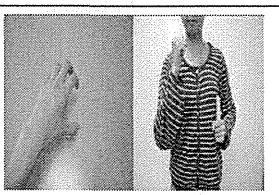
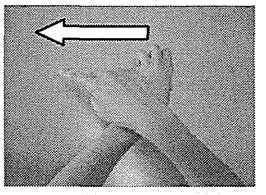
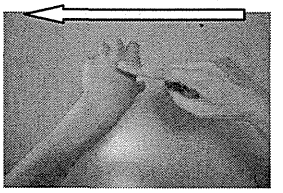
高岡滋・川田裕慈・太田富雄（1993）聴覚障害児の格助詞の誤用傾向に関する一考察.大阪教育大学障害児教育研究紀要, 16,55-66.
武居渡（2005）ろう児の手話獲得と第２言語としての日本語. 手話を活用したろう教育実践. 日本手話研究所ろう教育研究部, 62-75.
都立大塚ろう学校（2010）児童の実態に応じた語彙力と文法力を高める指導（1）～視覚的効果をねらった教材を用いた指導の工夫を通して. 第44回全日本聾教育研究大会（北海道大会）研究収録, 133-134.

図１．手話助詞表

意味	助詞	手話助詞	助詞と一緒に使う動詞
動作主	が		例：【ある】【来る】【思う】【終わる】【遊ぶ】【走る】【泣く】 【頑張る】【笑う】【起きる】【かかる】【止まる】【逃げる】 【始まる】【変わる】【疲れる】【回る】
対象	が		【できる】【分かる】【聞こえる】
	を		【言う】【見る】【しまう】【食べる】【取る】【持つ】【作る】【出す】【考える】【書く】【買う】【置く】【かける】【使う】【知る】【待つ】【開ける】【切る】【止める】【呼ぶ】【飲む】【喜ぶ】【読む】 【忘れる】【探す】【休む】
	に		【怒る】【なる】【びっくりする】【話す】【負ける】【勝つ】
手段 材料	で		例：【遊ぶ】
時	で	時間 	
	に	時刻 	

<table>
<tr><td rowspan="4">場所</td><td rowspan="2">に</td><td>点
 
  </td><td>例：【いる】【立つ】【座る】【並ぶ】【寝る】</td></tr>
<tr><td>到着点
  </td><td>例：【入れる】【上がる】【行く】【着く】【帰る】
【入る】【乗る】</td></tr>
<tr><td>で</td><td>  </td><td></td></tr>
<tr><td rowspan="2">を</td><td>出発地
  </td><td>例：【出る】</td></tr>
<tr><td>通過点
  </td><td>例：【歩く】【飛ぶ】【上がる】【降りる】【通る】</td></tr>
</table>

相手・対象	～に…を	【くれる】【教える】【もらう】

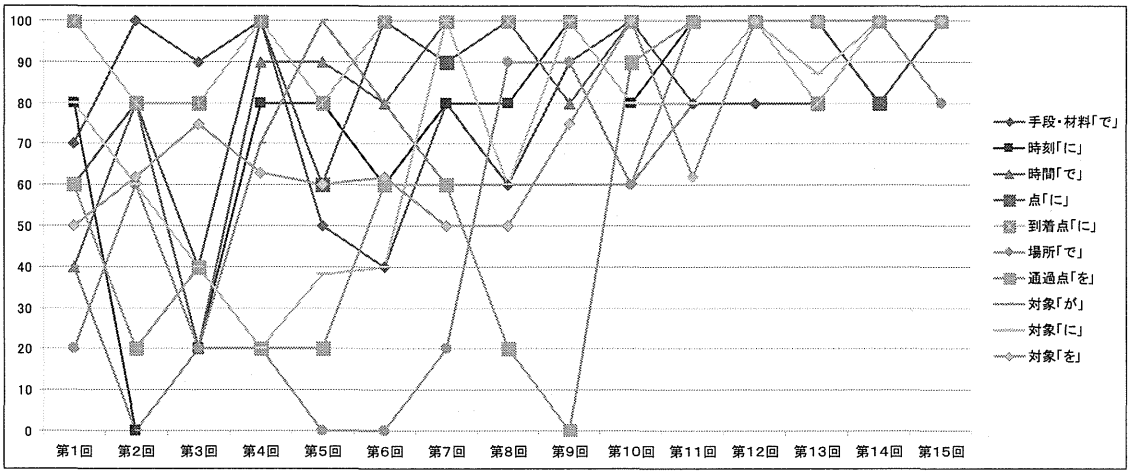
表１．プレテストでの正答率

		正答率（%）	正答率（%）
動作主	主語「が」	81.8	81.8
対象	対象「が」	66.7	65.6
	対象「を」	70.1	
	対象「に」	60	
手段・材料	手段・材料「で」	28.6	28.6
時間	時刻「に」	71.4	37.5
	時間「で」	0	
場所	点「に」	44	50.6
	到着点「に」	57.1	
	場所「で」	0	0
	出発点「を」	100	100
	通過点「を」	71.4	71.4

表２．テスト結果

	第1回	第2回	第3回	第4回	第5回	第6回	第7回	第8回	第9回	第10回	第11回	第12回	第13回	第14回	第15回
手段・材料「で」	70	100	90	100	50	40	80	60	90	100	80	80	80	100	100
時刻「に」	80	0	20	80	80	60	80	80	100	80	100	100	100	80	100
時間「で」	40	80	20	90	90	80	100	100	80	100	100	100	100	100	100
点「に」	60	80	40	100	60	100	90	100	100	100	100	100	100	80	100
到着点「に」	100	80	80	100	80	100	100	100	100	100	100	100	80	100	100
場所「で」	20	60	20	20	0	0	20	90	90	60	100	100	100	100	80
通過点「を」	60	20	40	20	20	60	60	20	0	90	100	100	100	100	100
対象「が」	40	0	20	70	100	80	60	60	60	60	80	100	100	100	100
対象「に」	80	60	40	20	38	40	100	60	100	80	80	100	87	100	100
対象「を」	50	62	75	63	60	62	50	50	75	100	62	100	100	100	100

※ ▒ は指導ターゲット語、 ▒ は指導後に正答率 80%以下であったものを示す



研究成果の刊行に関する一覧表

書籍

著者氏名	書　籍　名	出版社名	出版年
大橋謙策、福島邦博、笠井紀夫、大森佳奈ほか	聴覚障害児の日本語言語発達のために～ALADJINのすすめ～	公益財団法人テクノエイド協会	2012

雑誌

発表者氏名	論文タイトル名	発表誌名	巻号	ページ	出版年
Kunihiro Fukushima, Norio Kasai, Kana Ohmori, Akiko Sugaya, Akie Fujiyoshi, Tomoko Taguchi, Takayuki Konishi, Syuuhei Sugishta, Wataru Takei, Hiroshi Fujino, Toshiyuki Ojima, Kazunori Nishizaki	Assessment package for language development in Japanese hearing-impaired children (ALADJIN) as a test battery for the development of practical communication.	Ann Otol Rhinol Laryngol	121 suppl 202	3－15	2012
Norio Kasai, Kunihiro Fukushima, Kana Omori, Akiko Sugaya, Toshiyuki Ojima	Effects of early identification and intervention on language development in Japanese children with prelingual severe to profound hearing impairment.	Ann Otol Rhinol Laryngol	121 suppl 202	16－20	2012
Akiko Sugaya, Kunihiro Fukushima, Norio Kasai, Akie Fujiyoshi, Tomoko Taguchi, Kana Omori, Toshiyuki Ojima, Kazunori Nishizaki	Language ability in the intermediate-scoring group of hearing-impaired children.	Ann Otol Rhinol Laryngol	121 suppl 202	21－27	2012
Akie Fujiyoshi, Kunihiro Fukushima, Tomoko Taguchi, Kana Omori, Norio Kasai, Shinya Nishio, Akiko Sugaya, Rie Nagayasu, Takayuki Konishi, Syuuhei Sugishita, Jyunpei Fujita, Kazunori Nishizaki	Syntactic development in Japanese hearing-impaired children.	Ann Otol Rhinol Laryngol	121 suppl 202	28－34	2012

発表者氏名	論文タイトル名	発表誌名	巻号	ページ	出版年
Syuuhei Sugishta, Kunihiro Fukushima, Norio Kasai, Takayuki Konishi, Kana Ohmori, Tomoko Taguchi, Akie Fujiyoshi, Toshiyuki Ojima	Language development, interpersonal communication, and academic achievement among Japanese children as assessed by the ALADJIN.	Ann Otol Rhinol Laryngol	121 suppl 202	35－39	2012
Satoshi Iwasaki, Shinya Nishio, Hideaki Moteki, Yutaka Takumi, Kunihiro Fukushima, Norio Kasai, Shin-ichi Usami	Language development in Japanese children who receive cochlear implant and/or hearing aid.	International Journal of Pediatric Otorhinolaryngology	76(3)	433－438	2012
岩崎　聡、西尾信哉、茂木英明、工　穣、笠井紀夫、福島邦博、宇佐美真一	人工内耳装用時期と言語発達の検討　－全国多施設調査研究結果－	Audiology Japan	55(1)	56－60	2012
菅谷明子、福島邦博、笠井紀夫、片岡祐子、前田幸英、長安吏江、問田直美、大森修平、西崎和則	当院にて手術を施行した人工内耳装用児の言語発達評価	Audiology Japan	55(2)	126－131	2012
西尾信哉、岩崎　聡、宇佐美真一、笠井紀夫、福島邦博	難聴児における低出生時体重児の占める割合およびその言語発達に関する検討	Audiology Japan	55(2)	146－151	2012
菅谷明子、福島邦博	新生児聴覚スクリーニングの現状と問題点	外来小児科	Vol. 14	119－124	2011
笠井紀夫	言語習得前の難聴は言語発達に影響するのか？	JOHNS	28(3)	301－303	2012
笠井紀夫	言語発達遅滞では何を考え，何を検査するのか？	JOHNS	28(3)	304－307	2012
中澤　操	新生児聴覚スクリーニングはなぜ必要なのか？	JOHNS	28(3)	278－279	2012

Suppl 202-1-F

Annals of Otology, Rhinology & Laryngology 121(4)Suppl 202:3-15.

Assessment Package for Language Development in Japanese Hearing-Impaired Children (ALADJIN) as a Test Battery for the Development of Practical Communication

Kunihiro Fukushima, MD, PhD; Norio Kasai, MD, PhD; Kana Omori; Akiko Sugaya, MD; Akie Fujiyoshi; Tomoko Taguchi; Takayuki Konishi; Syuuhei Sugishita; Wataru Takei, PhD; Hiroshi Fujino, PhD; Toshiyuki Ojima, MD, PhD; Kazunori Nishizaki, MD, PhD

Objectives: The measurement of language development in hearing-impaired children is an important step in assessing the appropriateness of an intervention. We proposed a set of language tests (the Assessment Package for Language Development in Japanese Hearing-Impaired Children [ALADJIN]) to evaluate the development of practical communication skills. This package consisted of communication skills (TQAID), comprehensive (PVT-R and SCTAW) and productive vocabulary (WFT), comprehensive and productive syntax (STA), and the STRAW.

Methods: A total of 638 children with greater than 70-dB hearing impairment were subjected to this set of language tests. Additional tests, including the PARS, the RCPM, and parental questionnaires, were administered to assess the backgrounds of the children.

Results: A trimodal distribution was observed among hearing-impaired children by the histogram-based analysis of each test.

Conclusions: The ALADJIN is a useful Japanese-language evaluation kit for hearing-impaired children.

Key Words: communication, hearing impairment, language development, syntax, vocabulary.

INTRODUCTION

The evaluation of language development in hearing-impaired children is important in assessing the appropriateness of devices (ie, hearing aids or cochlear implants), assessing the efficacy of educational support, and identifying additional disabilities such as learning disabilities and disproportionate language impairment.[1-3] Several different packages, including the Nottingham Early Assessment Package[4] and others,[5-7] have been established to evaluate the development of communication and language for children with hearing impairment. Each of these tests has its own distinctive approach that evaluates different aspects or domains of language.

Among the most important language skills that are critical for hearing-impaired children in early childhood are interpersonal communication skills,[8] which constitute pragmatic skills. We aimed to evaluate the Test for Question-Answer Interaction Development (TQAID)[9] as a tool that measures interpersonal communication skills. Toyama et al[10] were the first to report on the TQAID as a test for language development in children during early childhood. This test comprises 57 questions in 10 categories, including formulaic questions (eg, "How old are you?" and "What is your name?") and complicated narrative questions (eg, "Please explain how to make a tunnel in the sand pit" and "Please explain the story of Momotarou" [an old Japanese tale]). It investigates pragmatic aspects of language development, ie, the ability to add linguistic information in response to different situations.[9]

Second, the development of interpersonal commu-

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nication skills is related to the development of several different language domains and cognitive functions, including vocabulary, syntax, and reading and writing skills. By exploring these language domains, we may be able to refine the intervention strategies and encourage better interpersonal communication skills development. In this study, we also examined tests of several language domains, including vocabulary perception and production, Japanese-language syntax perception and production, and reading and writing Japanese characters, in the same participants. By evaluating these tests simultaneously, we propose the Assessment Package for Language Development in Japanese Hearing-Impaired Children (ALADJIN) as a language performance evaluation procedure for hearing-impaired children.

Third, the accumulation of these language domain profiles among hearing-impaired children can build a robust epidemiological data set that is indispensable for health-care planners in establishing supporting systems for hearing-impaired children.[2] In 2009, we planned to assess the current status of hearing-impaired children in Japan with the Research on Sensory and Communicative Disorders (RSCD) project, and the ALADJIN was used as a part of this nationwide research project. The RSCD project was originally developed to assess the effectiveness of interventional methods for hearing-impaired children, including newborn hearing screening. Therefore, several hearing-impaired children from different areas of Japan participated in the RSCD project. Eventually, we will be able to know the domain-specific language status of Japanese hearing-impaired children, not only in selected institutions and schools, which potentially yield biases, but also in various institutions in Japan. To improve long-term outcomes of hearing impairment at the population level and establish proper health care or welfare system aid for hearing-impaired children, knowing the population-based distribution in each language domain is important.

SUBJECTS AND METHODS

Subjects. The study included 638 hearing-impaired children who had participated in the RSCD project in Japan. (Written informed consent was provided in 2009.) First, during the period of open recruitment of institutions for hearing-impaired children, we invited schools for the deaf, schools for the hard-of-hearing, mainstream schools, daycare centers, and hospital training rooms to participate in the RSCD project (Table 1 and Fig 1), and the majority of the children at the institutions were recruited to this project according to the following inclusion criteria: 1) age from 48 months (2 years before elementary school entrance, ie, grade –2) to 155 months (6th grade of primary school, ie, grade 6); and 2) congenital hearing impairment, with a hearing level of greater than 70 dB (on average) appearing no later than 4 years of age. Children who were unable to complete the ALADJIN because of additional disabilities were excluded. All ALADJIN testing was conducted by trained speech-language hearing therapists or deaf-school teachers in a noise-minimized area. The study design was approved by the ethical review board of the Association for Technical Aids. Background information, including hearing level, age at identification, diagnosis of hearing impairment, modes of communication, hearing devices, and age at commencement of hearing intervention, was collected by parental questionnaire. The hearing status of each child, including the pure tone threshold for the better-hearing ear and the aided hearing threshold, was also obtained from either the hospital or the school.

TABLE 1. INSTITUTIONS AND CHILDREN WHO PARTICIPATED IN PROJECT

	No.	*%*
Total number of institutions	124	
Hospitals or clinics	66	
Deaf schools	24	
Mainstream schools	5	
Preschool training centers	9	
Universities	7	
Others	2	
Total number of children	638	
Grade –2 (48-59 mo of age)	107	16.8
Grade –1 (60-71 mo of age)	90	14.1
Grade 1 (72-83 mo of age)	102	16.0
Grade 2 (84-95 mo of age)	76	11.9
Grade 3 (96-107 mo of age)	76	11.9
Grade 4 (108-119 mo of age)	63	9.9
Grade 5 (120-131 mo of age)	67	10.5
Grade 6 (132-143 mo of age)	57	8.9

TQAID. A brief explanation of the TQAID is given above. All children were administered the TQAID, and the results were summarized according to the manual. The children received these tests through their favored mode of communication — oral, aural, or manual — and the mode of communication used for the test was documented. The following tests were conducted for each participant on the day after administration of the TQAID.

Vocabulary Tests. The Word Fluency Test (WFT) was conducted as a productive vocabulary task.[11-13] The children were asked to generate as many words from a category as possible in 60 seconds. The category used in this study was 3 phonetic tasks (words starting with 3 different morae /*a*/, /*ka*/, and /shi/) or a semantic task (names of animals). The numbers of

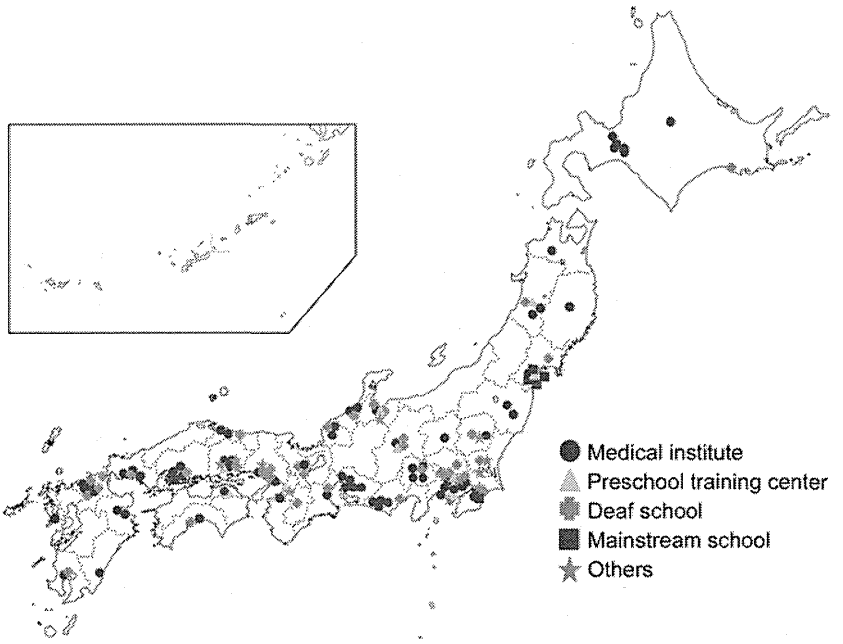

Fig 1. Collaborative institutions of Research on Sensory and Communicative Disorders project in Japan.

words that were represented either orally or manually were counted separately, except for the onomastic words. This procedure has already been established for examining language ability that relates to damaged frontal lobe function.[11,13] The Japanese version of the Peabody Picture Vocabulary Test–Revised (PVT-R)[14] and the Standardized Comprehension Test of Abstract Words (SCTAW)[15] were conducted as comprehensive vocabulary tasks, and an adjusted score was used in this study. The SCTAW consists of 32 or 45 abstract words selected from Japanese textbooks. The details of this method for hearing-impaired children are reported elsewhere.[15,16] The SCTAW is performed solely for school-age children. For these tests, the children were first encouraged to use a phonetic presentation of stimulus words, and if the child could not hear the stimulation words, the words were spelled out for the child either with letters or with the manual alphabet.

Reading and Writing. The Screening Test of Reading and Writing for Japanese Primary School Children (STRAW) was also conducted to examine the children's reading and writing achievement.[17,18] Because preschool children were not expected to have learned *katakana* or *kanji* characters, only the *hiragana* test was conducted for children in grade 1. The test procedures and analysis were conducted according to the manual included with the test.[18] The number of correct answers was determined. Each test word was repeated by the children to avoid misunderstandings owing to hearing impairment.

Syntax. The Syntactic Processing Test of Aphasia (STA), a Test for Reception of Grammar–like syntax test for Japanese language users, is a test to evaluate the ability of the perception and production of syntactic structures. The children were asked to choose 1 of 4 or 6 pictures that were appropriate for the tester's presentation (perception test) or to express a sentence according to the picture that a tester indicated (production test).[19] The tests evaluated perception and production of irreversible sentences, reversible sentences, Japanese grammatical particles (*jyo-shi*), and other syntactic structures, including relative pronouns.

Additional Information. To evaluate additional disabilities, we used the Pervasive Developmental Disorders ASJ [Autism Society of Japan] Rating Scales (PARS) for determining autistic tendencies[20]

TABLE 2. PARTICIPANTS' BACKGROUND

	No.	*%*
Sex		
Male	315	49.4
Female	312	48.9
Not documented	11	1.7
Use of sign language		
Yes	316	49.5
No	318	49.8
Not documented	4	0.6
Use of cochlear implant		
Yes	285	44.7
No (hearing aid only)	349	54.7
Not documented	4	0.6
Participation in newborn hearing screening		
Yes	199	31.2
No	414	64.9
Not documented	25	3.9

Average pure tone hearing level (mean ± SD) was 100.12 ± 12.97 dB unaided, and 42.00 ± 14.00 aided.

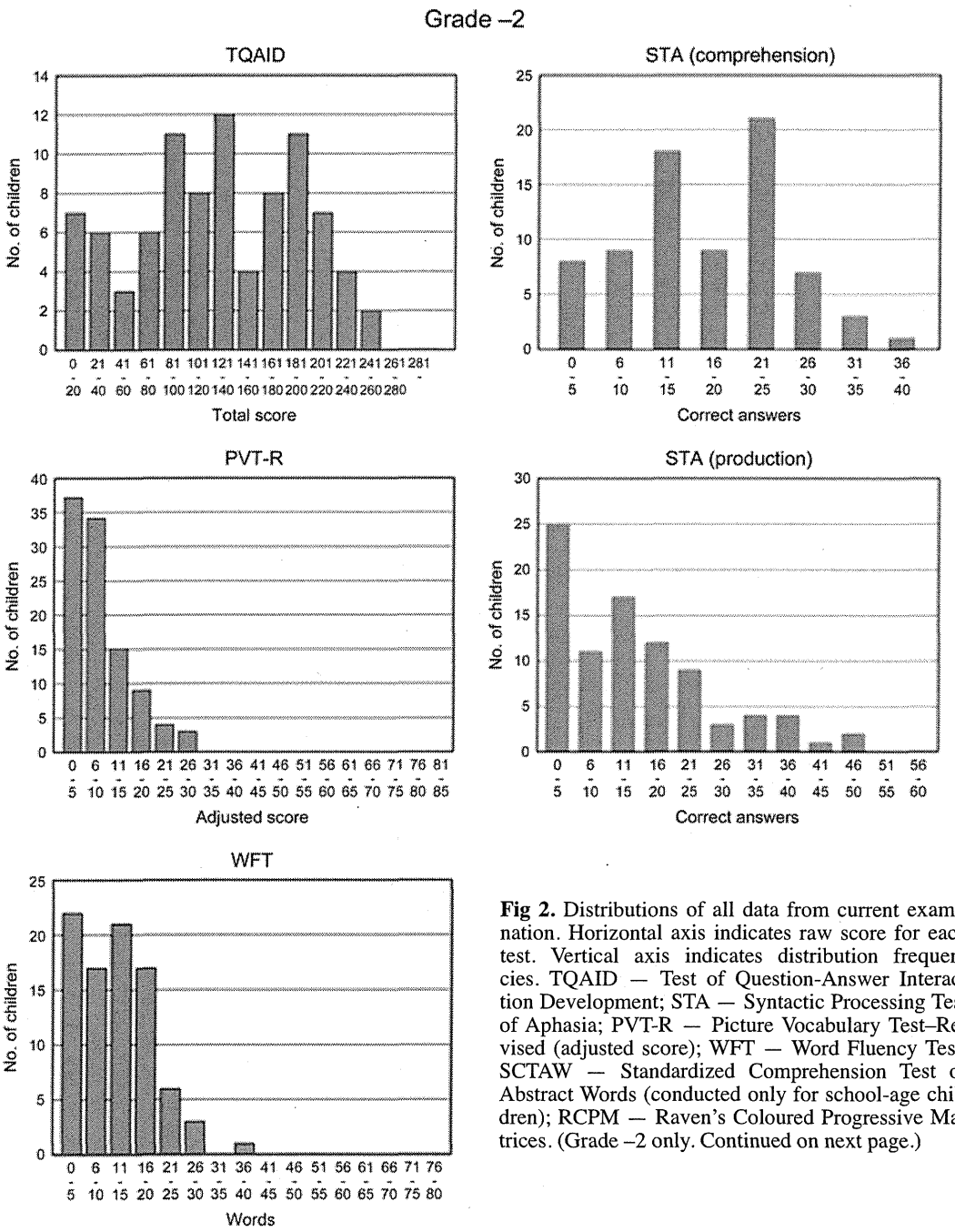

Fig 2. Distributions of all data from current examination. Horizontal axis indicates raw score for each test. Vertical axis indicates distribution frequencies. TQAID — Test of Question-Answer Interaction Development; STA — Syntactic Processing Test of Aphasia; PVT-R — Picture Vocabulary Test–Revised (adjusted score); WFT — Word Fluency Test; SCTAW — Standardized Comprehension Test of Abstract Words (conducted only for school-age children); RCPM — Raven's Coloured Progressive Matrices. (Grade –2 only. Continued on next page.)

and Raven's Coloured Progressive Matrices (RCPM) test for testing nonverbal intelligence.[21] In addition, inquiry-based information was collected from the caregivers and/or teachers. This information included daily communication modes, parental attitude toward education, family structure and income, educational background, and school achievement.

Statistical Analysis. All statistical values were calculated by IBM SPSS Statistics 19 (IBM Corp, Armonk, New York). The correlations of each test and the standard deviation (SD) were examined, and the contribution of the TQAID score to each language domain (vocabulary, syntax, and reading and writing) was evaluated by multiple linear regression analysis.

RESULTS

Table 2 shows the demographic and audiological characteristics of all samples. Of the 638 children, 349 children (54.7%) used only a hearing aid, whereas 285 children (44.7%) used a cochlear implant with or without a hearing aid in their contralateral ear; 199 children (31.2%) had received newborn hearing screening as newborns, whereas 414 children (64.9%) had not. The remaining 25 par-

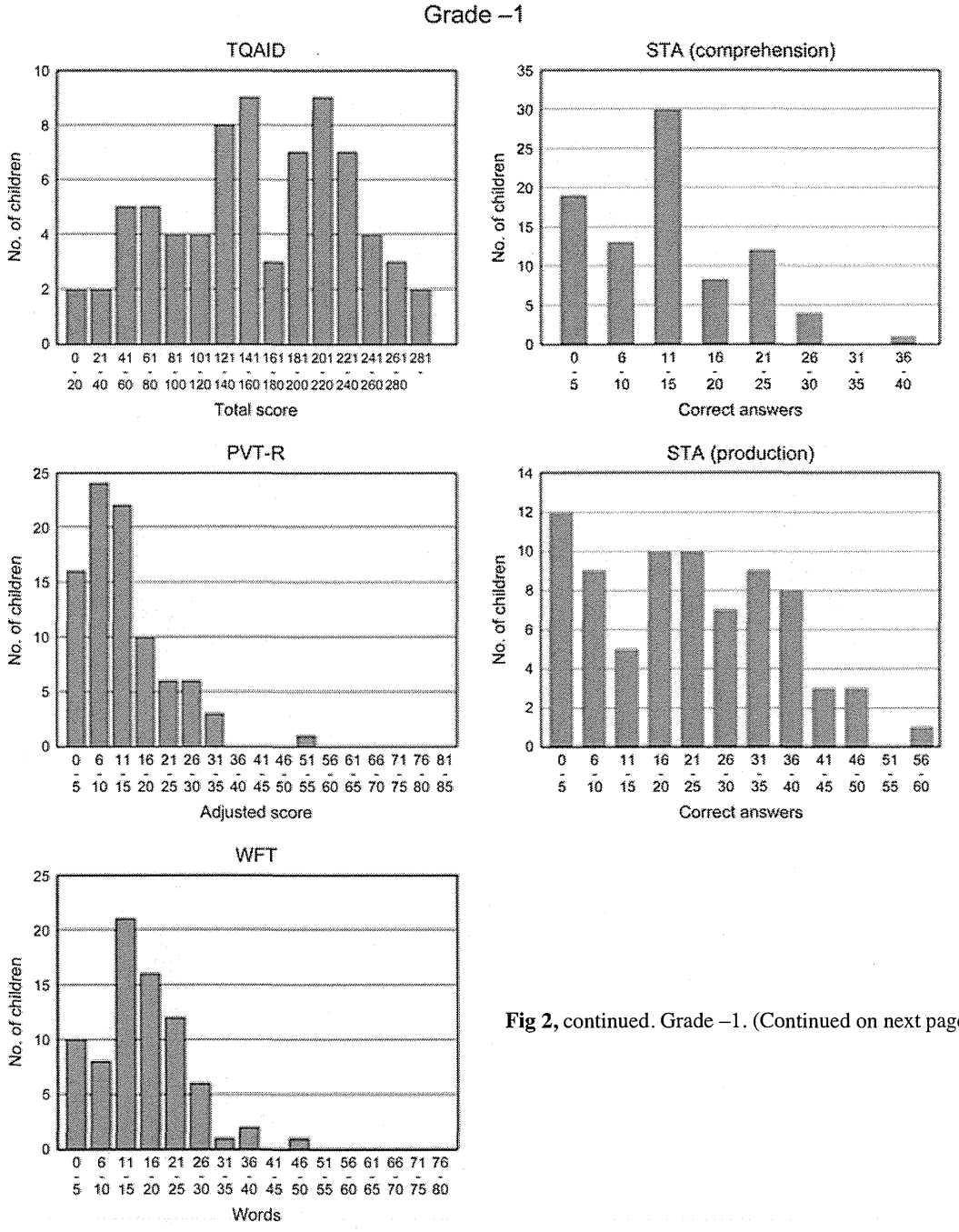

Fig 2, continued. Grade –1. (Continued on next page.)

ents did not remember or did not answer whether their children had received newborn hearing screening. According to the response from caregivers, 316 children (49.5%) used sign language to some extent, and 318 children (49.8%) did not use sign language. The mean pure tone hearing level was 100.12 dB (SD, 12.97 dB), and the mean aided hearing level was 42.00 dB (SD, 14.00 dB).

All language test results are summarized in Fig 2, and the demographic distribution is described. According to the TQAID manual, normal-hearing children in grade 1 are expected to score more than 240 points (maximum points, 303). However, only 9 (12.7%) of the hearing-impaired children of the same age achieved language development comparable to that indicated in the original TQAID report.

Table 3 shows the comparison between test scores of the TQAID and other language tests in each grade. All results of the language tests (WFT, PVTR, STA, and SCTAW) except one showed positive correlation (correlation coefficient, 0.356 to 0.781; $p < 0.05$) with those of TQAID. The only exception was the result of the WFT for children in grade 6 (correlation coefficient, 0.237; $p = 0.152$).

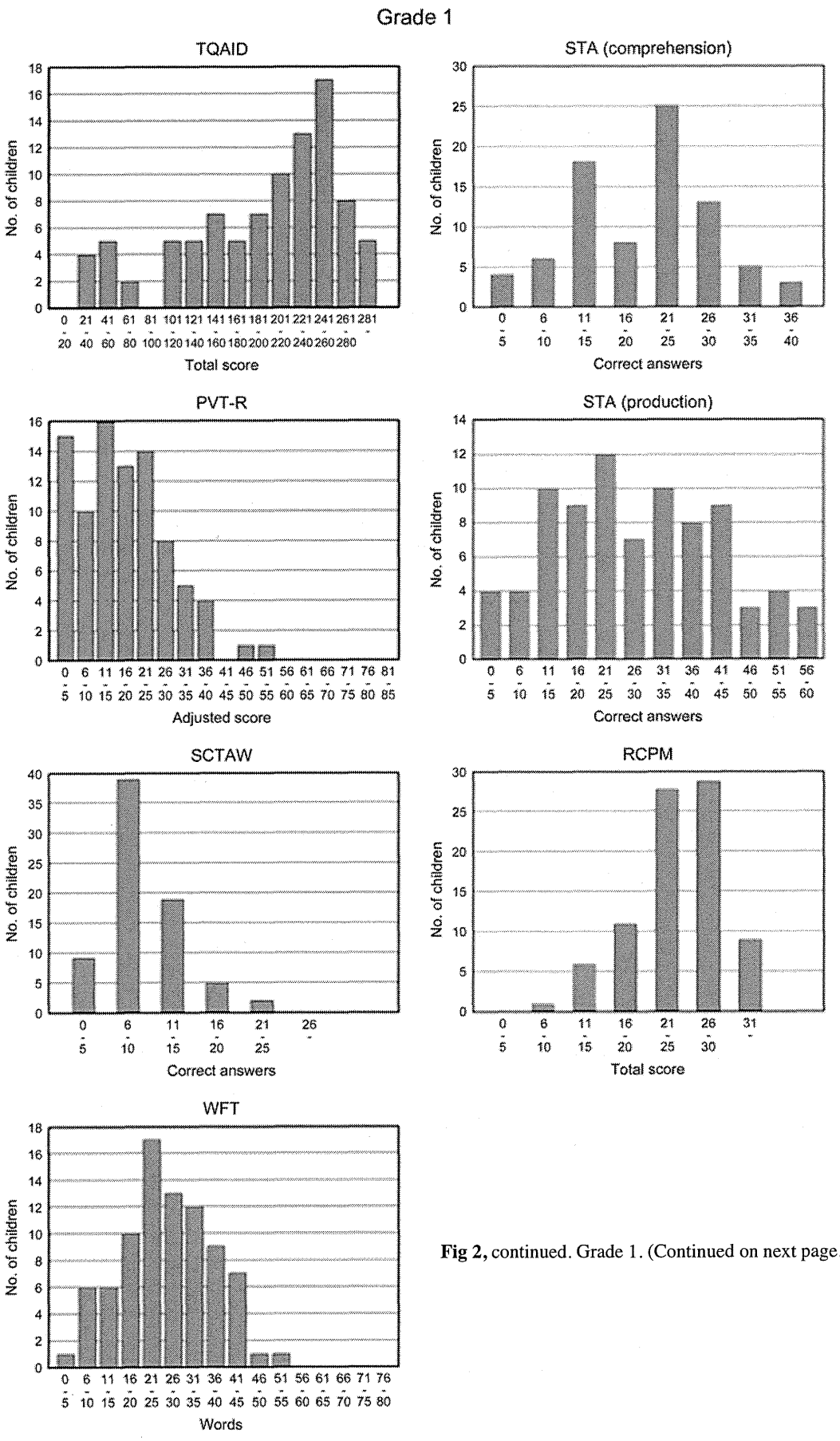

Fig 2, continued. Grade 1. (Continued on next page.)

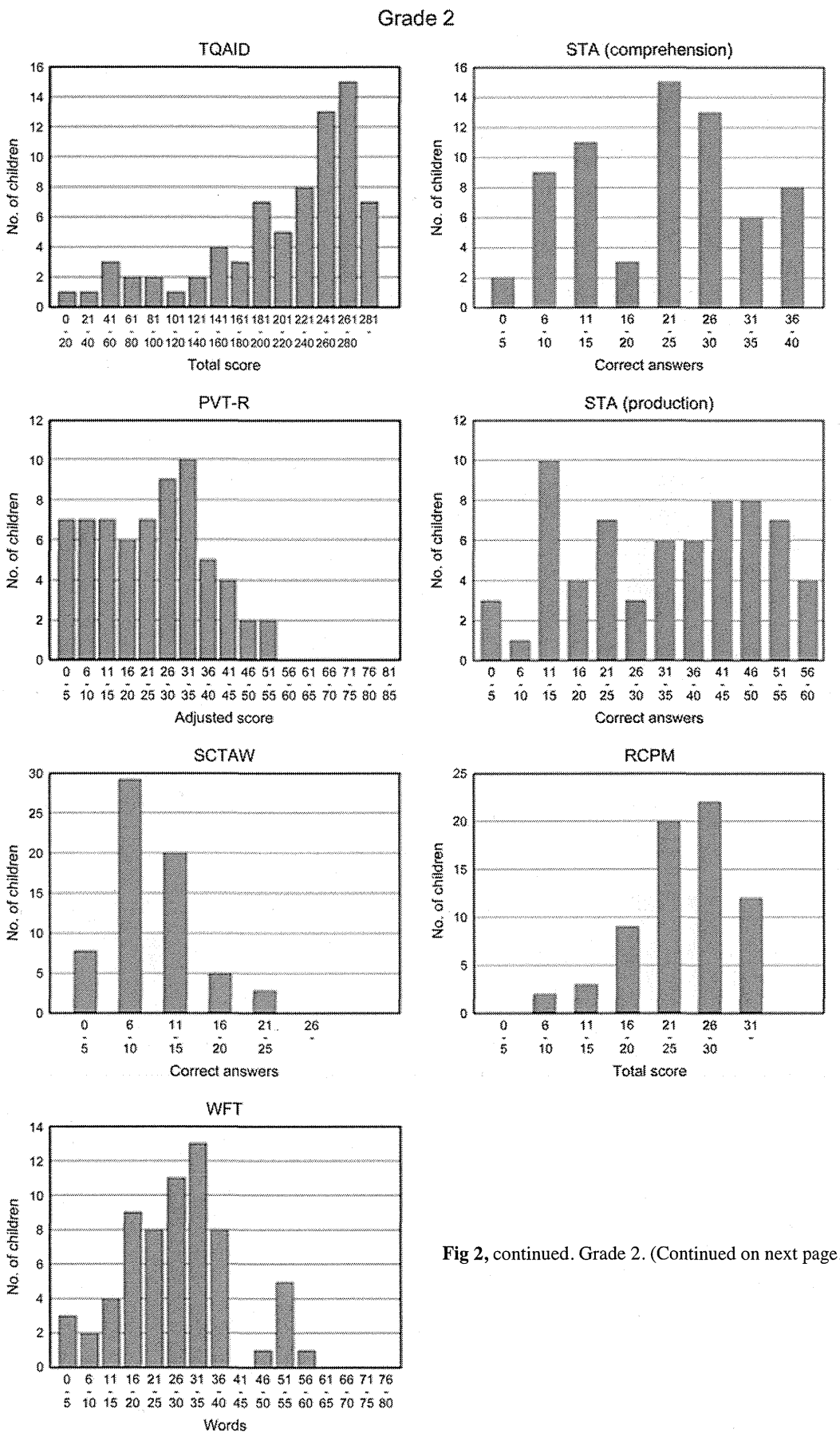

Fig 2, continued. Grade 2. (Continued on next page.)

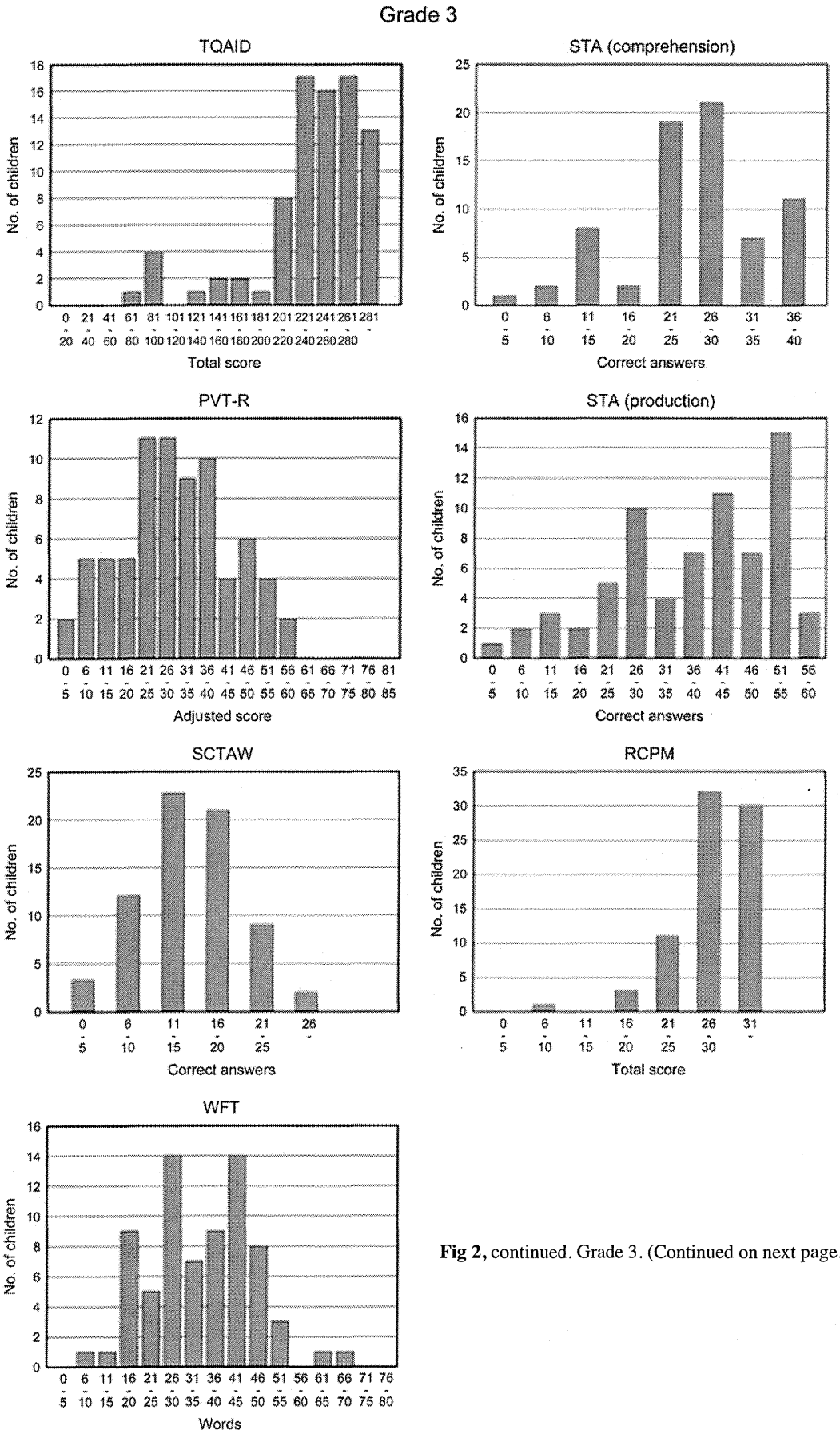

Fig 2, continued. Grade 3. (Continued on next page.)

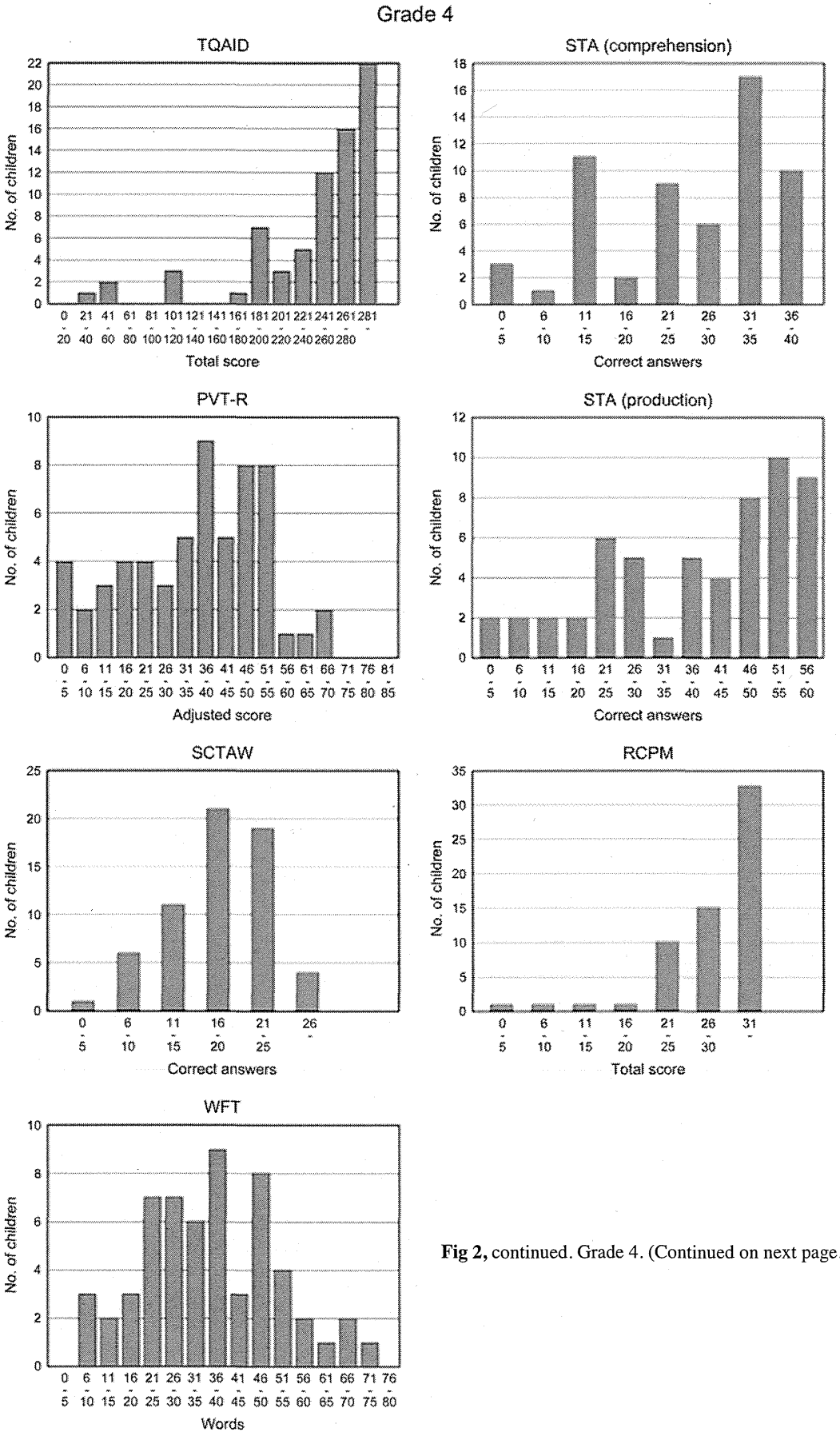

Fig 2, continued. Grade 4. (Continued on next page.)

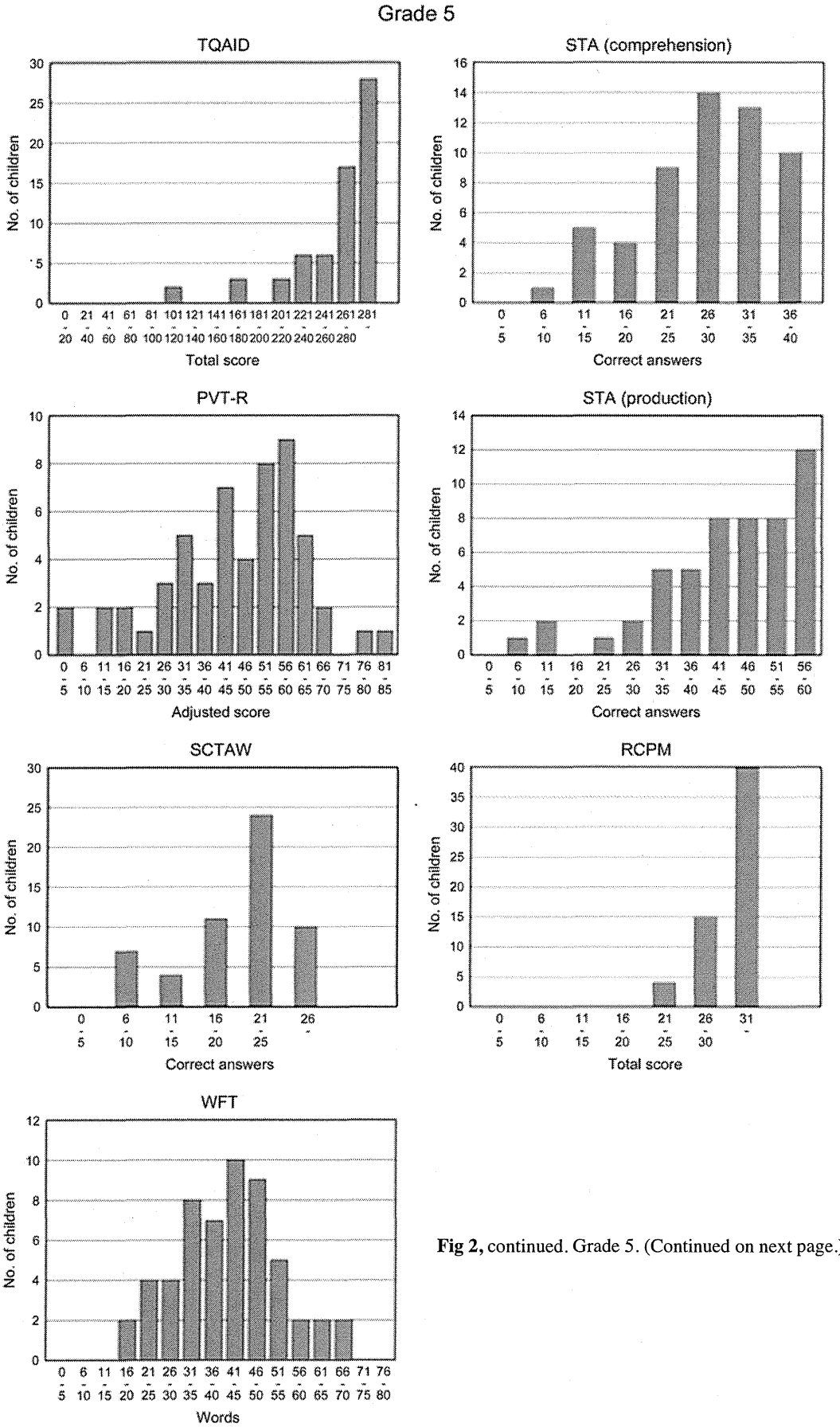

Fig 2, continued. Grade 5. (Continued on next page.)

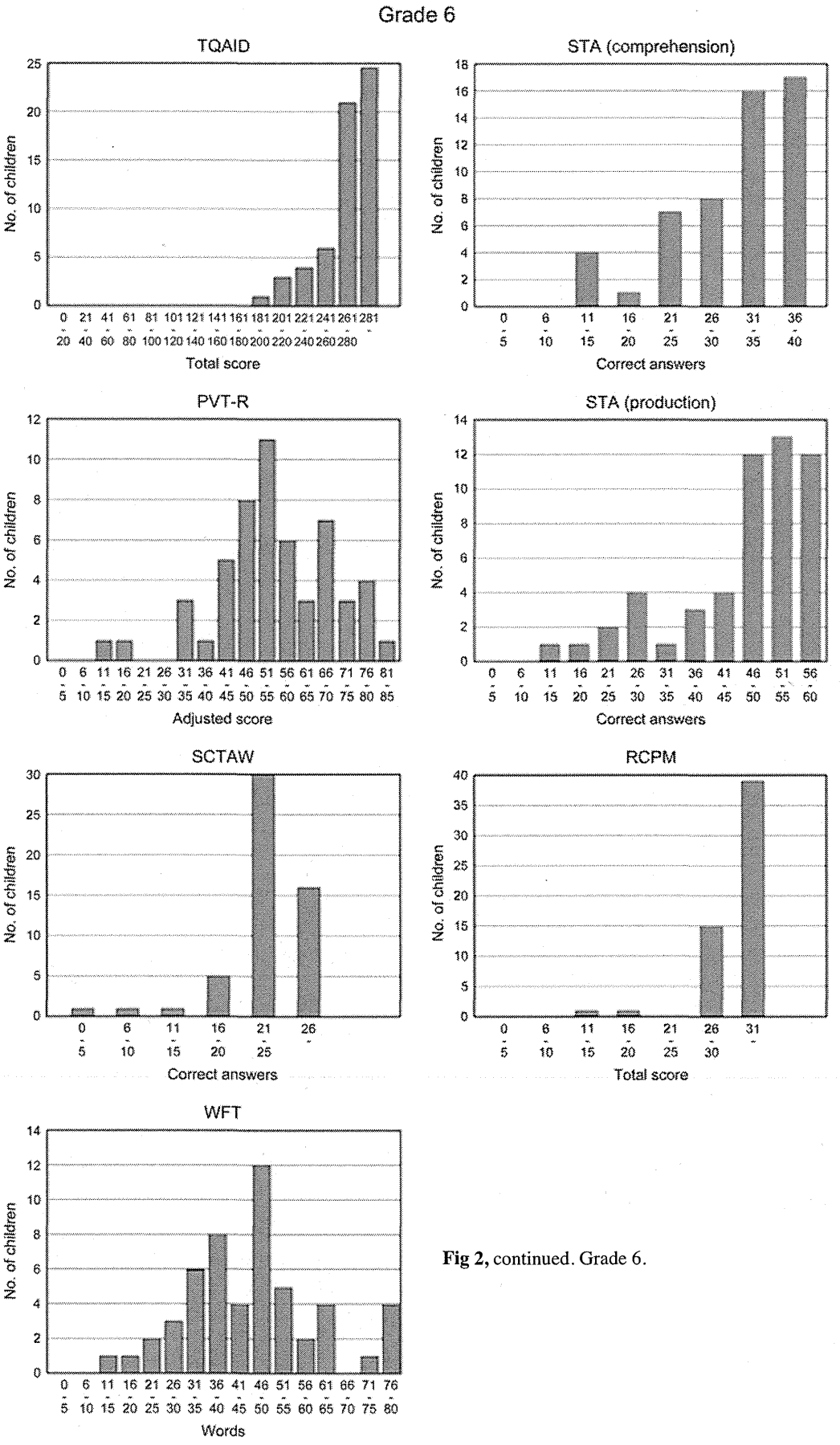

Fig 2, continued. Grade 6.

TABLE 3. CORRELATION OF TQAID WITH OTHER LANGUAGE TESTS

	WFT	*PVT-R*	*STA(C)*	*STA(P)*	*SCTAW*
Grade −2					
Correlation coefficient	0.733	0.705	0.676	0.610	NA
Two-tailed p value	<0.001	<0.001	<0.001	<0.001	NA
Grade −1					
Correlation coefficient	0.643	0.544	0.651	0.745	NA
Two-tailed p value	<0.001	<0.001	<0.001	<0.001	NA
Grade 1					
Correlation coefficient	0.616	0.690	0.673	0.704	0.621
Two-tailed p value	<0.001	<0.001	<0.001	<0.001	<0.001
Grade 2					
Correlation coefficient	0.472	0.781	0.662	0.643	0.611
Two-tailed p value	0.001	<0.001	<0.001	<0.001	<0.001
Grade 3					
Correlation coefficient	0.356	0.654	0.557	0.510	0.622
Two-tailed p value	0.010	<0.001	<0.001	<0.001	<0.001
Grade 4					
Correlation coefficient	0.578	0.439	0.763	0.777	0.608
Two-tailed p value	<0.001	0.005	<0.001	<0.001	<0.001
Grade 5					
Correlation coefficient	0.499	0.610	0.700	0.634	0.636
Two-tailed p value	0.001	<0.001	<0.001	<0.001	<0.001
Grade 6					
Correlation coefficient	0.237	0.515	0.467	0.439	0.520
Two-tailed p value	0.152	0.001	0.003	0.005	0.001

WFT — Word Fluency Test; PVT-R — Picture Vocabulary Test–Revised; STA(C) — Syntactic Processing Test of Aphasia, subdivision for comprehension; STA(P) — Syntactic Processing Test of Aphasia, subdivision for production; SCTAW — Standardized Comprehension Test of Abstract Words; NA — not available.

DISCUSSION

Overall, 600 to 700 hearing-impaired children are currently studying in mainstream elementary schools, schools for the hard-of-hearing, or schools for the deaf in each grade in Japan.[22] According to governmental statistics,[23] 10,600 children from 5 to 14 years old were welfare clients with handicaps in hearing and language. Watkin and Baldwin[24] reported that 1.51 per 1,000 children had moderate or worse bilateral deafness in their education periods in the United Kingdom. Among these cases, 0.9 per 1,000 were diagnosed and 0.11 per 1,000 were missed at birth. Thus, approximately 70% of children who wear hearing aids or cochlear implants met the inclusion criteria of this study. On the basis of these facts, approximately one eighth of all hearing-impaired children in Japan were assumed to be enrolled in this RSCD project. Compared with normal-hearing children, the language development in hearing-impaired children varied considerably in all aspects of the language domain, as noted by Gilbertson and Kamhi[25] and Geers and Moog.[26] More precisely, there seem to be 3 different groups among hearing-impaired children: an "upper group" who demonstrate language development comparable to that of normal-hearing peers; a "lower group" who remain in the lowest level of language development; and an "intermediate group" of average hearing-impaired children who score considerably lower than their hearing peers in language development. This trimodal distribution of language development in hearing-impaired children can be observed in the results of the TQAID, as well as those of the PVT-R, STA, and SCTAW.

One of the most important features in testing hearing-impaired children is the robustness of different modes of communication. The variables that are most important in evaluating the language development of hearing-impaired children are those that include both sign-communication performance and oral-communication performance. Our study and other studies in Japanese suggest that the pragmatic approach of the TQAID can be applied to various hearing-impaired children in different conditions. In addition, comparing data from other language users would give us noteworthy insight into language development. To make these comparisons possible, the ALADJIN set of tests was developed to share, when possible, common backgrounds and rules with the tests used for language evaluation of English speakers. Thus, this test set can potentially

be used for comparison not only among different institutions in Japan, but also among different language systems.

In this study, however, the language data of the TQAID apparently demonstrated a ceiling effect before grade 4 of elementary school. In other words, most hearing-impaired children in grade 4 or higher can achieve the basic interpersonal communication skills required to complete the TQAID. Originally, the TQAID was designed to evaluate Japanese language development during the preschool period. In any event, this test may be useful for evaluating the language development of hearing-impaired children up to 9 years of age. It may also be useful for screening older children to determine whether the minimally required interpersonal communication skills have been acquired. This analysis is potentially important for hearing-impaired children, because it can suggest details of their problems and eventually result in problem-oriented intervention programs for these children.

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REFERENCES

1. Apuzzo M, Yoshinaga-Itano C. Early identification of infants with significant hearing loss and the Minnesota Child Development Inventory. Semin Hear 1995;16:124-39.

2. Wake M, Hughes EK, Poulakis Z, Collins C, Rickards FW. Outcomes of children with mild-profound congenital hearing loss at 7 to 8 years: a population study. Ear Hear 2004;25:1-8.

3. Hawker K, Ramirez-Inscoe J, Bishop DVM, Twomey T, O'Donoghue GM, Moore DR. Disproportionate language impairment in children using cochlear implants. Ear Hear 2008;29:467-71.

4. Nikolopoulos TP, Archbold SM, Gregory S. Young deaf children with hearing aids or cochlear implants: early assessment package for monitoring progress. Int J Pediatr Otorhinolaryngol 2005;69:175-86.

5. Anderson I, Phillips L, Roberts L, Jamieson L, Costa A, Cross S. TeenEARS: development of a pilot assessment battery for cochlear implanted adolescents. Cochlear Implants Int 2008;9:119-31.

6. Lin FR, Ceh K, Bervinchak D, Riley A, Miech R, Niparko JK. Development of a communicative performance scale for pediatric cochlear implantation. Ear Hear 2007;28:703-12.

7. Fagan MK, Pisoni DB, Horn DL, Dillon CM. Neuropsychological correlates of vocabulary, reading, and working memory in deaf children with cochlear implants. J Deaf Stud Deaf Educ 2007;12:461-71.

8. Hogan A. Implant outcomes: towards a mixed methodology for evaluating the efficacy of adult cochlear implant programmes. Disabil Rehabil 1997;19:235-43.

9. Satake T, Higachie H, Chinen H. Manual for test of query-answering relationship [in Japanese]. Tokyo, Japan: Escor Co Ltd, 1996.

10. Toyama H, Hisano M, Chinen H, Satake T. Test of query-answering relationship. Vol 1. Scope and data from normally developed children. Jpn J Logoped Phoniatr 1994;35:338-48.

11. Koren R, Kofman O, Berger A. Analysis of word clustering in verbal fluency of school-aged children. Arch Clin Neuropsychol 2005;20:1087-104.

12. Riva D, Nichelli F, Devoti M. Developmental aspects of verbal fluency and confrontation naming in children. Brain Lang 2000;71:267-84.

13. Arffa S. The relationship of intelligence to executive function and non-executive function measures in a sample of average, above average, and gifted youth. Arch Clin Neuropsychol 2007;22:969-78.

14. Ueno K, Nagoshi S, Konuki S. Picture Vocabulary Test–Revised [in Japanese]. Hiroshima, Japan: Saccess Bell Co Ltd, 2008.

15. Haruhara N, Kaneko M, Uno A. The standardized comprehension test of abstract words [in Japanese]. Tokyo, Japan: Interuna Publishers, Inc, 2002.

16. Kunisue K, Fukushima K, Kawasaki A, et al. Comprehension of abstract words among hearing-impaired children. Int J Pediatr Otorhinolaryngol 2007;71:1671-9.

17. Uno A, Wydell TN, Haruhara N, Kaneko M, Shinya N. Relationship between reading/writing skills and cognitive abilities among Japanese primary-school children: normal readers versus poor readers (dyslexics). Reading Writing 2009;22:755-89.

18. Uno A, Haruhara N, Kaneko M. Reading/writing screening test for school aged children: an approach to detect developmental dyslexia [in Japanese]. Tokyo, Japan: Interuna Publishers, Inc, 2006.

19. Nakajima R, Horai T, Sugata T, Tatsumi H, Hamanaka T. Syntactic and communication abilities of aphasics as assessed by CADL, STA and CADL family questionnaire. Jpn J Logopedics Phoniatr 1997;38:161-8.

20. Yamada A, Suzuki M, Kato M, et al. Emotional distress and its correlates among parents of children with pervasive developmental disorders. Psychiatry Clin Neurosci 2007;61:651-7.

21. Raven's Coloured Progressive Matrices in Japanese Children as a screening intelligence test for children with learning disorder and acquired childhood aphasia. Jpn J Logop Phoniatr 2005;46:185-9.

22. Hearing assistance for hearing-impaired children who use hearing aids and cochlear implant [in Japanese]. Tokyo, Japan: Japanese Society of School Health, 2004:3-7.

23. http://www.e-stat.go.jp/SG1/estat/List.do?lid=00000 1059905 [in Japanese]. Accessed April 6, 2011.

24. Watkin PM, Baldwin M. Identifying deafness in early childhood: requirements after the newborn hearing screen. Arch Dis Child 2011;96:62-6.

25. Gilbertson M, Kamhi AG. Novel word learning in children with hearing impairment. J Speech Hear Res 1995;38:630-42.

26. Geers AE, Moog JS. Spoken language results: vocabulary, syntax, and communication. Volta Rev 1994;96:131-50.