 原 著

Longitudinal Study of Factors Relating to Recovery from Childhood Stuttering

Masashi Shiomi^{1,2)}, Nobufumi Yasuda²⁾ and Atsuhiko Ota²⁾

Abstract: Investigations of factors relating to recovery from childhood stuttering are usually based on univariate analysis. Due to this, these factors may not be properly understood, because the relationship between a specific characteristic and recovery from stuttering may be confounded by other factors, or because the relationship between a characteristic and recovery may differ according to whether the subject possesses another factor concurrently. We conducted a longitudinal study of stuttering children who received treatment at stuttering treatment facilities and performed a multivariate analysis by sex and time from onset. We examined the associations between recovery and pre-treatment characteristics by following 97 stuttering children (average age at first consultation at a research institute, 55.7 months; range, 24-111 months) who received stuttering treatment from speech-language-hearing therapists in 14 stuttering treatment facilities. The average time from onset until recovery or end of observation was 36.0 months (range, 5-83 months). Characteristics associated with recovery from stuttering on univariate analysis were simultaneously entered into a proportional hazards model. In this model, stuttering developmental phase was identified as a factor independently related to recovery on analysis of all subjects and analysis by sex. On analysis by time from onset, pre-treatment characteristics were associated with recovery only in the group that received consultations at a stuttering treatment facility within 24 months of onset. An onset age of 24 months or earlier, female sex and a stuttering developmental phase of 1 were found to be associated with a high recovery rate in a mutually independent manner. The period when predictive factors of stuttering recovery can be observed is within 24 months of onset; prognosis for stuttering treatment begun within this time frame can be predicted based on onset age, sex, and pre-treatment developmental phase.

Key words: childhood stuttering, predictive factors, sex, time from onset, stuttering developmental phase

幼児期吃音の治癒に関連する因子を明らかにする縦断研究

塩見 将志^{1,2)} 安田 誠史²⁾ 太田 充彦²⁾

¹⁾Department of Speech, Language and Hearing Pathology, Kochi Rehabilitation Institute: 1139-3 Otsu, Takaoka-cho, Tosa-shi, Kochi 781-1102, Japan

²⁾Department of Public Health, Kochi Medical School: Kohasu, Okoh-cho, Nankoku-shi, Kochi 783-8505, Japan

高知リハビリテーション学院言語療法学科¹⁾ : 〒781-1102 高知県土佐市高岡町乙 1139-3

高知大学医学部公衆衛生学教室²⁾ : 〒783-8505 高知県南国市岡豊町小蓮

2010年4月23日受稿 2010年10月1日受理

要 約：吃音治療施設で、言語聴覚士による治療を受けた吃音児 97 名を対象とする縦断研究を実施して、性別と発吃からの期間別に多変量解析を行い、吃音児の治療前の特性と治癒との関連を検討した。単変量解析で吃音治癒との関連が見られた特性を同時に投入した比例ハザードモデルでは、標本全員を用いた解析でも性別解析でも、吃音の進展段階が治癒の独立した関連因子として検出された。発吃からの期間別解析では、発吃から 24 ヶ月以内に吃音治療施設を受診した群でのみ、児の治療前の特性と治癒との関連が認められ、発吃年齢が 24 ヶ月以下であること、女であること、進展段階が 1 相であることが、相互に独立して、高い治癒率に関連した。吃音治癒を予知する因子の把握が可能な期間は発吃から 24 ヶ月以内であり、この期間中に開始する吃音治療については、発吃年齢、性別そして治療前の進展段階に基づいて予後を予測できる。

索引用語：幼児期吃音、予後関連因子、性別、発吃からの期間、吃音進展段階

Introduction

The cumulative incidence of childhood stuttering is 4.99% by 3 years of age and 5.19% by 9 years of age¹⁾. The recovery rate is between 62% and 79%^{2,3)} and may reflect the maturation of speech-motor control mechanisms⁴⁾. Recovery from childhood stuttering usually occurs within 24 months of onset, with recovery becoming more difficult after 24 months^{1,5)}.

Kalinowski and Saltuklaroglu⁶⁾ reported that there are no personal characteristics that indicate whether subjects will recover from childhood stuttering. However, several other studies have reported characteristics related to recovery from childhood stuttering. Riper⁷⁾ and Conture⁸⁾ reported that stuttering can easily become chronic if the main symptoms are blocks and prolongations. Yairi³⁾ reported that, compared to the recovered group, the persistent group had a 5- to 8-month-older onset age, a longer time between onset and first consultation, and lower scores for comprehension and expressive ability in developmental testing. Also, boys tend to have a lower recovery rate than girls⁹⁻¹¹⁾, although this difference did not reach a significant level.

In previous research, associations between characteristics of stuttering children and recovery were investigated using univariate analysis, which ignores the influence of other characteristics. Because of this, there is the possibility that reported associations may be confounded by other factors. In addition, it is unclear whether the relationship of a characteristic to recovery differs depending on the concurrent presence or absence of another factor.

In this longitudinal study, pre-treatment characteristics of stuttering children were surveyed at the time of first consultation at facilities where speech-language-hearing therapists treat stuttering. Characteristics studied include sex, onset age, time from onset, history of counseling for stuttering, age and condition of stuttering at time of consultation, and type of therapy. The condition of stuttering was followed, and the association between recovery from stuttering and each characteristic was examined after adjusting for mutual influence. In addition, taking sex as a non-modifiable factor and time from onset as a modifiable factor, we investigated whether characteristics related to recovery from stuttering differed according to levels of each factor (male/female; time from onset ≤ 24 months/ >25 months). Based on the results of these investigations, it was clarified whether there are characteristics that can provide information useful to speech-language-hearing therapists in predicting the prognosis of treatment in stuttering children.

Methods

1. Study subjects

The cases were taken from 14 facilities where the first author or research collaborators were employed as speech-language-hearing therapists in charge of stuttering treatment. Between January 1992 and December 2007, 108 children consulted the 14 facilities for the first time and began treatment for childhood stuttering by speech-language-hearing therapists. One facility was located in the Kanto region (International University of Health and

Welfare Clinic Medical Clinic · Speech-Language-Hearing Center), four in the Chubu region (Iso Hospital, Japan College of Rehabilitation and Welfare Professionals, Konan Kosei Hospital, Kuwana Rehabilitation Center for Children with Disabilities), seven in the Shikoku region (Kochi Medical School Hospital, Hosogi Hospital, Susaki Kuroshio Hospital, Noichi Chuo Hospital, Uda ENT Clinic, Kamojima Hospital, Mino Tanaka Hospital), and two in the Kyushu region (Oita Rehabilitation Center for Children with Disabilities, Tenseido Clinic).

We excluded 11 cases from analysis because of complications due to mental retardation, language retardation, or expressive language disorder, and analyzed the remaining 97 cases (75 boys, 22 girls). Fifty-five subjects were examined directly at collaborating research institutions without passing through other medical institutions, whereas 34 subjects were examined after being referred from other medical institutions. Eight subjects had missing values for counseling history.

The follow-up of the cases was examined on May 11, 2009. For stuttering children whose treatment ended before the start of this research (April 2007), medical records were reviewed by the speech-language-hearing therapist in charge of their treatment, and anonymized information necessary for this research was collected. For children already receiving treatment for stuttering at the start of this research project and those who began treatment after the start of this research project, the speech-language-hearing therapist in charge of their treatment explained the goals of this research to the child's guardian and requested their participation in this research; consent was obtained from all subjects.

This research was performed with approval from the Kochi Medical School ethics committee.

2. Study variables

The items surveyed include: sex, onset age, age at first consultation at a collaborating research institution, calendar date at first consultation at a collaborating research institution, time from onset until first consultation at a collaborating research institution, counseling history prior to consultation at a collaborating research institution, condition of

stuttering at time of first consultation at a collaborating research institution (stuttering developmental phase¹²⁻¹⁶) and presence or absence of dyslalia), conditions other than stuttering (presence or absence of a non-stuttering disorder and developmental test findings), and the type of therapy used by the collaborating research institution's speech-language-hearing therapist (indirect approaches vs. direct approaches). Calendar date at first consultation at a collaborating research institution was included as a study variable in order to address influences of medical advancement on the recovery rates. With regard to the type of therapy, indirect approaches work on the premise that stuttering is best dealt with by changing the environment in which it develops; direct approaches specifically target speech output¹⁷.

Numerical variables were divided into two categories as follows. Calendar date of first consultation was divided at the median. Onset age was divided at the month of 24 because a previous study reported that the youngest onset age of the subjects with persistent stuttering was 24 months¹. Age at first consultation was divided at 36 months because the previous study reported that the mean age of the first consultation for the subjects who recovered from stuttering was 36 months³. Months post onset was divided at 24 months because recovery has been reported to be more difficult after 24 months^{1,5}. The stuttering developmental phase was dichotomized into phase 1 in which the feature of fluent periods is episodic and phases 2-4 in which the feature of fluent periods is chronic.

The severity of stuttering was evaluated by referring only to the symptom features of the developmental phase of stuttering¹². The symptoms of respective phases were as follows: phase 1, syllable repetition, part-word repetition, or prolongation; phase 2, repetition, prolongation, block, or associated symptoms; phase 3, all symptoms except for avoidance of speech, elaborately developed symptomatology with postponement, starting, and release devices; phase 4, fully developed symptomatology with avoidance, postponement, starting, and release devices. At approximately

3-month intervals, a speech-language-hearing therapist in charge of the child evaluated occurrences and frequencies of the respective symptoms as the child spoke freely in the examination room. When the child spoke little in the examination room, the guardian's reports on the occurrences and frequencies of stuttering symptoms in the child's daily activities were addressed. If the attending therapist perceived that the child exhibited no problem in terms of the symptom features of the stuttering developmental phase or the frequencies of respective symptoms were within normal ranges, the therapist judged that the child was recovered from the stuttering. The date of recovery was set as the date of the examination when the child was judged by the attending speech-language-hearing therapist to be recovered.

Of the items surveyed, developmental test results were excluded from the variables analyzed because only 37 subjects received developmental tests (38.1% of subjects analyzed).

3. Statistical analysis

The observation period for the subjects was measured from the date of first consultation at a collaborating research institution. The date of end of the observation was defined as follows: the date of recovery for a subject who was judged to be recovered, the date of the last consultation with a speech-language-hearing therapist for a subject with whom the therapist could not make contact, and the examined date (May 11, 2009) for a subject who was still under treatment at the end of this research.

For univariate analysis, recovery rates were compared between categories for each variable, and differences were analyzed using a log-rank test. For multivariate analysis, a proportional hazards model was used to calculate the ratio of recovery rates, which reveals the relationship between each variable and recovery, while adjusting for the mutual influences of the variables.

After analyzing all subjects, the subjects were then stratified by sex and by time from onset until first consultation (≤ 24 months and > 24 months).

Statistical analyses were performed using SPSS 11.0J (SPSS Japan, Tokyo, Japan). All tests were

2-tailed. The level of significance was set at 5%.

Results

1. Pre-treatment characteristics of subjects

The average onset age of the subjects was 35.2 months (range, 12-58 months), average age at first consultation at a collaborating research institution was 55.7 months (range, 24-111 months), and average time from onset until first consultation at a collaborating research institution was 20.6 months (range, 0-75 months).

At the time of first consultation at a collaborating research institution, 44 subjects (45.4%) were classified as having a stuttering developmental phase of 1, 10 subjects (10.3%) were diagnosed with dyslalia (including possible cases) and 34 subjects (35.1%) received consultations from specialists before their first consultation at a collaborating research institution. Fifty subjects (51.5%) received their first consultation at a collaborating research institution before August 2004. Eighty-nine subjects (91.8%) received indirect therapy from a speech-language-hearing therapist at a collaborating research institution.

Fifty-five subjects (56.7%) recovered during the follow-up period. The average time from onset until recovery or end of observation was 36.0 months (range, 5-83 months).

2. Analyses performed on all subjects

The results of univariate analysis are summarized in Table 1. No differences were found in recovery rate between categories in sex, consultation date, onset age, dyslalia, counseling history, or treatment method. Subjects aged 36 months or younger at the time of consultation at a collaborating research institution tended to have a higher recovery rate than subjects aged 37 months or older. Subjects who received consultations at collaborating research institutions within 24 months of onset also tended to have a higher recovery rate than subjects receiving consultations at 25 months after onset or later. Subjects with a stuttering developmental phase of 1 at the time of first consultation at a collaborating research institution had a significantly higher recovery rate than subjects with phase 2 or greater.

Table 1 Crude recovery rates of children with stuttering according to categories of pretreatment characteristics (N=97)

	Number of cases	Person-years	Number of recoveries	Recovery rate	P value
Sex					
Females	22	34.6	13	0.423	0.514
Males	75	99.3	42	0.376	
Calendar date of first consultation					
Before August 31, 2004	50	81.1	33	0.407	0.663
After September 1, 2004	47	52.8	22	0.421	
Onset age					
12-24 months	14	14.5	8	0.552	0.199
25-58 months	83	119.5	47	0.393	
Age at first consultation					
24-36 months	11	9.6	7	0.729	0.059
37-111 months	86	124.4	48	0.386	
Time from onset until first consultation					
0-24 months	60	83.3	40	0.480	0.098
25-75 months	37	50.6	15	0.296	
Stuttering developmental phase at time of first consultation					
Phase 1	44	52.5	31	0.590	0.002
Phase 2-3	53	81.5	24	0.294	
Dyslalia					
Absent	87	118.2	50	0.423	0.527
Present including possible cases	10	15.7	5	0.318	
Counseling history*					
Absent	55	77.0	32	0.416	0.646
Present	34	42.1	19	0.451	
Therapy					
Indirect approach only	89	124.4	53	0.430	0.349
Direct approach only and combination with indirect approach	8	9.6	2	0.208	

*8 subjects had missing values for counseling history.

Table 2 Adjusted recovery rate ratio of children with stuttering by pretreatment characteristics, by sex

	Recovery rate ratio, adjusted*	95% confidence interval		P Value
Age at first consultation, 37-111 months/24-36 months	0.51	0.22	1.17	0.110
Time from onset until first consultation, 25-75 months/0-24 months	0.78	0.41	1.48	0.441
Stuttering developmental phase at time of first consultation, Phase 2-3/Phase 1	0.46	0.26	0.80	0.006

*Adjusted for characteristics described in the table simultaneously.

Table 2 shows the results when age at first consultation, time from onset until consultation, and stuttering developmental phase at time of consultation were simultaneously entered into a proportional hazards model. A stuttering developmental phase of 1 at the time of consultation was associated with a significantly higher recovery rate.

3. Analyses by sex

The results of univariate analysis according to sex are shown in Table 3. Female subjects aged 36 months or younger at the time of first consultation at

a collaborating research institution had a significantly higher recovery rate than subjects aged 37 months or older. Likewise, female subjects who received consultations at collaborating research institutions within 24 months of onset also had a significantly higher recovery rate than female subjects who received consultations at 25 months or later after onset. Female subjects with a stuttering developmental phase of 1 at the time of consultation at a collaborating research institution had a significantly higher recovery rate than subjects with phase 2 or greater. Male subjects with a stuttering

Table 3 Crude recovery rates of children with stuttering according to categories of pretreatment characteristics, by sex

	Number of cases	Person-years	Number of recoveries	Recovery rate	P value
Females (N = 22)					
Onset age					
12-24 months	5	5.3	3	0.566	0.350
25-58 months	17	7.3	10	0.340	
Age at first consultation					
24-36 months	3	1.0	3	3.000	<0.001
37-111 months	19	33.6	10	0.298	
Time from onset until first consultation					
0-24 months	11	12.6	9	0.556	0.020
25-75 months	11	22.1	4	0.181	
Stuttering developmental phase at time of first consultation					
Phase 1	9	6.7	7	1.045	0.001
Phase 2-3	13	27.9	6	0.215	
Dyslalia					
Absent	19	27.6	13	0.471	0.077
Present including possible cases	3	7.0	0		
Counseling history					
Absent	13	20.7	9	0.435	0.313
Present	7	10.4	2	0.192	
Therapy					
Indirect approach only	20	31.9	13	0.408	0.321
Direct approach only and combination with indirect approach	2	2.8	0		
Males (N = 75)					
Onset age					
12-24 months	9	9.2	5	0.541	0.362
25-58 months	66	90.1	37	0.411	
Age at first consultation					
24-36 months	8	8.6	4	0.465	0.694
37-111 months	67	90.8	38	0.419	
Time from onset until first consultation					
0-24 months	49	70.7	31	0.438	0.941
25-75 months	26	28.6	11	0.385	
Stuttering developmental phase at time of first consultation					
Phase 1	35	45.8	24	0.524	0.097
Phase 2-3	40	53.5	18	0.336	
Dyslalia					
Absent	68	90.6	37	0.408	0.418
Present including possible cases	7	8.7	5	0.575	
Counseling history					
Absent	42	56.3	23	0.409	0.297
Present	27	31.7	17	0.536	
Therapy					
Indirect approach only	69	92.5	40	0.432	0.649
Direct approach only and combination with indirect approach	6	6.8	2	0.294	

developmental phase of 1 at the time of consultation at a collaborating research institution tended to have a higher recovery rate than subjects with phase 2 or greater.

Characteristics that were determined to be associated with recovery in either male or female

subjects on univariate analysis (age at first consultation, time from onset until first consultation, and stuttering developmental phase at time of consultation) were simultaneously entered into a proportional hazards model, and the adjusted results are shown in Table 4. After adjusting for the mutual

Table 4 Adjusted recovery rate ratio of children with stuttering by pretreatment characteristics, by sex

	Recovery rate ratio, adjusted*	95% confidence interval		P Value
Females (N = 22)				
Age at first consultation, 37-111 months/24-36 months	0.14	0.02	0.91	0.040
Time from onset until first consultation, 25-75 months/0-24 months	0.50	0.11	2.27	0.366
Stuttering developmental phase at time of first consultation, Phase 2-3/ Phase 1	0.21	0.05	0.95	0.042
Males (N= 75)				
Age at first consultation, 37-111 months/24-36 months	0.76	0.26	2.240	0.620
Time from onset until first consultation, 25-75 months/0-24 months	1.06	0.51	2.200	0.874
Stuttering developmental phase at time of first consultation, Phase 2-3/ Phase 1	0.59	0.31	1.100	0.096

*Adjusted for characteristics described in the table simultaneously.

influences of these three variables, an age of 36 months or younger at the time of consultation and a stuttering developmental phase of 1 at the time of consultation were associated with a significantly higher recovery rate in female subjects. In male subjects, a stuttering developmental phase of 1 at the time of consultation tended to be associated with a higher recovery rate.

4. Analyses by time from onset to consultation

The results of univariate analysis according to duration from onset to consultation are shown in Table 5. In stuttering children who received consultations at collaborating research institutions within 24 months of onset, subjects with an onset age of 24 months or younger tended to have a higher recovery rate than those aged 25 months or older, and subjects with a stuttering developmental phase of 1 at the time of first consultation had a significantly higher rate of recovery than subjects with phase 2 or higher. In subjects who received consultations at collaborating research institutions 25 or more months after onset, male subjects tended to have a higher recovery rate than female subjects.

Characteristics that were associated with recovery in subjects receiving a consultation either within 24 months of onset or 25 or more months after onset on univariate analysis (sex, onset age, and stuttering developmental phase at first consultation) were simultaneously entered into a proportional hazards model; the adjusted results are shown in Table 6. In stuttering children who received consultations within 24 months of onset, an onset age of 24 months or

younger and a stuttering developmental phase of 1 at the time of first consultation were associated with significantly higher recovery rates even after adjusting for the mutual influences of the variables. Female subjects also tended to have a higher recovery rate than male subjects. In stuttering children who received consultations 25 months or later after onset, the relationship between sex and recovery disappeared.

Discussion

The results of multivariate analysis using all subjects suggest that stuttering developmental phase is a predictive factor of recovery independent of time from onset until first consultation, which is known as a predictive factor of stuttering recovery³⁾. Stuttering developmental phase is a consistent predictive factor of recovery even in analyses stratified by sex. In reports about the relationship between severity of stuttering and lack of recovery (persistence), having blocks and prolongations as major symptoms or having a high proportion of blocks was associated with persistent stuttering^{7,8,17)}. Considering blocks and prolongations in this research, the recovery rate was higher in phase 1 cases (which display only prolongations), which is consistent with the previous reports.

In analyses stratified by time from onset, stuttering developmental phase was a predictive indicator of stuttering recovery only in the subjects that received consultation at a stuttering treatment facility within 24 months of onset. If children receive

Table 5 Crude recovery rates of children with stuttering according to pretreatment characteristics, by period from onset to first consultation

	Number of cases	Person-years	Number of recoveries	Recovery rate	P value
Within 24 months (N = 60)					
Sex					
Females	11	12.6	9	0.714	0.168
Males	49	70.7	31	0.438	
Onset age					
12-24 months	8	5.90	5	0.847	0.067
25-58 months	52	77.4	35	0.452	
Age at first consultation					
24-36 months	11	9.6	7	0.729	0.130
37-111 months	49	73.8	33	0.447	
Time from onset until first consultation					
0-6 months	24	29.5	18	0.610	0.120
7-24 months	36	53.8	22	0.409	
Stuttering developmental phase at time of first consultation					
Phase 1	30	38.9	25	0.643	0.018
Phase 2-3	30	44.4	15	0.338	
Dyslalia					
Absent	55	76.1	38	0.499	0.409
Present including possible cases	5	7.2	2	0.278	
Counseling history					
Absent	31	43.7	22	0.503	0.798
Present	23	30.4	16	0.526	
Therapy					
Indirect approach only	57	76.9	39	0.507	0.222
Direct approach only and combination with indirect approach	3	6.4	1	0.156	
More than 25 months (N = 37)					
Sex					
Females	11	22.1	4	0.181	0.092
Males	26	28.6	11	0.385	
Onset age					
12-24 months	6	8.6	3	0.349	0.895
25-58 months	31	42.0	12	0.286	
Age at first consultation					
41-72 months	20	27.7	9	0.325	0.664
73-111 months	17	22.9	6	0.262	
Time from onset until first consultation					
25-36 months	17	25.5	6	0.325	0.381
37-75 months	20	25.1	9	0.359	
Stuttering developmental phase at time of first consultation					
Phase 1	14	13.6	6	0.441	0.142
Phase 2-3	23	37.1	9	0.243	
Dyslalia					
Absent	32	42.1	12	0.285	0.721
Present including possible cases	5	8.5	3	0.353	
Counseling history					
Absent	24	33.3	10	0.300	0.713
Present	11	11.7	3	0.256	
Therapy					
Indirect approach only	32	47.5	14	0.295	0.810
Direct approach only and combination with indirect approach	5	3.1	1	0.323	

Table 6 Adjusted recovery rate of children with stuttering by pretreatment characteristics, by period from onset to first consultation

	Recovery rate ratio, adjusted*	95% confidence interval		P Value
Within 24 months from the onset (N = 60)				
Sex, Males/Females	0.49	0.22	1.06	0.068
Onset age, 25-58 months/12-24 months	0.34	0.13	0.91	0.032
Stuttering developmental phase at time of first consultation, Phase 2-3/ Phase 1	0.41	0.21	0.81	0.010
More than 25 months from the onset (N = 37)				
Sex, Males/Females	0.33	0.07	1.64	0.176
Onset age, 25-58 months/12-24 months	0.62	0.15	2.58	0.512
Stuttering developmental phase at time of first consultation, Phase 2-3/ Phase 1	0.53	0.16	1.78	0.304

*Adjusted for characteristics described in the table simultaneously by a cox proportional hazards model

a consultation at a treatment facility during this time period, it is possible for therapists to predict treatment progress based on sex, onset age, and developmental phase; this will improve the explanation about treatment policies to guardians. In order to increase the number of stuttering children receiving consultations at stuttering treatment facilities within 24 months of onset, it is necessary to encourage children's guardians, day care facility employees, and pediatric medical staff to introduce stuttering children to treatment facilities without delay following onset. In the American guidebook "If Your Child Stutters - A Guide for Parents"⁵⁾, repetition of polysyllables and/or prolongations are reported to be warning signs of stuttering, and the guidebook recommends that a child should receive a consultation with a specialist. We believe that the creation of such a guidebook in Japan would be useful.

Among children who received a consultation at a collaborating research institution within 24 months of onset, girls tended to have a higher recovery rate than boys, although this did not reach a significant level. This sex difference in recovery rate indicates that certain sex-related genetic factors may be associated with recovery. Ambrose⁹⁾ indicated that in order to understand the higher recovery rate of female subjects, a linkage analysis of the parents from whom the susceptibility to stuttering was inherited is necessary, rather than analyzing the stuttering children themselves. In addition, sex

differences in brain activity indicated in research on stuttering adults¹¹⁾ may aid in explaining the sex differences in childhood stuttering recovery rates. Sato¹⁸⁾ compared brain activity between 12 stuttering school children aged 6-12 years old and 8 stuttering children aged 3-5 years old by brain oximetry with near infrared spectroscopy and reported that a connection between stuttering and functional aberrations of the auditory area was observable in the stuttering children group. We believe that it would be useful to examine sex differences in brain activity related to stuttering using this measurement technique.

Limitations of this research

First, recovery was judged based on perceived evaluation by the attending therapist in terms of occurrences and frequencies of the stuttering symptoms. The diagnosis of stuttering recovery is usually made by recording a child's speech and determining the frequency of core symptoms in the speech (repetition of syllables, repetition of language sections, prolongations, and blocks). A frequency of less than 3% is considered to be normal. It is necessary to confirm the correspondence between the perceived evaluation according to the symptom features of the stuttering developmental phase and the objective measurement of the frequencies of core symptoms.

Second, the reason we were unable to find factors relating to recovery in children who received

consultations at collaborating research institutions after a significant amount of time had elapsed since onset may be because this group contained a disproportionate number of intractable cases. If we were able to identify, survey, and follow-up all stuttering children born in a community, we would be able to examine the influence of this selection bias.

Third, 24 of the research participants (24.7%) stopped visiting the collaborating research institutions during the observation period; therefore, it is necessary to examine the influence of these withdrawals. When the analysis was conducted only for the 73 subjects who either recovered during the observation period or were still receiving therapy at the end of the observation period, the differences in recovery rates between categories of the subjects' characteristics were essentially the same as those presented in Table 1 (the results upon request to the authors). There were no significant differences in sex distribution, developmental phase distribution, average onset age, or average age at first consultation at a collaborating research institution between the 73 children who either recovered during the observation period or were still receiving therapy at the end of the observation period and the 24 children who withdrew from the study during the observation period. In addition, between the withdrawals and those who did not withdraw, there was no difference in the proportion of children who were observed for 24 months or more since the stuttering onset (70.8% in the withdrawals vs. 74.0% in those who did not withdraw). The period of 24 months since the onset is the time when the cumulative recovery rate is reported to plateau^{1,5)}. According to those similarities, it is unlikely that the observed associations between recovery and the characteristics of stuttering children were biased by the presence of withdrawals.

Finally, spontaneous recovery from stuttering is well known¹⁹⁾, and it is thought that children who spontaneously recovered were present among the subjects of this study. It is necessary to keep in mind that the results of this study indicate factors relating to recovery when recovery due to successful

treatment and spontaneous recovery are not distinguished.

Conclusions

The relationship between stuttering recovery and pre-treatment characteristics of stuttering children was examined by performing a longitudinal study of stuttering children receiving consultations at stuttering treatment facilities. Characteristics that were associated with recovery were found only when children received consultations at a treatment facility within 24 months of onset. Onset age of 24 months or younger, female sex, and a stuttering developmental phase of 1 were associated with a high recovery rate in a mutually independent manner. The period within 24 months of onset is not just the time when stuttering is easiest to treat (as indicated in previous research), it is also important as the period when factors relating to stuttering recovery are observable. It is possible to predict the prognosis of treatment begun during this period based on onset age, sex, and pre-treatment stuttering developmental phase.

Appendix

The research collaborators are S. Niimi and N. Maehara, International University of Health and Welfare Clinic Medical Clinic·Speech-Language-Hearing Center, Tochigi; T. Iso and Y. Mitsuta, Iso Hospital, Aichi; T. Tanahashi, M. Tsuchiya, and S. Tajima, Japan College of Rehabilitation and Welfare Professionals, Aichi; Y. Katou, M. Matsuoka, and K. Nakanishi, Konan Kosei Hospital, Aichi; E. Matsuoka and K. Murata, Kuwana Rehabilitation Center for Children with Disabilities, Mie; T. Sugiura, H. Wakiguchi, M. Miyake, and S. Kishimoto, Kochi Medical School Hospital, Kochi; H. Nakaya, Kochi Rehabilitation Institute, Kochi; K. Hashimoto and T. Nagae, Hosogi Hospital, Kochi; S. Tamura and M. Matsuo, Susaki Kuroshio Hospital, Kochi; M. Kumon, F. Toyonaga, A. Katou, and Y. Morishita, Noichi Chuo Hospital, Kochi; J. Uda and H. Nagashima, Uda ENT Clinic, Tokushima; T. Tsuchihashi and K. Okada, Kamojima Hospital, Tokushima; T. Tanaka, K. Miyata, and K. Takeda, Mino Tanaka Hospital, Tokushima; T. Satake, J. Urashima, and M. Sogo, Oita Rehabilitation Center for Children with Disabilities, Oita; M. Shiiba and H. Hirata, Tenseido Clinic, Miyazaki.

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