The classification of the children by their behavior for the dental treatment using cluster analysis

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Abstract   The aim of this study is construct a systematic classification system of children by their behavior. The study population consisted of 104 children who visited the pediatric dentistry at the Dental Hospital of Tsurumi University for the first time. The behavior of the children was evaluated by the Frankl Behavior Rating Scale and the behavior evaluation score developed by Kurosu. For the classification, *k*-means and two-step cluster and a large scale clustering method, the Kohonen network were used. The Frankl Behavior Rating Scale and all clusters were statistically significant according to Fisher's exact tests. Among them, the results using the two-step cluster analysis were well classified for the Frankl Behavior Rating Scale and may seem to be clinically available. Decision analysis to clarify the decision rules for affiliation extracted 5 items such as 'Moving the body left and right', 'Putting hands over the mouth', 'Crying softly', 'Holding the hands of the dentist', 'Closing the eyes'. And these items would be key items to peg uncooperative behavior in clinical practice. By the observation of some of the behavior of the children and using decision tree, systemic decisions can be made for the obscured Frankl Behavior Rating Scale.

Introduction

In pediatric dentistry, one of the most important skills for the dentist is to evaluate children's behavior. The behavior of children is varied. Therefore, physiological[1–4], psychological[5–7] and behavioral techniques[8,9] for the evaluation of children have been developed. For the evaluation of child behavior, the praxiological observation and recording of behavior have been used. Frankl *et al.* classified child behavior into four groups according to the child's attitude and cooperation or lack of cooperation during dental treatment[8]. However, this classification, known as the Frankl Behavior Rating Scale, does not provide definite items for observation. In contrast, Kurosu *et al.* proposed a classification of child behavior during dental treatment that does provide 37 detailed items for observation[9]. Despite this advantage, this classification, which is also well known in Japan as the Behavior Evaluation Scale (BES), does not allow for the easy observation of the 37 items in daily clinical practice.

However, no scale is used in daily clinical practice in pediatric dentistry. In addition, no clear criteria for the classification of the behavior of the children have been presented. Thus, the aims of this study is to classify the children by four methods for cluster analysis[10] and to find out the characteristic behavior of the children.

Table 1   Positive distribution for each item for the behavior evaluation score developed by Kurosu

Difficulty	Item	No. of children	%
1	Winching	15	14.4
	Closing the eyes	7	6.7
	Looking at the dental equipment	18	17.3
	Stiffening the face	4	3.8
	Rolling the eye	13	12.5
	Staring at the ceiling	8	7.7
	Looking at the fingertips of the dentist	16	15.4
	Looking at the face of dentist	5	4.8
	Linking	14	13.5
	Looking around	16	15.4
2	Moaning	10	9.6
	Crying softly	4	3.8
	Crying out 'Oh'	4	3.8
	Holding up the hands	4	3.8
	Putting hands over the chest	22	21.2
	Moving the hands	12	11.5
	Screaming, 'it hurts'	8	7.7
	Moving the legs up and down	8	7.7
	Screaming, 'No, no'	8	7.7
	Asking what are you going to do?	13	12.5
3	Moving the body left and right	15	14.4
	Putting hands over the mouth	9	8.7
	Moving the body up and down	6	5.8
	Shaking the legs	10	9.6
	Holding the hands of the dentist	5	4.8
	Shaking the head	10	9.6
	Nodding the head	13	12.5
	Beating off the equipment	4	3.8
	Crying loudly	8	7.7

The behavior evaluation score developed by Kurosu classified the behavior of the children into three groups by the expression of the behavior for the dental equipment and following it's disturb for the dental treatment.

Materials and Methods

Study population and behavior evaluation

The study population was obtained from patients who attended for the first time at the pediatric dental clinic of the dental hospital of Tsurumi University from 2003 to 2004. In total, 104 patients (52 boys and 52 girls) were included. Their mean age was 5.1 ± 1.41. For the evaluation of the behavior of the children, the Frankl Behavior Rating Scale and BES were used.

Statistical analysis

For the classification, k-means and two step cluster and Hierarchical Cluster Analysis, and Kohonen network were used. The variables used for the cluster analysis were each item of BES. Then, cross tabulation for the affiliation of clusters of each patient and the Frankl Behavior Rating scales were carried out to evaluate the validity of each cluster analysis. To clarify the decision rules for affiliation, decision analysis was carried out by C5.0 analysis. All the analyses were carried out by the SPSS ver. 12.0 and Clementine ver. 8.6 (SPSS, Tokyo, Japan).

Result

The criteria of the Frankl Behavior Rating Scale and its frequency distribution were as follows. For rating 1: Refusal of treatment, crying forcefully,

Table 2   Cross tabulation between the results of each cluster analysis and the Frankl Behavior rating scale

	Cluster	1	2	3	4	Total	*P*-value
		Frankl Behavior rating scale		
k-means Cluster	1	9	15	53	17	94	<0.01
Analysis	2	6	4	0	0	10	
Two step	1	1	4	48	17	70	<0.01
Cluster Analysis	2	14	15	5	0	34	
Hierarchical	1	13	18	53	17	101	<0.01
Cluster Analysis	2	2	1	0	0	3	
	00	4	6	4	0	14	
	01	1	1	0	0	2	
	02	8	3	1	0	12	
	10	0	1	3	0	4	
Kohonen network	11	2	1	1	0	4	<0.01
	12	0	1	0	0	1	
	20	0	1	31	11	43	
	21	0	0	7	2	9	
	22	0	5	6	4	15	
Total		15	19	53	17	104	

fearful, or any other overt evidence of extreme negativism 15 (14.4%); Rating 2: Reluctant to accept treatment, uncooperative, some evidence of negative attitude but not pronounced, i.e./sullen, withdrawn 19 (18.3%); Rating 3: Acceptance of treatment, at times cautious, willingness to comply with the dentist, at times with reservations but patient follows the dentist's directions cooperatively 53 (51.0%), Rating 4: Good rapport with the dentist, interested in the dental procedures, laughing and enjoying the situation 17 (16.3%).

For BES, each item and the frequency of distribution in the population investigated in this study are shown in Table 1. Using BES, the items that dominated in more than 14% were 'Putting hands over the chest', 'Looking at the dental equipment', 'Looking at the fingertips of the dentist', 'Looking around', 'Winching', and 'Moving the body left and right'. Among these, 4 items were concerned with the eyes and face.

As shown in Table 2, the results of the all cluster analysis were statistically significant using Fisher's exact tests. However, when comparing the correlation between affiliation and the Frankl Rating Scale, the two-step clusters may seem to be clinically available. Cluster 1: cooperative, Cluster 2: uncooperative. Thus, we adopted the results of the two-step cluster analysis.

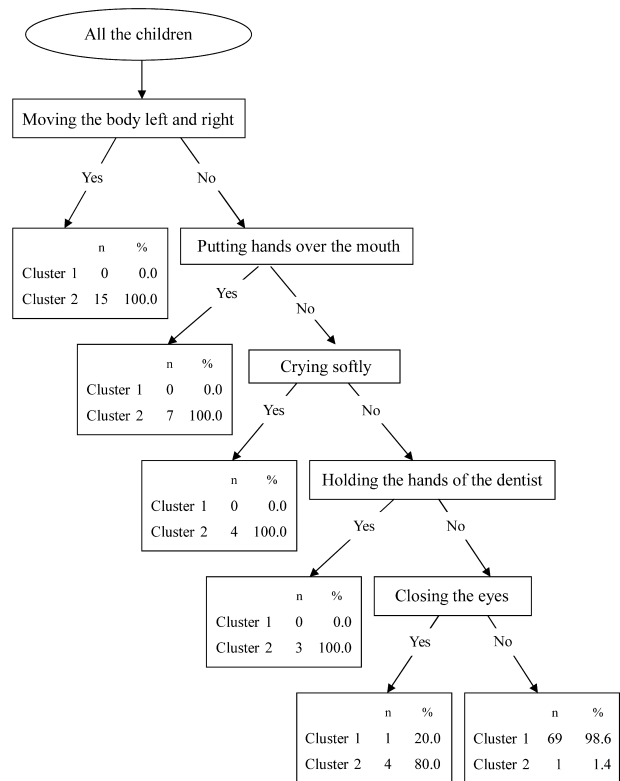Figure 1 shows the results of decision analysis to

Fig. 1   The decision tree for the classification by behavior of the difficulty of children in accepting dental treatment

Cluster 1 indicated the cooperative children. And Cluster 2 indicated the uncooperative children.

clarify the decision rules for affiliation. Five items such as 'Moving the body left and right', 'Putting hands over the mouth', 'Crying softly', 'Holding the hands of the dentist', 'Closing the eyes' extracted. The items higher on the decision tree are more important than lower items for the classification of the children.

Discussion

In this study, the distribution of the Frankl Behavior Rating Scale indicated that level 3 was the most frequent, followed by level 2, 4 and 1. However, the distribution of our previous report[11] was level 3 (66.7%), level 2 (15.2%), 1 (15.2%) and 4 (3.1%). The difference may be because the age of the study population used in the study was older than previous author report.

For BES, items that concerned with the eyes and face were high frequent. However, high-frequency items in the our previous report[11] the items which were concerned with the limbs. This difference may also be because the age of the study population used in the study was older than in the our previous report.

Recently, data mining has been developed to analyze a vast amount of data, especially in the business field. One of the techniques is to identify the specific group i.e. trusted client, some available method for the clustering have applied, and then the most available model is adopted for practical use. Thus, in this study, we applied four methods for clustering.

Decision analysis to clarify the decision rules for affiliation extracted 5 items such as 'Moving the body left and right', 'Putting hands over the mouth', 'Crying softly', 'Holding the hands of the dentist', 'Closing the eyes'. And these items would be key items to peg uncooperative behavior in clinical practice. As shown in Table 1, Kurosu classified the items for the treatment of the children. Among these, 'Moving the body left and right', 'Putting hands over the mouth', 'Holding the hands of the dentist' are difficulty level 3 by BES. 'Crying softly' is difficulty level 2 to dentist take it for granted that children behavior by BES. However, a crying voice would be a stress factor to a dentist. 'Closing the eyes' is difficulty level 1 according to BES. However, we keep observing eye movement to make Tell Show Do at all times and to be not conceive negative imagination that close eyes children.

In conclusion, by observation of some of the behavior of the children and by using a decision tree, a systemic decision can be made for the obscured Frankl Behavior Rating Scale.

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