



Research Article

Application of a Visual Oral Health Literacy Instrument in Elementary Schoolchildren

Anish Harshad Kothari^{1,2}, Takashi Zaitzu^{1*}, Masayuki Ueno¹ and Yoko Kawaguchi¹

¹Department of Oral Health Promotion, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University, Japan

²The Walden Dental Clinic, Saffron Waldon, Essex, United Kingdom

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Correspondence should be addressed to Takashi Zaitzu, Japan

E-mail: zaitzu.ohp@tmd.ac.jp

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Abstract

A visual oral health literacy instrument has previously been used to assess the oral health literacy of high school students. This study applied the visual instrument to 292 elementary schoolchildren in Saitama Prefecture to assess the level of oral health literacy and investigate relationships between oral health literacy and age, gender, and oral health habits. A self-administered questionnaire survey investigated self-perceived oral health, brushing frequency, and frequency of sweet food and drink intake. Subjects drew their anterior dentition and gingivae using a hand mirror, and the drawings were scored according to set criteria. Subjects were split into three age groups: younger, middle, and older. Oral health literacy increased as age group ascended. Tooth drawings had higher scores than gingival drawings in all age groups ($p < 0.001$). In older schoolchildren, females had higher scores than males ($p < 0.01$), and more frequent tooth brushing was associated with higher scores ($p < 0.05$). In younger children, more frequent consumption of sweet food was related to lower gingival scores ($p < 0.05$). The findings suggest that this instrument is appropriate for assessing oral health literacy in elementary school children, but for gingival drawings may be best suited to children aged 10 or above, due to limited drawing ability.

Keywords

Health Education; Health Promotion; Oral Health; Oral Health Literacy; Schoolchildren

Introduction

The World Health Organization's global policy for improving oral health places schools in a central role [1,2]. Oral health education has been found to relate to significant improvement in oral health, the health behavior of children, and better health knowledge and attitudes of parents and teachers, although not all aspects of oral health show significant improvement following oral health education in schools [3]. It is important to understand the level of oral health literacy of schoolchildren to ensure that oral health instruction is appropriate for the target groups to maximize improvements in oral health.

There is a growing effort to increase the oral health literacy of adults and children alike, with the aim of improving oral health [4,5]. Research on the level of oral-health literacy of adolescents, adults, the elderly, and caregivers of preschool children has been conducted [6-12]. In comparison, relatively little information exists on the level of oral-health literacy of elementary school children, partly due to the difficulty of applying conventional oral-health literacy instruments to children of this age.

Previous oral health literacy instruments have used questionnaires, interviews, or text-based assessments to establish the level of oral health literacy in a sample [12-15]. The studies that have investigated elementary schoolchildren have also used self-administered questionnaires for data collection [15,16]. For children of school age, it is possible that these will be perceived as additional work akin to school-exam exercises, which might lead to a degree of demotivation with respect to oral health activities.

The visual oral health literacy instrument has previously been used with high school students; study participants examined and drew their mouths using hand mirrors, paper, and drawing utensils [17,18]. This instrument did not measure the same aspects of oral health literacy as conventional instruments. However, it offered insight into a particular aspect of oral health literacy, namely awareness of normal anatomical and morphological features of dentition and gingival tissues.

The purposes of this study were twofold: (1) to investigate the oral health literacy level of elementary schoolchildren through the application of the visual instrument; and (2) to compare the differences between children of different ages and genders with respect to oral health literacy, oral hygiene practices, and eating behaviors.

Materials and Methods

Participants

This study was conducted in an oral-health education program as part of the 2010 school curriculum. Therefore, all students participated in the activity. The participants were 292 schoolchildren in grades 1 to 6, aged 6 to 12 years old, in

an elementary school in Saitama Prefecture, Japan.

Questionnaire survey

A self-administered questionnaire survey reported on “self-perceived oral health,” (“good,” “normal,” or “poor”); brushing frequency (“daily,” “sometimes,” or “never”); and the frequency of consumption of sweet foods and drinks (“every day,” “sometimes,” “rarely,” or “never”). Questionnaire items are shown in table 1.

1	How do you evaluate your oral health status?
2	How often do you brush your teeth every day?
3	How often do you eat sweet foods?
4	How often do you drink sweet drinks?

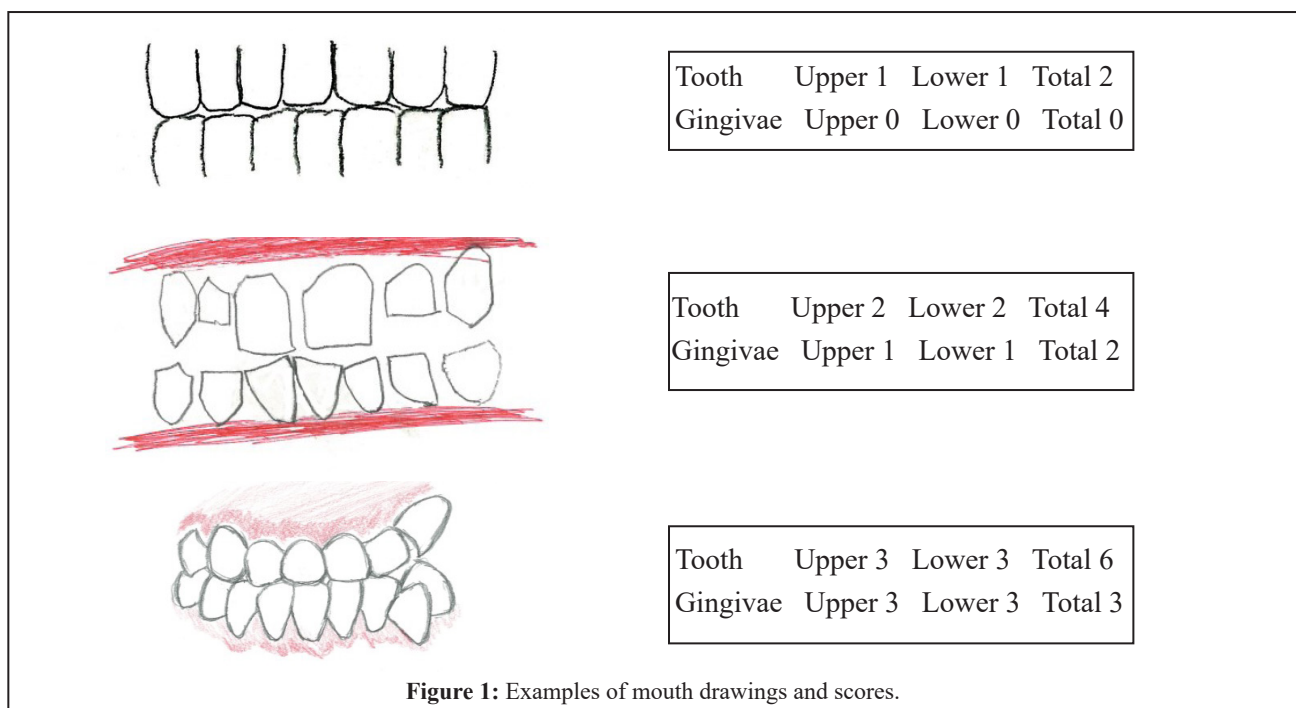
Table 1: Questionnaire items used for schoolchildren.

Mouth drawings

During the oral health education program, children were provided with colored pencils, paper, and a hand mirror. They were instructed to draw their anterior teeth and gingivae.

Scoring criteria of mouth drawings

The schoolchildren’s mouth drawings were used as the visual instrument for oral health literacy assessments. The criteria used to score drawings were identical to those set by Ueno et al., [17], as shown in table 2 and figure 1. Upper and lower jaws were scored separately, and the scores combined to give a tooth score and gingival score, each of which had a minimum of 0 and maximum of 6. Some drawings were chosen at random and scored independently by experienced scorers to ensure proper calibration.



Score	Evaluation Criteria	
Tooth Score	0	Teeth are not drawn
	1	Teeth are drawn, but not clear
	2	Either tooth shape or tooth alignment is properly drawn
	3	Both tooth shape and tooth alignment are properly drawn
Gingival Score	0	Gingivae are not drawn
	1	Gingivae are drawn, but not clear
	2	Either interdental papillae or marginal gingivae are drawn properly
	3	Both interdental papillae and marginal gingivae are drawn properly

Table 2: Criteria for scoring mouth drawings.

Statistical analysis

Schoolchildren in adjacent grades were paired into age groups; a grade 1 and 2 comprised the younger group, grades 3 and 4 the middle group, and grades 5 and 6 the older group.

For questionnaire survey items, brushing frequency, sweet food consumption, and sweet drink consumption were categorized as either “daily” or “non-daily.”

Distributional differences in questionnaire responses and drawing scores between age groups and between genders were analyzed with chi-square tests. Differences between mean drawing scores for teeth and those for gums were analyzed using paired-sample t tests, independent t tests, and a one-way ANOVA. Statistical tests were carried out using IBM SPSS Statistics software, version 22.0. The significance level was set at $p < 0.05$.

Ethics

This study was approved by the Tokyo Medical and Dental University ethical committee (No. 599).

Results

Table 3 shows the number of participants by sex. A total of 242 subjects had complete questionnaires and mouth drawings, of whom 142 were males and 100 females. The younger group

was 54 children, the middle group was 93 children, and the older group was 95 children.

Distribution of drawing score by age group and gender

Table 4 shows the distribution of tooth and gingival drawing scores. For the tooth drawings, there were no subjects with a score of 0. In the younger group, 42.6% of drawings had a score of 2, and none had scores of 5 or 6. In the middle group, more than 66% of drawings scored 4 or above. In the older group, 22.1% of drawings had the full score of 6.

There were significant distributional differences in the tooth scores between all age groups ($p < 0.001$). There were no significant distributional differences between males and females in the younger or middle groups. However, significant distributional differences in tooth scores between males and females were found in the older group ($p < 0.05$).

For the gingival drawings, the proportion of drawings that had a score of 0 were 68.5% in the younger group, 32.3% in the middle group, and 14.7% in the older group. There were significant distributional differences between age groups ($p < 0.001$), with higher scores as the participants’ age ascended. There was no significant distributional difference in the gingival scores between males and females in any age group.

Group	School grade	Male		Female		Total	
		n	%	n	%	n	%
Younger	1st and 2nd	30	55.5	24	44.4	54	100
Middle	3rd and 4th	57	61.3	36	38.7	93	100
Older	5th and 6th	55	57.9	40	42.1	95	100
Total		142	58.7	100	41.3	242	100

Table 3: The number of participants by sex.

Drawing Score:	n (%)										Total	p-value	
	0	1	2	3	4	5	6	6	6	6			
Tooth Score	Younger	Male	0 (0.0)	0 (0.0)	15 (50.0)	1 (3.3)	14 (46.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	30 (100.0)	0.197
	Female	0 (0.0)	1 (4.2)	8 (33.3)	4 (16.7)	11 (45.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	24 (100.0)		
	Total	0 (0.0)	1 (1.9)	23 (42.6)	5 (9.3)	25 (46.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	54 (100.0)		
Middle	Male	0 (0.0)	0 (0.0)	12 (21.1)	10 (17.5)	33 (57.9)	1 (1.8)	1 (1.8)	1 (1.8)	1 (1.8)	57 (100.0)	0.153	
	Female	0 (0.0)	0 (0.0)	2 (5.6)	7 (19.4)	24 (66.7)	3 (8.3)	0 (0.0)	0 (0.0)	36 (100.0)			
	Total	0 (0.0)	0 (0.0)	14 (15.1)	17 (18.3)	57 (61.3)	4 (4.3)	1 (1.1)	1 (1.1)	93 (100.0)			
Older	Male	0 (0.0)	0 (0.0)	9 (16.4)	3 (5.5)	33 (60.0)	2 (3.6)	8 (14.5)	55 (100.0)	0.024			
	Female	0 (0.0)	0 (0.0)	1 (2.5)	3 (7.5)	18 (45.0)	5 (12.5)	13 (32.5)	40 (100.0)				
	Total	0 (0.0)	0 (0.0)	10 (10.5)	6 (6.3)	51 (53.7)	7 (7.4)	21 (22.1)	95 (100.0)				
Younger	Male	21 (70.0)	0 (0.0)	4 (13.3)	4 (13.3)	1 (3.3)	0 (0.0)	0 (0.0)	30 (100.0)	0.157			
	Female	16 (66.7)	2 (8.3)	1 (4.2)	1 (4.2)	5 (20.8)	0 (0.0)	0 (0.0)	24 (100.0)				
	Total	37 (68.5)	0 (0.0)	6 (11.1)	5 (9.3)	6 (11.1)	0 (0.0)	0 (0.0)	54 (100.0)				
Middle	Male	18 (31.6)	1 (5.3)	11 (19.3)	10 (17.5)	15 (26.3)	0 (0.0)	0 (0.0)	57 (100.0)	0.638			
	Female	12 (33.3)	2 (5.6)	6 (16.7)	3 (8.3)	12 (33.3)	0 (0.0)	1 (0.0)	36 (100.0)				
	Total	30 (32.3)	5 (5.4)	17 (18.3)	13 (14.0)	27 (29.0)	0 (0.0)	1 (0.0)	93 (100.0)				
Older	Male	12 (21.8)	1 (1.8)	9 (16.4)	9 (16.4)	18 (32.7)	2 (3.6)	4 (0.0)	55 (100.0)	0.104			
	Female	2 (5.0)	0 (0.0)	6 (15.0)	3 (7.5)	20 (50.0)	4 (10.0)	5 (12.5)	40 (100.0)				
	Total	14 (14.7)	1 (1.1)	15 (15.8)	12 (12.6)	38 (40.0)	6 (6.3)	9 (9.5)	95 (100.0)				

Table 4: Distribution of tooth and gingival drawing scores between age groups and genders.

Drawing scores by age group and gender

Table 5 shows the comparison of the tooth and gingival drawing scores by age group and gender. Comparison of tooth scores showed that the older group had a significantly higher mean tooth score than the younger group ($p < 0.001$) for both males and females. For males, the older group had a

significantly higher mean tooth score than the middle group ($p < 0.05$), though there was no significant difference between the middle and younger groups. Females in the middle group had a significantly higher mean tooth score than those in the younger group ($p < 0.05$), and they had a significantly lower mean tooth score than those in the older group ($p < 0.001$).

No significant gender differences were found in the mean tooth scores of the younger and middle groups. However, the mean tooth score was significantly higher for females than for males in the older group ($p < 0.01$). For the gingival drawings, for both males and females, the younger group had a significantly lower mean score than the older group ($p < 0.001$). In males, the younger group had a significantly lower mean score than the middle group ($p < 0.01$), though there was no significant difference between the middle and older groups. Among the females, the younger group was not significantly different from the middle group, though the middle group had a significantly lower mean score than the older group ($p < 0.001$).

No significant differences were found between males and females for the mean gingival scores in the younger or middle groups. However, in the older group, the mean gingival score for females was significantly higher than for males ($p < 0.01$).

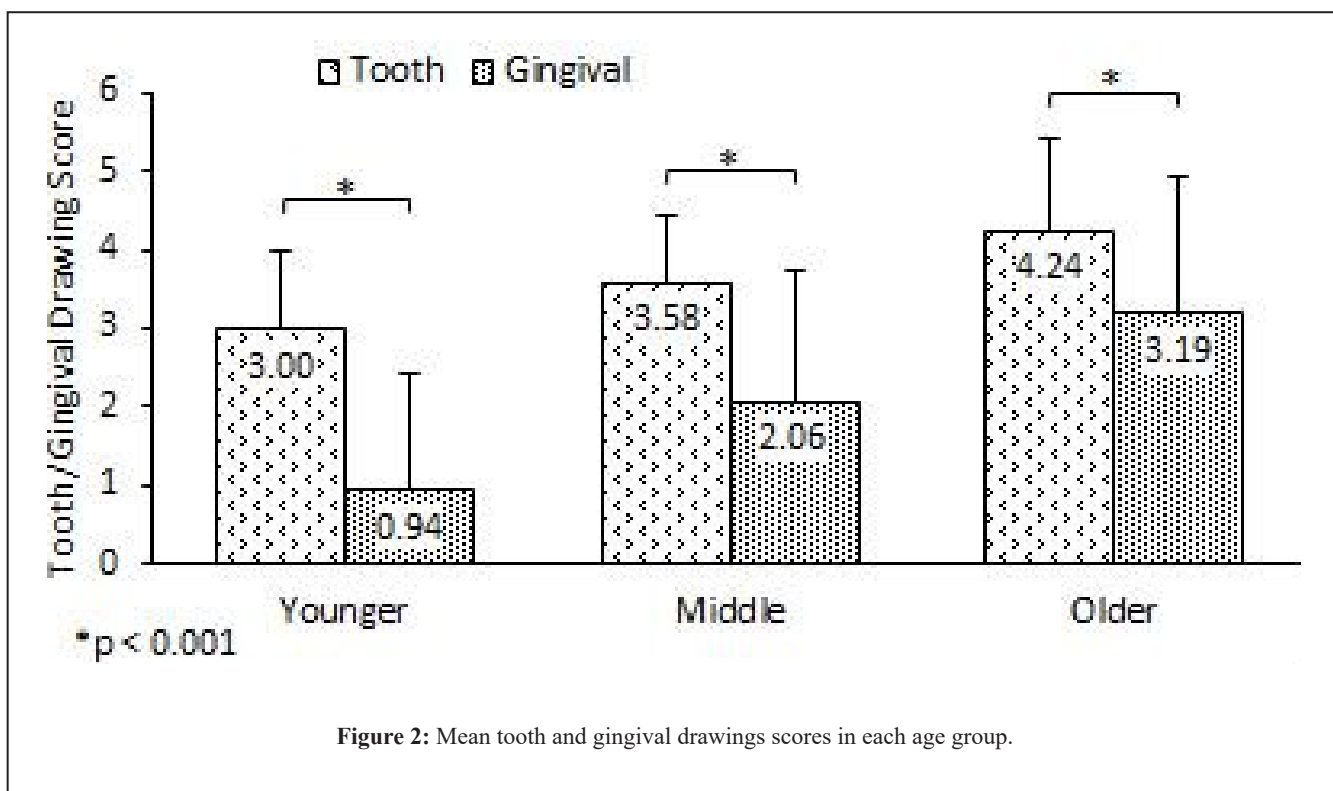
Figure 2 shows a comparison of mean tooth and gingival drawing scores. The mean gingival scores were significantly lower than the mean tooth scores within each age group ($p < 0.001$).

Table 6 shows the questionnaire responses and the tooth-drawing scores by age group. The responses to questionnaire items-“Good,” “Normal,” or “Poor” and “Daily” or “Not Daily”-had

no significant distributional differences among the age groups. For self-perceived oral health, in the younger group, 7.4% of the subjects rated their own oral condition as “poor.” That proportion in the middle group was 11.8%, and in the older group it was 5.2%. The mean tooth scores of those who rated themselves as good, normal, or poor showed no significant difference within any age group.

For tooth brushing and poor oral health behavior (i.e., less-than-daily brushing), the proportion was 16.7%, 22.6%, and 13.7% for the younger, middle, and older subjects, respectively. No significant differences in tooth scores were found between daily and non-daily tooth brushing in the younger group or in the middle group, although in the older group, the mean tooth score of children who brushed daily was significantly higher than those who did not brush daily ($p < 0.05$).

For sweet food consumption, in the younger group, 14.8% of the subjects reported eating sweet foods daily. That proportion was 10.8% in the middle group and 11.6% in the older group. For sweet drink consumption, reports of daily intake were 33.3% for the younger group, 26.9% for the middle group, and 17.9% for the older group. For sweet food and sweet drink consumption, no significant difference in mean tooth score was observed between daily and less-than-daily intake within each age group.



	Younger					Middle					Older				
	n	(%)	Mean	± SD	p-value	n	(%)	Mean	± SD	p-value	n	(%)	Mean	± SD	p-value
Self-perceived oral health															
Good	20	(37.0)	3.20	± 1.06		49	(52.7)	3.51	± 0.84		41	(43.2)	4.24	± 1.09	
Normal	30	(55.6)	2.97	± 0.96	0.210	33	(35.5)	3.79	± 0.78	0.146	49	(51.6)	4.27	± 1.30	0.894
Poor	4	(7.4)	2.25	± 0.50		11	(11.8)	3.27	± 0.90		5	(5.2)	4.00	± 0.71	
Toothbrushing															
Daily	45	(83.3)	2.98	± 1.01		72	(77.4)	3.61	± 0.86		82	(86.3)	4.34	± 1.16	0.039
Less than daily	9	(16.7)	3.11	± 0.93	0.716	21	(22.6)	3.48	± 0.75	0.519	13	(13.7)	3.62	± 1.19	
Sweet food consumption															
Daily	8	(14.8)	3.38	± 0.92		10	(10.8)	3.40	± 0.84		11	(11.6)	4.55	± 1.29	0.368
Less than daily	46	(85.2)	2.93	± 1.00	0.250	83	(89.2)	3.60	± 0.84	0.474	84	(88.4)	4.20	± 1.17	
Sweet drink consumption															
Daily	18	(33.3)	2.94	± 1.11		25	(26.9)	3.44	± 0.92		17	(17.9)	4.29	± 1.21	0.843
Less than daily	36	(66.7)	3.03	± 0.94	0.787	68	(73.1)	3.63	± 0.81	0.329	78	(82.1)	4.23	± 1.18	

Table 6: Questionnaire responses and tooth drawing scores, by age group.

Table 7 shows the questionnaire responses and gingival drawing scores by age group and shows a comparison of the gingival scores according to the responses. For self-perceived oral health,

the mean gingival scores of those who rated themselves as good, normal, or poor showed no significant difference within any age group.

	Younger					Middle					Older				
	n	(%)	Mean	± SD	p-value	n	(%)	Mean	± SD	p-value	n	(%)	Mean	± SD	p-value
Self-perceived oral health															
Good	20	(37.0)	1.35	± 1.76		49	(52.7)	2.08	± 1.79		41	(43.2)	3.17	± 1.72	
Normal	30	(55.6)	0.80	± 1.32	0.185	33	(35.5)	2.21	± 1.58	0.527	49	(51.6)	3.24	± 1.83	0.561
Poor	4	(7.4)	0.00	± 0.00		11	(11.8)	1.55	± 1.57		5	(5.2)	2.80	± 1.10	
Toothbrushing															
Daily	45	(83.3)	1.00	± 1.51	0.544	72	(77.4)	2.19	± 1.73	0.170	82	(86.3)	3.34	± 1.74	0.032
Less than daily	9	(16.7)	0.67	± 1.41		21	(22.6)	1.62	± 1.50		13	(13.7)	2.23	± 1.48	
Sweet food consumption															
Daily	8	(14.7)	0.25	± 0.71	0.025	10	(10.8)	1.80	± 1.99	0.602	11	(11.6)	3.55	± 1.57	0.473
Less than daily	46	(85.2)	1.07	± 1.55		83	(89.2)	2.10	± 1.66		84	(88.4)	3.14	± 1.76	
Sweet drink consumption															
Daily	18	(33.3)	0.56	± 1.15	0.133	25	(26.9)	1.72	± 1.84	0.234	17	(17.9)	2.47	± 1.74	0.060
Less than daily	36	(66.7)	1.14	± 1.61		68	(73.1)	2.19	± 1.62		78	(82.1)	3.35	± 1.71	

Table 7: Questionnaire responses and gingival drawing scores, by age group.

No significant difference was observed between daily and non-daily brushers in the younger or middle groups; however, in the older group, those who brushed daily had a significantly higher mean gingival score than those who did not ($p < 0.05$).

For frequency of sweet food intake, in the younger group, the daily consumption group showed a significantly lower mean gingival score than non-daily consumption ($p < 0.05$). The mean differences in the middle and older groups were not statistically significant.

Discussion

This study was the first to apply the visual oral-health literacy instrument to children in elementary school. Previous studies that applied this instrument to high school children found that tooth scores were higher than gingival scores, females had higher drawing scores than males, and subjects with daily observation of their own mouths with a mirror had higher tooth and gingival scores than those with non-daily observation [17,18].

In this study, both the tooth and gingival components of visual oral-health literacy were higher as the age group ascended. Moreover, the higher scores (5 and 6) comprised a greater proportion of scores as the age group ascended. These findings suggest that reproduction of both dental and gingival anatomy using this instrument is better as age increases in elementary schoolchildren.

As in previous studies, the current study found that tooth drawing scores were higher than gingival drawing scores in all cases. With respect to the gingival drawings, there were a high proportion of scores of 0 in the younger (around two-thirds) and the middle group (one-third). On the other hand, for tooth drawings, there were no scores of 0 in any age group. This suggests that awareness of gingivae is lower than that of dentition; the teeth are more readily visible and recognizable as entities in the mouth with a particular function. Therefore, children are likely to be better able to recognize features of their dentition better than their gingival condition.

Given these findings, it is probable that children in the younger and middle groups particularly are limited not only by their knowledge but also by their drawing ability when trying to reproduce gingival anatomical features. In contrast, children in the younger and middle groups can reproduce dental features with greater accuracy. Consequently, it is suggested that while this instrument can be used to assess the dental component of visual oral-health literacy for elementary schoolchildren of all ages, for the gingival component, the visual instrument may be better suited to those aged 10 or above.

Previous studies have shown that a range of differences exists

between genders [19,20], with some evidence that females exhibit a higher degree of health knowledge, engage in healthier behaviors, and hold more positive attitudes toward dental visits [20]. Differences in the drawing scores between males and females were observed in the older group, with females having a higher level of visual oral-health literacy than males. It has previously been reported that gender differences exist in oral health literacy [17,21]. Gender differences have also been observed in other types of health literacy [22].

This study examined the relationship among visual oral-health literacy level and self-perceptions of oral health and some oral-health behaviors. Self-perception of oral health was found to have no bearing on the tooth or gingival scores. That is, self-rated oral health did not seem to translate to better or worse awareness or reproduction of dental and gingival anatomy. The same finding was also reported previously when using the visual instrument with high school children [18].

In contrast, drawing scores were associated with some health behaviors. Older children who brushed daily exhibited higher tooth and gingival scores. It is possible that children who brush daily are more likely to exhibit greater concern and diligence toward their oral health. This may be associated with greater awareness of the appearance of oral structures. Moreover, frequent brushers may be more likely to view their own mouths in mirrors and be more familiar with the appearance of their teeth and gums.

Daily or less-than-daily consumption of sweet foods and drinks had no relationship with tooth scores. However, younger children who ate sweet foods daily were more likely to exhibit lower gingival scores. It is possible that those who engage in unhealthy behaviors are less concerned with the appearance of their mouths, especially gingival tissues. It is also possible that children with higher health literacy are more likely to engage in favorable dietary behaviors and are more likely to perform better in the types of tasks required when undergoing assessments using this instrument. More effort would be necessary to make such children recognize and reproduce gingivae in drawings.

The visual instrument offers several advantages compared to conventional oral-health literacy instruments. These include low cost and speed of administration; potential for non-health care professionals, such as teachers, to administer the instrument in a classroom setting; a more engaging and enjoyable way of measuring oral health literacy than conventional questionnaire-based instruments for children and adolescents; and instilling the habit of oral self-examination in those undergoing assessments via the instrument, when used in combination with oral health education. Some of these advantages are of particular benefit when assessing elementary schoolchildren.

This instrument is expected to enhance the self-checking ability of schoolchildren. They can recognize problems with their teeth and gingivae at early stage and would be motivated to seek treatment and prevention.

Limitations

A limitation, as acknowledged in earlier uses of this instrument, is that careful calibration is necessary before scoring to minimize variation among individual scorers. A further limitation is that this study applied the visual instrument only to one particular elementary school in Saitama Prefecture, Japan; thus, the findings may not apply to all elementary school children in other areas or countries.

Conclusion

Tooth scores were higher than gingival scores in all age groups. As age increased, both tooth and gingival scores increased. Differences between males and females were found only in the older group, with females having higher tooth and gingival scores. The visual instrument can be used in elementary schoolchildren to assess a different dimension of oral-health literacy than conventional instruments, though in the case of gingival health literacy, it may be more suitable for children aged 10 and above. There is potential for use with children and adolescents in conjunction with modified versions of conventional instruments to give a broader understanding of oral health literacy.

Conflicts of Interest

All authors declare no conflicts of interest in this article.

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