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Effects of an oral health education program targeting oral malodor prevention in Japanese senior high school students

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Abstract

Objective. Previous research has suggested that oral malodor could be a useful motivational tool for increasing the awareness of oral health in adolescents and improving their oral health behaviors. Hence, the aims of this research were: (1) to develop an oral health education program that included oral malodor prevention and (2) to test the effects of the program in Japanese senior high school students by comparing the changes of oral health outcomes between the intervention and control groups. ***Materials and methods.*** Subjects were 163 Grade 1 and 135 Grade 2 senior high school students in Tokyo, Japan. A novel oral health education program, which incorporated prevention of oral malodor, was developed and conducted on all Grade 1 students (intervention group). Grade 2 students (control group) did not receive the program. Changes in oral health status from baseline to 1-year follow-up were compared between the intervention and control groups. ***Results.*** The intervention group, compared with the control group, had a significantly higher proportion of students who improved or maintained good oral health status (i.e. dental plaque, gingivitis, tongue coating and oral malodor). Among students in the intervention group, the change was more evident in subjects with detectable oral malodor at the commencement of the program. ***Conclusions.*** An oral health education program focusing on the prevention of oral malodor is effective for promoting oral health among Japanese senior high school students. Therefore, embedding such a program in the school oral health curriculum would be beneficial for adolescents.

Key Words: *adolescents, oral health education, oral malodor, school health*

Introduction

Oral malodor (bad breath or halitosis) is a common complaint in human society [1]. In Japan, about 15% of the general population aged over 15 years who have some oral health problems are concerned about oral malodor, according to the Health and Welfare Survey [2]. Further, an epidemiological survey of oral malodor in Japan reported that 6–23% of adults have oral malodor [3]. Recently, studies on oral malodor in children and young people have indicated that the prevalence of oral malodor in children or young people is similar to that found in adults [4–6].

Our previous study on oral malodor in a Japanese senior high school found that 40% of students had detectable oral malodor. There also was a strong relationship of oral malodor with dental plaque, tongue coating and not eating breakfast. Moreover, over 42% of the students were conscious or anxious about their oral malodor and most of the subjects reported being troubled by it in their daily lives [7]. Other research suggests that the oral malodor level becomes higher in cases of poor oral hygiene or in the presence of periodontal disease [8–12]. It is especially salient that children's oral malodor is mainly caused by poor oral hygiene [13]. These findings suggested to us that oral malodor would be a useful motivational tool for adolescents to increase their oral health awareness. They might be encouraged to clean their mouth more intensively because increased oral malodor hinders communication and human relationships [14]. By changing to more favorable oral health behaviors, their oral health condition would also be expected to improve.

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Oral health education is a powerful and successful tool in promoting oral health in adolescents [15–18]. Adolescence is an important life stage for establishing adult behaviors [19]. Hence, school is an ideal place to provide oral health education programs in order to control the growing burden of dental diseases and to promote oral health by forming appropriate oral health behaviors.

Systematic reviews by Kay and Locker [20] suggested that an individual's level of knowledge about oral health could be relatively easily improved by oral health education. However, there was no clear evidence for an impact of increased oral health knowledge on behavior. Because people have different learning styles or characteristics in processing information, developing attitudes and changing behaviors [6], health education programs should be tailored to each situation.

A school-based oral health education program that incorporates oral malodor prevention may be more beneficial than an ordinary education program because it could not only reduce oral malodor but also improve other oral health conditions. Moreover, such a program might more effectively bring about a desirable change in students' oral health behavior. It is also expected that any improvement of oral health behaviors, such as oral hygiene and eating habits, might contribute to improvement of general health by promoting positive general health behaviors.

Currently, school oral health education programs in kindergartens, elementary schools and high schools in Japan mainly focus on prevention of dental caries or periodontal disease. None of these programs include a component on preventing oral malodor. Therefore, the main purposes of this research were: (1) to develop and conduct a new oral health education program, particularly targeting the prevention of oral malodor, for senior high school students, and (2) to compare the 1-year changes of oral health outcomes in the intervention group with those in the control group.

Materials and methods

Subjects

This research was conducted at one of the senior high schools belonging to the 'Encourage School' programs in Tokyo. The subjects were 163 Grade 1 (male: 79, female: 84, mean age: 15.0 ± 0.1) and 135 Grade 2 (male: 65, female: 70, mean age: 16.0 ± 0.1) students as of April, 2007. The intervention group comprised all Grade 1 students and they received the new oral health education program. Grade 2 students, who served as the control group, received an existing school oral health education program.

Examination of oral health status

Both grades of students underwent the annual school oral examination in April. Assessment criteria for the examination were based on the standard procedures for the Japanese School Dental Examinations [21]. Oral examinations were carried out by three dentists, one of whom was a school dentist, and the other two were specialist dentists from the Fresh Breath Clinic at Tokyo Medical and Dental University.

Dental health status, such as presence of decayed teeth, was examined using a dental mirror and an explorer and was classified as either presence or absence of decayed teeth. Oral hygiene status was evaluated by a dental plaque score ranging from 0–2 (0 = no observable plaque, 1 = less than 1/3 of anterior teeth with observable plaque and 2 = more than 1/3 of anterior teeth with observable plaque). Gingivitis was investigated by a gingival status score ranging from 0–2 (0 = healthy gingiva, 1 = slight gingivitis without dental calculus around one or more anterior teeth and 2 = moderate gingivitis with dental calculus around one or more anterior teeth). The area of tongue coating was visually investigated using the score described by Oho et al. [22], which ranged from 0–3 (0 = no observable tongue coating, 1 = less than 1/3 of tongue dorsum with coating, 2 = 1/3–2/3 of tongue dorsum with coating and 3 = coating on more than 2/3 of tongue dorsum). The tongue coating status was dichotomized depending on the existence (score 1–3) or non-existence (score 0) of a tongue coating. Students were notified of the results of the oral examination and received recommendations for dental treatment, if necessary.

Assessment of oral malodor

The organoleptic test described by Rosenberg [23] was used for the oral malodor measurement. The measurement was carried out in the morning prior to the oral examination. Students breathed out through a mouthpiece that was inserted in a screen separating the examiner and examinee and dentists evaluated the odor produced. Malodor was initially diagnosed as: 0 = Absence of odor; 1 = Questionable malodor; 2 = Slight detectable malodor; 3 = Moderate malodor; 4 = Strong malodor; and 5 = Severe malodor. Oral malodor was evaluated by the two specialist dentists and an average score was recorded. The value of Cohen's kappa between two examiners was 0.783. For later analyses, malodor scores were dichotomized: 'malodor –' no detectable malodor (scores 0 and 1) and 'malodor +' detectable malodor (scores 2–5). Students were given feedback on the result of oral malodor assessment right after the measurement.

Oral health education

The intervention group received a 100-min oral health education program twice a year (July and December) by research staff dentists. This program specifically targeted prevention of oral malodor. The content of the program included detailed explanations of causes, treatments and prevention of oral malodor using visual materials such as photographs, figures and dental models.

The control group received only the existing school oral health education program that was provided as part of the school health curriculum. This program comprised a 60-min oral health lecture on causes, symptoms, treatments and prevention of dental caries and periodontal disease. The program was delivered in December by one of the research staff dentists. The intervention group also received this program.

Statistical analysis

Data on oral health outcomes were collected twice, at the annual school oral examination in 2007 and 12 months later in 2008. For the analysis of 1-year changes in oral health outcomes, students in both the intervention and control groups were sub-grouped by the presence (malodor +) or absence (malodor –) of detectable oral malodor at the baseline examination in 2007. Subjects were further categorized into those who either 'maintained a good oral health status or improved their oral health status' (= positive change group) and those who either 'retained a poor oral health status or worsened their oral health status' (= negative change group) during the 1 year. Chi-square tests were used to examine the distributional differences between the two groups. All statistical analyses were performed using SPSS 18J software (IBM SPSS, Tokyo, Japan). The level of significance was set at $p < 0.05$.

Human subject approval statement

This study has been approved by the Tokyo Medical and Dental University institutional review board (IRB).

Results

Baseline condition

Table I summarizes the variables investigated at baseline. There was no significant difference in gender distribution between the intervention and control groups. No significant difference was observed in the proportion of students with decayed teeth, dental plaque, gingivitis, tongue coating or oral malodor between the intervention and control groups. At the baseline, 42.6% of all students had oral malodor and there was no significant difference in the prevalence of oral malodor between the intervention and control groups.

Table I. Gender and oral health status at baseline in intervention and control groups.

		Intervention group		Control group	
Variables	Category	*n*	%	*n*	%
Gender	Male	79	48.5	65	48.1
	Female	84	51.5	70	51.9
Decayed teeth	Absence	76	46.6	67	49.6
	Presence	87	53.4	68	50.4
Dental plaque	0	82	50.3	63	46.7
	1	70	42.9	55	40.7
	2	11	6.7	17	12.6
Gingivitis	0	78	47.9	68	50.4
	1	63	38.7	55	40.7
	2	22	13.5	12	8.9
Tongue coating	Absence	16	9.8	22	16.3
	Presence	147	90.2	113	83.7
Oral malodor	–	95	58.3	76	56.3
	+	68	41.7	59	43.7

Changes during 1-year period

Because there was no significant difference in the changes of any oral health status over the 12-months by gender, the following analysis was conducted by combining male and female data.

Oral malodor. At the 1-year follow-up examination, the prevalence of oral malodor decreased to 16.6% (from 41.7% at baseline) in the intervention group and to 28.1% (from 43.7% at baseline) in the control group. This was a statistically significant difference of oral malodor prevalence between the intervention and control groups ($p = 0.017$).

Oral health status. Table II shows the changes of oral health status between the baseline and the 12-month follow-up in the intervention and control groups by oral malodor status. There were no statistically significant differences between the intervention and control groups or between oral malodor sub-groups with respect to presence of decayed teeth.

For dental plaque, 69.9% of students in the intervention group and 55.6% in the control group maintained good oral hygiene status or improved their oral hygiene status. The intervention group showed a significantly higher proportion of positive change than the control group ($p = 0.011$). Further, students with oral malodor at baseline in the intervention

Table II. Changes of oral health status after 1 year in the intervention and control groups.

	Oral malodor status at baseline	Positive change		Negative change		Significance
		n	%	*n*	%	
			Decayed teeth			
Intervention group	Malodor −	33	34.7	62	65.3	
	Malodor +	22	32.4	46	67.6	
	Total	55	33.7	108	66.3	
Control group	Malodor −	34	44.7	42	55.3	
	Malodor +	26	44.1	33	55.9	
	Total	60	44.4	75	55.6	
			Dental plaque			
Intervention group	Malodor −	65	68.4	30	31.6	
	Malodor +	49	72.1	19	27.9	
	Total	114	69.9	49	30.1	*
Control group	Malodor −	43	56.6	33	43.4	*
	Malodor +	32	54.2	27	45.8	
	Total	75	55.6	60	44.4	
			Gingivitis			
Intervention group	Malodor −	42	44.2	53	55.8	
	Malodor +	35	51.5	33	48.5	
	Total	77	47.2	86	52.8	**
Control group	Malodor −	29	38.2	47	61.8	*
	Malodor +	15	25.4	44	74.6	
	Total	44	32.6	91	67.4	
			Tongue coating			
Intervention group	Malodor −	40	42.1	55	57.9	
	Malodor +	36	52.9	32	47.1	
	Total	76	46.6	87	53.4	**
Control group	Malodor −	30	39.5	46	60.5	*
	Malodor +	15	25.4	44	74.6	
	Total	45	33.3	90	66.7	

*$p < 0.05$, **$p < 0.01$.

group (72.1%) responded significantly more favorably by keeping good oral hygiene status compared to those with oral malodor in the control group (54.2%) ($p = 0.037$). The difference between the intervention and control groups was not statistically significant in students without malodor at baseline.

In total, 47.2% of students in the intervention group and 32.6% in the control group maintained a good gingival condition or improved their gingival health. The intervention group showed a significantly higher proportion of positive change than the control group ($p = 0.013$). In the oral malodor sub-groups, 51.5% of students with oral malodor at baseline in the intervention group and 25.4% in the control group demonstrated an improvement or maintenance of gingival health. This was a statistically significant difference between the two sub-groups ($p = 0.003$). However, there was no significant proportional difference between the intervention and control groups among students without oral malodor at baseline.

The overall percentages of students who maintained a good tongue coating condition or improved their tongue coating condition were 46.6% in the intervention group and 33.3% in the control group. The intervention group presented a significantly higher proportion of positive change than the control group ($p = 0.024$). In the oral malodor sub-groups, 52.9% of students with oral malodor at baseline in the intervention group and 25.4% in the control group maintained or improved their tongue coating condition. This was a statistically significant difference between the two groups ($p = 0.002$). On the other hand, between the sub-groups without oral malodor at baseline, there

was no statically significant difference between the intervention and control groups.

Discussion

This study demonstrated that a higher proportion of students in the intervention group maintained or improved their oral health status (i.e. oral malodor, dental plaque, gingivitis and tongue coating) than those in the control group who only received an ordinary oral health education program. The education program utilizing oral malodor as a motivational tool achieved a successful outcome towards students who are considered to be sensitive to their own oral malodor condition, while the existing program had little impact on the students' oral health behavior.

Overall, this novel intervention program brought the expected desirable results. In particular, the positive change was more remarkable in the students who had detectable oral malodor at baseline. In contrast, for students without detectable oral malodor, no significant differences in oral health outcome changes were observed between the intervention and control groups. These findings suggest that, by being exposed to the intervention program, students with oral malodor may become more interested in their oral health and clean their mouth more intensely or carefully than those without oral malodor. Being informed of oral malodor by the examiner at the assessment was thought to serve as a trigger for favorable oral health behavior changes, principally in students with oral malodor.

Among oral health outcomes, the positive change was most notably found in the dental plaque status. The degree of positive change in gingivitis was lower than that in the dental plaque. This result indicates that the oral health education can make students recognize the accumulation of dental plaque as well as change their oral hygiene behavior. Mild gingivitis without the deposition of dental calculus can be improved in a relatively short time with careful oral self-care; however, severe gingivitis, especially with the presence of dental calculus, cannot be cured without professional treatment at a dental clinic [13,17,24]. This is probably the reason why the positive change in gingivitis was not so pronounced in spite of the improved oral hygiene status.

There is still plenty of room for improvement of the current intervention program. The status of decayed teeth did not change in the intervention or control group. Although students had been given feedback about their dental needs from the dentist after the oral health assessment and had received oral health education, more than half of them did not seek dental treatment for their decayed teeth during the 1-year period. Similarly, 30–40% of students still did not improve their dental plaque status and more than half of the students presented with poor oral health status (i.e. gingivitis and tongue coating) at the 1-year follow-up examination.

Dental plaque and tongue coating can be improved by thorough oral hygiene, which could lead to the amelioration of gingivitis or oral malodor [13,25]. Dental caries, on the other hand, cannot be healed naturally even if oral hygiene is perfect; they must be managed through professional treatments at a dental clinic. More elaboration of current oral health education programs will be necessary to promote further positive change of students' behavior and to help them find a dentist and receive appropriate professional care.

An organoleptic test for oral malodor measurement [23] needs to be performed with this kind of health education program. In this study, we informed students of their oral malodor status after the organoleptic test, but recognize that caution should be exercised when disclosing the information to them because of privacy concerns. We believe that any dentists would be able to perform oral malodor evaluation if they receive appropriate training for oral malodor measurement [26]. However, it is important to keep in mind that adolescents may be very sensitive to issues like bad breath, body malodor and their appearance [27].

There are some limitations in this research. First, the senior high school which participated in this study belonged to the 'Encourage Schools' programs in Tokyo. An 'Encourage School' is a special school that admits and supports students who have lower levels of achievement socially and academically than average school students. The oral health status of these students is also lower, and they are at higher risk for oral diseases compared to general senior high school students [7]. One possible reason for the limited success of the intervention program on dental caries might be attributed to this character of the school. If the current health education program had been carried out at a general senior high school, improvement of oral health outcomes might have been greater. Thus, further research should be conducted to confirm the effects of the current education program in general senior high schools, obtain additional information for modifying the program and assist students to promote their oral health status.

Second, the intervention group was exposed to two different types of oral health education: the new oral health education that focused on oral malodor prevention and the ordinary oral health education. Therefore, the independent impact of the new program incorporating oral malodor prevention is not clear. A future study would be required to distinguish more specifically which program component has the greatest effect on behavioral change and to what extent.

Finally, the grade levels of the intervention (Grade 1) and control (Grade 2) groups were different. In a

school-based program, it is very difficult to allocate students in the same grade to different groups due to the principle of equal opportunity in education. However, no significant differences were detected in any variables at baseline between the two grades in this study. Hence, we consider the influence of different student grade levels on this study's outcomes to be minimal.

Conclusions

Although this study was conducted on special senior high school students, the results indicate that introducing an oral health education program that incorporates oral malodor prevention as a motivational tool for oral health promotion can be effective. Students may be more interested in and motivated to clean their mouth more carefully and intensively after receiving the program. This research implies that there are benefits to embedding an oral health education program that targets oral malodor prevention in the school oral health curriculum because it may effectively act as a trigger to drive senior high school students to favorably change their oral health behavior.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References

[1] Hughes FJ, McNab R. Oral malodour - a review. Arc Oral Biol 2008;53:S1–S7.

[2] Ministry of Health, Labour Welfare. Year 1999, reports on helath and welfare. Tokyo: Vital and Health Statistics Division, Statistics and Information Department, Ministry's Secretariat; 1999.

[3] Miyazaki H, Sakao S, Katoh Y, Takehara T. Correlation between volatile sulphur compounds and certain oral health measurements in the general population. J Periodontol 1995; 66:679–84.

[4] Nalçaci R, Sönmez IS. Evaluation of oral malodor in children. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008; 106:384–8.

[5] Liu XN, Shinada K, Chen XC, Zhang BX, Yaegaki K, Kawaguchi Y. Oral malodor-related parameters in the Chinese general population. J Clin Periodontol 2006;33:31–6.

[6] Nadanovsky P, Carvalho LB, Ponce de Leon A. Oral malodour and its association with age and sex in a general population in Brazil. Oral Dis 2007;13:105–9.

[7] Yokoyama S, Ohnuki M, Shinada K, Ueno M, Wright FAC, Kawaguchi Y. Oral malodor and related factors in Japanese senior high school students. J Sch Health 2010;80:346–52.

[8] Morita M, Wang HL. Association between oral malodor and adult periodontitis: a review. J Clin Periodontol 2001; 28:813–19.

[9] Pratibha PK, Bhat KM, Bhat GS. Oral malodor: a review of the literature. J Dent Hyg 2006;80:8.

[10] Çiçek Y, Orbak R, Tezel A, Orbak Z, Erciyas K. Effect of tongue brushing on oral malodor in adolescents. Pediatr Int 2003;45:719–23.

[11] Figueiredo LC, Rosetti EP, Marcantonio E, Marcantonio RA, Salvador SL. The relationship of oral malodor in patients with or without periodontal disease. J Periodontol 2002;73:1338–42.

[12] Ueno M, Yanagisawa T, Shinada K, Ohara S, Kawaguchi Y. Prevalence of oral malodor and related factors among adults in Akita Prefecture. J Med Dent Sci 2007;3:159–65.

[13] Kara C, Tezel A, Orbak R. Effect of oral hygiene instruction and scaling on oral malodour in a population of Turkish children with gingival inflammation. Int J Paediatr Dent 2006;16:399–404.

[14] Scully C, Greenman J. Halitosis (breath odor). Periodontol 2000 2008;48:66–75.

[15] Frencken JE, Borsum-Andersson K, Makoni F, Moyana F, Mwashaenyi S, Mulder J. Effectiveness of an oral health education programme in primary schools in Zimbabwe after 3.5 years. Community Dent Oral Epidemiol 2001;29: 253–9.

[16] Hawkins RJ, Zanetti DL, Main PA, Otchere DF, Dwyer JJM, Jokovic A, et al. Toothbrushing competency among high-risk grade one students: an evaluation of two methods of dental health education. J Public Health Dent 2001;61:197–202.

[17] Hugoson A, Lundgren D, Asklöw B, Borgklint G. Effect of three different dental health preventive programmes on young adult individuals: a randomized, blinded, parallel group, controlled evaluation of oral hygiene behaviour on plaque and gingivitis. J Clin Periodontol 2007;34:407–15.

[18] Kasila K, Poskiparta M, Kettunen T, Pietilä I. Oral health counselling in changing schoolchildren's oral hygiene habits: a qualitative study. Community Dent Oral Epidemiol 2006; 34:419–28.

[19] Kawamura M, Takase N, Sasahara H, Okada M. Teenagers' oral health attitudes and behavior in Japan: comparison by sex and age group. J Oral Sci 2008;50:167–74.

[20] Kay EJ, Locker D. Is dental health education effective? A systematic review of current evidence. Community Dent Oral Epidemiol 1996;24:231–5.

[21] Japan School Dental Association. Activity guidelines of school dentists, revised edition. Tokyo: Japan School Dental Association; 2007.

[22] Oho T, Yoshida Y, Shimazaki Y, Yamashita Y, Koga T. Characteristics of patients complaining of halitosis and the usefulness of gas chromatography for diagnosing halitosis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2001;91:531–4.

[23] Rosenberg M. First international workshop on oral malodor. J Dent Res 1994;73:586–9.

[24] Igić M, Apostolović M, Kostadinović L, Tricković-Janjić O, Surdilović D. The importance of health education in prevention of oral health in children. Med Pregl 2008;61:65–70.

[25] Pham TAV, Zaitsu T, Ueno M, Shinada K, Ngo KD, Lam PH, et al. Oral malodor and related factors among Vietnamese dental patients. Int J Clin Prev Dent 2010;6:63–71.

[26] van den Broek A, Feenstra L, de Baat C. A review of the current literature on aetiology and measurement methods of halitosis. J Dent 2007;35:627–35.

[27] Okada M, Suzue TFJ. Association between interpersonal relationship among high-school students and mental health. Environ Health Prev Med 2010;15:57–62.