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Intra-Oral Factors Influencing Halitosis in Young Women

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ABSTRACT

Objectives: The aim of this research was to determine intra-oral factors that affect halitosis in young women.
Methods: This study was performed between March 2014 to May 2014, and included 35 women in their 20s with good oral health. Correlation and logistic regression analyses were performed to investigate the change in halitosis immediately, and 1 hour after scaling.
Results: In both oral gas (OG) and extraoral gas (EG) groups, halitosis was reduced after scaling compared to before scaling. The logistic regression analysis of oral state factors in OG showed that as oral fluid [odds ratio (OR) = 0.792, $p = 0.045$] and dental plaque (OR = 0.940, $p = 0.016$) decreased by 1 unit, the OR in the OG group decreased (> 50). In addition, as glucose levels in the oral cavity (OR = 1.245, $p = 0.075$) and tongue coating index (OR = 2.912, $p = 0.064$) increased by 1 unit, the OR in the OG group increased (> 50). Furthermore, in the EG group, as oral fluid (OR = 0.66, $p = 0.01$) and dental plaque (OR = 0.95, $p = 0.04$) decreased, the OR in the EG group decreased (> 50) significantly.
Conclusion: To control halitosis, it is necessary to increase oral fluid and decrease the amount of tongue plaque. Furthermore, maintaining a healthy oral environment, aided by regular scaling and removal of dental plaque, may significantly control halitosis.

Introduction

Halitosis is the term used for bad breath, that describes the unpleasant odor detected on the breath that can be a blend of different types of odors based on the food and drink that has been consumed [1]. Halitosis is a significant social problem that is complex although, oral factors are responsible for the majority of cases (85%). These include feculent breath, periodontal disease, dental caries, coated tongue, decreased salivary secretion, changes in composition of the saliva, infection, and tumors of the intraoral. Extraoral causes include nasopharyngeal and respiratory disorders, diabetes, intestinal disease, and renal disease [2,3].

The prevalence of halitosis has been reported to be similar in countries worldwide. The American Dental Association reported that approximately 25% of adults have significant chronic halitosis [4]. In Brazil this figure has been reported to be 31%, and more than 1 family member had halitosis. In these cases, 24% reported that it was unpleasant to communicate with family members due to halitosis [5]. Previous studies that used apparatus to measure halitosis, revealed that 20% to 35% of Chinese [6] and 20% of Japanese individuals [7] had a halitosis concentration above the standard value. In Korea, whilst only 26% of Korean individuals had halitosis, only 54%

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wanted treatment it [8]. The prevalence rate of halitosis in the adult population of Italy has been reported as 54%, and a statistically significant correlation was found between organoleptic and gas chromatographic measurements [9-11]. Even though approximately 70% of women in their 20s in Korea have experienced halitosis, only 30% show levels above normal values. In a study assessing the frequency of halitosis in Korea, the subjective prevalence rate was found to increase with age in both men and women. Self-evaluation of halitosis in women has been more statistically significant than in men [12-14]. These earlier studies show that the prevalence of halitosis is increasing and is becoming a common problem.

Studies have shown that halitosis disrupts not only a person's social life and relationships, but causes psychological, and emotional anxiety resulting in a lack of confidence. Accordingly, because oral health impacts not only general health but also social life and mental health, timely diagnosis and management are essential [15,16].

This study aimed to analyze oral factors influencing halitosis to identify its cause, and consequently improve oral health to efficiently manage halitosis.

Materials and Methods

1. Research design and participants

This study was conducted from March to May 2014, with participants enrolled from students majoring in dental hygiene in Chungbuk Health & Science University in Chungcheongbuk-do. The study included 35 women in their 20s who had good oral health, were non-smokers, and did not consume alcohol. The influence of oral factors on halitosis were analyzed. Patients with systemic disease which might influence halitosis, drug users, and patients with periodontal disease and dental caries were excluded. Halitosis and associated risk factors were analyzed and the change in halitosis immediately, and an hour after scaling, were assessed.

2. Halitosis measurements and analysis method

2.1. Assessment of oral risk factors

2.1.1. Decay teeth test

The anterior teeth were categorized into mesial, distal, labial, and lingual surfaces, and the posterior teeth into mesial, distal, buccal, lingual, and occlusal surfaces. The number of carious teeth were identified after assessing each surface. Carious teeth were classified as: Degree 1 - caries limited to the enamel; Degree 2 - caries extending into the dentine; Degree 3 - caries involving the pulp; and Degree 4 - decay extending into the root or only a retained root. Patients were excluded if they had carious teeth over Degree 3, as this might influence halitosis in this study.

2.1.2. Dental plaque test

Dental plaque is used to evaluate the oral hygiene status and can be removed by brushing. Even though many indices are used to measure dental plaque, d the O'Leary index was used because it is easy to implement and has high reliability and reproducibility. Hence, it is useful for quantifying the status of oral hygiene management.

Disclosing solution was spread on all the teeth surfaces and the participant then asked to rinse their mouth with water. Presence of dental plaque on the teeth surfaces were scored. Absence of dental plaque was scored as '0,' and presence as '1.' The final score for each participant was scored as the sum of the scores for natural teeth and fixed dental prostheses, which was then multiplied by 4.

2.1.3. Tongue plaque test

The degree of attachment of plaque to the tongue was assessed by asking participants to stick their tongue out completely and examining the posterior part. To measure the tongue plaque index, the posterior part of the tongue was divided into 3 zones, either horizontally or vertically, and then subdivided into 9 parts. The presence of tongue plaque attachment in each part was assigned a score of 1. The individual score was calculated by summing up the scores for all 9 parts ranging from a minimum of 0 to a maximum of 9.

2.1.4. Saliva flow rate test

Stimulated saliva was collected in a measuring cylinder for 5 minutes by asking the participants to chew 1 g of tasteless and odorless paraffin wax. After 5 minutes, the measuring cylinder was placed on a flat surface for 1 minute to eliminate the bubbles.

2.1.5. Saliva buffering capacity test

This test was performed to measure the capacity of the saliva to resist changes in pH. The amount of acid needed to lower the pH of saliva to pH 5.0 was measured by placing 2 mL of saliva into a test tube. Then 3 drops of 0.04% equivalent of bromocresol green and bromocresol purple were added into the test tube with the saliva. Using a calibrated dropper, 0.1 N lactic acid solution was added drop-by-drop to the test tube, whilst continually shaking it. The number of drops of 0.1 N lactic acid needed to decrease to pH 5.0 were recorded. To avoid any measurement bias, each test was conducted twice and the values averaged.

2.1.6. Salivary pH

The pH of the stimulated saliva in a beaker was measured using a pH meter.

2.1.7. Salivary Snyder test

Based on the theory that salivary bacteria form acid, it was essential to measure the degree of activity of acidogenic bacteria in the saliva by colorimetry. The Snyder test media was prepared using 1,000 mL distilled water, 3 g beef extract (0.3%), 20 g dextrose, 20 g agar, 50 mL 0.04% bromocresol green, and then modified the pH using 0.1 N lactic acid solution to pH 5.0 using a pH meter. The solution was divided into 10 mL aliquots into glass test tubes and placed in an autoclave and sterilized at 15 lb pressure and 121°C for 20 minutes. During the course of sterilization, paraffin wax with no scent and no taste was used to collect stimulated secreted saliva. After cooling the sterilized solution slightly, 0.2 mL of the well-mixed stimulated saliva was added to the solution using a 1 mL disposable syringe which was mixed well by shaking. After placing the test tube in a water bath for 10 minutes and dissolving the saliva completely, the tube was cooled to 50°C. After leaving it at room temperature for 30 minutes and then placing it in an incubator, the color change of the solution was examined for 72 hours at 24-hour intervals and 37°C. If there was no change and the solution retained a blue-green color even after 72 hours, the score was 0. If the color changed to yellow after 72 hours, the score was 1. If the color changed between 48 to 72 hours, the score was 2; if the color changed between 24 to 48 hours, the score was 3; and if the color changed within 24 hours, the score was 4.

2.1.8. Salivary glucose test

As glucose in the oral cavity provides nutrition to bacteria, it can influence dental disease. After eating candy, the color changes at 3-minute intervals was examined using test-tape till the glucose no longer remained in the oral cavity.

2.1.9. Streptococcus mutans bacterium test

The Dentocult SM® bacterium test selectively cultures *Streptococcus mutans*, which is the main causative organism for dental caries. By taking out the slide badge from the culture tube and placing saliva on the badge, the bacterium was cultured for 4 days at 37°C, and the bacteria was quantified as colony-forming units (CFUs). In case of negligible CFUs, the score was 1. In case there were less than 105 CFU/mL the score was 2. If there were over 105 CFU/mL, the results were tabulated, and the scores were 3 or 4.

2.1.10. Lactobacillus sp. bacterium test (Dentocult LB)

Dentocult LB bacterium test selectively cultures only Lactobacilli colonies in saliva. By taking out the slide badge from the culture tube and placing saliva on the badge, the bacteria were cultured for 4 days at 37°C and the bacteria quantified as CFUs. As in the *Streptococcus mutans* bacterium test results, in cases with negligible CFUs, the score was 1; in cases where there were less than 105 CFU/mL, the score was 2; and if there were over 105 CFU/mL, the results were tabulated, and the scores were 3 or 4.

2.2. Halitosis measurement test

Halitosis was measured for 2 hours after breakfast in the research participants using BB Checker (mBA-21, Plustech, Korea) [17,18].

2.2.1. Oral gas measurement

The concentration of oral gas (OG) was measured in nasal respiration as follows.

The power adaptor was connected with the power turned on automatically and the device was warmed-up for 5 minutes.

After the OG button was turned on, the participant was asked to close their mouth and perform nasal respiration during a preliminary countdown of 180 seconds and OG was accumulated.

Once the preliminary countdown finished and measurement began, the measurement sensor within a prove paper tube was inserted into the oral cavity and the patient was asked to close her lips lightly.

Whilst the patients held their breath, OG was measured for 15 seconds.

After measurement, the values of OG were recorded and presented on the LCD screen.

2.2.2. Extraoral gas measurement

To measure the concentration of extraoral gas (EG), OG needed to be excluded; the measurement method was as follows.

After pressing the EG button, during the preliminary countdown for 30 minutes, the mouth remained closed and the patient performed nasal respiration during a preliminary countdown of 3 minutes, accumulating OG.

After the preliminary countdown was finished and measurement began, the measurement sensor in the prove paper tube was inserted into the oral cavity and the patient was asked to close their lips lightly.

The maximal EG emitted slowly through the mouth was measured for 15 seconds.

After measurement, the values of EG were recorded and presented on the LCD screen.

2.3. Scaling method

Scaling was performed using an ultrasonic scaler. Ultrasonic scalers remove deposits with minute vibrations of electromagnetic waves with high frequency. By changing the electrical energy into vibrational energy, the scaler tip vibrates with a frequency of 25,000 to 42,000 Hz. Scaling was performed for 20 minutes or so for each participant; there was

bleeding depending on the gingival status. After scaling and brushing the teeth with only water, without dental surface abrasives, mouthwashes, or mouth rinses, we measured halitosis. Additionally, for an hour after scaling, the participants were advised to refrain from eating/drinking, except brushing with water. Following this, halitosis was measured and recorded in the same areas.

2.4. Statistical analysis

In the present study, halitosis was evaluated before scaling, immediately after scaling, and 1 hour after scaling to determine the change in halitosis severity before and after scaling. Then, differences in the average halitosis severity change before and after scaling was analyzed using a paired *t* test. After performing the test of normality for each factor, we conducted the Pearson correlation analysis between intra-oral factors and halitosis incidence.

In addition, the subjects were classified into 2 groups based on OG and EG, using a cutoff value of 50, and the influence of intra-oral factors such as oral fluid, buffering power, bacterial activity, hydrogen pH, glucose levels in the oral cavity, dental plaque, tongue coating index, tooth decay, solid media, and lysogeny broth were determined through logistic regression analysis. Statistical analyses for comparison of the 2 groups were performed using the *t* test and Mann-Whitney test.

For continuous variables in OG or EG, we performed linear regression analysis using backward elimination to examine which factors among oral fluid, tongue coating index, dental plaque, glucose levels in the oral cavity, solid media, and lysogeny broth, influence the presence of halitosis. All of these statistical analysis methods were performed using IBM SPSS Statistics, version 24.0 (IBM Corp, Armonk, NY, USA). Results with a $p < 0.05$ were considered statistically significant.

Results

1. Comparison of halitosis before and after scaling

Both OG and EG had less halitosis immediately after scaling compared to before scaling, with less halitosis 1 hour after scaling compared to immediately after scaling (Table 1).

The results of the paired sample *t* test showed that OG had significantly less halitosis immediately after scaling than before scaling ($p = 0.001$; Table 2). Halitosis was also significantly less 1 hour after scaling compared to before scaling ($p < 0.001$).

In EG, even though halitosis was less immediately after scaling compared to before scaling, the difference was not significant ($p = 0.962$). In EG, halitosis was less 1 hour after scaling compared to before scaling, but the difference was not significant ($p = 0.114$).

2. Intra-oral factors and correlation analysis with halitosis

Correlation analysis was performed to analyze the correlation of each measured oral environmental factor with halitosis. Before performing the correlation analysis, the degree of normality of each variable was identified. As the sample size was 35 (< 50), the Shapiro-Wilk test was performed as one of 2 statistical tests. The Shapiro-Wilk test revealed that oral fluid, hydrogen pH, glucose levels in the oral cavity, tongue coating index, tooth decay, bacterial activity, solid media, and lysogeny broth were associated with a significance level of < 0.05; thus, the null hypothesis was rejected and normality was met for these factors. The test revealed that for buffering power, dental plaque, OG, and EG, normality was met.

After performing the normality tests, correlation analysis was performed to determine the association between each intra-oral factor and halitosis incidence. Based on the normality test results, Pearson correlation analysis was performed for

Table 1. Incidence of Halitosis before scaling, immediately after scaling, and 1 hour after scaling.

Variable	Mean	*N*	SD	SEM
OG	51.85	35	15.11	2.55
SC OG	35.17	35	28.63	4.84
SCA OG	29.94	35	20.69	3.49
EG	57.00	35	19.50	3.29
SC EG	56.77	35	29.78	5.03
SCA EG	48.69	35	30.48	5.15

EG = extra gas before scaling; OG = oral gas before scaling; SC OG = oral gas immediately after scaling; SC EG = extra gas immediately after scaling; SCA EG = extra gas 1 hour later after scaling; SCA OG = oral gas 1 hour after scaling; SEM = standard error mean.

Table 2. Paired t test results of halitosis incidence rate before and after scaling.

Variable	Mean	SD	95% Confidence Interval		*p*
			Lower	Upper	
OG-SC OG	16.7	27.4	7.3	26.1	0.001
EG-SC EG	0.2	27.9	-9.3	9.8	0.962
OG-SCA OG	21.9	20.8	14.8	29.1	< 0.001
EG-SCA EG	8.3	30.3	-2.1	18.7	0.114

EG = extra gas before scaling; OG = oral gas before scaling; SC OG = oral gas immediately after scaling; SC EG = extra gas immediately after scaling; SCA EG = extra gas 1 hour later after scaling; SCA OG = oral gas 1 hour after scaling; SEM = standard error mean.

buffering power and dental plaque, and Spearman correlation analysis was performed for the other variables. The results of the correlation analysis are shown in Table 3.

The factors with a significant correlation with halitosis in both OG and EG were saliva oral fluid [OG (p = 0.004, r = -0.472) and EG (p = 0.002, r = -0.504)] and tongue coating index [OG (p < 0.001, r = 0.618) and EG (p = 0.010, r = 0.430)], and these factors have a higher correlation coefficient than the other factors. However, there were no significant correlations with factors such as buffering power [OG (p = 0.915), EG (p = 0.769)], pH [OG (p = 0.875), EG (p = 0.527)], dental plaque [OG (p = 0.214), EG (p = 0.143)], tooth decay [OG (p = 0.353), EG (p = 0.822)], bacterial activity [OG (p = 0.845), EG (p = 0.448)] with halitosis. It was shown that halitosis in OG (p = 0.003, r = 0.485) has a significant correlation with glucose levels in the oral cavity but halitosis in EG (p = 0.077, r = 0.303) does not have a significant correlation. Both solid media and lysogeny broth were not significantly correlated with halitosis.

Table 3. Pearson correlation analysis based on the normality test results.

	OG		EG	
	Correlation	p	Correlation	p
Oral fluid	-0.472	0.004	-0.504	0.002
Buffering power	-0.019	0.915	0.052	0.769
Bacterial activity	0.034	0.845	-0.132	0.448
pH	0.027	0.875	-0.111	0.527
Oral glucose	0.485	0.003	0.303	0.077
Dental plaque	-0.215	0.214	-0.253	0.143
Tongue coating index	0.618	< 0.001	0.430	0.010
Dental caries	0.162	0.353	0.039	0.822
SM agar	-0.014	0.937	0.061	0.728
LB agar	0.145	0.405	-0.003	0.985

EG = extra gas before scaling; OG = oral gas before scaling.

3. Logistic Regression analysis of intra-oral factors and halitosis

After correlation analysis, to investigate the influence of each oral factor on the incidence of OG and EG, 50 was considered the standard cutoff value for halitosis factors. Participants were divided into 2 groups and basic statistical analysis was then performed and the results are shown in Table 4. The results of the OG group before scaling show that glucose levels in the oral cavity (p = 0.006), dental plaque (p = 0.0039), and tongue coating index (p = 0.006) have significant correlation with halitosis. In the EG group, only oral fluid (p = 0.009) was shown to have a significant correlation. The results suggest that factors affecting halitosis before scaling are different from those after scaling.

For covariate analysis, logistic regression analysis was performed using the backward elimination method,

Table 4. The results of the basic statistical analysis of the OG and EG group.

	OG_Group			EG_Group		
	~50	51~	p	~50	51~	p
# of patients	14	21		13	22	
Secretion of saliva	12 (5.5, 15)	8 (5,15)	0.071	12.5 (5,15)	8 (5,15)	0.009
Buffering power	7 ± 1.3	7.14 ± 2.29	0.887	6.92 ± 1.66	7.18 ± 2.11	0.708
Bacterial activity	2 (0,3)	3 (0,4)	0.805	3 (0,4)	1 (0,4)	0.239
Hydrogen pH	6.5 (6,8)	6.5 (6,8)	1.000	6.5 (6,8)	6.5 (6,7)	0.429
Oral glucose	12 (9,15)	15 (9,24)	0.006	15 (9,18)	15 (9,24)	0.126
Dental plaque	64.14 ± 13.36	51 ± 20.1	0.039	62.15 ± 12.48	52.77 ± 21.01	0.154
Tongue coating index	2 (1,4)	3 (2,5)	0.006	3 (2,4)	3 (1,5)	0.192
Dental caries	0.5 (0,6)	0 (0,7)	0.928	1 (0,6)	0 (0,7)	0.555
SM agar	2 (1,3)	2 (1,4)	0.872	2 (1,3)	2 (1,4)	0.744
LB agar	1 (1,3)	1 (1,3)	0.659	1 (1,3)	1 (1,3)	0.861

*Statistic is mean and SD.
EG = extra gas before scaling; OG = oral gas before scaling.

considering the following factors: oral fluid, buffering power, bacterial activity, hydrogen pH, glucose levels in the oral cavity, dental plaque, tongue coating index, tooth decay, solid media, and lysogeny broth. The results of this analysis are shown in Tables 5 and 6.

As shown in Table 5, as oral fluid and dental plaque value decreased by 1 unit, the odds decreased in the OG > 50 group. In addition, as glucose levels in the oral cavity and tongue coating index increased by 1 unit, odds increased in the OG > 50 group. That is, odds in the OG > 50 group increased 1.245 times as glucose levels in the oral cavity increased by 1 unit. As tongue coating index increased by 1 unit, the odds increased 2.912 times.

Table 6 shows that as oral fluid (p = 0.01) and dental plaque (p = 0.04) reduced, odds in the EG > 50 group were significantly reduced.

In addition, we performed linear regression analysis using backward elimination, considering the following factors: oral fluid, tongue coating index, dental plaque, glucose levels in the oral cavity, solid media, and lysogeny broth as covariates. Table 7 shows the results of this analysis.

In OG, the value increased as tongue coating index (p < 0.001) increased, oral fluid (p = 0.009) decreased, and dental plaque (p = 0.009) decreased. In EG, only oral fluid (p < 0.001) and dental plaque (p = 0.009) were the statistically significant variables. As shown in Table 7, the adjusted R^2 value was 0.511 in OG and 0.344 in EG, which means that OG has more power of explanation.

Table 5. The results of the logistic regression analysis of intra-oral factors in the OG group.

	B	SE	p	OR	95% CI for OR	
					Lower	Upper
Oral fluid	-0.233	0.117	0.045	0.792	0.630	0.995
Oral glucose	0.219	0.123	0.075	1.245	0.978	1.584
Dental plaque	-0.061	0.025	0.016	0.940	0.895	0.988
Tongue coating index	1.069	0.576	0.064	2.912	0.941	9.010

OG = oral gas before scaling.

Table 6. The results of the logistic regression analysis of intra-oral factors in the EG group.

	B	SE	p	OR	95% CI for OR	
					Lower	Upper
Oral fluid	-0.42	0.15	0.01	0.66	0.49	0.88
Dental plaque	-0.06	0.03	0.04	0.95	0.90	1.00

EG = extra gas before scaling.

Table 7. The results of the linear regression analysis.

Dependent variable	Independent variable	B	SE	Beta	t	p	Adjusted R^2
OG	(constant)	55.576	13.533		4.107	< 0.001	0.511
	Tongue coating index	8.497	2.251	0.492	3.774	0.001	
	Oral fluid	-1.687	0.606	-0.374	-2.785	0.009	
	Dental plaque	-0.222	0.102	-0.274	-2.177	0.037	
EG	(constant)	114.152	13.501		8.455	< 0.001	0.344
	Oral fluid	-3.394	0.836	-0.583	-4.060	< 0.001	
	Dental plaque	-0.418	0.150	-0.400	-2.786	0.009	

EG = extra gas before scaling; OG = oral gas before scaling.

Discussion

The results of the present study suggest that halitosis in both OG and EG reduces immediately after scaling compared to before scaling. Furthermore, halitosis reduces 1 hour after scaling compared to immediately after scaling. However, in EG, even though halitosis reduces more immediately after scaling compared to before scaling, the difference is not significant. After testing normality of data, correlation analysis was performed to identify the association between each intra-oral factor and halitosis incidence. According to the results of the correlation analysis, oral fluid rate, glucose levels in the oral cavity, and tongue coating index, have significant correlations with halitosis in both OG and EG, and buffering power, tooth decay, dental plaque, and bacterial activity have no significant correlations with halitosis in both OG and EG. According to logistic regression analysis, as oral fluid and a reduction in the value of dental plaque by 1 unit, odds in the OG > 50 group reduced, and as glucose levels in the oral cavity and tongue coating index increased by 1 unit, odds in the OG > 50 group increased. As oral fluid and the value of dental plaque decreased, odds in the EG > 50 group decreased significantly. In addition, the regression analysis revealed that halitosis in OG increases as tongue coating index increases, oral fluid decreases, and dental plaque value decreases, and for halitosis in EG, only oral fluid and dental plaque are the significant variables.

The concept of health, which initially focused only on physical health, now focuses on mental and social health as well. Furthermore, in the modern world, oral health has increased in focus due to its effects on the quality of life. Prevention, treatment, and rehabilitation of oral diseases are important factors in the prevention and elimination of halitosis, which helps in good social acceptance. There are a variety of causes and treatment strategies to manage halitosis. The causes of halitosis are classified into general, psychological, physiological, and oral. Most cases of halitosis occur due to decay of food residue in the mouth by the bacteria in the oral cavity. The bacteria in the oral cavity decomposes proteins and amino acids and produces VSCs. As VSCs increase the mucosal permeability and decomposition of collagen, it changes the vitality of dermal and gingival fibroblasts. This in turn changes periodontal ligament cells and inflammatory cells, and subsequently causes halitosis. Accordingly, in the present study, we selected and assessed young women in their 20s with good oral health, who had no general disease and had no medical history of ulcer, abscess, infection, oral cancer, wrong prosthetic appliance, periodontal disease in the oral cavity, smoking, drinking, or drug use. For halitosis evaluation, a BB Checker (mBA-21, Plustech, Korea) was used, which measures the concentration of VSCs in the oral cavity, together with gas in the oral cavity and EG. Previous studies have reported that VSC concentrations 1 week and 1 month after periodontal treatment in patients with periodontal disease decreases significantly compared to before treatment [19]. As tongue coating, dental plaque, food residue, and so on cause not only halitosis but also periodontal disease, scaling to remove tartar from teeth must be performed to prevent these 2 oral conditions.

In the present study, logistic regression analysis was performed to identify how intra-oral factors influence the concentrations of volatile sulfur compounds. In the OG group, among intra-oral factors, oral fluid and dental plaque showed a significant correlation with halitosis, whilst glucose levels in the oral cavity and tongue coating index were not significantly correlated with halitosis, but odds ratio analysis showed a significant result. Meanwhile, in EG, even though the odds ratio of oral fluid and dental plaque was less than 1, it was statistically significant. In addition, for the present study, we selected subjects with a healthy oral status, to exclude several halitosis-causing diseases, in order to identify the intra-oral factors that affect the incidence of halitosis. Accordingly, compared with the results of existing research, periodontal disease, xerostomia, amount of bacteria, history of taking medicine and ageing, are influenced by intra-oral factors such as oral fluid, dental plaque index, tongue coating index, and bacteria. It has been reported that the degree of halitosis generally decreases 3 to 4 hours after a meal, but halitosis becomes severe more than 4 hours after a meal. The presence of food residue, as well as speaking and outflow of saliva are assumed to cause decomposition in the oral cavity.

There are limitations to the present study. Halitosis evaluation was performed 2 hours after breakfast, so halitosis may not have been as high as expected. Therefore, further research to extensively measure halitosis at longer time intervals would be useful. In addition, further analysis for individual reasons for halitosis is needed through consistent prevention, early treatment, and oral care to control halitosis .

Conclusion

In conclusion, the results of the present study suggest that oral fluid needs to be increased to control halitosis in young women. Furthermore, because tongue coating index has a strong correlation with halitosis, brushing the tongue may be a useful method for reducing the coating on the tongue that may lead to halitosis. In addition to removing dental plaque with regular scaling, it is important to continue managing halitosis in those with a healthy oral status.

Conflicts of Interest

No potential conflicts of interest relevant to this article was reported.

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