

Investigating the Effect of Oral Health Education on the Dental Plaque Index

Abdullah Ali Alrobayan^{1*}, Saad Saleh Alamri¹, Asim Ali Alghamdi¹, Hadeel Mohammed Alnowaiser¹, Abdulrazak Khalid Alsowidan², Ziyad Saad Alharbi², Abdulmajeed Ali Almayman², Wael Salem Almutairi², Rawabi Saleh Almufadaa³, Samar Ali Albogami³

¹Dentist, Prince Sultan Medical Military Hospital, Riyadh, Saudi Arabia.

²Dental Hygienist, Prince Sultan Medical Military Hospital, Riyadh, Saudi Arabia.

³Dental Assistant, Prince Sultan Medical Military Hospital, Riyadh, Saudi Arabia.

ABSTRACT

Awareness of bad breath as a motivational tool to improve oral health behaviors. The main purpose of this study was to compare health education with various educational topics related to oral and dental health and to examine the sustainability of the effect of these methods in improving oral health. 161 students were randomly divided into three groups. The plaque index was measured before the intervention, two weeks, and two months after the intervention, and its changes over time were recorded. Data were analyzed using Chi-square (Bonferroni adjustment), McNemar, Paired t, and Kruskal-Wallis tests. Based on the obtained results, there was no statistically significant difference between the halitosis group and the traditional group, but both groups were significantly different from the control group (P-value < 0.05). Positive changes in the bad breath group, especially in girls, were more lasting than other groups (P-value < 0.05). According to the results of this study, oral and dental health education along with education about bad breath, caries, and gum disease have a greater effect on improving the health level of students. In addition, education about bad breath has a more lasting effect. Therefore, it is suggested to include this teaching method in educational programs.

Keywords: Oral health, Dental plaque, Education, Bad breath.

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Corresponding author: Abdullah Ali Alrobayan

E-mail ✉ Alrobayan@gmail.com

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INTRODUCTION

Performing activities related to oral and dental hygiene depends on having knowledge in its field, which leads to creating a strong motivation and finally performing the desired behaviors. Although knowledge is a necessary part of any behavior change, it is often not enough to change behavior [1-4]. According to the efforts in the field of oral health education, the index of decayed, pulled, filled teeth (DMFT) is still high [1, 5]. Therefore, more efforts are needed to improve health education. It is mentioned in a study that it is necessary to change the traditional

methods of health education [6-8]. Traditional education has been based on providing information about tooth decay and gum disease and how to brush and floss, and it is expected that this information will change people's behavior and increase the level of health, but considering the high DMFT index. In 12-year-old children, the need to change the method is felt [3].

One of the consequences of not observing oral and dental hygiene is bad breath. Halitosis or bad breath has attracted the human mind for hundreds of years, and in the ancient texts, there are articles about this and its treatment methods. Most adults suffer from bad breath at least

occasionally [9, 10]. Halitosis is not a disease, but a sign of a disease in a part of a person's body. The most common cause of bad breath is poor oral hygiene [6, 11-13], for this reason, one of the ways to solve it is to observe oral and dental hygiene [14, 15]. Bad breath may be one of the most important motivational tools to improve oral and dental health, especially in teenagers due to their high sensitivity to social relationships. By focusing on positive behavioral change, adolescents are more intensively involved in oral hygiene and Dentists try to reduce their bad breath [16].

There is a link between bad breath and decreased social relationships, and people with this problem try to distance themselves from others, cover their mouths, or talk less. On many social levels, people do not realize their problem, but the negative effects of bad breath affect their relationships [17, 18]. The higher the amount of bad breath, the worse the mental condition of people [8, 19, 20]. Flossing and brushing teeth as oral health self-care behaviors are considered the most important factors in prevention. However, the amount of use of toothbrushes and dental floss is still low [21, 22]. For this reason, it seems that traditional education has not had much effect, and giving knowledge in the field of caries and gum diseases does not produce a lot of motivation and sustainability to observe oral hygiene, and if knowledge is given about bad breath, maybe the motivation be stronger for oral hygiene.

A Japanese study of junior high school students found that 40% of students had detectable bad breath, which was closely related to the amount of dental plaque, tongue coating, and not eating breakfast. 42% of the students knew about their bad breath and were worried about it [16]. Another study also found that an oral health education program focusing on bad breath prevention was effective as a motivational tool to promote oral health among high school students in Japan. Therefore, embedding such a program in the school's oral and dental health program will be useful for teenagers, and students will clean their mouths with more interest, motivation, and precision [23].

The purpose of this study was to investigate the effect of common oral and dental health education along with creating motivation

through teaching topics such as bad breath or tooth decay on oral and dental health indicators.

MATERIALS AND METHODS

The target group in this study was students, three classes from three girls' schools and three classes from three boys' schools were randomly selected, and after obtaining informed consent from the parents for their child's participation, the sample subjects were included in the study. First, demographic characteristics and oral health behaviors (number of brushing and flossing times per day) were asked of the volunteers participating in the study. Then dental examinations were performed using the Silness and Loe Index and the presence or absence of bad breath.

To evaluate bad breath, the sensory test method recommended in previous studies [6] was used. The examinee was asked to exhale through the mouth and the examiner determined the presence or absence of bad breath. Two trained people performed examinations on a regular chair with natural light using a mirror and a probe. The two examiners were calibrated before performing the examinations, and the Kappa coefficient between the two examiners was 0.76, which indicates the agreement of the two examiners. To ensure that the groups are the same in terms of the mentioned indicators, the examination form was checked, and due to the absence of significant differences between the three classes, the subjects were included in the study. Exclusion criteria included the presence of known respiratory, digestive, kidney, and liver diseases or acute dental caries.

Common oral hygiene training included brushing and flossing. The first group (bad breath) was given health education and information about bad breath and its causes and treatment was given to the people. The second group (traditional) was given health education, and in addition, information about decay and gum diseases was given to people. As for the third group (control group), only health education was given to them.

To remove the confounders, all samples were given the same soft toothbrush, dental floss, and toothpaste, and they were asked to use them during the study. In addition, examinations were performed at least 1 hour after eating breakfast. To blind the study, the examination was

performed by two people and the third person performed the interventions. Plaque index and bad breath were taken from all people at the beginning of the study as a criterion for the level of hygiene. All of them filled out a questionnaire based on demographic characteristics and oral health behaviors. 2 weeks and 2 months after the interventions, the initial examinations were repeated by the previous examiners (first examination: before the intervention, second examination: 2 weeks after the intervention, and third examination: 2 months after the intervention) [24].

In different periods, a decrease in the plaque index was considered a positive change, and an increase in the plaque index or its lack of change was considered a negative change. For data analysis, SPSS version 23 software and chi-square test (Bonferroni adjustment), McNemar, paired t (with a significance level of 0.016), and

Kruskal-Wallis (with a significance level of 0.05) were used.

RESULTS AND DISCUSSION

Among 161 students, 109 students (67%) had bad breath and 52 students (33%) did not have it. 52 of the girls (68%) and 57 of the boys (67%) had bad breath and no statistically significant difference was found between the two sexes.

According to the chi-square (to compare percentages) and Kruskal-Wallis (to compare averages) statistical tests and **Table 1**, it can be seen that there is a statistically significant difference between different groups in terms of gender, the prevalence of bad breath, and the average plaque score. It does not exist before the intervention and the groups are the same (P-value = 0.05).

Table 1. The percentage and number of different variables of gender, bad breath, and the average score of plaque and gums in different groups before the intervention.

Variable		Bad breath group		Traditional group		Control group		Total	
		N	%	N	%	N	%	N	%
Gender	Male	23	47.9	28	49.1	25	44.6	76	47.2
	Female	25	52.1	29	50.9	31	55.4	85	52.8
Bad breath	With	12	25	23	40	17	30	52	32
	Without	36	75	34	60	39	70	109	68
Mean Plaque Index									
MD = 1.61				1.79 ± 0.57					
MD = 1.51				1.6 ± 0.56					
MD = 1.36				1.46 ± 0.53					

In addition, based on the Paired t-test and **Table 2**, it was found that in all three groups, the average plaque score decreased significantly

within two weeks. However, the plaque score has continued to decrease significantly only in the bad breath group within two months.

Table 2. Comparison of the average plaque score at three time points in three groups.

Group	Beginning of the study	Changes in two weeks		Changes from two weeks to two months		Changes in two months	
		Positive changes	Negative changes	Positive changes	Positive changes	Negative changes	Positive changes
Bad breath	+	29	7	24	12	33	3
	-	7	5	9	3	10	2
	Total	36	12	33	15	43	5
Traditional	+	33	7	21	19	33	7
	-	12	5	9	8	16	1
	Total	45	12	30	27	49	8
Control	+	25	8	22	11	22	11

	-	17	6	6	17	15	8
	Total	42	14	28	28	37	19
Total	+	87	22	67	42	88	21
	-	36	16	24	28	41	11

In addition, according to the chi-square and McNemar test, it can be seen that two months after health education (third examination), in the group that had initial bad breath, bad breath education was found to be more effective than health education alone (P-value = 0.01). Also, two months after health education, regardless of the presence or absence of bad breath, there was a statistically significant difference between the bad breath group (P-value = 0.005) and the traditional group (P-value = 0.013) with the control group, but no statistically significant difference was reported between bad breath training and traditional training. According to the results, two weeks after health education (second examination), in the group that did not have bad breath, the type of training did not show a statistically significant difference, while during the third examination compared to the second examination, bad breath training was significantly (P-value = 0.006) more effective than health education alone. In general, health education has been effective in any way, and with time, its effect has decreased significantly in the traditional group (P-value =

0.012) and the control group (P-value = 0.014). In people who did not have bad breath, the effect of health education during the third examination compared to the second examination had a significant drop (P-value = 0.045).

In addition, according to the McNemar test and Bonferroni adjustment chi-square, as well as **Table 3**, it can be seen that in general, the behavior change of boys was more stable than that of girls (P-value = 0.004). Especially in the traditional group (P-value = 0.001) and control group (P-value = 0.016). Traditional education (P-value = 0.003) or bad breath education (P-value = 0.002) has been more effective than health education alone among girls. Two weeks after health education (second examination), traditional education among Girls was more effective than health education alone (P-value = 0.015), but at the time of the third examination compared to the second examination, these positive changes dropped sharply in the two traditional groups, so that bad breath education compared to the traditional education (P-value = 0.001) and health education alone (P-value = 0.003) was recognized as more effective.

Table 3. Changes in the number plate of three groups, considering gender at different times.

Group	Gender	Changes in two weeks		Changes from two weeks to two months		Changes in two months	
		Positive changes	Negative changes	Positive changes	Negative changes	Positive changes	Positive changes
Bad breath	Male	17	6	14	9	20	3
	Female	9	6	9	6	23	2
Traditional	Male	17	11	21	7	23	5
	Female	28	1	9	20	26	3
Control	Male	19	6	17	8	20	5
	Female	23	8	11	20	17	14
Total	Male	53	23	52	24	63	13
	Female	70	15	39	46	66	19

Among 161 students, 109 students (67%) had bad breath and 52 students (33%) did not have it. 52 of the girls (68%) and 57 of the boys (67%) had bad breath and no statistically significant difference was found between the two sexes. The prevalence of bad breath in London was 30% in

a study conducted by Hughes and McNab [17]. In a study conducted by Yokoyama *et al.* [6] in Japan, 42% of students had anxiety or awareness of bad breath on at least one occasion, and 39% of them had detectable bad breath. These results

all show the high prevalence of bad breath and the importance of this issue.

From the results of this study, it can be seen that in our study, like other studies [4, 25-27], in all groups, the average plaque index showed a significant decrease, which indicates the effect of preventive health education programs on the improvement of oral health indicators. Therefore, in the bad breath group, in the second and third examinations, we saw a significant decrease in the average plaque score. However, in the traditional group, from the second to the third examination, the average plaque score did not decrease statistically.

Despite a significant decrease compared to the first examination, also in the control group despite a significant decrease in the average plaque score at the time of the second examination, this decrease was not significant at the time of the third examination. It can be concluded that in the halitosis group, the motivation created and strengthened over time due to the elimination of halitosis has led to more compliance with oral hygiene so even with time, significant progress was made in improving the plaque index. As a result, it can be said that the effect of bad breath training is more lasting. However, in the traditional group, the improvement of the plaque index between the second and third examination has almost stopped and has not been so significant that the cause can be attributed to the lack of sufficient motivation. In the control group, the improvement of the plaque index from the second to the third examination, not only did not increase but also decreased, which indicates the greater effect of topical education (bad breath or traditional) than health education alone. Bad breath education in the group that had bad breath at the beginning of the study was found to be more effective than hygiene education alone (control group). This difference also existed in the article by Ueno *et al.* [24] with the difference that our traditional group was equivalent to their control group. These findings show that the motivation of people with bad breath can be further strengthened with this training method. The effect of health education in people who did not have bad breath has significantly decreased over time. This difference also existed in Ueno *et al.*'s article [24]. That is, people without bad breath had less motivation to observe hygiene

than people with bad breath. In all people (with or without bad breath), bad breath education was not different from traditional education, but it was more effective than health education alone. In a Japanese study [23], bad breath training was found to be more effective than traditional training.

CONCLUSION

The main purpose of this study was to compare health education with various educational topics related to oral and dental health and to examine the sustainability of the effect of these methods in improving oral health. According to the results of the present study, subject education along with health education (bad breath or caries and gum disease) is more effective than health education alone, and bad breath education along with health education has a more lasting effect. Therefore, it is suggested to implement a continuous training program on bad breath training along with health training.

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REFERENCES

1. Watt RG. Strategies and approaches in oral disease prevention and health promotion. *Bull World Health Organ.* 2005;83(9):711-8.
2. Petersen PE, Baez RJ, Ogawa H. Global application of oral disease prevention and health promotion as measured 10 years after the 2007 World Health Assembly statement on oral health. *Community Dent Oral Epidemiol.* 2020;48(4):338-48. doi:10.1111/cdoe.12538
3. Vanobbergen J, Declerck D, Mwalili S, Martens L. The effectiveness of a 6-year oral health education program for primary schoolchildren. *Community Dent Oral Epidemiol.* 2004;32(3):173-82.
4. Gurav KM, Shetty V, Vinay V, Bhor K, Jain C, Divekar P. Effectiveness of oral health educational methods among school children aged 5-16 years in improving their oral

- health status: A meta-analysis. *Int J Clin Pediatr Dent.* 2022;15(3):338-49. doi:10.5005/jp-journals-10005-2395
5. Bourgeois D. Next preventive strategies for oral health: Evolution or revolution? *Front Public Health.* 2023;11:1265319. doi:10.3389/fpubh.2023.1265319
 6. Yokoyama S, Ohnuki M, Shinada K, Ueno M, Wright C, Allan F, et al. Oral malodor and related factors in Japanese senior high school students. *J School Health.* 2010;80(7):346-52.
 7. Nazir MA, Almas K, Majeed MI. The prevalence of halitosis (oral malodor) and associated factors among dental students and interns, Lahore, Pakistan. *Eur J Dent.* 2017;11(4):480-5. doi:10.4103/ejd.ejd_142_17
 8. Khounganian RM, Alasmari ON, Aldosari MM, Alghanemi NM. Causes and management of halitosis: A narrative review. *Cureus.* 2023;15(8):e43742. doi:10.7759/cureus.43742
 9. Dey A, Khan MA, Eva FN, Islam T, Hawlader MD. Self-perceived halitosis and associated factors among university students in Dhaka, Bangladesh. *BMC Oral Health.* 2024;24(1):909. doi:10.1186/s12903-024-04586-y
 10. Briceag R, Caraiane A, Raftu G, Horhat RM, Bogdan I, Fericean RM, et al. Emotional and social impact of halitosis on adolescents and young adults: A systematic review. *Medicina.* 2023;59(3):564. doi:10.3390/medicina59030564
 11. Kay E, Locker D. Is dental health education effective? A systematic review of current evidence. *Community Dent Oral Epidemiol.* 1996;24(4):231-5.
 12. Bashirian S, Khoshravesh S, Ayubi E, Karimi-Shahanjarini A, Shirahmadi S, Solaymani PF. The impact of health education interventions on oral health promotion among older people: A systematic review. *BMC Geriatr.* 2023;23(1):548. doi:10.1186/s12877-023-04259-5
 13. Loy F, Underwood B, Stevens C. Watch and learn? A systematic review comparing oral health educational videos with written patient information aimed at parents/carers or children. *Br Dent J.* 2021;1-6. doi:10.1038/s41415-021-3616-5
 14. Tonzetich J. Direct gas chromatographic analysis of sulfur compounds in mouth air in man. *Arch Oral Biol.* 1971;16(6):587-97.
 15. Tamaki N, Kasuyama K, Esaki M, Toshikawa T, Honda SI, Ekuni D, et al. A new portable monitor for measuring odorous compounds in oral, exhaled and nasal air. *BMC Oral Health.* 2011;11:1-6. doi:10.1186/1472-6831-11-15
 16. Bricker SL, Langlais RP, Miller CS. Oral diagnosis, oral medicine, and treatment planning. Philadelphia: Lea & Febiger; 1994. pp. 3-6.
 17. Hughes FJ, McNab R. Oral malodour-A review. *Arch Oral Biol.* 2008;53:S1-7.
 18. Bollen C, Beikler T. Halitosis: The multidisciplinary approach. *Int J Oral Sci.* 2012;4(2):55-63. doi:10.1038/ijos.2012.39
 19. Talebi M, Taghavi A, Ehteshammanesh K, Farzam H. Evaluation of prevalence and etiology of halitosis. *Yazd Uni Med Sci* 2005;13(2):34-27.
 20. Kapoor U, Sharma G, Juneja M, Nagpal A. Halitosis: Current concepts on etiology, diagnosis and management. *Eur J Dent.* 2016;10(2):292-300. doi:10.4103/1305-7456.178294
 21. Murata T, Yamaga T, Iida T, Miyazaki H, Yaegaki K. Classification and examination of halitosis. *Intern Dent J.* 2002;52(3):181-6.
 22. Aydin M, Harvey-Woodworth CN. Halitosis: A new definition and classification. *Br Dent J.* 2014;217(1):E1. doi:10.1038/sj.bdj.2014.552
 23. Suzuki N, Yoneda M, Naito T, Iwamoto T, Hirofujii T. Relationship between halitosis and psychologic status. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2008;106(4):542-7.
 24. Ueno M, Shinada K, Zaito T, Yokoyama S, Kawaguchi Y. Effects of an oral health education program targeting oral malodor prevention in Japanese senior high school students. *Acta Odontol Scand.* 2011;70(5):426-31.
 25. Buischi YA, Axelsson P, Oliveira LB, Mayer M, Gjermo P. Effect of two preventive programs on oral health knowledge and habits among Brazilian schoolchildren. *Community Dent Oral Epidemiol.* 1994;22(1):41-6.
 26. Haque SE, Rahman M, Itsuko K, Mutahara M, Kayako S, Tsutsumi A, et al. Effect of a school-

based oral health education in preventing untreated dental caries and increasing knowledge, attitude, and practices among adolescents in Bangladesh. *BMC Oral Health*. 2016;16:1-0. doi:10.1186/s12903-016-0202-3

27. Rodrigues JA, Dos Santos PA, Garcia PP, Corona SA, Loffredo LC. Evaluation of motivation methods used to obtain appropriate oral hygiene levels in schoolchildren. *Int J Dent Hyg*. 2003;1(4):227-32.