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Original Article

A Comparative Study of the Effect of Conventional Oral Hygiene Education and Education Based on Bad Breath on Students' Oral Health Indicators

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ABSTRACT

Oral hygiene education based on bad breath can be more effective than other conventional educational methods because bad breath is considered a motivational tool for improving health-related behaviors. This study aimed to compare health education with different topics and compare their effects. In this study, students were randomly divided into three groups: oral hygiene education based on bad breath, traditional hygiene education based on caries and gum disease, and a control group (oral hygiene education only). The changed gingival index, plaque index, and bad breath were measured before the study, one month, and six months later. McNemar's test, Paired and independent t-test, and Wilcoxon tests were used to analyze the data. The study findings showed no significant improvement in the plaque index in the control groups at both follow-ups. At the one-month follow-up, the gingival index in the first group had a significant change compared to the other groups ($P < 0.05$). In terms of changes in bad breath, only in the first group, in both sexes, a decrease in the prevalence and severity of bad breath was observed compared to the beginning of the study ($P < 0.01$). According to the results of the present study, oral hygiene education based on bad breath was more effective, more lasting, and faster on students than traditional education and education alone.

Keywords: Student, Oral hygiene education, Bad breath, Oral health

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Introduction

Bad breath is one of the consequences of poor oral hygiene and one of the most common reasons for visiting a dentist after tooth decay and periodontal disease [1, 2]. The etiology of halitosis includes intraoral and extraoral factors, of which 78% of patients with bad breath complaints have an intraoral factor, the most common of which is poor oral hygiene [2-4].

On the other hand, there is also a relationship between bad breath and reduced social relationships. Based on the comparison between Maslow's hierarchy and the dimensions of health, it can be seen that bad breath can be a major obstacle to social health and belonging and acceptance in large social units [5-7]. As a result, bad breath can be a strong motivational factor for improving the level of oral health of individuals, especially in children and adolescents [8, 9]. Because bad breath can have adverse effects on children's performance in school [10, 11].

Health education is one of the best, easiest, and least expensive ways to ensure the oral health of individuals in society and is a process that establishes a connection between health information and individual performance and creates motivation and ability to change lifestyle [12]. The simplest method of health education is to provide the necessary knowledge about health-threatening factors and teach the necessary skills to prevent and deal with them. Repetition of these types of programs is essential to increase their effects

[13, 14]. On the other hand, educational programs with positive reinforcement are more successful in adults and children than the previous one and create a habit of desirable behavior in the short term. Other strategies are often combined with psychological approaches that are reinforced by intrinsic motivation [11, 15, 16].

The age group 6-12 years old is at the top of the priority groups for oral health programs due to the high prevalence of caries and the relatively valuable position in terms of the development of permanent teeth on the one hand and the formation of beliefs, habits, and lifestyle on the other. Meanwhile, schools provide an excellent environment to reach this age group [17, 18].

On the other hand, a systematic review did not find a relationship between the level of health knowledge and health behaviors in different individuals [8]. Therefore, there is a need to change the method of health education commonly used in schools. It seems that educational programs designed based on halitosis can be more effective than conventional programs because they not only reduce halitosis, but also improve other oral health conditions and health behaviors [8]. Therefore, this article aimed to investigate the effect of conventional oral hygiene education combined with motivation through education on topics such as halitosis or the effect of tooth decay on oral health indicators.

Materials and Methods

This experimental intervention study was conducted using a clinical trial method. To determine the sample size, considering a significance level of 5% and a test power of 80%, and considering the standard deviation of the dental plaque index of S = 0.5, to achieve a significant difference of one unit from the mean of the plaque index and considering a 10% loss, 50 people were calculated in each group.

To prevent the exchange of information between different groups about the method of oral health education and considering the same cultural status of the schools, students from one school were placed in one group.

165 students entered the study after obtaining written consent from their parents, of which 69 were excluded from the study due to debilitating diseases such as thalassemia, feeling uncomfortable due to taking plaque-revealing tablets, or missing one of the follow-ups, and finally, 136 people participated in this study. Other exclusion criteria were the presence of severe dental caries and very poor oral health.

The students were divided into three groups based on the education they received: Group 1 (bad breath): general hygiene education + information about bad breath, its causes, and treatment, Group 2 (gums and caries): general hygiene education + information about caries and gum diseases in a language understandable to this age group, and Group 3 (control): general hygiene education only. After that, the students were asked checklist questions and examined.

The examinations were performed by a pediatric dental specialist in a room with sufficient natural light and a mirror and at least one hour after breakfast during school hours without their prior notice. A dental student was also present as a data entry person. All students were examined by only one person. The education was provided in a group in the classroom in the form of lectures and questions and answers, in the form of PowerPoint and cartoon photos, short texts, and practical training on a tooth model by one person. The first follow-up session (one month later) was provided with three different types of educational brochures with appropriate pictures and explanations, depending on each educational group. In the first group (bad breath), students were given information about the origin of bad breath (gastrointestinal tract, tongue, and gum disease) and its treatment methods.

In the second group (gums and decay), age-appropriate explanations were provided to children about how decay and gum disease occur due to eating sweets and cariogenic substances and the formation of dental plaque with schematic shapes in PowerPoint format. In the control group, no training was provided on how to perform hygiene measures, and was only reminded to use a toothbrush twice a day and floss once a day.

During the examination, the plaque index [19], the changed gingival index [20], and the degree of bad breath [21] were recorded as criteria for the level of hygiene compliance. These examinations were repeated 1 and 6 months after the first examination.

To measure the plaque index, tooth surfaces were examined using a disposable dental mirror and calculated as a relative number (percentage). The degree of gingival inflammation was also measured using the modified gingival index, which is as follows: 0-no inflammation, 1-mild inflammation, a slight change in color and texture of any part except the marginal and papillary gingiva, 2-mild inflammation, slight change in color and texture involving the marginal and papillary gingiva, 3-moderate inflammation, redness and edema or hypertrophy of the marginal and papillary gingiva, 4-severe inflammation, marked redness and edema or hypertrophy of the marginal and papillary gingiva, spontaneous bleeding, and the presence of ulcers. To assess bad breath, a sensory (organoleptic) test method was used, and the

examinee was asked to exhale through the mouth and the examiner determined the presence or absence of bad breath and the degree of bad breath.

A checklist was used to assess oral and dental hygiene behaviors (toothbrushing and flossing), nutritional behaviors, frequency and reason for visiting the dentist, and the child's assessment of his or her oral odor and methods for eliminating it if there was a bad odor, according to the Yokoyama *et al*. study questionnaire [22]. The checklist was used by the dentist; in such a way that the child was asked one question at a time. The questions asked included the following: hygiene habits and behaviors (toothbrushing and flossing), frequency of these behaviors, visits the dentist for a visit and their repetition, the last visit and its reason, consumption of snacks, the presence of bad breath (the individual's assessment of the presence of bad breath in himself or herself) and the methods used to eliminate it, and finally, the history of respiratory, digestive, renal, and hepatic diseases that may affect oral odor.

Data analysis was performed using SPSS software (version 23) and paired, independent t-test, Chi-square, McNemar and Kruskal-Wallis, Wilcoxon signed Ranks, and Mann-Whitney tests. Generalized estimating equation (GEE) analysis was used to compare MGI and halitosis indices (ordinal variables) and Repeated Measure ANOVA (analysis of variance with repeated measures) was used to compare the results of plaque index (quantitative variable with normal distribution).

Results and Discussion

This study was conducted on 136 students. Changes in the one-month follow-up showed that in all groups, considering gender, except for the first group and boys, the plaque index had decreased compared to the beginning of the study, although this lack of improvement in this group was not statistically significant (P = 0.575). Among the three groups of girls, only the control group did not show a significant decrease in the plaque index. The decrease in the plaque index was not significant in either gender of the control group (P > 0.05) **(Table 1)**.

Table 1. Mean and standard deviation of the plaque index in different groups at different time points

Group		Before intervention	1-month follow-up	6-month follow-up
Bad breath (Group 1)	Boy	79.55 ± 20.52	81.52 ± 18.95	94.41 ± 6.93
	Girl	89.69 ± 15.01	77.41 ± 12.56	87.13 ± 12.97
Traditional (Group 2)	Boy	90.93 ± 11.37	69.24 ± 10.96	84.89 ± 14.44
	Girl	84.05 ± 13.73	78.44 ± 12.65	89.56 ± 13.24
Control (Group Third)	Boy	79.16 ± 16.27	73.11 ± 13.27	88.33 ± 12.14
	Girl	84.47 ± 13.73	78.47 ± 12.72	91.27 ± 11.59
P-value	Boy	0.034	0.025	0.030
	Girl	0.392	0.963	0.629

Given that the modified gingival index (MGI) is a qualitative ordinal index, the data were entered in the table as the median. Among the three groups, only the first group not only did not decrease in terms of the MGI index, but we also witnessed a significant improvement in this index (P=0.029). In the control groups of both sexes and the second group of girls, we witnessed a significant increase in the MGI index (P=0.001), although the second group of boys did not show improvement in this index **(Table 2)**. In general, MGI decreased after one month in the first group of boys and remained stable in the second and third groups. In the first group of girls, it remained stable and the second and third groups showed an increase. The variable of bad breath was a quantitative discrete type and the median was used to compare the results between the groups. Among the three groups, only the first group showed a significant decrease in the severity of bad breath (P<0.001) and a decrease in the prevalence of bad breath (from 79.4% to 61.5%) **(Table 2)**.

The prevalence of bad breath in the first group of girls decreased significantly from 82.4% to 28.4% (P= 0.002), and a significant improvement was also observed in the severity of bad breath (P = 0.001); also, although the prevalence of bad breath in the first group of boys increased from 77.3% to 86.4%, this increase was not statistically significant (P=0.125). In addition, the severity of bad breath in this group decreased significantly (P<0.000).

Table 2. The median and interquartile range of the changed gingival index and bad breath in different groups at different time points

Variable	Group	Before intervention	1-month follow-up	6-month follow-up

Altered gingival index	Bad breath (Group 1)	Boy	1.50 (1)	1.00 (1)	1.00 (1)
		Girl	1.00 (1)	1.00 (0)	1.00 (1)
	Traditional (Group 2)	Boy	2.00 (1)	2.00 (1)	1.00 (2)
		Girl	1.00 (0)	2.00 (1)	2.00 (1)
	Control (Group 3)	Boy	2.00 (0)	2.00 (1)	1.50 (1)
		Girl	1.00 (0)	2.00 (1)	1.00 (1)
	P value (between groups)		0.114	< 0.001	0.387
Bad breath	Bad breath (Group 1)	Boy	2.00 (1)	1.00 (0)	1.00 (2)
		Girl	1.00 (1)	0.00 (1)	0.00 (1)
	Traditional (Group 2)	Boy	1.00 (2)	1.00 (1)	1.00 (2)
		Girl	1.00 (1)	1.00 (1)	1.00 (1)
	Control (Group 3)	Boy	1.00 (2)	1.00 (0)	1.00 (2)
		Girl	2.00 (1)	-	0.1 (0)
	P value (between groups)		< 0.001	0.248	0.002

In the second group, the prevalence of halitosis increased (from 65.3% to 73.4%), and the severity of halitosis did not improve in either sex (P > 0.05). In the control group of girls, the prevalence of halitosis increased significantly from 64.7% to 94.1% (P = 0.031), but the severity of halitosis did not decrease significantly (P = 0.296). In general, the halitosis index decreased in boys in the first and third groups and remained constant in the second group. In girls, halitosis decreased in the first group but remained constant in the second and third groups.

The plaque index (PI) increased in the six-month follow-up compared to the one-month follow-up in all groups, which was also statistically significant (P < 0.05). The plaque index improved in the six-month follow-up compared to the beginning of the study in the first group of girls and the second group of boys, but increased in the second group and control boys and the second group of girls. It was significant (P < 0.05) **(Table 1)**.

According to the results of the Repeated Measure ANOVA test, the changes in the plaque index over time were significant (P = 0.001). However, the interaction effect of time and different groups did not show a significant difference, meaning that the changes occurred in parallel in the groups. The comparison of the groups in general was not significant in all follow-up periods (P > 0.05).

In the six-month follow-up, the MGI index in the three groups of boys had more favorable changes compared to the initial indicators in the girls' groups. Among the girls' groups, only the first group did not have a decrease in the MGI index compared to the beginning of the study. Regardless of gender, among the three groups, only the second group did not witness a deterioration in this index compared to the beginning of the study.

The changes from one-month to six-month follow-up were generally such that in the first group of boys, the changed gingival index was stable, and this index decreased in the second and third groups. In girls, this index remained constant in the first and second groups and decreased in the third group. According to the GEE method, considering the control group as the initial baseline, the difference between the first group and the control group was significant (OR = 0.48, P = 0.006), but the second group did not show a significant improvement in the changed gum index (P > 0.05, OR=1.04).

In both sexes, the prevalence of bad breath in the first group decreased significantly compared to the beginning of the study (P = 0.008), with changes being more significant in the female sex (Boys: from 77.3% to 68.2%, girls: from 82.4% to 42.2%). In addition, in both sexes of this group, the severity of bad breath showed a significant decrease compared to the beginning of the study. (P ≤ 0.003).

In both sexes of the second group, the prevalence of bad breath increased compared to the beginning of the study. Also, the severity of bad breath not only did not improve compared to the previous two time periods, but it also significantly increased in boys compared to the one-month follow-up (P = 0.010).

In the control group, only in boys, compared to the beginning of the study, we had a decrease in the prevalence of bad breath (from 63.3% to 30.0%) and a significant decrease in the severity of bad breath (P = 0.010). However, the prevalence of bad breath in girls in this group not only increased (from 64.7% to 76.5%) but there was also no improvement in terms of severity. In general, during the 1- to 6-month follow-up, the bad breath index remained stable in all groups.

According to the GEE method, by placing the control group as the initial base, the first and second groups did

not show a significant decrease in the halitosis index compared to the control group (in the first group, OR = 1.06 and P > 0.05, and in the second group, OR = 0.99 and P > 0.05, respectively).

In addition, in this study, oral and dental hygiene behaviors (using a toothbrush and flossing), nutritional behaviors, and self-assessment of halitosis and the method that students use to eliminate their halitosis were examined and analyzed with the Chi-Square test. Nearly one-third of the subjects (29.4%) had never visited a dentist at this age. Of the 91 subjects (70.5%) who had visited a dentist at least once, nearly half of them (50.5%) had been to their last dental appointment for more than 6 months. 61.5% had visited the dentist for emergency treatment such as pain, infection, dental pulp treatment, and extraction, and 38.4% had visited for treatments such as root canal treatment, fluoride therapy, periodic examinations, or orthodontic treatments, which were included in the non-emergency treatment group. The student's health behaviors and their frequency of using toothbrushes and dental floss are given in **Table 3**.

Table 3. Survey of oral and dental health behaviors and nutritional behaviors

Variable		Bad breath (Group 1)	Traditional (Group 2)	Control (Group Third)	Total
Number of times you brush your teeth	Twice a day	5 (13.9%)	4 (9.1%)	4 (9.1%)	13 (10.5%)
	Once a day	16 (44.4%)	25 (56.8%)	14 (31.8%)	55 (44.4%)
	Every other day	3 (8.3%)	1 (2.3%)	4 (9.1%)	8 (6.5%)
	Sometimes	12 (33.3%)	14 (31.8%)	22 (50%)	48 (38.7%)
	Not used	2 (5.3%)	1 (2.2%)	2 (4.3%)	5 (3.9%)
	Total	38 (100%)	45 (100%)	46 (100%)	129 (100%)
How often to floss	Twice a day	1 (2.6%)	1 (2.2%)	2 (4.3%)	4 (3.1%)
	Once a day	3 (7.8%)	3 (6.6%)	2 (4.3%)	8 (6.2%)
	Every other day	0 (0%)	1 (2.2%)	2 (4.3%)	3 (2.3%)
	Sometimes	12 (31.5%)	21 (46.6%)	18 (39.1%)	51 (39.5%)
	Not used	22 (57.9%)	19 (42.2%)	22 (47.8%)	63 (48.8%)
	Total	38 (100%)	45 (100%)	46 (100%)	129 (100%)
Snack consumption	Low	14 (36.8%)	14 (31.1%)	13 (28.9%)	41 (32%)
	Medium	19 (50%)	25 (55.6%)	26 (57.8%)	70 (54.7%)
	High	5 (13.2%)	6 (13.3%)	6 (13.3%)	17 (13.3%)
	Total	38 (100%)	45 (100%)	45 (100%)	128 (100%)

63% of students mentioned using a toothbrush, dental floss, and mouthwash as a solution to eliminate bad breath. 23% used methods to mask bad breath, such as using gum and air fresheners, eating and drinking, and 13.5% used methods other than the above methods, such as using salt and salt water, etc. to eliminate bad breath (P = 0.042).

Health education is one of the basic principles of oral health prevention. Among the various target groups defined for oral health education, children (especially school-aged children) are of particular importance because behavior change and persistence in correct health behavior at this age can last for a lifetime. Ghaffari *et al*. reported in a meta-analysis the maximum effect of oral health education programs on improving health behaviors, including tooth brushing and motivation to maintain health [23]. De Souse *et al*. also showed the effect of oral health education interventions in terms of less confrontation and more favorable changes in health behaviors [24].

Esan *et al*. also reported improved dietary habits and the use of fluoride toothpaste in children who underwent educational interventions [25]. In this regard, our study aimed to evaluate and compare the effect of the education topic (health education with or without education about bad breath or information about gums and tooth decay) on motivation to improve oral health in a group of third-grade elementary school students, and their oral health and dietary habits were also examined. The aim of examining different indicators in the two genders was to determine the effect of gender on the factors under study.

Among the three groups of female students, the first group made more progress in improving the plaque index in both the one-month and six-month follow-up than the other two groups, and it can be said that in girls, education based on bad breath is more effective

than education alone and even traditional hygiene education. This improvement in results in both genders has also been observed in the study of Ueno *et al*. [8]. In the study of Yazdani *et al*. the plaque index of both education groups improved compared to the control group, which is consistent with our study, since both education protocols caused significant improvement [17]. A significant decrease in the visible plaque index in the group receiving health education compared to the control group after a four-month follow-up was also observed in the study by De Farias *et al*. [26].

In the study by Rodrigues *et al*. the mean plaque index also showed a significant decrease, indicating the effect of preventive health education programs on improving the plaque index [27]. In the study by Yekaninejad *et al*. the health education group for children and parents caused a significant decrease in the gingival index compared to the control group [28].

The plaque index of the control group did not improve significantly at any of the follow-ups, which indicates that health education alone will not be effective and the extent of the effect of oral and dental health education in the traditional way has decreased.

Given the decrease in the plaque index at the six-month follow-up compared to the one-month follow-up in all groups, oral and dental health education for children should be repeated at shorter intervals; This was also confirmed in the study by Shenoy and Sequeira, where reinforcing students with repeated oral hygiene education sessions led to improvements in knowledge and oral health indicators such as plaque index and gum health [29]. Other studies that were conducted over a short period and without repetition showed good initial short-term results, but poor and unacceptable long-term results [29]. A one-month interval between two training sessions can be considered effective in achieving improvements in oral health, as was also observed in the study by Bassir *et al*. [30].

The effect of health education based on bad breath on improving gum health was greater than that of other groups (especially among boys), which was in line with the results of the study by Uneo *et al*. although, in this study, girls and boys did not differ in terms of improving gum health [8]. In the other two groups, a significant increase in MGI was observed, indicating the ineffectiveness of these two types of education in motivating students to change their behavior to maintain and improve their oral health. The study by Yazdani *et al*. and De Farias *et al*. also showed a significant improvement in gum health (as measured by gingival bleeding) in the oral hygiene education group compared to the control group [17, 26].

In terms of the speed of effect among the three groups, the first group to show improvement in the MGI index was the halitosis group at the one-month follow-up, but the other two groups showed improvement only at the six-month follow-up, which indicates that education based on halitosis has a faster effect than the other two types of education. The persistence of the effect was greater in the halitosis group and the male gender. A decrease in the prevalence of halitosis was observed only in the halitosis group and in the female gender at the initial follow-up, and in both genders at the secondary follow-up. The severity of halitosis also decreased only in this group.

These results once again confirm the effectiveness of education based on bad breath and indicate that bad breath among children is often of oral origin, and by providing information about the origin of bad breath and methods for eliminating or preventing it, a significant and continuous decrease in the prevalence and severity of bad breath can be observed.

The prevalence of bad breath at the beginning of the study was 68.38%. Many studies have been conducted on the prevalence of bad breath, but it is often difficult to compare the results, due to reasons such as different sample sizes, age groups of the samples, and methods of detecting bad breath in the studies. In a study conducted by Yokoyama *et al*. on 474 high school students, the prevalence of bad breath was 40% [22].

The majority of people who considered themselves to have bad breath only sometimes had bad breath, and the lowest percentage was related to people who had bad breath most of the time or always. This may indicate that bad breath often originates in the mouth and can be remedied by occasional interventions such as maintaining oral hygiene or masking it by consuming fragrant foods and drinks and chewing gum. For this reason, people do not always have bad breath. In contrast, people who have constant bad breath may have bad breath of non-oral origin that cannot be remedied by self-interventions and may require medical intervention. Most students used a toothbrush, dental floss, and mouthwash to eliminate bad breath, which indicates that most students are aware of the relationship between oral hygiene and bad breath and know that bad breath can indicate poor oral hygiene and have an intraoral origin. However, 36.5% of students still used methods other than increasing oral hygiene, such as consuming any type of food, drink, and chewing gum, to combat bad breath. Although these substances have a masking effect on bad breath, they do not eliminate its main cause. In addition, the consumption of sugary foods, drinks, and chewing gum also provides the basis for tooth decay; decayed teeth

themselves are one of the main factors causing bad breath. As a result, a person will face an increase in bad breath in the long term and enter a vicious cycle in which all these incorrect behaviors are due to a lack of awareness. For this reason, the effects of the gap in the topic of bad breath in health education in schools are still seen among students and it is necessary to teach students as an independent subject.

In this study, out of 129 people who completed the questionnaire, 96.1% of students brushed their teeth and only 10.5% used their teeth twice a day, which was different from the results of other studies [31, 32]. The reason for this is the difference in the age group of the study groups and also the difference in the level of oral and dental hygiene culture in different countries.

Nearly half of the students did not floss at all. The majority (39.5%) of the students who did floss had an unacceptable pattern of flossing, flossing more than every other day; only 6.2% flossed once a day. The figures for toothbrushes and flossing patterns again highlight the need for hygiene education in schools, with the need for more education on flossing. Given that 68% of the subjects reported eating more than "little" snacks, the need for dietary changes in children of this age is felt. Nearly one-third (29.4%) had not visited a dentist by this age, compared with 48.86% in another study in Saudi Arabia [31].

Of the 91 students who had ever visited a dentist, nearly half (50.5%) had been more than 6 months since their last dental visit. These results indicate that there are factors that prevent regular dental visits by students. These factors include the high cost of dental treatments, lack of easy access to a dentist, lack of awareness of the importance of oral health, and fear of dental treatments, especially among children. To address all these factors, in addition to raising public awareness, we need to formulate appropriate policies in the field of oral health.

More than half (61.5%) of the subjects cited emergency treatment as the reason for their last visit to the dentist. This rate was 13.9% in a study by Tomar *et al*. in India, which was conducted on students aged 10-15; the difference between the two results can be attributed to the difference in the age groups of the two studies, as well as the difference in the level of culture and oral hygiene in the two countries [32].

Conclusion

This study aimed to compare health education with different topics and compare their effects. The study findings showed no significant improvement in the plaque index in the control groups at both follow-ups. At the one-month follow-up, the gingival index in the first group had a significant change compared to the other groups. In terms of changes in bad breath, only in the first group, in both sexes, a decrease in the prevalence and severity of bad breath was observed compared to the beginning of the study. According to the results of the present study, oral hygiene education based on bad breath was more effective, more lasting, and faster on students than traditional education and education alone.

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