Evaluation of Halitosis in Children and Mothers

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Abstract

Purpose: The purpose of this study was to investigate the occurrence and clinical parameters that are associated with halitosis in pediatric dental patients and compare these findings with those found for the patients' mother.

Methods: Children aged 5 to 12 years old were evaluated with mothers present during a dental visit. Each mother completed the child's medical history and a breath odor questionnaire. The mother and an oral breath judge (OBJ) evaluated the child's oral breath using organoleptic methods. A commercial breath analyzer (CBA) measured the oral and nasal levels of volatile sulfur compounds (VSCs) for child and mother before and after tongue debridement. A number of oral parameters were recorded for the children.

Results: Thirty children (mean age=8.8 years) and 18 mothers participated. Halitosis (VSC>100 parts per billion, or ppb) was found in 23% of children and 11% of mothers, but was not significantly correlated. In contrast, 61% of mothers reported halitosis in themselves and their child. Significant differences were found between VSC levels and frequency of tooth-brushing ($P<.05$, univariate ANOVA). There was significant correlation in the detection of breath odor between mother and OBJ ($P<.05$, Pearson); however, there was no significant correlation between evaluators and CBA. A positive correlation existed between the presence of interproximal restorations and breath odor by OBJ ($P<.05$, Pearson).

Conclusions: Halitosis may be a problem in some healthy children, but it does not correlate well with mothers' breath odor or common oral parameters. The organoleptic and CBA results were inconsistent, suggesting factors other than VSCs may be associated with halitosis in children. (*Pediatr Dent.* 2003;25:553-558)

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Although 20% of the population views mouth odor as a serious concern[1], reports of the prevalence of halitosis are scarce and the lack of epidemiological studies makes it difficult to assess the percentage of the population that has oral malodor. To date, most of the research in halitosis has concentrated on the adult population, with only 2 studies focused on children.[2,3]

Odorous substances in the breath can originate either from oral or nonoral sources.[4] Delanghe et al,[5] report that 87% of halitosis can originate from an oral source and 13% from nonoral sources. Nonoral sources may include gastrointestinal problems, pulmonary diseases, nasal and sinus diseases, tonsillitis, pharyngitis, parasitosis and even psychological or psychiatric illness.[5-10] Patients with halitosis of an oral origin present typically with tongue coating, gingivitis, and periodontitis.[5] Furthermore, Sulser et al,[4] report that carious lesions provide sites for food retention and putrefaction. Other food-retentive factors such as crowns, orthodontic appliances, defective restorations, and fixed and removable prostheses may contribute to halitosis if there is a lack of proper oral hygiene.[9] As nonoral sources for halitosis have been implicated, a thorough medical history with a detailed questionnaire is an important requisite before diagnosing and treating a patient with a complaint of halitosis.

Halitosis of oral origin is associated primarily with the proteolytic activity of the bacteria commonly found in the mouth.[6,7] The offending bacteria undergo a process called putrefaction that involves the combination of protein hydrolysis

and catabolism of amino acids in the production of volatile sulfur compounds (VSCs).[11-13] Volatile sulfur compounds such as hydrogen sulfide, dimethylsulfide, and methyl mercaptan are thought to be primarily responsible for halitosis.[14-17] However, other gases, such as organic acids (acetic, propionic), volatile aromatic compounds (indole, skatole), and amines (cadaverine),[18] have also been implicated. In vitro studies demonstrate that gram-negative anaerobic bacteria have the ability to produce VSCs from incubated saliva[19] and blood products.[20] *Treponema denticola, Porphyromonas gingivalis, Prevotella intermedia, Bacteroides forsythus,* and *Fusobacterium* species (*F nucleatum, F fusiform,* and *F polymorphum*) are among the bacteria that can produce large amounts of hydrogen sulfide and methyl mercaptan from serum proteins, cysteine and methionine.[21,22] Other studies implicate bacteria found on the dorsal surface of the tongue as the primary source of microbial putrefaction in the mouth.[19-22]

Tonzetich et al,[23] find that removal of the tongue coating reduces production of VSCs. Additionally, studies show that colonization of the oral cavity by gram-negative anaerobic bacteria occurs soon after birth and continues with the eruption of the primary and secondary dentitions.[24,25] As bacteria that cause dental caries lesions and periodontitis have a possible intrafamilial transmission,[26-30] a correlation between breath odor in the parent and child may exist.

There is a lack of an established "gold standard" for accurate and rapid measurement of halitosis. Two common methods for evaluating halitosis are the use of a sulfide monitor and organoleptic testing. The term "organoleptic" is defined as the ability to receive a sense impression, in this case, the sense of smell. Organoleptic scoring is the use of one's nose to smell and rank the intensity of the odors emanating from the mouth.[31] VSCs may be measured directly with the aid of an industrial hydrogen sulfide monitor, the Halimeter (Interscan Corporation, Chatsworth, Calif).[32,33] Another method to assess halitosis is an organoleptic evaluation which includes an odor judge who scores the mouth odor by smelling the mouth breath, the wrist-lick test, counting from 1 to 10, and the floss test of the interdental areas.[33] Organoleptic assessments by a human judge correlate positively with VSCs and oral malodor.[34]

Elimination of VSC production can be accomplished by several methods. One method is tongue debridement with a tongue scraper whose primary objective is to mechanically remove anaerobic bacterial plaque accumulated on the dorsum of the tongue.[35] In addition to the commercially available tongue scraping devices, toothbrushes and the common household spoon have been recommended for bacterial plaque removal. In a recent report, patients compliant with a tongue-hygiene regimen show a decrease of bacteria in the tongue-coating and lower-VSC readings.[36]

In one of the studies in the pediatric population, children perceived by their parents as having oral malodor are found to have a higher bacterial concentration in the saliva. Paryavi-Gholami et al,[2] report that veillonella species and *Prevotella oralis* are the predominant VSC-producing bacteria in the saliva of children ages 2 to 7 years. Amir et al,[3] suggest that oral malodor in children, as in adults, is related primarily to both oral and nasal factors. Similar to adults' oral malodor, many halitosis cases in children are related to tongue odor caused by putrefaction of postnasal drip, which accumulates on the back of the tongue.[3] Another unusual source for halitosis in children is the impaction of a foreign body in the nares.[37]

Due to the paucity of clinical research on halitosis in the pediatric population, the purpose of this clinical study was to investigate the occurrence and clinical parameters that are associated with halitosis in pediatric dental patients and compare these findings with those found for the patient's mother. In addition, the use of a commercial breath analyzer (CBA) for the detection of VSC was compared to a breath odor questionnaire and an organoleptic evaluation.

Methods

A cross-sectional study, using a convenience sample of children who presented for a routine initial or recall dental visit at a postgraduate pediatric dental clinic, were invited to participate. To be included in the study, the children were healthy (ASA I or II), between 5 to 12 years of age, and escorted by their mothers. Mother or child exhibiting signs and/or symptoms of a current upper respiratory infection were excluded. In addition, children with a severe gagging reflex did not participate in the study. This study was approved by the University's Committee for the Protection of Human Subjects. The procedures, possible discomforts or risks, as well as possible benefits were explained fully to the mother and child. After obtaining consent from the mother and assent from the child, the youth was led to a dental room by the oral breath judge (OBJ).

A single, calibrated OBJ was designated to determine the organoleptic scores as described by Rosenberg (1991),[32] using the wrist-lick test, whole mouth breath, counting from 1 to 10, and the flossing test from an interdental area (POH dental floss, Tulsa, Okla). After some practice smelling multiple odors, the OBJ was able to consistently score bad breath correctly. Meanwhile, the mother completed the child's medical history and the breath-odor history questionnaire, as modified from Yaegaki,[8] for both the child and the mother. This modified questionnaire contained 23 questions for the child and 6 questions for the mother pertaining to the child's demographics, oral-hygiene habits, dentifrice and mouthwash use, medical history and halitosis history. Furthermore, each child's oral breath rating and each mother's self-reported oral-breath rating were scored on the questionnaire outside the child's presence.

Later, the mother had her VSC level measured by orally breathing, right-nostril exhaling, and left-nostril exhaling into the Halimeter, as per the manufacturer's instructions. The child then modeled the mother's actions. Next, the mother was instructed to use the organoleptic tests to score her child's breath in the same sequence as the OBJ. Blinded

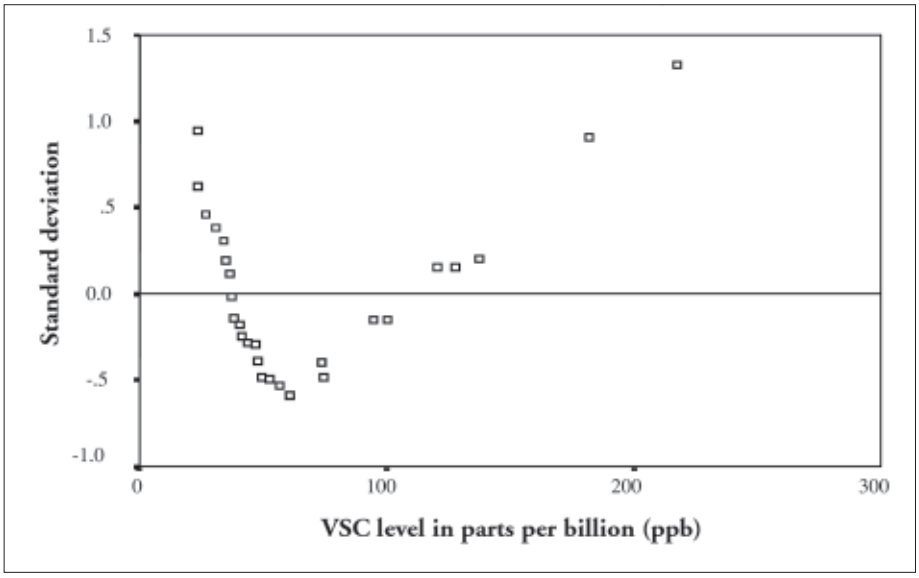

Figure 1. Volatile sulfur compound (VSC) readings of the children.

to the oral and nasal readings, another evaluator documented the tonsil size and assessed the dorsal tongue surface of both the mother and child for distribution, color, and quantification of tongue coating.[38]

Furthermore, the child received a routine clinical dental exam that included the following:

1. caries lesion assessment;
2. modified plaque index;[39]
3. modified gingival index;[40]
4. crowding assessment;
5. number of interproximal restorations and stainless steel crowns;
6. presence of an oral appliance.

Children were consecutively numbered and randomly assigned to 2 different treatment groups. Children from Group 1 had their tongue scraped using 3 strokes of a toothbrush (Crest soft compact size 30, Procter and Gamble, Cincinnati, Ohio), followed by rinsing with a half-ounce of water for 5 seconds and then expectorating. Subjects in Group 2 followed the same sequence, with the substitution of a round plastic spoon for the debridement of the tongue. VSC levels were recorded with the Halimeter, as described previously for both groups following tongue scraping/brushing, rinsing, and expectoration. Statistical analyses included univariate ANOVA, paired sample correlation, paired *t* test, and Pearson correlation. A *P* value of ≤.05 was considered significant.

Results

Thirty children (mean age=8.8 years) and 18 mothers participated in this study. The gender of the children was 67% females (N=20) and 33% males (N=10), with the following race/ethnicity composition: 50% black (N=15), 27% Hispanic (N=8), and 23% white (N=7). All patients were in good health, with none taking medications. As reported by each parent, no subject had a current upper respiratory infection, nasal polyps, or a current episode of otitis media. From the questionnaire, significant differences were found between VSC levels and frequency of toothbrushing, with increased frequency of tooth cleaning associated with lower VSC levels (*P*=.021, univariate ANOVA). Furthermore, 61% of mothers reported breath odor in themselves and their child. No other significant findings were observed for the other variables on the questionnaire.

Halitosis was defined as the mean VSC readings of 100 ppb or greater for both oral and nasal measurements, which was 0.5 standard deviations above the mean (Figure 1). This included 23% of children and 11% of mothers. Mothers' organoleptic evaluation detected 23% of the children as having breath odor, while OBJs' organoleptic evaluation detected 37% of the children as having breath odor. There was significant correlation in the detection of breath odor between mother and OBJ (*P*=.047, Pearson; Table 1). However, there was no significant correlation between both evaluators and the CBA, except for the wrist-lick test with judge (*P*=.029) and the mother (*P*=.041) (Table 2). When 2 methods of mechanical debridement were compared, there was no significant difference in VSC readings. There were no significant findings for a child's VSC levels and oral parameters, including tongue coating (Table 3).

However, a significant correlation was noted between mother's and child's tongue coatings when the distribution was assessed (*P*=.002). Another significant correlation was between the judge's breath score and the number of interproximal restorations in the child

Table 1. Correlation of Child's Organoleptic Evaluations between Mother and Judge*

	Judge's breath score	Judge's wrist score	Judge's floss score	Judge's count score
Mother's breath score	*P*=.047† *r*=0.409	*P*=.854 *r*=0.040	*P*=.302 *r*=0.220	*P*=.099 *r*=0.345
Mother's wrist score	*P*=.121 *r* =0.325	*P*=.221 *r*=0.259	*P*=.337 *r*=0.205	*P*=.748 *r*=0.069
Mother's floss score	*P*=.328 *r*=0.208	*P*=.928 *r*=0.020	*P*=.746 *r*=0.070	*P*=.846 *r*=-0.042
Mother's count score	*P*=.158 *r*=0.298	*P*=.825 *r*=0.048	*P*=.347 *r*=-0.201	*P*=.465 *r*=0.156

*Child's VSC<100 ppb.
†Significant correlation *P*<.05; Pearson correlation (*r*).

(P=.019; Table 4). As none of the variables above (Tables 1, 2, 3, and 4) deviated significantly from normal distribution, Pearson correlation was employed.

Table 2. Correlation Between Child's VSC Reading and Child's Organoleptic Evaluation

	Child's VSC reading
Judge's breath score	r=0.150; P=.430
Judge's wrist score	r=0.398; P=.029*
Judge's floss score	r=0.348; P=.059
Judge's count score	r=0.141; P=.459
Mother's breath score	r=-0.233; P=.214
Mother's wrist score	r=0.375; P=.041*
Mother's count score	r=-0.205; P=.278
Mother's floss score	r=-0.042; P=.826
Mother's VSC reading	r=-0.091;P=.634

*Significant correlation P<.05; Pearson correlation (r).

Discussion

This is the first study to investigate the prevalence of halitosis in children in a dental clinic setting. From the questionnaire, 61% of mothers reported breath odor in themselves and their child. In contrast, 23% of children were found to have breath odor at VSC levels above 100 ppb. Thus, there was an over-reporting of halitosis when the questionnaire was used in this study. In addition, the questionnaire showed that significant differences were found between VSC levels and frequency of tooth-brushing. This is an expected finding, since increased frequency of tooth-brushing should result in a decrease in oral bacteria and, consequently, a decrease in VSC production. This is consistent with the findings of Brunette et al,[1] who report that tooth-brushing with or without dentifrice decreases VSC levels.

The mother's organoleptic evaluation detected 23% of the children as having breath odor, while OBJ's organoleptic evaluation detected it in 37%. Organoleptic scores between mother and OBJ had similar values; although these values did not correlate significantly with high VSC readings (VSC>100 ppb). However, the overall breath scores from mother and OBJ were significantly correlated, suggesting intraevaluator agreement of the human nose. There was no correlation between VSC readings and the mother's organoleptic scores or OBJ's organoleptic scores. This finding is in contrast to a previous report that showed the organoleptic evaluation has a positive correlation with VSC readings when used to evaluate adults.[34] The inconsistent result between the VSC readings and organoleptic scores may suggest that other factors are involved in halitosis for this pediatric population. VSCs are considered the main constituents of halitosis; however, expired air may contain volatile fatty acids and cadaverine that would also contribute to breath odor. Although these constituents can be perceived organoleptically, they would not be detected by the portable sulfide monitor.[20] Recent observations support this idea, as Goldberg and colleagues[18] identify cadaverine in the saliva of patients with complaints of halitosis, who showed that the concentration of the byproducts correlates with odor scores. Furthermore, in this study, the only significant correlation between children's VSCs and organoleptic evaluations were the judge's and mother's wrist-lick tests. The main reason may be that when skin dries out, nonsulfur-containing gases such as cadaverine, putrescine, skatole, indole, butyric acid, and isovaleric acid are released and may be better detected by the human nose.[41]

No significant correlation between mother's VSC and child's VSC readings was detected. Large clinical trials may be necessary to test the hypothesis that VSC-producing

Table 3. Correlation of Child's VSC Reading and Oral Parameters*

Child's tongue coating	r=-0.0131; P=.944
Mother's tongue coating	r=0.174; P=.358
Modified plaque index	r=-0.021; P=.910
Modified gingival index	r=-0.215; P=.255
High caries lesions≥4	r=-0.020; P=.916
Tonsil size	r=-0.009; P=.964
Interproximal restorations	r=-0.071; P=.708
Crowding of teeth	r=-0.060; P=.754
Appliances	r=0.096; P=.614

*No significant correlation P<.05; Pearson correlation (r).

Table 4. Summary of Oral Parameters in the Children

Oral parameters	No. of children
Caries lesion status:	
No caries lesions	7
1-3 carious teeth	8
4 or more carious teeth	15
Presence of appliance	4
Presence of crowding	13
Interproximal restorations (1-3)	8
Interproximal restoration and crowns	10*
Tonsil size:	
Size=0	5
Size+1	8
Size+2	12
Size+3	5
No tongue coating	2
Partial tongue coating	24
Entire tongue	4

*Significant correlation with halitosis as detected by oral breath judge; P<.05, Pearson correlation.

bacteria may be involved in intrafamilial transmission, and subsequently contribute to halitosis in family members. This would be expected since studies have demonstrated this association in dental caries lesions and periodontal diseases.[26-30] Concerning clinical parameters, interproximal restorations, including stainless steel crowns, had a significant correlation with the judge's breath score. Increased risk for gingivitis, plaque accumulation, and food retention would be contributing factors. This finding emphasizes the need for careful brushing and flossing to eliminate plaque around restorations.

VSC readings did not differ between the 2 methods of tongue debridement, although VSC readings were increased slightly following mechanical tongue debridement, despite the method used. This finding is in contrast to the decreased VSC readings immediately after tongue deplaquing with a toothbrush, as observed by Seemann et al.[42] However, the focus of their study was on adults and not children. A mild gagging response may have accounted for the paradoxical increase in the child's VSC readings, resulting in the measurement of more pharyngeal breath. In addition, Springfield et al,[43] report that minute-to-minute variability in oral VSC concentration is a biological phenomenon, which may also account for this increase.

Amir et al,[3] found correlations between halitosis parameters and dental parameters such as plaque index, number of bleeding sites, food impaction, tongue coating, and regular tooth-brushing. They further showed a significant correlation between nasal odor and oral parameters, particularly with posterior dorsum of the tongue malodor, the presence of tongue coating, and brushing habits. However, this study did not find a correlation except for frequency of tooth-brushing. In part, the small sampling size in both this study and the former investigation may account for this variability. Larger studies evaluating children are needed to identify additional parameters that contribute to breath odor in this age group.

Conclusions

1. Breath odor was a problem in a number of healthy children who were seen for routine oral health care.
2. No consistent relationship between the VSC readings of the children and their mothers was identified; therefore, maternal-child transmission of bacteria commonly associated with bad breath could not be proven in this study.
3. Based on this pilot study, the presence of interproximal restorations was the most important oral parameter for bad breath in children.

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