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Prevalence of breath malodour in 7-11 year old children living in Middle Anatolia, Turkey.

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Objective: To determine the prevalence of breath malodour and to assess the relationships between breath malodour parameters such as dental caries, habitual mouth breathing, tooth-brushing, and the frequency of upper respiratory-tract infection. ***Methods:*** A total of 628 healthy children (327 boys, 301 girls) ranging in age from 7 to 11 who were living in Kirikkale, Middle Anatolia, Turkey were included. Subjects who were taking antibiotics, having any suspicion of upper respiratory tract infection, sinusitis or tonsillitis at the time of survey were excluded from the study. Oral malodour assessment was carried out by organoleptic method. The DMFT/S was used to record caries. Pearson's correlation coefficients were calculated to determine the association of each clinical variable to organoleptic oral malodour rating. Bivariate logistic regression analysis was performed to detect the degree of association between oral malodour and various dental-habitual parameters. ***Results:*** The prevalence of halitosis was 14.5%. Organoleptic oral malodour ratings were significantly higher in older age groups. Gender, frequency of tooth brushing, habitual mouth breathing did not influence oral malodour ratings. D(T), DMF(T), d(s) played the most significant role in higher oral malodour ratings, followed by d(t) and df(s). The frequency of tooth brushing, habitual mouth breathing did not contribute to the prevalence of halitosis:. ***Conclusion:*** Age, prevalence and severity of dental caries were significantly related to breath malodour.

Key words: Breath malodour, dental caries, halitosis,. organoleptic rating.

Introduction

Halitosis or bad breath or oral malodour is a social and psychological handicap for affected individuals. This common disease has been ignored for too long by dental professionals including periodontologists, even though the most common cause is related to microbiota of the subgingival areas and tongue coating (van Steenberghe and Quiryen 2003).

Oral malodour may be caused by several intra- and extraoral factors. For the latter, ENT, gastrointestinal, respiratory, and systemic diseases may contribute to oral malodour. Despite the multiple possible aetiologies, the majority of breath malodour cases originate from the oral cavity as the result of microbial metabolism on the tongue dorsum, in the saliva and in the periodontal pockets and volatile sulphide compounds have been cited as the predominant source of oral malodour (Kleinberg *et al*, 2002).

Rosenberg and McCulloch (1992) classified oral malodors into six groups: odour typical of subgingival putrefaction; odour from the anterior of the tongue dorsum; odour from the posterior of tongue dorsum; nasal odour; denture odour and smokers' odour.

Miyazaki et al (1995) found that 24% of 18-64 year olds in Japan exhibited clinically-detectable oral malodour. Yoshida *et al* (2001) reported that 45.7% of parents complained of oral malodour in their children. These findings were based on a subjective evaluation by the parents.

In the study of 119 children aged 3-5 years habitual mouth breathing was found to be associated with oral malodour whilst plaque levels, history of caries or frequency of tooth brushing were not (Kanehira *et al* 2004). Amir *et al* (1999), reported that oral malodour in children related primarily to oral factors where correlations between nasal and oral malodour were evident, suggesting that postnasal drip played a major role. Postnasal drip (PND) is the drainage of secretions from the nose or paranasal sinuses into the pharynx (Pratter, 2006). Apart from the report by Amir et al (1999) who studied oral malodour in a small sample of 5-15 year-old children (n=29), the condition has been rarely studied in children. Hence the aims of this study were to determine the prevalence of oral malodour in children and to assess the relationships between other parameters such as dental caries, habitual mouth breathing, tooth-brushing, and the frequency of upper respiratory-tract infection..

Methods

Two primary schools in the city of Kirikkale, Middle Anatolia,Turkey, were selected. The study included healthy children (327 boys, 301 girls) aged from 7 to 11 years. These schools were in the city centre, one with high to moderate socio-economic status and the other with low. Written consent was obtained from the parents of the children. The parents were interviewed about the medical history, habitual mouth breathing and frequency of tooth brushing and frequency of upper respiratory tract

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infection in their children. The study was approved by the Institutional Review Board, and carried out by the permission of the National Educational Directorship of Kirikkale city.

Organoleptic measurements were carried out by a single examiner (RN) (Amir *et al*, 1999, Çicek *et al,* 2003, Kanehira *et al*, 2004). The examiner was tested for smell acuity by means of a smell identification test (SIT; Sensonics Inc., Haddon Heights, NJ, USA) (Greenman *et al*, 2004) and avoided drinking coffee, tea, juice, smoking and using scented cosmetics prior to assessment of organoleptic score (Yaegaki and Coil 2000). Each subject was instructed to remain quite with lips closed for a period of 30 seconds and then asked to exhale through the mouth with a moderate force at the distance of approximately 10 cm from the investigator (Amir *et al*, 1999). The oral malodour (OM) scores were recorded on a scale of 0-5 as follows: 0: no odour, 1: barely noticeable, 2: slight but clearly noticeable, 3: moderate, 4: strong, 5: extremely foul (Rosenberg and Mc Cullock 992) and score 2 and over was diagnosed as halitosis (Murata et al, 2002).

Caries (dmft/dmfs, DMFT/DMFS) was recorded under artificial light by a single investigator who was blind to the OM measurements. All tests were performed in the morning between the hours 10:30-12:00 noon. The children were asked to refrain from tooth brushing, eating, drinking or chewing gum for at least two hours before the examination. A total of 1,089 children were examined but subjects who were taking antibiotics, having any suspicion of upper respiratory tract infection, sinusitis and tonsillitis at the time of survey were excluded from the study. For these reasons 461 children were excluded.

Pearson's correlation coefficients were calculated to determine the association of each clinical variable with organoleptic OM rating. Bivariate logistic regression analysis was performed to detect the degree of association between OM and various dental habit parameters. The data was analyzed using SPSS for Windows version 12.0 (SPSS Inc, Chicago, Illinois, USA).

Results

A total of 628 healthy children (327 boys and 301 girls) were included. Overall 14.5 % of the children had halitosis. Means and standard deviations of the various variables tested and organoleptic ratings are listed in Table 1. Age was found to be significantly associated with OM. (Odds Ratio (OR)=1.12, p=0.059, Table 2). Also the frequency of upper respiratory-tract infection was found to be significantly correlated with OM (OR= 1.38, CI: 0.98-1.94, p=0.06). OM and frequency of tooth-brushing as well as type of dentition (mix, primary or permanent), habitual mouth-breathing and gender were not significantly correlated (p>0.05).

The prevalence of dental caries and OM of the study group were 84.9 %and 14.5 % respectively. There was a positive correlation between the presence of dental caries and OM (OR=1.58, CI:0.99-2.5, p=0.053) (Table 3). The number of permanent teeth with dental caries (DT) was found to be significantly associated with OM (OR=1.19, CI:1.03-1.36, p=0.017). However, there was no significant relationship between the number of decayed surface [D(S)] for permanent teeth and OM. A significantly positive correlation (OR=1.033, CI:1.008-1.058, p=0.01) was found between OM and the number of decayed surface [ds], but not for dt. A positive correlation was found between OM and filled teeth [ft] (OR=1.12,CI:1.00-1.25, p=0.047), but there was no statistical correlation in filled surface [fs] for OM.

With respect to total number of decayed-missing and filled surfaces, a highly significant correlation was found

Table 1. Means and standard deviation of oral malodour ratings by gender, age, frequency of upper respiratory tract infection, frequency of tooth brushing, and habitual mouth breathing.

		n	*Organoleptic malodour rating Mean±Std*
Gender	Male	327	0.65±0.90
	Female	301	0.56±0.84
Age	7	132	0.60±0.95
	8	130	0.42±0.64
	9	117	0.54±0.78
	10	148	0.87±0.98
	11	101	0.55±0.87
Frequency of upper respiratory tract infection	Yes	208	0.53±0.82
	No	420	0.65±0.89
Frequency of tooth brushing	Twice a day	249	0.61±0.86
	once a day	243	0.55±0.76
	2 or 3 times/ week	115	0.76±1.11
	Once a week	16	0.43±0.62
	None	5	0.40±0.89
Habitual Mouth Breathing	Positive	242	0.60±0.87
	Negative	386	0.62±0.87

for deciduous dentition [dfs] (OR=1.23, CI:1.10-1.38, p=0.0001) with OM. Also, for the permanent dentition, DMF(T) and DMF(S) were found to be significantly associated with organoleptic oral malodour ratings; a higher DMF(T) and DMF(S) was found to be associated with higher oral malodour rating ($p<0.01$ and $p<0.05$ respectively).

Discussion

Disorders of the oral cavity cause 80 percent to 90 percent of halitosis. Anaerobic bacteria within the oral cavity are mainly responsible for bad breath. They degrade the sulphur containing amino acids cystine, cysteine, and methionine to the foul smelling volatile sulphur compounds (VSC) hydrogen sulphide (H_2S) and methylmercaptan (methanethiol, CH_3SH) (Kleinberg *et al,* 2002). Halitosis of oral origin is associated with poor oral hygiene, dental plaque, dental caries, gingivitis, stomatitis, periodontitis, tongue coating, and oral carcinoma.

There are two main methods used in the evaluation of halitosis: subjective evaluation (organoleptic), and objective evaluation (quantitative measure of VSC and gas chromatography (GC) (Yaegaki and Coil, 2000, Çiçek *et al*, 2003). The organoleptic method is considered to be the gold standard of evaluating halitosis, although it lacks objectivity (Van Steenberghe and Quirynen, 2003). It is considered less reliable and used sparsely in epidemiological surveys (Liu *et al*, 2006) but easier to perform. However, standardization and calibration of odour judges were developed recently (Greenman *et al*, 2005). Quantitative analysis of VSC gases by GC is considered to be a reliable measurement for the diagnosis of halitosis (Murata *et al*, 2002), since it can measure the levels of specific VSCs (Sopapornamorn *et al*, 2006). Moreover, GC results are highly objective and reproducible (Murata *et al*, 2002). However, GC is not appropriate for chair-side clinical use because it requires a costly large-scale system, a long run time and an experienced operator (Sopapornamorn et al, 2006).

Table 2. The prevalence of oral malodour by age

Age		*Organoleptic Oral Malodour Rating*					
		No odour	*Barely noticeable odour*	*Slight but clearly noticeable odour*	*Moderate odour*	*Strong odour*	*Extremely strong odour*
7 years old	n=132	82	29	16	2	2	1
	%	62.1	22.0	12.1	1.5	1.5	0.8
8 years old	n=130	86	33	11	0	0	0
	%	66.2	25.4	8.5	0.0	0.0	0.0
9 years old	n=117	71	31	12	3	0	0
	%	60.7	26.5	10.3	2.6	0.0	0.0
10 years old	n=148	62	57	17	10	1	1
	%	41.9	38.5	11.5	6.8	0.7	0.7
11 years old	n=101	65	21	11	3	1	0
	%	64.4	20.8	10.9	3.0	1.0	0.0
Total	n=628	366	171	67	18	4	2
	%	58.3	27.2	10.7	2.9	.6	0.3

Table 3. Means ± standard deviations and ranges of the dental parameters and Pearson coefficients (r) between oral malodour (n=628).

	Mean±Std	*Range*	*r*
Permanent teeth with caries [D(T)]	0.77±1.13	0-8	0.135**
Filled permanent teeth [F(T)]	0.05±0.36	0-5	-0.031
Filled permanent teeth surface[F(S)]	0.04±0.41	0-6	-0.019
Carious permanent teeth surface [D(S)]	0.89±1.60	0-17	0.046
Deciduous teeth with caries [d(t)]	3.43±3.02	0-15	0.087*
Filled deciduous teeth[f(t)]	0.31±2.45	0-23	0.035
Carious deciduous teeth surface [d(s)]	6.25±6.51	0-44	0.112**
df(s)	3.54±3.07	0-15	0.082*
DMF(T)	0.94±1.53	0-10	0.120**
DMF(S)	0.95±1.64	0-17	0.094*

* $p<0.05$
**$p<0.01$

Table 4. Relationships of oral malodour ratings with clinical param-

			Organoleptic Oral Malodour Rating					
			No odour	*Barely noticeable odour*	*Slight but clearly noticeable odour*	*Moderate odour*	*Strong odour*	*Extremely strong odour*
Number of D(T)	0	n=372	240	85	37	7	2	1
	1-3	%	64.5	22.8	9.9	1.9	.5	.3
		n=233	116	79	26	9	2	1
	More than 4	%	49.8	33.9	11.2	3.9	.9	.4
		n=23	10	7	4	2	.0	.0
Number of d(t)	0	%	43.5	30.4	17.4	8.7	.0	.0
		n=133	88	33	8	2	2	.0
	1-5	%	66.2	24.8	6.0	1.5	1.5	.0
		n=344	197	96	38	12	1	.0
	6-11	%	57.3	27.9	11.0	3.5	.3	.0
		n=145	78	41	20	3	1	2
	More than 12	%	53.8	28.3	13.8	2.1	.7	1.4
		n=6	3	1	1	1	.0	.0
Number of df(s)	0	%	50.0	16.7	16.7	16.7	.0	.0
		n=129	84	33	8	2	2	.0
	1-3	%	65.1	25.6	6..2	1.6	1.6	.0
		n=210	125	55	24	5	1	.0
	4-8	%	59.5	26.2	11.4	2.4	.5	.0
		n=242	129	71	30	10	1	1
	9-12	%	53.3	29.3	12,4	4.1	.4	.4
		n=43	25	12	5	.0	.0	1
	13 and over	%	58.1	27,9	11.6	.0	.0	2.3
		n=4	3	.0	.0	1	.0	.0
Number of DMF(T)	0	%	75.0	.0	.0	25.0	.0	.0
		n=358	230	81	37	7	2	1
	1-3	%	64.2	22.6	10.3	2.0	.6	.3
		n=235	124	73	26	9	2	1
	4-6	%	52.8	31.1	11.1	3.8	.9	.4
		n=27	11	10	4	2	.0	.0
	9 and over	%	40.7	37.0	14.8	7.4	.0	.0
		n=8	1	7	.0	.0	.0	.0
Number of DMF(S)	0	%	12.5	87,5	.0	.0	.0	.0
		n=370	233	90	37	7	2	1
	1-3	%	63.0	24.3	10.0	1.9	.5	.3
		n=218	114	68	24	9	2	1
	4-8	%	52.3	31.2	11.0	4.1	.9	.5
		n=36	15	13	6	2	.0	.0
	9 and over	%	41.7	36.1	16.7	5.6	.0	.0
		n=4	4	.0	.0	.0	.0	.0
		%	100.0	.0	.0	.0	.0	.0

Between these extremes portable sulfide monitors and VSCs monitors have been reported to be inexpensive, easily used devices for measurement of VSCs concentration (Sopapornamorn *et al*, 2006). However, recent studies showed relatively higher correlations between VSC and organoleptic method (Liu *et al*, 2006, Greenman *et al*, 2004). We used the organoleptic method in evaluation of halitosis because of these advantages.

The mean value of organoleptic rating was 0.61±0.87. Kanehira *et al* (2004) reported mean organoleptic rating of 3-5 year old children as 0.44±0.61, which is less than that in our study. It could be possible that some children aged 3-5 years could not exhale mouth air correctly as suggested by the authors. According to a study by Amir *et al* (1999), mean organoleptic rating of 5-14 year old children was 1.9±0.8, which is greater than our mean value of organoleptic rating. However, their study group consisted of children whose parents complained of oral malodour.

Kanehira *et al* (2004) reported habitual mouth breathing contributed to oral malodour. Mouth breathing leads to tongue and palate moisture loss, thus possibly enabling escape of malodour volatiles into mouth air (Kleinberg *et al*, 2002). However, we have not found an association between mouth breathing and OM ratings. Thorough tooth brushing reduces the number of bacteria and fermentable substrates in the mouth (Haffajee *et al*, 2001). We found no relationship between frequency of tooth brushing and oral malodour. The possible explanation for these results may be poor brushing technique of the children or incorrect answers given by the parents about habitual mouth breathing. Actually during the examinations, we observed that many children did not know the correct brushing technique and seemed to spend a shorter time than needed.

Dental parameters D(T), D(S), d(t), d(s),df(s), DMF(T) and DMF(S) were found to be significantly correlated with oral malodour. These findings were consistent with those of the study of Amir *et al* (1999). However, Tanaka *et al* (2003) have not found a significant relation between OM and dental parameters, especially "decay" component. This can in part, be due to intense mutans colonization rather than some staphylococcus species which are usually responsible for bad breath in adults (Kato *et al*, 2005).

Conclusion

We found that organoleptic OM ratings varied with age. Gender, frequency of tooth brushing, habitual mouth breathing did not influence OM ratings. D(T), DMF(T), d(s) played the most significant role in higher OM ratings, followed by d(t) and df(s). The frequency of tooth brushing and habitual mouth breathing did not contribute to the incidence of halitosis.

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