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內文：

● Abstract

Aim: The purpose of the present study was to **measure the oral malodor** of volunteers by means of a subjective **1.organoleptic method** and a **2.sulfide monitor** as well as to evaluate the diagnostic value of the Halimeter® in the diagnosis of halitosis.

Methods and Materials: Sulfide monitoring and organoleptic oral malodor assessment methods were performed on **77 volunteers (51 females, 26 males)** selected from academic staff, students, clerks, and patients of the Shaheed Beheshti University of Medical Sciences and Health Services, Dental School. The organoleptic method of assessment and sulfide monitoring were conducted by three calibrated judges. The Kendall's tau-b correlation analysis was used to calculate correlation coefficients between the sulfide monitor and organoleptic scores.

(The Kendall tau coefficient (τ) has the following properties:

- If the agreement between the two rankings is perfect (i.e., the two rankings are the same) the coefficient has value 1.
- If the disagreement between the two rankings is perfect (i.e., one ranking is the reverse of the other) the coefficient has value -1.
- For all other arrangements the value lies between -1 and 1, and increasing values imply increasing agreement between the rankings. If the rankings are completely independent, the coefficient has value 0 on average.)

Results: The **Kendall's correlation coefficient** between sulfide monitoring and organoleptic scores was **0.493 (p<0.001)**. Sensitivity and specificity were assessed to be 61.1% and 87.8% respectively. The positive predictive value (PPV) and the negative predictive value (NPV) were 81.5% and 72%, respectively. The intra-class correlation coefficient for the three episodes of monitoring was calculated as 97%.

		P't with halitosis		
		Positive	Negative	
Test of halitosis	Positive	True Positive	False Positive (Type I error, P-value)	TP / (TP + FP) → Positive predictive value 81.5%
	Negative	False Negative (Type II error)	True Negative	TN / (TN + FN) → Negative predictive value 72%
		TP / (TP + FN) Sensitivity 61.1%	TN / (FP + TN) Specificity 87.8%	

Conclusion: Use of a sulfide monitoring device in conjunction with the organoleptic method is an effective strategy for diagnosing oral malodor.

Clinical Relevance: Because of its **small size** and **simplicity** of handling the Halimeter sulfide monitor is **convenient to use**. This method of evaluation of patients for oral malodor is capable of differentiating normal patients (such as with Pseudohalitosis and halitophobia) from the others and for halitosis screening along with other techniques such as the organoleptic method. However, **when used alone, it may lead to a misdiagnosis** of some cases in terms of intensity.

Introduction

- Halitosis(fetor oris) : Common problem affecting > 50% of the general population.
- Major gases associated with halitosis breath malodor : Volatile sulfur compounds (VSCs) such as hydrogen sulfide, methyl mercaptan, and dimethyl sulfide
- The role of general dentists : the most appropriate professionals to diagnose and manage this condition is essential since **50 to 90%** of all bad breath problems emanate from the oral cavity.
- Techniques for the evaluation of halitosis :
 1. Halimeter® : the use of analytical methods such as gas chromatography
 2. Organoleptic method : based on the olfactory sensory system
- Halimeter :
 - **Advantages** : simple, portable, highly sensitive, and reproducible
 - **Disadvantages** : influenced noticeably by alcohol, strong mouthwashes, and acquired gases during gum chewing
- Organoleptic method :
 - **Advantages** : **popular, convenient, most reliable**, sensitive, and practical
 - **Disadvantages** : **objectivity, reproducibility. Same verdict** and the risk of transmission respiratory diseases
- **History** :
 1. August 1991 ; Rosenberg et al : organoleptic scores were highly correlated

- with sulfide monitor values
2. 1996 and 1997 Shimura et al : similar results; recommended clinical application of the sulfide monitor in the diagnosis and management of halitosis
 3. 2000 Takahiko and coworkers : determined a high correlation between sulfide monitor values and organoleptic scores. In addition, they estimated the sensitivity, specificity and diagnostic accuracy of the sulfide monitor method

Methods and Materials

- **Sample** : 77 volunteers (26 males, 51 females) among academic staff, students, staff personnel, and patients of the Shaheed Beheshti University of Medical Sciences, Dental School in Tehran, Iran

* Individuals with self-reporting systemic diseases affecting breath odor such as **uremia, hepatic cirrhosis, diabetes mellitus (Type 1), and sinusitis** were excluded from the study

- **Requests of volunteers** :

1. refrain from eating and drinking eight hours prior to the test and to avoid eating garlic or onions within 24 hours before the assessment
2. They were also asked to abstain from tooth brushing, using toothpaste, mouthwash, breath fresheners, scented cosmetics, or grooming aids
3. All subjects were tested within a few consecutive days between 8:00 and 10:00 a.m.

- **Methods** : first using the organoleptic method and then by the sulfide monitor

➤ The organoleptic evaluation panel :

1. three judges who were trained and calibrated with each other beforehand by sniffing the mouths of 15 individuals within three consecutive days
2. If at least two judges had the same opinion regarding the presence of mouth odor, the organoleptic score would be determined
3. organoleptic test was conducted using a screen which concealed the judge from the individuals and a sterile glass tube (10 x 2 cm) which was fitted into a hole in the screen
4. Each volunteer was requested to close his/her mouth for one to two minutes prior to sampling and place about 4 cm of the glass tube into his/her mouth, then slowly exhale his/her mouth breath through the glass tube. This step was repeated three times during each test
5. One judge at a time smelled the mouth odor of the individuals until all three judges had evaluated the subjects

➤ Organoleptic scores :

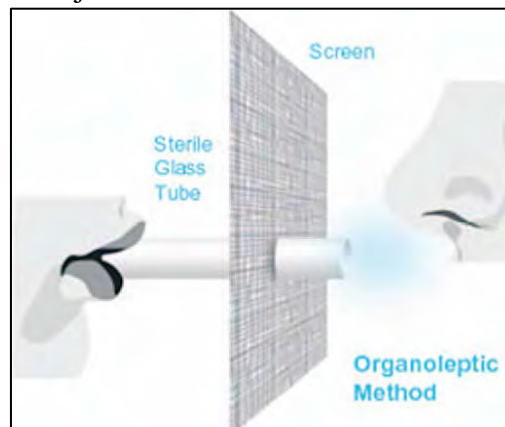
0 : No malodor

1 : Slight malodor

2 : Clearly noticeable

3 : Strong malodor (strong intensity of mouth odor with entirely unacceptable or objectionable characteristics)

malodor



- Sulfide monitor (Halimeter) test :
 1. Patients were asked to keep their mouths closed for 3 minutes prior to testing while breathing through the nose.
 2. After 3 minutes, a disposable plastic straw was mounted at the mouthpiece of the Halimeter and was inserted into the subject’s mouth and the subject was asked to exhale briefly through the straw for 30 seconds
 3. These steps were repeated in three trials for each subject and in each turn the peak value was recorded by the Halimeter
 4. Then the mean value of three peak recordings was calculated and the final value for each patient was recorded as parts per billion (ppb) sulfide equivalents
- Halimeter measurements were divided into three categories :
 - ☞ Normal = 80-160 ppb
 - ☞ Weak = 160-250 ppb (malodor at a close distance)
 - ☞ Strong = >250 ppb (malodor at a greater distance)
- **Statistic methods :**
 1. Kendall’s tau-b correlation coefficient : used to determine the level of correlation between the organoleptic scores and the sulfide monitor values
 2. The Tukey’s post hoc test : compare the sulfide monitor scores and different organoleptic rankings
 3. Mann-Whitney test : determine the difference between men and women in terms of scores of the two methods

Results

- The study population consisted of subjects with an average age of 26.4±7.4 (SD) and ranged from 19 to 58 years
 - **Table 1. Organoleptic and sulfide monitor grades (according to the manufacturer) for 77 individuals.**

Organoleptic Score	Sulfide Monitor Grades			Total
	Normal Range (≤160 ppb)	Slight Halitosis (161-250 ppb)	Severe Halitosis (>250 ppb)	
0	36 (46.8%)	4 (5.2%)	1 (1.3%)	41
1	14 (18.2%)	5 (6.5%)	4 (5.2%)	23
2	-	1 (1.3%)	9 (11.7%)	10
3	-	-	3 (3.9%)	3
Total	50	10	17	77

- **Table 2. Categorizing individuals by organoleptic score and sulfide monitor grades.**

		Organoleptic Score	
		Normal	Halitosis
Sulfide Monitor Grade	Normal	36	14
	Halitosis	5	22

- The subjects were divided into four groups (with and without halitosis) based on the organoleptic score (0 and ≥1), and the degree of halitosis estimated by sulfide monitor values (≤160 ppb as normal and >160 ppb and as abnormal)
- The mean (±SD) of sulfide monitor values for males and females were 155.0±99.0 and 176.4±111.2 ppb, respectively (T test; t=0.828; p=0.410). Moreover, the organoleptic scores of males and females showed no statistically significant difference (Mann-Whitney test; mean ranks: 40.4 and 38.3, respectively; p=0.669).

		Organoleptic score		
		Halitosis	Normal	
Sulfide monitor grade	Halitosis	True Positive 22	False Positive 5	TP / (TP + FP) → Positive predictive value 81.5%
	Normal	False Negative 14	True Negative 36	TN / (TN + FN) → Negative predictive value 72%
		TP / (TP + FN) Sensitivity 61.1%	TN / (FP + TN) Specificity 87.8%	

Discussion

- In this study the Kendall’s correlation coefficient between the average of sulfide monitor values and organoleptic scores was 0.493 (P<0.001) which indicates an intermediate level of correlation
- Differences among these results may arise from :
 - variations in the conduct of the organoleptic method, inclusion criteria, and study populations, the number of judges, scoring methods, judge calibration, use of the bag sampling method or direct technique, or use of intervening screen, type of sulfide monitor, number of monitors in use, calibration of the monitor, and use of a filter, commercial brands of sulfide monitors, sample size of the present study was smaller
- The sulfide monitor’s specificity and sensitivity were respectively lower and higher than values in the research by Takahiko et al
- In addition, almost all of Takahiko’s patients had some degree of oral malodor which was often objectionable, whereas in the present study a large number of participants were university students who had no objectionable breath malodor except for a few subjects which may affect the results.
- The PPV and NPV obtained in the present study were indicators the **sulfide**

monitor is more accurate in diagnosis (75%) of subjects with halitosis than subjects without halitosis.

Conclusion

- Within the limits of this study it can be stated the use of a sulfide monitoring device in conjunction with the organoleptic method is an effective strategy for diagnosing oral malodor.
- This method of evaluation of patients for oral malodor is capable of differentiating normal patients (such as with Pseudohalitosis and halitophobia) from the others and for halitosis screening, along with other techniques such as the organoleptic method. However, when used alone, it may lead to a misdiagnosis of some cases in terms of intensity.

題號	題目
1	造成口腔異味(malodor)之主要氣體，下列何者為非 (A) hydrogen sulfide (B) methyl mercaptan (C) sodium sulfide (D) dimethyl sulfide
答案(C)	
題號	題目
2	診斷口腔異味(halitosis)之方法何者最佳？ (A) Organoleptic method (B) Sulfide monitor (C) Sodium monitor (D) sulfide monitoring + organoleptic method
答案(D)	