The validation of one halitosis measuring device (Etiquette checker)

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Original Article

Abstract

BACKGROUND AND AIM: Various measurement devices are available for detection of halitosis. For epidemiologic studies, it is necessary to use a portable and small device. This study aimed to investigation of correlation between measuring the device (Etiquette checker) with Halimeter.

METHODS: One hundred volunteers (students and patients) participated in this study. The amount of volatile sulfur compounds was carried out by Halimeter and compared with Etiquette measurement. The sensitivity and specificity of Etiquette checker was detected comparing with Halimeter.

RESULTS: The sensitivity and specificity test with Etiquette checker were 86% and 100%, respectively. The best sensitive and specific point of this device was no. 2 for mouth odor detection.

CONCLUSION: Etiquette checker had acceptable sensitivity and specificity for detection of oral malodor. In the future epidemiologic studies, this device could be used.

KEYWORDS: Halitosis, Halimeter, Instrumental Measurement, Sensitivity, Specificity

Citation: Kakoei Sh, Babak-Amini A, Kakooei S. **The validation of one halitosis measuring device (Etiquette checker).** J Oral Health Oral Epidemiol 2014; 3(2): 37-41.

Many people suffer from oral offensive malodor. It seems that halitosis is a common problem in society.[1] Halitosis is the clinical term to describe mouth's malodor, which can be caused by oral in 90% or non-oral in 10-13%.[2-4] This issue can be cause social, emotional, and psychological embarrassment.[5] According to previous studies about 25% of people worldwide are suffering from bad breath.[6]

In 85%, this phenomenon is the result of microbial activity in the mouth.[7] The main cause of bad breath is anaerobic negative proteolytic microorganism and the activity of microorganisms on a protein substrate of oral epithelium, blood cells, food debris produce amino acids cysteine, and methionine and then ultimately leading to volatile sulfur compound (VSC) that containing hydrogen sulfide (H_2S), methyl mercaptan (CH_3SH), and dimethyl sulfide [$(CH_3)_2S$].[8]

Gram-negative bacteria that cause bad breath, including strains of *treponema denticola, Porphyromonas gingivalis, Intermediate-Portela, tannerella forsythia, Porphyromonas endodontalis,* and *strain of eubacteria.* In contrast, *Streptococcus salivarius* and other Gram-positive bacteria commonly found in people without low halitosis.[9] It seems that tongue's coating, periodontal diseases, infection around the implant, tooth decay, tooth exposure, necrosis, oral ulcers, healing wounds, food impaction, un-cleaned dentures, and xerostomia can cause mouth odor.[10]

In addition, many extra-oral factors like pulmonary disorders, some systemic diseases such as nasal infection, chronic sinusitis, diabetes mellitus, liver insufficiency, liver's

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cirrhosis, uremia, lung cancer, and nasal discharge;[10] menstrual cycle[11] have been identified as a cause of bad breath. Most of the previous studies were about different diseases in relation to bad breath[1,4,6] and some of them were about different materials and remedies for solving this problem[8,10] or some researches were about the different methods and devices for measuring halitosis.[5,12,13]

Evaluation of halitosis can be done in various ways. Organoleptic is the most practical method to measure a patient's mouth odor. This method is done by clinician's perception on a patient's breath and scored between 0 and 5. This method highly depend on clinician' skill and experience.[5] The other method for assessment of malodor is gas chromatography by quantitative analysis of VSCs such as H_2S, CH_3SH, and $S(CH_3)$. This method has high reliability, but uneasy accessible.[5]

Using the Halimeter is the next method that is very sensitive to hydrogen sulfide, but does not measure other volatile compounds such as ethanol, methanol, and acetone. Vandekerckhove et al. revealed that sensitivity and specificity of the Halimeter compared to organoleptic assessment were 63 and 98, respectively. The sensitivity and specificity this device comparing to gas chromatography were 69 and 100, respectively.[12] Now-a-days, other monitor portable devices (such as Halitox, Etiquette checker, Fresh Kiss, etc.) are used widely.[13]

By closing mouth to the Etiquette checker's sensor, the device should show a number between 1 and 6. According to figures on the instrument the numbers above 3 indicate bad breath. In 2010, Brunner et al. assessed correlation between organoleptic method and bad breath measuring instruments such as Fresh Kiss, Halimeter, and Halitox. The result of that study showed the organoleptic method had more correlation with Halimeter and less correlation with Fresh Kiss.[13]

Romano et al. reported the relationship between self-assessment of oral malodor and the grade of organoleptic tests, and found that they had 93.3% correlation.[14] Iwanicka-Grzegorek et al. reported a relationship between the organoleptic clinical diagnosis and the Halimeter.[15]

In epidemiologic studies, researchers need to use portable and small devices that they can carry to evaluate malodor in a large number of samples. Few studies have been done on these kinds of devices such as Etiquette checker. It is better to use small and portable devices with acceptable sensitivity and specificity. Therefore, this study aimed to investigation of correlation of diagnostic sensitivity and specificity between measuring devices (Etiquette checker and the Halimeter).

Methods

This study was approved with an ethical code of 41/90/K in the Research Council of Kerman University of Medical Sciences. In this cross-sectional study 100 volunteers (students and patients referred to Kerman Dental School) with sampling participated in the study. Participants were asked to give written consent.

Participants were asked to abstain from eating garlic and onions 2 days and avoid from smoking and drinking coffee 12 h before the examination and using gum, mint, perfume, or mouthwash on examination day. Furthermore, patients were allowed to eat breakfast and use brush regularly for at least 2 h before examination. The participants have been examining between 8 and 12 am.

On the 2nd day, a portable device of the Halimeter (Halimeter®; Interscan Corp., CA, USA) (Figure 1) was used to determine VSC level. Patients should not speak 1 min before the test and a special thin tube of Halimeter device (sample) was keep close on the posterior of mouth and dorsal of their tongue (about 2.5-5 cm depth in the mouth). The pipe should not contact with the tongue or oral mucosa and individuals were not

allowed to breathe deeply during each sampling and were asked to open their mouths about 1.5 cm to record maximum value of VSC.
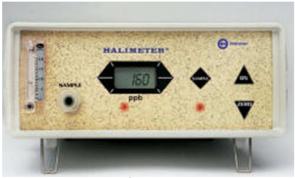

Figure 1. Halimeter®; Interscan Corp., CA, USA

As the Halimeter was used in previous studies and approved a good device for detection of mouth odor, especially in epidemiologic investigations, in this study, we supposed it as a gold standard.[12] According to instruction of company the scoring of halitosis with Halimeter was done as follows: people with lower level of 50 ppb consider as without halitosis, those with VSC levels between 50 ppb and 100 ppb consider as mild halitosis and for patient with >100 ppb of VSC level was considered a strong halitosis.[16]

Finally, the amount of bad breath based on 1-6 evaluated with Etiquette checker instrument (Etiquette Topland Co., Japan) (Figure 2) (1 = without halitosis, 2 = very mild halitosis, 3 = mild halitosis, 4 = moderate halitosis, 5 = intensive halitosis, 6 = severe halitosis). Collected data were statistically analyzed by sensitivity and specificity, positive, and negative predictive values.

Figure 2. Etiquette Topland Co., Japan

Results

One hundred people participated in this study. Mean age of them was 22.7 (range = 12-63). Other demographic data are shown in table 1. In this study, according to Etiquette checker 16 individuals had no bad breath by grade 1, 40 persons had grade 2, seven out of 40 persons with grade 2 by Etiquette checker evaluated assessed without halitosis by the Halimeter, 44 people had grades 3 and 4 by Etiquette checker had halitosis according to the Halimeter.

Table 1. Demographic data of participants

Variables	Percentage
Gender	
Male	63
Female	37
Age (years)	
≤ 20	45
21-25	41
> 25	14
Smoking	
Yes	7
No	93

Table 2 shows the status of halitosis using Etiquette checker according to results of Halimeter. In the result of halitosis measurement by Etiquette checker and its comparing with Halimeter, grade 1 (without halitosis) had 100% sensitivity and 33% specificity, and accuracy 67% (Table 3). In grade 2 (very mild halitosis) recorded by Etiquette checker comparing to Halimeter, sensitivity 86%, specificity100%, and accuracy of 93.0% were obtained (Table 3).

In grade 3 (mild halitosis) recorded by Etiquette checker comparing to Halimeter, sensitivity 23%, specificity 100%, and accuracy 61% was achieved (Table 3). Based on the above results, the best accuracy point for assessing mouth odor by the Etiquette checker was 2. In this number, this device has the best positive and negative predictive value.

Table 2. Survey status of halitosis with using Etiquette checker according to the results of Halimeter

Etiquette checker	Without halitosis (ppb < 50)		Mild halitosis (ppb ≥ 50-100)		Total	
	Frequencies	Percentage	Frequencies	Percentage	Frequencies	Percentage
Without	16	32.7	0	0.0	16	16.0
Very mild	33	67.3	7	13.7	40	40.0
Mild	0	0.0	32	62.7	32	32.0
Moderate	0	0.0	12	23.5	12	12.0
Total	49	100	51	100	100	100

ppb: Parts per billion

Table 3. The sensitivity, specificity, accuracy, and positive and negative predictive value of Etiquette checker measuring according to the Halimeter (ppb <50 = without halitosis, ppb ≥ 50-100 = mild halitosis)

Tests	Etiquette checker		
	Without halitosis (Percentage)	Very mild halitosis (Percentage)	Mild halitosis (Percentage)
Sensitivity	100	86.0	23.5
Specificity	33.0	100	100
Accuracy	67.0	93.0	61.0
Positive predictive value	61.0	100	100
Negative predictive value	100	87.5	56.0

ppb: Parts per billion

Discussion

This study aimed to investigation of correlation of diagnostic sensitivity and specificity between two measuring devices (Etiquette checker and Halimeter). This study showed that according the numbers showing in Halimeter, individuals that had the number above 2 by Etiquette checker had bad mouth odor. The sensitivity and specificity of the Etiquette checker in comparison with the Halimeter were (86-100%), respectively. These grades for using in screening studies were good.

There are small and easy handle and performance devices for mouth odor assessing. If these instruments have acceptable sensitivity and specificity, they can be used in some investigations. Etiquette checker is a small and light instrument can be used in some studies.

In medicine, the effort of making different instruments has been down for varieties of purposes. For instance, the Glucowatch is a very routine home use instrument for diabetic patients for self-monitoring of blood sugar.[17] The detection and evaluation of oral odor need many devices and instruments such as organoleptic assessment, gas chromatography, and Halimeter. These devices cannot be used by patients. Many different instruments are accessible for assessing bad breath by people, but they have not evaluated in respect of accuracy or sensitivity and specificity. Probably, some of these cheap and easy to use instruments can be used in an epidemiologic study with a large number of samples.

However, the Halimeter only monitors VSCs concentration and could be used for evaluating treatment in patients who suffering from bad breath. But, other instruments even organoleptic method can categorize the mouth odor, and they are not able to recognize VSCs concentration.[13] In addition, the accuracy of organoleptic method is highly depend on examiner's skill and experience. Baharvand et al. showed that although the organoleptic method with Halimeter can recognize false mouth odor, Halimeter has a positive correlation with organoleptic method that is a gold standard for halitosis measurement.[18] Ueno et al. showed the significant correlation a small and simple instrument measurement for mouth odor with organoleptic method and gas chromatography and they found it useful for halitosis screening.[19]

In one study, Brunner et al. compared many instrumental measurements with

organoleptic method. They found the best correlation in organoleptic with Halimeter and the least correlation with Fresh kiss.[13] However, a very few studies have been done for comparing different small and easy handle devices for using out of office, especially for epidemiologic studies.

according Halimeter measurement. In the future epidemiologic studies, this device could be used due to the easy handle and low consumption of time.

Conclusion

With comparing Etiquette checker with Halimeter, the former had acceptable sensitivity and specificity for detecting of oral malodor. The accuracy point for assessing mouth odor by the Etiquette checker was 2

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

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