

Oral malodor and related factors among community dwelling elderly Thai

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Abstract

The purpose of this study was to examine the oral malodor and relationship of oral malodor with socio-demographic factors, oral health behavioral and oral health status in community-dwelling elderly Thai. The subjects were 612 elderly (158 males and 454 females; mean age = 68.8 SD= 5.9) who lived in Maung, Phitsanulok, Thailand. Oral malodor was measured by the organoleptic method and using oral Chroma™. The socio-demographic and oral health behavioral characteristics were investigated by a questionnaire. Oral examination including teeth and periodontal conditions were examined. Salivary flow rate were measured. For the results, prevalence of oral malodor diagnosed by the organoleptic method was 64.7%. Logistic regression showed that the risk factors related to oral malodor were level of education (OR=1.58), dental visit behaviors (OR=1.68), deep pockets (OR=2.95), gingival bleeding (OR=2.47), tongue coating (OR=58.36), salivary flow rate (OR=1.77) and pH of saliva (OR=1.26). There was a high prevalence of oral malodor, which was associated with oral health and behavioral factors in community dwelling elderly Thai. The effective treatment of periodontal disease, improvement of oral hygiene condition and appropriate oral health education are all important to ameliorate oral malodor and improve oral health of the elderly.

Key words : *Oral Malodor, Oral health status, Elderly*

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Introduction

Halitosis is a general term used to describe an unpleasant or foul smelling breath that originates from intra or extra oral sources.¹ In approximately 90% of all cases, halitosis emanates from the oral cavity² and is therefore defined as oral malodor. Oral malodor arises from microbial degradation of organic substrates such as glucose, mucins, peptides and proteins that are present in oral soft tissues, saliva, crevicular fluids and retained debris. In particular, gram-negative anaerobic bacteria degradation of sulfur-containing amino acids such as methionine, cystine and cysteine produces Volatile Sulfur-containing Compounds (VSCs), mainly consisting of hydrogen sulfide (H_2S), methyl mercaptan (CH_3SH) and dimethyl sulfide ($(CH_3)_2S$).^{1,3}

The most valid clinical oral malodor measurement is the organoleptic methods,⁴ which is based on the subjective smelling sensation of the examiner to the mouth odor. Recently, an Oral Chroma™ device, developed as a compact and simple gas chromatography machine showed a highly positive correlation with gas chromatography.⁵ In addition, oral malodor is associated with socio-demographic and dental health behavioral characteristics such as age, gender, level of education, frequency of dental visit,⁶ frequency of tooth brushing,⁷ experience of oral hygiene instruction, smoking behavior⁸ and tongue cleaning behavior.

This is the first study that was conducted in Thailand with the aim to examine oral malodor status, and the relationship of oral malodor to oral health status, sociodemographic and health behavioral characteristics, and to propose appropriate prevention and treatment programs for Thai elderly.

Methods

The study protocol was approved by Naresuan University. The subjects were selected from community elderly people aged 60 years or older from Mueang district, Phitsanulok. A total of 612 people (158 males and 454 females; mean age = 68.8 SD= 5.9), subjects agreed to join the study. All the subjects answered in questionnaires about sociodemographics and health behaviors. Medical history, intake of medicines, and dental health behaviors were also asked through the interview.

Oral malodor measurement

The subjects were requested to refrain from eating, drinking, smoking, tooth brushing and rinsing their mouth for a minimum of 2 hours prior to the examination. Oral malodor was measured by the organoleptic test (OT) and using Oral Chroma™. For the OT measurement, subjects were asked to close their lips tightly for 3 minutes sitting upright in a dental chair and then exhale briefly and softly from the mouth through a paper tube. The breath was evaluated by a trained

dentist (who passed the smell test) with a six-point OT scale: 0, no odor; 1, questionable odor; 2, slight but clearly noticeable odor; 3, moderate odor; 4, strong odor and 5, severe odor.⁹

For the Oral Chroma™ measurement, a disposable 1mL capacity syringe was inserted into the subject's mouth. Three kinds of VSCs (H_2S , CH_3SH , and $(CH_3)_2S$) were analyzed automatically in 8 minutes, and the concentration values (ng/10mL) were displayed.²⁵ The VSCs measurement of 3 gases, H_2S , CH_3SH and $(CH_3)_2S$, were also dichotomized (non-oral malodor and oral malodor groups) by the threshold criteria ($H_2S=1.5$ ng/10mL, $CH_3SH=0.5$ ng/10mL and $(CH_3)_2S=0.2$ ng/10mL).¹⁰

Oral examination

All subjects underwent a standard oral examination. The number of decayed, missing and filled teeth was recorded. Periodontal pocket depths were assessed at 6 sites on each tooth with a Williams periodontal probe. Gingival bleeding was recorded when observed following the pocket depth measurement.¹¹

Both the area and the thickness of the tongue coating were recorded on scale from 0 to 3 by visual inspection.¹² The scores of area of tongue coating were: 0, no tongue coating; 1, less than one-third of tongue dorsum surface coated; 2, more than one-third and less than two-third dorsum surface coated; 3, more than two-third of tongue of tongue dorsum surface coated.

The scores of thickness of tongue coating were as follows: 0, none; 1, thin tongue coating; 2, moderate tongue coating; 3, thick tongue coating. Unstimulated whole saliva was obtained by requesting the subjects to spit saliva into a disposable paper cup for 5 minute. Subjects whose flow rate of resting saliva was below 0.1 mL/min were classified as hyposalivation.¹³ The pH of unstimulating saliva was determined by a pH paper test (ADVANTEC BTB, Japan).

Results

The number of subjects aged 60-69 years was 354 (57.8%) and those aged over 70 years was 258 (42.2%). Almost three-fourth of subjects (74.2%) was females. Most subjects (91.3%) had no education. Less than half of subjects (45.3%) claimed not to have enough income. Most subjects were non smokers (85.3%) and very few subjects (1.5%) regularly drank alcohol. Systemic diseases were observed in 74.8% of subjects: hypertension 37.3%, diabetes mellitus 18.3%, heart disease 6.5% and other diseases 12.7%. About three-fourth of subjects (76.1%) routinely took medicines. The proportion of subjects who rarely or never had a dental visit, or only visited when they had a dental problem was 79.9%. Subjects who brushed their teeth at least twice a day was 74.0%. A low percentage of subjects reported to brush their tongue every day (28.4%).

Prevalence of oral malodor

Oral malodor measurement by OT showed a high proportion of subjects with oral malodor (64.7%). The proportions of subjects classified as oral malodor using the threshold of H_2S , CH_3SH and $(CH_3)_2S$ by OC were 60.5%, 62.9% and 80.7%, respectively. All three VSCs gas concentrations were higher than their threshold levels in the oral malodor groups by OT. The mean H_2S , CH_3SH and $(CH_3)_2S$ concentrations in the oral malodor group were 4.96 ng/10mL (SD=3.5), 1.69 ng/10mL (SD=1.1) and 1.42 ng/10mL (SD= 0.9), respectively.

Oral health status

Thirty percent of subjects (n=184) were edentulous. Active decay of teeth was observed in 57.8% of subjects. Half of subjects (50.0%) had at least one deep (5 mm or deeper) periodontal pocket. The percentage of subjects who had at least one teeth with gingival bleeding was 67.6. As for the area of the tongue coating, 22.0% of subjects had score 1, 62.6% had score 2, and 15.4% had score 3. Regarding the thickness of the tongue coating, 27.5% of subjects had score 1, 71.4% had score 2 and 1.1% had score 3. Ratio of subjects with salivary flow rate below 0.1mL/min was 24.7%. The mean pH of saliva of all subjects was 7.1.

Sciodemographics and behaviors related with oral malodor

Age and gender did not show any significant relationships with oral malodor.

Educational level, smoking, drinking alcohol, taking medicines, systemic diseases, frequency of tooth and tongue brushing were significantly related to the oral malodor by OT measurement (Table 1).

Oral health status related with oral malodor

The subjects with oral malodor evaluated by OT had significantly higher number of deep pockets, teeth with gingival bleeding, tongue coating scores (area and thickness), pH of saliva and significantly lower flow rate of saliva than the non-oral malodor group (Table 2).

Oral malodor and its related factors

As presented in Table 3, subjects with lower education level were more likely to have oral malodor than those with a higher education level (OR=1.58). Subjects who were not frequent dental visitors were more likely to have oral malodor compared with their counterparts (OR=1.68) ($p<0.05$). However, dental behaviors such as frequency of tooth brushing, tongue brushing behavior, experience of oral hygiene instruction and smoking behaviors were not statistically associated with oral malodor. Subjects with at least one 5mm or greater pocket (OR=2.95), those with at least one tooth with bleeding gingival (OR=2.47) and those with thickness of tongue coating score 2 or greater (OR=58.36) ($p>0.05$) were more likely to have oral malodor compared with their counterparts. Subjects with lower

Table 1 Bivariate relationship between oral malodor and sociodemographics and behaviors

Variables	Categories	Number	Organoleptic test				P
			Oral malodor (-)		Oral malodor (+)		
			N	%	N	%	
Age	60-69 years old	354	122	34.5	232	65.5	0.669
	>70 years old	258	94	36.4	164	63.6	
Gender	Male	158	51	32.2	165	67.8	0.385
	Female	454	107	36.3	289	63.7	
Education level	Primary or lower	559	192	34.3	367	65.7	0.034
	Secondary or upper	53	24	43.6	29	56.4	
Economic status	Not enough income	277	92	33.2	185	66.8	0.142
	Enough income	335	124	37.0	211	63.0	
Take medicines	Routinely	466	140	30.1	326	69.9	0.042
	No	146	55	37.6	89	62.4	
Systemic diseases	Yes	458	148	32.3	310	67.7	0.038
	No	154	60	38.9	94	61.1	
Dental visit	Never, rarely	488	170	34.8	318	65.2	0.074
	Regular	124	46	37.1	78	62.9	
Tooth brushing	≤Once/day	159	49	30.8	110	69.2	0.038
	>twice/day	453	173	38.2	280	61.8	
Tongue brushing	No	438	140	31.9	298	68.1	0.023
	Yes	174	72	41.4	102	58.6	
Smoking	Non smoker	514	183	35.6	331	64.4	0.035
	Current smoker	98	33	33.7	65	66.3	
Drinking alcohol	None or moderate	599	209	34.9	390	65.1	0.039
	Regular	13	7	53.8	6	46.2	

Table 2 Bivariate relationship between oral malodor and oral health factors

Variables	Oral Malodor	Organoleptic test (-): n= 216, (+): n= 396		
		Mean	SD	p
Number of decayed teeth ^a	(-)	2.07	2.81	0.067
	(+)	2.47	3.21	
Number of teeth with periodontal pockets >5mm ^a	(-)	2.71	3.26	<0.001
	(+)	6.230	4.07	
Number of teeth with gingival bleeding ^a	(-)	4.33	2.99	<0.001
	(+)	7.16	3.44	
Area of tongue coating ^b	(-)	1.43	0.59	<0.001
	(+)	2.21	0.41	
Thickness of tongue coating ^b	(-)	1.29	0.45	<0.001
	(+)	1.98	0.23	
Flow rate of resting saliva (mL/min) ^a	(-)	0.22	0.16	0.032
	(+)	0.16	0.12	
pH of saliva ^a	(-)	6.66	0.71	0.026
	(+)	7.26	0.83	

^a Independent Sample T Test, ^b Mann-whitney U Test

flow rates (OR=1.77), or higher pH of saliva (OR=1.26) were more likely to have oral malodor, in comparison with those who had higher flow rate or lower pH of saliva ($p < 0.05$).

Discussion

The OT and Oral ChromaTM were used in this study. All three concentrations of VSC gases by Oral ChromaTM surpassed the threshold level of oral malodor in the oral malodor group diagnosed by OT, which

confirmed the good agreement between the OT and Oral ChromaTM. Previous study show that Organoleptic test is a goal standard for oral malodor measurement.¹⁴ The choice of which method to use, therefore, depends on the nature and design of the particular study.

This study found that age and gender were not related with oral malodor, consistency with previous studies.¹⁵ In the present study, there were a high proportion of subjects who did not regularly attend a

Table 3 Logistic regression analysis of oral malodor status

	Independent factors	Number(%)	OR	Organoleptic test		p-value
				95% Lower	CI Upper	
Age	60-69 years (reference)	354 (57.8)				
	>70 years	258 (42.2)	0.63	0.36	1.09	0.105
Gender	Male (reference)	158 (25.8)				
	Female	454 (74.2)	0.75	0.38	1.47	0.405
Education	High school/upper (reference)	53 (8.7)				
	Not study or primary school	559 (91.3)	1.58	1.23	2.45	0.049
Income	Enough (reference)	335 (54.7)				
	Not enough	277 (45.3)	1.16	0.68	1.97	0.574
Dental Visit	Often, regular (reference)	124 (20.3)				
	Never, rarely	488 (79.7)	1.68	1.33	2.40	0.033
Tooth brush	≥2 times/day (reference)	453 (74.0)				
	≤once/day	159 (26.0)	1.19	0.67	2.12	0.534
Tongue brush	Yes (reference)	174 (28.4)				
	No	438 (79.7)	0.73	0.39	1.35	0.323
Systemic disease	No (reference)	161 (26.3)				
	Yes	451 (73.7)	2.28	0.821	6.353	0.064
Intake of medicines	No (reference)	146 (23.9)				
	Yes	466 (76.1)	0.85	0.31	2.32	0.762
Smoking	Non smoker (reference)	514 (84.0)				
	Smoker	98 (16.0)	1.51	0.72	3.15	0.265
Decayed	0 decayed tooth (reference)	258 (42.2)				
	≥1 decayed tooth	534 (57.8)	0.91	0.48	1.70	0.771
Gingival bleeding	0 tooth(reference)	198 (32.4)				
	≥1 tooth	414 (67.6)	2.47	1.19	3.18	0.044
Periodontal pocket	0 tooth (reference)	306 (50)				
	≥1 pocket	306 (50)	2.95	1.12	3.97	0.045

Table 3 (continue)

Independent factors	Number(%)	OR	Organoleptic test		p-value
			95% Lower	CI Upper	
Tongue coating	Score 0 or 1 (reference)	135 (22.1)			
	Score 2 or 3	477 (77.9)	58.36	11.94	258.34
Salivary flow	≥0.1mL/min (reference)	451 (75.3)			
	≤0.1 mL/min	151 (24.7)	1.77	1.41	2.43
Salivary pH	≤7.2 (reference)	593 (96.9)			
	≥7.2	19 (3.1)	1.26	1.04	3.14

dentist. This might be one of the reasons why many complicated dental problems were observed in these subjects. The close relationship between less oral malodor and higher education was also reported by Al-Ansari et al, (2006).¹⁶ The oral health care for the elderly should be a concern for access to visit dentist. The present study showed a strong association between oral malodor and tongue coating. The dorsum of the tongue is considered to be a major site of oral malodor production and the accumulation of tongue coating contributes to VSC production.¹⁷⁻¹⁸ The higher the degree of tongue coating is, the higher the concentrations of H₂S, CH₃SH become.¹⁹ Patients with periodontitis have a higher level of tongue coating than healthy individuals.²⁰ The subjects with abundant tongue coating tended to have more severe periodontal disease and oral malodor. It is suggested that knowledge of tongue coating

aetiology and the importance of tongue cleaning may not be well known among the elderly Thai.

The results of this study showed that the significant association of oral malodor, periodontal pockets and gingival bleeding. Periodontal diseases are one of the causes of oral malodor. VSCs concentrations are reported to be higher in subjects with gingival bleeding on probing because *Porphyromonas gingivalis* requires heme from hemoglobin for growth.²⁰⁻²¹ This study found that the association between salivary flow rate and oral malodor. Flow rate of saliva below 0.1mL/min is indicated to be one of the risk factors for oral malodor formation.²² The pH of saliva has also been shown to play a role in oral malodor formation.²³

Oral malodor appears to be a major problem in elderly Thai, accompanied by multiple risk factors such as periodontal

disease, tongue coating, oral dryness, systemic disease and intake of medicines. Moreover, most subjects have little knowledge about halitosis aetiology and few subjects recognized that they had this disorder. Treatment of halitosis has not received much attention by the dental profession in Thailand, thus updated information on halitosis is necessary. In addition, dental education programs and oral health promotion activities should be conducted at individual and community levels to provide adequate information concerning oral disease and halitosis. Current findings reflected multiple problems in community elderly, and provided new and valuable information for further research

on oral malodor in the general population.

Conclusion

There was a high prevalence of oral malodor in community elderly Thai. The most important factors associated with detectable oral malodor included periodontal disease, tongue coating, salivary flow rate, systemic disease and intake of medicines. Level of education and frequency of dental visit were also significant risk factors. The effective treatment of periodontal disease, improvement of oral hygiene condition and appropriate oral health education are necessary to reduce oral malodor in community elderly Thai.

เอกสารอ้างอิง

1. Tonzetich J. Production and origin of oral malodor: a review of mechanisms and methods of analysis. *J Periodontol.* 1977 Jan;48(1):13-20.
2. Tangerman A, Winkel EG. Intra- and extra-oral halitosis: finding of a new form of extra-oral blood-borne halitosis caused by dimethyl sulphide. *J Clin Periodontol.* 2007 Sep;34(9):748-55.
3. Murata T, Yamaga T, Iida T, Miyazaki H, Yaegaki K. Classification and examination of halitosis. *Int Dent J.* 2002 Jun;52 Suppl 3:181-6.
4. Wozniak WT. The ADA guidelines on oral malodor products. *Oral Dis.* 2005;11 Suppl 1:7-9.
5. Murata T, Rahardjo A, Fujiyama Y, Yamaga T, Hanada M, Yaegaki K, et al. Development of a compact and simple gas chromatography for oral malodor measurement. *J Periodontol.* 2006 Jul;77(7):1142-7.
6. Soder B, Johansson B, Soder PO. The relation between foetor ex ore, oral hygiene and periodontal disease. *Swed Dent J.* 2000;24(3):73-82.
7. Bornstein MM, Stocker BL, Seemann R, Burgin WB, Lussi A. Prevalence of halitosis in young male adults: a study in swiss army recruits

เอกสารอ้างอิง

- comparing self-reported and clinical data. *J Periodontol.* 2009 Jan;80(1):24-31.
8. Khaira N, Palmer RM, Wilson RF, Scott DA, Wade WG. Production of volatile sulphur compounds in diseased periodontal pockets is significantly increased in smokers. *Oral Dis.* 2000 Nov;6(6):371-5.
 9. Rosenberg M, Kulkarni GV, Bosy A, McCulloch CAG. Reproducibility and sensitivity of oral malodor measurements with a portable sulphide monitor. *J Dent Res* 1991;70:1436-1440.
 10. Yaegaki K, Coil JM. Diagnosis of halitosis by utilizing questionnaire and organoleptic measurement. *Quintessence* 1999; 18:745-53.
 11. World Health Organization. Oral health surveys: basic methods. 4th edition, 199
 12. Oho T., Yoshida Y., Shimazaki Y., Yamashita Y., Koga T.. Characteristics of patients complaining of halitosis and the usefulness of gas chromatography for diagnosing halitosis. *Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodontics* 2001; 91:531-534.
 13. Bergdahl M. Salivary flow and oral complaints in adult dental patients. *Community Dentistry and Oral Epidemiology* 2000; 28(1):59-66.
 14. Rosenberg M, McCulloch CA: Measurement of oral malodor: current methods and future prospects. *J Periodontol* 1992, 63:776-782.
 15. Miyasaki H, Sakao S, Katoh Y, Takehara T. Correlation between volatile sulphur compounds and certain oral health measurement in general population. *J periodontol.* 1995 Aug;66:679-684.
 16. Al-Ansari JM, Boodai H, Al-Sumait N, Al-Khabbaz AK, Al-Shammari KF, Salako N. Factors associated with self-reported halitosis in Kuwaiti patients. *J Dent.* 2006 Aug;34(7):444-9.
 17. Yaegaki K, Sanada K. Biochemical and clinical factors influencing oral malodor in periodontal patients. *Journal of Periodontology* 1992; 63(9):783-9.
 18. Lee C.H., Kho H.S., Chung S.C., Lee S.W., Kim Y .K. The relationship between volatile sulfur compounds and major halitosis-inducing factors. *Journal of Periodontology.* 2003; 74:32-37.
 19. Hinode D., Fukui M., Yokoyama N., Yoshioka M., Nakamura R. Relationship between tongue coating and secretory-immunoglobulin A level

เอกสารอ้างอิง

- in saliva obtained from patients complaining of oral malodor. *Journal of Clinical Periodontology* 2003; 30:1017-1023.
20. Yagaki K, Sanada K. Volatile sulfur compounds in mouth air from clinically healthy subjects and patients with periodontal disease. *J periodontol Res* 1992;27:233-238.
21. Person S. Hydrogen sulphide and methyl mercaptan in periodontal pockets. *Oral Microbiol Immunol* 1992;7:378-379.
22. Koshimune S, Awano S, Gohara K, Kurihara E, Ansai T, Takehara T. Low salivary flow and volatile sulfur compounds in mouth air. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2003 Jul;96(1):38-41.
23. Kleinberg I, Westbay G. Oral malodor. *Crit Rev Oral Biol Med.* 1990;1(4):247-59.



การศึกษาภาวะกลืนปากและปัจจัยที่เกี่ยวข้องในผู้สูงอายุไทย

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บทคัดย่อ

วัตถุประสงค์ของการศึกษาในครั้งนี้เพื่อศึกษาสภาวะกลืนปากและความสัมพันธ์ระหว่างการมีกลืนปากกับภาวะทางสังคม การศึกษา พฤติกรรมทางทันตสุขภาพ และสุขภาพช่องปาก ในกลุ่มผู้สูงอายุที่อาศัยอยู่ในเขตชุมชนของประเทศไทย โดยกลุ่มเป้าหมายของงานวิจัยคือผู้สูงอายุที่มีอายุมากกว่า 60 ปี จำนวน 612 คน ประกอบด้วยชาย 158 คน และหญิง 454 คน ที่อาศัยอยู่ในเขตอำเภอเมือง จังหวัดพิษณุโลก ประเทศไทย การวัดกลืนปากทำโดยการดมกลิ่นด้วยจมูก (Organoleptic Test) และใช้เครื่องมือ ออรัลโครมา (Oral Chroma) ประเมินสภาวะสังคม การศึกษา พฤติกรรมด้วยการสัมภาษณ์แบบสอบถาม ประเมินสภาวะช่องปากด้วยการตรวจสภาพฟัน สภาวะปริทันต์ รวมถึงการวัดประเมินการหลั่งของน้ำลายด้วย จากการประเมินกลืนปากแล้วพบว่า ร้อยละ 60 ของผู้สูงอายุมีปัญหาการกลืนปาก จากการทดสอบทางสถิติพบว่า ปัจจัยที่มีผลต่อการมีกลืนปาก ได้แก่ ระดับการศึกษา พฤติกรรมการไปพบทันตแพทย์ ร่องลึกปริทันต์ ภาวะเหงือกอักเสบ คราบบนลิ้น อัตราการหลั่งของน้ำลาย และสภาวะความเป็นกรด ต่างในน้ำลาย จากการศึกษพบว่าผู้สูงอายุไทยมีภาวะกลืนปากค่อนข้างสูง ซึ่งปัจจัยที่เกี่ยวข้องก็มาจากเรื่องของพฤติกรรมทางทันตสุขภาพ ภาวะโรคในช่องปาก ซึ่งการรักษาโรคปริทันต์ การดูแลสุขภาพช่องปากที่ดีขึ้น รวมถึงการได้รับความรู้ทันตสุขภาพที่เหมาะสมก็จะช่วยให้ภาวะกลืนปากในกลุ่มผู้สูงอายุหมดไป

คำสำคัญ : กลืนปาก ภาวะสุขภาพช่องปาก ผู้สูงอายุ

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