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Prevalence of halitosis in elderly living in nursing homes

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Abstract: *Objectives:* Halitosis is a concern for many people, but has sparsely been studied in elderly living in nursing homes. The aim of this investigation was to study the prevalence of halitosis in this particular group and factors that could be associated with this condition. *Method and materials:* One hundred and twenty-four residents at three different nursing homes were included in the study. The level of halitosis was assessed using an organoleptic method based on a 6-graded scale. Oral status, including registrations of plaque, gingivitis and assessment of hyposalivation, was performed by two investigators who both examined all patients. Medical history, that is medication, neurological conditions, diabetes, cardiovascular disease, chronic obstructive pulmonary disease (COPD)/asthma, dementia and mental illness, was obtained from the patient files. Registrations of the use of oral hygiene aids, ADL (Activity of Daily Life) and the frequency of contact with dental services were included in the clinical examination. *Results:* Halitosis occurred in over 50% of residents living in nursing homes and was found to be associated with the presence of hyposalivation, periodontal disease, calculus, fixed prosthodontics and dementia. *Conclusion:* Halitosis was a common finding in the elderly living in Swedish nursing homes.

Key words: dementia; elderly; halitosis; nursing home

Introduction

The proportion of elderly in Sweden is increasing (1), and a growing number have their own teeth and/or fixed dentures supported by natural teeth or dental implants (2).

Consequently, providing oral care for elderly living in nursing homes, who are dependent on support for their personal hygiene, is a challenging and demanding task for the nursing staff (3). The proportion of elderly that need assistance by auxiliary personnel increases from 80 years of age. In Sweden, about 21% of the 80 years and older who live in their own homes receive support from the community and an additional number are cared for by their relatives, that is husband/wife or other family members. Sixteen % of the present age group live in nursing homes (4, 5).

The dental conditions in residents living in nursing homes are relatively well characterized. There are numerous reports describing poor dental status in many elderly and lack of proper daily oral hygiene (3, 6–8). Good oral hygiene is essential for maintaining oral health, and lack of oral care increases the risk for oral diseases such as dental caries and periodontal disease, conditions often associated with halitosis (9). Furthermore, studies have shown that if residents in nursing homes are subjected to regular oral hygiene the prevalence of pneumonia is decreased (10).

Halitosis is generated by bacteria that colonize in the mouth between (11, 12) the teeth and on the tongue. During anaerobic conditions, the bacteria in the mouth produce sulphurous gases (13). Food remnants in the mouth are partly degraded into amino acids, and particularly two amino acids, cysteine and methionine, are the main substrates for the formation sulphurous compounds. These amino acids are found in large amounts in high-protein diet. The sulphurous gases, which are also named volatile sulphur compounds (VSC), mainly consist of hydrogen sulphide, methyl mercaptan and dimethylsulphide. Thus, to prevent or reduce bad breath it is essential to maintain good oral health and optimal hygienic conditions (14, 15).

There are, however, additional factors not associated with oral health but merely originating from systemic conditions, that is tonsillitis, reflux, malignant processes in the lung, liver and gastrointestinal tract. Still, 80–90% of halitosis is considered to originate from oral sources (14, 16).

Bad breath is a problem for men and women of all ages, and studies show that up to 30% of the population consider this condition to be a problem (16). The prevalence of halitosis in elderly is sparsely studied. Samnieng and co-workers (17) observed a high prevalence of halitosis in independently living elderly in Thailand, and in an interview study on institutionalized elderly in Turkey (18), halitosis was considered a problem, especially among women. It cannot be excluded that bad breath may affect the daily nursing care. Individuals with bad breath may end up in a vicious circle where the nursing staff hesitates to perform oral hygiene measures which in turn may lead to worsening problems and a gradually deteriorating oral health. Bad breath may also have social implications. The relation to friends and relatives can be compromised for individuals with a bad breath condition which in turn could have considerable consequences for the quality of life for the elderly.

The objective of this study was to investigate the prevalence of and some general and local oral factors associated with halitosis in people living in nursing homes.

Material and method

Study outline

The study was conducted at three nursing homes in the city of Gothenburg, Sweden. The nursing homes represented different socio-economic areas. All 134 residents in the nursing homes were invited to participate in the study. Each resident received both oral and written information about the project prior to the start of the study by personnel from the nursing staff. The study was approved by the regional ethical review board at the University of Gothenburg (Dnr 670-09). Written consent was obtained from 124 residents who accepted to participate in the study and 10 declined. In case the participants were not able to sign the consent form, this was signed by a professional Guardian.

Clinical examinations

Oral clinical examinations were performed by a calibrated team consisting of one dental hygienist and one dentist.

A general medical history including medication and an evaluation according to the criteria of the Barthel ADL index (Activity Daily Living) was obtained by the charge nurse. The ADL index reflects degree of dependence of support for daily life to perform various hygiene procedures (19). Information of oral care habits including the use of antiseptic mouth rinses and regular dental care was obtained by means of an interview. If a resident was not able to respond, information was obtained from the nursing staff or in some cases from relatives. In addition, each subject was also asked whether they suffered from halitosis.

The clinical examination was performed under 'field condition', that is the residents were examined in their bed or, if possible, having the subject sitting in a chair. No particular instruction was given prior to the assessment of halitosis. A dental mirror, dental explorer and a dental probe (PerioWise Probes[®], Premier Dental Products C, PA, USA) were used and a strong flashlight as a light source. Examinations were carried out after the residents had performed their oral hygiene measures, usually in the morning and generally during daytime.

The clinical registrations were performed in the following order:

The level of halitosis was assessed using an organoleptic method as described by several authors (20–22). A six point scale was used according to the following criteria; 0 = no appreciable odour, 1 = a barely perceptible odour, 2 = small but noticeable odour, 3 = moderate odour, 4 = strong odour, 5 = extreme odour. The assessment of the level of halitosis was performed independently by both examiners. The results were compared, and in case of disagreement, consensus was reached after reassessment. The interexaminer agreement was 80% after the initial assessment.

The number of teeth and root remnants, visible dental caries as well as presence of fillings and fixed or removable partial dentures were registered and the presence of supragingival calculus was assessed using a 3-grade scale modified to facilitate an estimate of the presence and amount of dental calculus during field conditions: 0 = *none or sparse amounts*. Flecks of calculus along the gingival contour of the tooth surface, 1 = *moderate amounts*. A continuous band of calculus along the gingival contour of the tooth surface, 2 = *abundant amounts*. Excessive amounts of calculus exceeding the gingival contour of the tooth surfaces. Lingual surfaces on canines and incisors in the lower jaw and buccal surfaces of the first maxillary molar were selected for the assessment of calculus. An mean score based on the individual scores of each tooth surfaces was calculated for each individual and averaged to the nearest integer.

Dental plaque was scored as present/non-present (23).

The classification of periodontal conditions was also assessed based on a clinical examination defined as either *healthy*, that is no marginal bleeding, tooth mobility 0–1, gingival recession ≤ 1 mm and no subgingival calculus; *moderate*, marginal bleeding (23), tooth mobility 1–2, gingival recession ≤ 2 mm and subgingival calculus or *severe*, bleeding on Probing (BoP+), tooth mobility 2–3, gingival recession ≥ 4 mm and subgingival calculus. An individual was classified as healthy (score 0) if no

moderate and/or severe signs of periodontal disease were found. Further, an individual was classified as severe (score 2) when showing $\geq 30\%$ of the teeth with severe signs of disease. Finally, remaining subjects were classified as having moderate periodontal disease (score 1).

Hyposalivation was assessed according to the following criteria based on the adhesiveness of a dental mirror placed onto the oral mucosa (22): none (score 0) = 'easily slides', moderate (score 1) = 'slip resistance' and severe (score 2) = 'trapped in the mucosa'.

Data analyses

Clinical parameters were compared between subjects with (score 2–5) and without (score 0–1) halitosis, using a 2-samples *t*-test (for means) or a chi-square test (for frequencies). The level of significance was set at 5%.

Results

General characteristics

The characteristics of the study population are described in Table 1. The mean age was high, 86.9 years (range 66–99 years). Most residents were females, and the mean number of years as resident at the nursing home was 2.7 years (range 0.3 – 3.2). The majority of the subjects suffered from one or more general disorders, the most frequent diseases being diabetes mellitus, myocardial infarction, stroke, dementia and arthritis. However, none of the residents suffered from general disorders, that is tonsillitis, reflux, malignant processes in the lung, liver and gastrointestinal tract reported to be associated with halitosis. Seventy-six residents were categorized as ADL 2 (partly help) or ADL 3 (help with everything) (Table 1).

Oral status

The oral conditions are presented in Table 2. The mean percentage of all tooth surfaces present with plaque was 41% (SD \pm 31%), and marginal gingival bleeding was 20% (SD \pm 28%). Twenty-two per cent were edentulous. Open cavities and root remnants were common. Moderate and severe periodontal conditions were observed in 77% of the dentate subjects. Periodontal disease was considered severe in 14% of the subjects assessed by visual inspection, that is gingival recession and tooth mobility. Forty per cent had fixed dentures, and 38% of the subjects had removable full and/or partial dentures. Hyposalivation (score 2) was observed in 11% of the subjects (Tables 2 & 4).

Oral hygiene habits

Most subjects (118) used a toothbrush. Of these, 88% used an ordinary toothbrush and the remaining subjects used an electric toothbrush. Twenty-three per cent of the subjects used interproximal cleaning devices (toothpick or interdental

brush) (Table 3), and 39% managed to carry out their oral hygiene without assistance. Twenty-three per cent used some form of mouth rinse, and of these, 48% subjects used a fluoride solution.

Table 1. Subject characteristics, ability for daily self-care and general health conditions

	No. (%)	Mean	Range
Age (years)	124	86.9	66–99
Male	28 (23)		
Female	96 (77)		
Number of years in nursing home		2.7	0.3–3.2
ADL			
1	48 (39)		
2	30 (24)		
3	46 (37)		
General Health			
CVD	67 (54)		
Diabetes	16 (13)		
Stroke	37 (30)		
COPD/Asthma	18 (15)		
Neurological disorder	15 (12)		
Dementia	45 (36)		
No general disease	17 (14)		
Number of medications		8.8	2–19

ADL, Activity of daily life.

CVD, Cardiovascular disease.

COPD, Chronic obstructive pulmonary disease.

Table 2. Oral status

	Subj. (%)	Mean (\pm SD)	Range
Teeth		18 (7.9)	0–30
Caries, open cavities	17 (14)	2.6 (3.4)	1–14
Root remnants	28 (23)	3.1 (3.1)	1–14
Plaque (%)	97 (78)	41*(31)	0–100
Gingivitis (%)	97 (78)	20*(28)	0–100
Calculus [†]			
0 none	53 (61)		
1 moderate	22 (25)		
2 abundant	12 (14)		
Periodontal disease [‡]			
0 healthy	22 (26)		
1 moderate	62 (70)		
2 severe	13 (14)		
Hyposalivation			
0 none	54 (43)		
1 moderate	57 (46)		
2 severe	13 (11)		
Halitosis			
0	9 (7)		
1	48 (39)		
2	39 (32)		
3	24 (19)		
4	4 (3)		
Fixed partial denture	50 (40)		
Full/partial denture			
Full	27 (22)		
Partial	14 (11)		
Full/partial	6 (5)		

*Mean percentage of surfaces with plaque or gingivitis.

[†]Data obtained from 87 individuals.

[‡]Data based on 97 dentate individuals.

Table 3. Dental care and oral hygiene aids

	No.(%)
Regular professional dental care	40 (32)
Oral care without assistance	48 (39)
Toothbrush	
manual	104 (84)
electric	14 (11)
Interproximal*	
brush	9 (9)
toothpick	20 (21)
Mouth rinse	
NaF	14 (14)
Other	15 (15)

*Based on 97 dentate individuals.

Prevalence of halitosis

Among the residents, 54% had halitosis (\geq score 2, Tables 2 and 4) whereas 62% were convinced that they suffered from halitosis according to the questionnaire.

A statistically significant association was found between halitosis grades 2 and 4 and the presence of hyposalivation (score 1 & 2; $P < 0.05$), periodontal disease ($P < 0.05$), calculus ($P < 0.02$), fixed prosthodontics ($P < 0.02$) and dementia ($P < 0.02$) (Table 4). There was no statistical difference in the prevalence of halitosis between the different nursing homes, neither was observed any statistical significant association between oral hygiene habits and halitosis.

Discussion

It was shown in the present study that halitosis was a frequent condition among elderly living in three Swedish nursing homes. All nursing homes fulfilled the quality requirements according to the Swedish National Board of Health and Welfare. The nursing homes were located in the city of Gothenburg and represented catchment areas with various socio-economic status. In two of the nursing homes, the majority of residents had lived in areas with high socio-economic status. The third nursing home was located in an area with lower socio-economic status. However, there was no statistical difference in the prevalence of halitosis between the different nursing homes.

Subjects with halitosis tended to have increased severity of periodontal disease, higher levels of calculus and were more likely to have hyposalivation, dementia and fixed prosthodontics than those without halitosis. These findings confirm the results from other studies (9, 24–26), but to our knowledge, however, the present study is the first to report a association between halitosis and dementia. A possible explanation could be that subjects suffering from dementia may have difficulties to manage their oral hygiene measures due to reduced oral motoric functions resulting in retention of food remnants and a lower oral clearance. Moreover, it is often very difficult for caregivers to assist a demented person with oral hygiene measures (27). Interestingly, most subjects in the present study had low-to-moderate plaque and gingivitis scores. In fact, the

Table 4. Distribution of various demographic and clinical parameters for subjects diagnosed with and without halitosis

Halitosis	All	0–1		2–5	P-value*
		Mean (SD)			
Age	86.9 (7.1)	87.4 (7.2)	86.4 (7.1)	NS	
Number of drugs	8.8 (3.8)	8.9 (3.3)	8.6 (3.2)	NS	
Years in nursery home	2.7 (3.2)	3.0 (3.6)	2.5 (1.7)	NS	
No of Teeth	18.0 (8)	16.4 (7.8)	18.9 (5.7)	NS	
Open cavities	2.6 (3.4)	4.3 (3.7)	2.1 (3.3)	NS	
Root remnants	3.0 (3.1)	3.5 (3.2)	2.9 (1.8)	NS	

	All	0–1		2–5	P-value†
		No(%)			
Gender					
Male	28	14 (24)	14 (21)	NS	
Female	96	43 (76)	53 (79)	NS	
Daily care (n = 110)					
0	56 (51)	27 (50)	29 (52)	NS	
1	26 (24)	13 (25)	13 (21)		
2	28 (25)	13 (25)	15 (27)		
Calculus (n = 86)					
0	52 (61)	24 (80)	28 (50)	<0.02	
1	22 (25)	5 (17)	17 (30)		
2	12 (14)	1 (3)	11 (20)		
Periodontal Disease (n = 97)					
0	22 (23)	13 (36)	9 (15)	<0.05	
1	62 (63)	21 (58)	41 (67)		
2	13 (13)	2 (6)	11 (18)		
Fixed partial denture (n = 124)					
0	74 (60)	41 (71)	33 (50)	<0.02	
1	50 (40)	17 (29)	33 (50)		
Hyposalivation (n = 124)					
0	54 (43)	31 (53)	23 (35)	<0.05	
1	57 (46)	24 (42)	33 (50)		
2	13 (11)	3 (5)	10 (15)		
Dementia (n = 124)					
0	79 (64)	43 (76)	36 (53)	<0.01	
1	45 (36)	14 (24)	31 (47)		

*Paired *t*-test

†Chi-square test.

level of oral hygiene was comparable to what often is reported in a younger population (28). Thus, the oral hygiene routines in these nursing homes seemed to be adequate. Our results indicate therefore that further studies focusing on the relationship between dementia, oral hygiene and halitosis are needed.

For the subjects in the present study, improved self-performed daily oral hygiene measures may therefore not be the only alternative to reduce the prevalence of halitosis. Most of the subjects had the ability to cooperate when oral hygiene was performed by caregivers, but were not able to carry out oral hygiene by themselves. This implicates that it may be possible to reduce their halitosis with methods carried out by caregivers or dental personnel. Examples of such measures are supra-/subgingival scaling, measures to reduce hyposalivation and/or the use of an antimalodor rinsing solution may also be effective alternatives.

Our observation of a high prevalence of halitosis in dependent elderly is in line with data from Samnieng *et al.* (17) who studied independently living elderly.

An interesting observation was that 62% of the subjects were convinced that they had halitosis which was higher than was observed with the organoleptic method. Provided that the organoleptic method reflects the presence of halitosis, this observation may be important. Subjects who are convinced that they suffer from halitosis may avoid closer contact with others, and as a consequence, their social relations could be impaired.

In retrospect, it would have been interesting also to assess and evaluate the presence of tongue deposits. Unfortunately, this was not included in the clinical examination. However, in a recent study Ademovski *et al.* (29, 30) showed that the use of tongue scraper did not provide long-term additional benefits compared to a mouth rinse containing zinc or chlorhexidine.

Another weakness in the present study is that all examinations were not performed at the same hours during the day. This was, however, not possible due to factors such as general health of the residents and the daily caring routines in the nursing homes. Despite this, our observations may be of importance as it cannot be ruled out that halitosis could be a negative factor affecting the caretaking of an individual suffering from this condition. Further research on halitosis and its effect in the care of residents in nursing homes would be of value. Particularly interesting is the resident's social relationship with the staff and relatives. Most findings in the present study that show an association with halitosis, that is dry mouth, periodontal disease, fixed prosthodontics and calculus, are conditions which may be possible to influence by the dental profession and the nursing staff in collaboration.

Conclusion

Halitosis was observed in >50% of the nursing home residents. An association was found between halitosis and hyposalivation, periodontal disease, presence of calculus, fixed prosthodontics and dementia.

Clinical relevance

Scientific rationale

Up to 30% of the population consider halitosis to be a problem. The prevalence of halitosis in elderly is not systematically studied.

Principal findings

Halitosis occurred in over 50% of residents living in nursing homes and was found to be associated with presence of hyposalivation, periodontal disease, calculus, fixed prosthodontics and dementia.

Practical implications

Bad breath may affect the daily nursing care if nursing staff hesitates to perform oral hygiene measures due to this condition, which may lead to worsening problems and a gradually deteriorating oral health.

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