# The influence of oral hygiene and health on oral malodour

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## Abstract

**Schulze A, Pökel C, Busse M. The influence of oral hygiene and health on oral malodour (CSMI) 2013, 6(1): 14-17.**

**Purpose**
To assess the influence of oral health and lifestyle on the prevalence of oral malodour among university students, considering gender differences. Halitosis may indicate gingivitis, which is a precursor of periodontitis, or even a possible whole body inflammation. This, in turn, may increase the risk of cardiovascular and metabolic diseases and decrease performance.

**Methods**:
30 female and 27 male students underwent a clinical oral examination and completed an oral hygiene and halitosis self-questionnaire. Screening periodontal parameters included the gingivitis (GI), papillary bleeding index (PBI), and visible plaque index (VPI), periodontal screening and recording (PSR) and probing pocket depth (PPD). The plasma levels of C-reactive protein, interleukin-6, triglyceride, cholesterol, HDL, LDL as well as specific anthropometric data were measured. Halitosis was assessed with a halimeter (RH-17) that determines the concentration of volatile sulphur compounds in expired breath.

**Results**
The results highlight the influence of oral self-care and lifestyle on malodour. Oral malodour was found in 42 % of the students (219.25 ± 188.80 ppb) and corresponded with the incidence of insufficient oral hygiene and gingivitis, which are preconditions for future periodontitis in this age, too. Values higher than 100 ppb speak for an unpleasant or offensive odour emanating from the breath. Halimeter measurement showed no significant gender difference (female: 149.20 ± 171.46 ppb, male: 124.38 ± 98.4 ppb). Four students had a score > 250 ppb (517 ± 346.64 ppb).

**Conclusions**:
Concerning intense oral and dental hygiene, media pays special attention to young generations. This study revealed a high incidence of oral malodour and a low level of oral hygiene in students in the mid-twenties. Public awareness, diagnosis and treatment of malodour are very important. Malodour can have a distressing effect. The affected person may avoid socializing and is primarily oral health warning.

**Key words:** halitosis, periodontal disease, oral hygiene, oral malodour

## Introduction

Halitosis is a general term used to define an unpleasant or offensive odour emanating from the breath that originates from oral or non-oral sources and may decrease self-confidence and social interactions. The major cause for oral halitosis is poor oral hygiene due to gingivitis or periodontitis. Other causes include bacterial accumulation on the posterior tongue, tonsillitis and others. Dry mouth has been implicated as a potential cause of halitosis. It is a contributing factor in other chronic diseases such as sinusitis or is induced by radiation. This disorder is regularly affecting an estimated 10-30 % of the population and can affect peoples of all ages. Malodour is the consequence of microbial (mainly gram-negative bacteria) breakdown of food debris, cells, saliva and blood. The agents that give rise to halitosis especially include the volatile sulphur compounds (VSC), diamines and short-chain fatty acids of which only the VSC can be detected in the clinical setting by using a halimeter.

The prevalence of malodour / halitosis was investigated among students in their mid-twenties in connection with their oral hygiene, oral health, lifestyle and gender.

## Methods

30 female and 27 male students participated in this study.The clinical dental examination was done by a single dentist to avoid differences in the measurements and all participants have not been clients before. Laboratory analyses were performed 8h after a 12h overnight fast. Concentrations of IL-6 and C-reactive protein were measured as well as the lipid profiles (triglycerides, cholesterol, high- and low-density lipoproteins (HDL, LDL)) and biometric data, dental and periodontal parameters and oral malodour were assessed with a halimeter in combination with a specific halitosis questionnaire.

Breath malodour was measured in the 57 students by using the halimeter RH-17, which detects volatile sulphur compounds (VSC) in expired breath such as hydrogen sulphide ($H_2S$), methyl mercaptan ($CH_3$)SH, dimethyl sulphide ($CH_3$)$_2$S and dimethyl disulphide (($CH_3$)S)$_2$. Calibration was focused on the principal component hydrogen sulphide ($H_2S$). The range of the halimeter measurement amounts to 0-2000 ppb hydrogen sulphide ($H_2S$). The concentration of all volatile sulphur compounds in expired breath was summarized measured without precise distinction (Ansyco GmbH).

Each subject underwent three halimeter measurements and the mean score was used for calculations.

**Questionnaire**

All self-questionnaires were filled out before the intraoral examination. The self-questionnaire (1) contains 20 items covering psychological stress, physical discomfort, psychological discomfort, physical disability, social disability, oral hygiene behaviour and experience with oral malodour.

**Dental and periodontal status**

The intraoral examination with special attention to periodontal tissues and plaque accumulation was done by a single dentist in the morning after the blood samples were taken. The following scores were measured: periodontal screening and recording (PSR), probing pocket depth, papillary bleeding index (PBI), visible plaque index (VPI) and gingival index (GI). The tooth position and the number and extent of dental restorations were also registered.

All data are presented as means ± SD. The tests of significance included the t-test for two independent groups with normal distributed data and the Wilcoxon rank-sum test for non-parametric data. A p-value $< 0.05$ was considered to indicate significance, $p < 0.01$ was accepted as very significant and $p < 0.005$ as extremely significant.

## Results

30 female (mean age 23.33 ± 2.80 years) and 27 male students (mean age 24 ± 2.48 years) were enrolled in the study. Biometric data, inflammatory and blood lipid parameters are shown in Table 1.

Male participants had extremely significant lower values of s-CRP and HDL than female participants ($p < 0.0006$ and $p < 0.0001$), whereas the triglycerides and cholesterol levels were significantly lower.

Halimeter measurement showed no significant gender difference. Females had a value of 149.20 ± 171.46 ppb, and males of 124.38 ± 98.45 ppb. Values above 100 ppb speak for a noticeable oral malodour. 24 of the students (42 %) had halimeter values higher than 100 ppb (219.25 ± 188.80 ppb). The remaining 33 students had an average value of 77.45 ± 11.57 ppb and 2 female and 2 male participants presented halimeter values higher than 250 ppb (mean average 517 ± 346.64 ppb).

**Tab. I: height (m), weight (kg), BMI, C-reactive protein (s-CRP in mgxl$^{-1}$), interleukin-6 (IL-6 in pgxl$^{-1}$), triglyceride (Trigl.), cholesterol (Chol), high densitiy protein (HDL) und low-density protein (LDL) in mmolxl$^{-1}$ and significances (p) in gender comparison (f = female, m = male).**

| | height | weight | BMI | s-CRP | IL-6 | Trigl | Chol | HDL | LDL |
|---|---|---|---|---|---|---|---|---|---|
| f | 1.67±0.07 | 61.24±8.2 | 21.83±2.1 | 2.49±5.50 | 2.40±1.63 | 1.04±0.54 | 4.83±0.88 | 1.88±0.29 | 2.72±0.83 |
| m | 1.79±0.07 | 74.62±8.5 | 23.29±2.3 | 0.41±0.20 | 2.31±0.81 | 0.77±0.31 | 4.23±0.66 | 1.50±0.21 | 2.61±0.87 |
| p | | | | <0.0006 | n.s. | <0.03 | <0.015 | <0.0001 | n.s. |

**Tab. II: number of teeth (n), existence of calculus (%), periodontal screening and recording index (PSR), visible plaque index (VPI), existence of plaque on all teeth (%), in the maxilla and mandible (%), and gingival index (GI according to Loe and Silness) and the significances (p) in gender comparison (f = females, m = males).**

| | number of teeth | calculus | PSR | VPI | plaque on all teeth | plaque in maxilla | plaque in mandible | GI |
|---|---|---|---|---|---|---|---|---|
| f | 28.30±1.62 | 20% | 0.07±0.13 | 1.00±0.78 | 60% | 63% | 73% | 0.25±0.43 |
| m | 29.15±1.90 | 41% | 0.13±0.17 | 1,17±0.75 | 63% | 67% | 82% | 0.48±0.58 |
| p | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. |

No significant gender differences were found in the periodontal status and quantity of plaque.
In male participants the wisdom teeth were found more often, significance was found for the lower (38 and 48 ($p < 0.01$ and $p < 0.03$)). Anterior crowding was more frequent in the mandible.

**Tab. III: Existence of teeth 18, 28, 38, 48 and anterior crowding in mandible and maxilla (AC maxilla, AC mandible in %) and the significances (p) in gender comparison (f = females, m = males).**

| | 18 | 28 | 38 | 48 | AC maxilla | AC mandible |
|---|---|---|---|---|---|---|
| f | 23 % | 27 % | 17% | 23% | 10% | 30% |
| m | 48 % | 48 % | 48% | 52% | 3% | 26% |
| p | n.s. | n.s. | <0.01 | <0.03 | n.s. | n.s. |

**Tab. IV: Average number (n) of teeth with papillary bleeding index (PBI 1-4) and the significances in gender comparison (f = females, m =males).**

| | PBI 1 (n) | PBI 2 (n) | PBI 3 (n) | PBI 4 (n) |
|---|---|---|---|---|
| f | 2.33±2.56 | 4.43±4,22 | 0.47±1.14 | 0.03±0.18 |
| m | 2.48±2.05 | 4.33±3.49 | 0.67±1.21 | 0.11±0.32 |
| p | n.s. | n.s. | n.s. | n.s. |

No significant differences were found in the papillary bleeding index and periodontal status. No periodontal disease was diagnosed.
All halitosis questionnaires were completely filled out and were returned to the research staff.
No significant gender differences were found in the questionnaire reply.

**Tab. V: Stress at university (%), stress frequency (1 = little, 2 = average, 3 = much, 4 = very much), frequency of daily tooth brushing, percentage distribution of the following parameters: self-detected tongue coating, use of dental floss, tongue cleaning, gingival bleeding, use of mouthrinse, xerostomia, rhinitis, allergy, smokers, diet, stomach trouble, self-detected halitosis, sinusitis, bronchitis, social problems due to halitosis in females and males and the significances between gender (p).**

| | stress at university | stress frequency | tooth brushing per day | self-detected tongue coating | use of dental floss | tongue cleaning | gingival bleeding |
|---|---|---|---|---|---|---|---|
| f | 30% | 2.03±0.62 | 2.07±0.39 | 27% | 40% | 37% | 13% |
| m | 22% | 1.65±0.59 | 2.11±0.35 | 48% | 44% | 48% | 15% |
| | | | | | | | |
| | use of mouthrinse | xerostomia | rhinitis | allergy | smokers (n) | diet | stomach trouble |
| f | 20% | 13% | 10% | 23% | 0 | 0% | 30% |
| m | 41% | 7% | 30% | 33% | 3 | 0% | 19% |
| | | | | | | | |
| | self-detected halitosis | sinusitis | bronchitis | social problems due to halitosis | orthodontic treatment | | |
| f | 20% | 27% | 23% | 0% | 60% | | |
| m | 11% | 26% | 37% | 0% | 48% | | |
| | | | | | | | |
| p | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. |

## Discussion

During the dental examination and treatment of many adolescents, oral malodour was apparent in so many patients visiting our office that it gave rise to more detailed investigations in this age group. This is where the relevance of dental preventive medicine derives from. It also especially applies regarding the question whether there are already signs of gingivitis and periodontitis.
This first examination with a small study population already confirms the subjective impression of increased incidence in objective measurements of students, whereas at least tendential differences between men and women become apparent. Halimeter examination for the measurement of mouth odour showed no significant differences between the groups. In female students it amounted to 149.20 ± 171.46 ppb and in male students to 124.38 ± 98.45 ppb. In the total study population, a value of over 100 ppb could be measured in 24 of the students (42 %) speaking for a perceptible mouth odour (219.25 ± 188.80 ppb). The other 33 subjects had a value of 77.45 ± 11.57 ppb. In a total of 4 students from the population, values of over 250 ppb (intense odour) (517 ± 346.64 ppb) could be determined.
Altogether, the self-perception of mouth odour in female students was twice as high (20 %) than in male. The perception of gum bleeding was in both groups at approx. 15 %. 48 % males and 27 % females complained and

detected tongue coating. No significant gender differences could be found in oral hygiene behaviour. These tendencies are so obvious that additional studies had to be performed using a higher collective of 500 subjects to draw statistical conclusions. Furthermore, an ineffective practice of oral and dental hygiene was revealed. Only 40 % of the female students and 44 % of the male students used dental floss and tooth cleaning was performed by 37 % or 48 %. Calculus was detected more frequently in men (41 %) than in women (20 %) and papillary bleeding after probing could often be detected in both groups, especially at a visible plaque accumulation in the mandible (73-82 %) and the maxilla (63 - 67 %).

## Conclusion

Media pays keen attention to the younger generation regarding thorough mouth and dental care behaviour. In this first attempt of objectivization, it can be recognized that oral hygiene in students in their mid-twenties is not on the desired level. In 42 % of the examined people, a perceptible mouth odour was measurable. In percentage, this almost conforms to the incidence of insufficient mouth and dental care and the appearance of gingivitis that was observed too. Indications of future periodontal diseases were already found in this age group.

As a result, there is the necessity of intense mouth hygiene instructions in this age group, even though these groups have a great interest in clothing and lifestyle and learn a lot about strong body consciousness during their studies of sports science. 48 % of the male and 60 % of the female students underwent orthodontic treatment. This basically indicates interest in an attractive dental state but it did not result in an appropriate dental and mouth caring behaviour. The different approaches of this study need to be further solved. Only a considerable bigger study population and the determination of further parameters may clear the reason-effect relationship between the local and systemic parameters and the mouth odour. We will report about this in the future.

## References

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