

Short communication

Comparison of the oral health status and salivary flow rate of asthmatic patients with those of nonasthmatic adults – results of a pilot study

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The oral health status and stimulated salivary flow rate of 33 adult asthmatic outpatients were compared with those of 33 nonasthmatic controls. The groups were matched by age and sex, and an adjustment for education was made in the statistical analysis. In the oral examination, a small difference in the prevalence of caries was observed when the sums of decayed, missing, and filled teeth (DMFT) were compared. The mean (SD) crude DMFT score was 20.1 (5.8) in the asthma group and 18.4 (7.6) in the control group. A statistically significant difference was seen in the amount of periodontal inflammation and in the stimulated salivary flow rate between the groups. The mean (SD) crude periodontal status index (PSI) was 52.7% (23.8%) in the asthmatics and 37.1% (20.4%) in the controls. The 95% confidence interval (95% CI) for the difference in adjusted means of PSI ranged from 0.1% to 21.9% ($P=0.05$). In the stimulated salivary flow rate, crude mean values were 1.0 (0.5) ml/min and 1.3 (0.5) ml/min, respectively, and the 95% CI for the difference was from 0.05 ml/min to 0.57 ml/min ($P=0.01$). Mucosal lesions in the oral cavity were found in 15 asthmatics (45%) and in eight controls (24%). In conclusion, the results of this study support the hypothesis that adult asthmatics have a higher risk of oral diseases than nonasthmatic subjects.

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According to some reports, asthmatic patients suffer more from the two main oral diseases, caries and periodontal disease, than nonasthmatic subjects (1–3). This increased risk has been linked to the regular use of inhaled sympathomimetics for the treatment of asthma (2). Those reports indicating an increased risk are obtained primarily from studies of asthmatic children and adolescents. To our knowledge, there are no publications concerning the oral health of adult asthmatic patients. Because modern asthma treatment is based on inhaled drugs, especially steroids, patients often worry about harmful effects on the mouth. The aim of this pilot study was to investigate the oral health

status and stimulated salivary flow rate of a group of adult asthmatic and nonasthmatic subjects.

Material and methods

Subjects

Thirty-seven asthmatics were enrolled from among outpatients of the Clinic of Pulmonary Diseases, Tampere University Hospital (TUH), Finland. The inclusion criteria were age between 25 and 50 years, having diagnosed asthma, and living in the pre-defined geographic area. Patients taking medication for psychiatric diseases were excluded, as were

those with diabetes or any other disease which may directly or indirectly affect the oral cavity. Thirty-five nonasthmatic subjects were enrolled as controls both from among subjects who visited the Occupational Health Care Center of Tampere for regular checkups ($n=29$) and from among medical students at Tampere University ($n=6$). The inclusion criteria were the same as for the asthmatics except the diagnosed asthma. The exclusion criteria were also the same. The controls were matched with asthmatics by age and sex. Before enrolling in the study, all subjects were given oral and written information on the study, and written, informed consent was obtained from each subject. The study was carried out according to the Declaration of Helsinki and was approved by the ethics committee of TUH.

Study procedures

The severity of the disease in asthmatics was graded as follows: mild if short-acting sympathomimetics were used only as needed; moderate if a low dose of inhaled corticosteroids (less than 1 mg/day) was taken regularly, and severe if moderate or high doses of inhaled steroids were taken regularly. The asthmatics were classified as atopic if they had had at least one positive reaction in the skin prick test series of 14 common allergens, or if they had had elevated serum IgE concentrations (over 100 IU/l).

Before visiting a dentist, the subjects filled in a questionnaire on their backgrounds including education, professional training, place of residence, smoking history, alcohol intake, sugar consumption, oral hygiene habits (tooth brushing and use of dental floss, toothpicks, and mouthwashes), and the use of dental services.

Oral examinations

Oral examinations were carried out according to WHO guidelines (4). Subjects visited the dental surgeon in the morning at 0800–1000. The following items were recorded: filled teeth, missing teeth, decayed teeth, periodontal status, and the condition of oral mucous membranes (cheeks, tongue). In the recording of periodontal status, a single tooth was scored as periodontally inflamed if any of the following signs was present: gingival bleeding after probing, presence of dental calculus, or periodontal pocket depth of over 4 mm. The secretion of saliva was stimulated by chewing a piece of paraffin wax during a collection period of 5 min. The stimulated salivary flow rate (SSFR) was expressed as ml/min. The pH of the secreted saliva was measured with a dip slide (pH Indicator, Merck, Germany) immediately after collection.

Statistical analyses

The sum of decayed, missing, and filled teeth (DMFT) was calculated for each subject (5). The individual periodontal status index (PSI) was obtained by dividing the number of teeth with inflamed periodontal tissues by the number of all remaining teeth; the quotient is expressed as a percentage. The frequency of sugar intake was estimated by the sugar consumption index (SCI). In the questionnaire, the subjects were asked how often they consumed sweets, sugar, soft drinks, or sweet pastries. The answers for each item were scored from 0 to 4: 0=never; 1=once weekly or less; 2=two to six times weekly; 3=once or twice daily; and 4=more than twice daily. For the calculation of the SCI, these scores were summed. For the calculation of the oral health care index (OHC), the subjects entered scores for the frequency of tooth brushing and use of toothpicks, dental floss, and fluoride-containing mouthwashes (scale 0–4) in the questionnaire. In addition, a score measuring the frequency of visits to the dentist (scale 0–3) and the frequency of the use of fluoride-containing toothpaste (scale 0–2) were recorded. The OHC was calculated as a sum of these scores.

The statistical significance of the differences between the groups in SSFR, salivary pH, DMFT, and PSI was tested by analysis of covariance where the length of education was used as a covariate. The SCI and OHC were tested by the Wilcoxon rank sum test. Moreover, the 95% confidence interval (95% CI) for differences between the adjusted means of SSFR, salivary pH, DMFT, and PSI was calculated. All computations except 95% CI were performed with the BMDP statistical package (Version 1990). The 95% CI was calculated by the Confidence Interval Analysis (CIA) program running on a PC (Version 1.1). In statistical tests, a two-sided P value of ≤ 0.05 was considered statistically significant.

Results

Subject characteristics

Thirty-three asthmatics (24 female and nine male) of the 37 eligible were included. Four were excluded due to lack of a suitable control partner. The mean (SD) age was 36.0 (7.4) years in asthmatics and 36.5 (7.1) in controls. The mean duration of asthma was 5 years (range ≤ 1 –24 years), and in 16 asthmatics the diagnosis had been made less than 1 year before. In five asthmatics, the disease was graded as mild, in 22 as moderate, and in six as severe. Twenty-one subjects in the asthma group were atopic.

The groups were comparable in smoking habits and the frequency of alcohol intake, but differences between the groups were found in education and professional training (Table 1). In general, the subjects visited dentists regularly; the median time from the last visit was 1 year for both groups. The frequency of sugar intake was higher among the controls than among the asthmatics. The median SCI was 5 in the asthma group and 7 in the control group ($P=0.009$ for the difference between the groups). In the OHC, there was also a statistically significant difference between the groups ($P=0.007$): the medians were 7 and 8 in the asthmatics and controls, respectively.

Oral health

In the mean SSFR, there was a statistically significant difference between the groups (Table 2). No such difference was seen in salivary pH. The mean (SD) crude pH was 7.9 (0.4) in the asthmatics and 8.1 (0.3) in the controls. The mean (SD) crude DMFT scores were 20.1 (5.8) and 18.4 (7.6), respectively. Eighteen asthmatics had one or more decayed teeth, compared to 16 controls. When only the subjects with two or more decayed teeth were taken into account, the numbers were nine and two for asthmatics and controls, respectively. The asthmatics had higher PSI scores than the controls, and the difference between the groups was statistically significant (Table 2).

Fifteen asthmatic subjects had oral mucosal lesions, and 10 (67%) of these patients were atopic. Similar lesions were observed in eight control subjects. The most common mucosal findings were found on the tongue (lingua geographica and fissured tongue).

Discussion

The asthmatics in this study had a greater incidence of periodontal disease and slightly more dental caries than the nonasthmatic controls. A significant difference in the stimulated salivary flow rate was found between the groups. Salivary pH was slightly higher in the controls than in the asthmatics, and oral mucosal lesions were more common among asthmatics than among controls. As indicated by the OHC, there was a difference in oral hygiene habits between the groups which may have biased the study. In view of this, as well as the limited number of subjects in this pilot study, the results should be interpreted with caution.

In periodontal disease, the host response via the immune defense system is considered important (6, 7). Although the role of allergy is not clear, IgE-mediated mechanisms are supposed to be involved

Table 1. Numbers (percent proportion) of subjects in different categories of basic education, professional training, smoking, and alcohol consumption

	Asthmatics	Controls
Education		
6 years or less	10 (30)	5 (15)
9 years	9 (30)	3 (9)
12 years	14 (40)	25 (76)
Professional training		
Un- or semiskilled	13 (39)	6 (18)
Skilled workers	6 (19)	2 (6)
Lower white collar	13 (39)	15 (46)
University degree	1 (3)	10 (30)
Smoking history		
Never	19 (58)	19 (58)
Ex-smokers	4 (12)	9 (27)
Current smokers	10 (30)	5 (15)
Frequency of alcohol consumption		
Never	5 (15)	1 (3)
Once monthly or less	13 (40)	10 (30)
2-4/month	11 (33)	18 (55)
2-3/week	4 (12)	4 (12)

Table 2. Adjusted mean (SD) of stimulated salivary flow rate (SSFR); salivary pH; sum of decayed, missing, and filled teeth (DMFT); and periodontal status index (PSI) and 95% confidence interval (95% CI) for differences between means. *P* values were obtained from analysis of covariance

	Asthmatics	Controls	95% CI	<i>P</i> value
SSFR (ml/min)	1.0 (0.5)	1.3 (0.5)	-0.6 to 0.0	0.0103
Salivary pH	7.9 (0.4)	8.1 (0.4)	-0.4 to 0.0	0.0630
DMFT	19.3 (5.8)	18.9 (7.3)	-2.2 to 3.0	0.8253
PSI (%)	50.3 (23.7)	39.4 (20.4)	0.9 to 20.9	0.0462

in the pathogenesis of gingival and periodontal diseases (8, 9). In patients having birch pollen allergy, an increased amount of gingivitis was observed during the pollen season when compared with the off-season (10). Platelet-activating factor, one of the mediators of allergic inflammatory reactions, is also present in inflamed gingival tissues (11). Interestingly, some of the cytokines which mediate inflammatory processes in the mucous membranes of airways are also found in inflamed periodontal tissues. Gingival mononuclear cells obtained from adult patients with chronic periodontitis can produce increased amounts of interleukin (IL)-5 and IL-6 (12). Recently, it has been reported that there is a general defect in the mucosal permeability of asthmatics, independently of atopic status (13). Taken together, it seems that inflammation processes in both asthma and periodontal diseases share partly similar pathophysiologic features, a fact which may in some degree explain the increased prevalence of periodontal inflammation in asthmatics.

In contrast to other reports (2), only a very small difference was seen in DMFT scores in favor of the

controls in our study. However, the higher proportion of subjects in the asthma group having several decayed teeth indicates that the morbidity of caries may differ between asthmatics and nonasthmatics. In the development of caries, diet, especially the frequency of sugar intake, plays a crucial role. In our study, asthmatics had slightly higher DMFT scores despite their significantly lower SCL.

A clear difference between the groups was found in SSFR. This is consistent with previous findings (2). The decreased salivary flow rate among asthmatics has been linked to the regular use of sympathomimetic drugs (14). The regulation of saliva secretion is a complex system involving at least adrenergic, cholinergic, and nonadrenergic, noncholinergic nerves. Hormonal status and several neuropeptides also affect both the synthesis and secretion of saliva. Adrenergic nerves primarily regulate protein synthesis in salivary glands (15), and the stimulation of β -receptors of salivary gland cells *in vitro* leads to enhanced protein synthesis (16). On the other hand, the intake in healthy volunteers of a single dose of beta-blocker resulted in decreased salivary protein concentrations, while no effect was seen on the salivary flow rate (17). Asthmatics in the present study used inhaled sympathomimetics on an as-needed basis only and were less exposed to these drugs than the asthmatics in earlier studies. Thus, asthma medication is probably not the only explanation of the decreased SSFR seen in our study.

In conclusion, the results from this study support the hypothesis that asthmatic patients have a higher risk of oral diseases than nonasthmatic subjects. We shall deal with this issue in later studies.

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