Oral hygiene and dental health as part of an occupational health examination

Schulze A[1], Pökel Ch[2], Busse M[2,3]

Sports Dentistry[1], General Outpatient Ambulance[2] of the Institute of Sports Medicine, University of Leipzig
([1]Head: Antina Schulze, DDS)
([3]Director: Prof. Martin Busse, MD)

Abstract

Schulze A., Pökel Ch., Busse M. Oral hygiene and dental health as part of a workplace health examination *Clinical Sports Medicine International (CSMI)* **2015, 8: 6-11**

Introduction
Workplace health promotion becomes more and more important, especially concerning nutrition, physical activity and exercises but also social components. However, dental health is often not taken under consideration, although oral health may influence work efficiency and life quality. Such mechanisms could be pain, effects on nutrition and mental wellbeing but also increased systemic inflammatory stress. Aim of the examination was to determine the overall condition and the perception of oral health in terms of introducing components for the promotion of oral health but also for the establishment of long-term oral hygiene programs.

Material and Methods
89 persons from a real estate management company volunteered on the health examination (57 women at an average age of 48.2 ± 9.4 years and 32 men at an average age of 45.1 ± 8.8 years). The participants underwent a general physical examination and filled out questionnaires about their physical activity, stress level, oral hygiene and state of health. Out of a total of 89 participants, 49 women and 30 men received an oral health examination during which the following parameters were determined: Gingival Index according to Löe and Silness (GI), visible Plaque Index (PI), periodontal probe depths, Periodontal Screening and Recording (PSR), Papillary Bleeding Index (PBI), number of teeth and mobility grade. All participants received their diagnosis, dental hygiene instructions and a group presentation about the results and the consequences of chronic inflammatory stress and its consequences for systemic diseases. A follow-up examination was performed 6.5 months later.

Results
Oral hygiene: 56 % of the female participants and only 12 % of the male participants used dental floss for cleaning interdental spaces. Women cleaned their tongue (26 %) and used mouthwash solution (39 %) twice as often as men. There were no differences in the frequency of daily tooth cleaning (twice per day), the determination of coating of the tongue (14 % in women and 18 % in men) and gingival bleeding (26 % in women and 24 % in men).
Oral health: The average number of teeth was 26.4 ± 4.3 in women, and 27.3 ± 4.9 in men. Women had significantly less calculus ($p < 0.02$) and visible plaque (PI) ($p < 0.02$) and the number of teeth with bleeding index 3 was also significantly lower ($p < 0.04$). Women used dental floss markedly more often than men ($p < 0.0001$). Periodontitis was diagnosed in 11 women (22.4 %), 5 of them were already informed about it by their family dentist, in comparison to one of 30 men who was not previously informed. 21 women underwent a follow-up and showed a highly significant improvement of their gingivitis (GI: $p < 0.004$), papillary bleeding grade 2 (PBI 2: $p < 0.002$) and a decreased plaque amount (PI: $p < 0.04$). Only 8 men came to the follow-up examination, so a comparison was not possible.

Conclusion
The occupational oral health examination showed a better behavior towards oral hygiene in the 49 female participants with significantly less plaque and calculus and a lower papillary bleeding index of 3. However, in 22.4 % (n = 9) periodontitis was diagnosed and only half of them have already been informed about it by their family dentist. In one of the 30 male participants periodontitis was newly detected. Females showed a highly improved oral health in the follow-up examination, whereas only 8 men participated on the follow-up, making a comparison impossible.

Keywords: Oral health, oral hygiene, periodontitis, company health examination, company health scheme

Introduction
Workplace health promotions often neglect the aspect of dental health and chronic inflammatory stress caused by dental and oral diseases, which have remote effects, lead to performance reductions and have systemic effects on other organs and organ systems. Clinical examinations, for example, indicate a three-time higher risk for apoplexies and a double risk for myocardial infarction in persons with periodontitis. So oral hygiene/oral health is the third column of health promotion, which is usually more oriented towards activities, nutrition and psychological factors. In the scope of this operational examination, the overall health, the perception and the continuing behavior of the participants (follow-up) were examined. The aim is to introduce and establish components for oral health in workplaces on a long-term basis, similar to the habit of hand washing after eating. It is well known, that pure information and health education have no permanent effect. It is also known for behavioral therapy in the context of health-promoting measures that information about the importance of health-promoting measures in general does not lead to relevant behavioral changes in the addressed patient groups. From the point of view of behavioral medicine it is always necessary to generate a very special motivation to achieve a desired behavioral change, and this motivation often has nothing to do with the actual aim of the behavioral change. Basically, such motivational factors have enhanced markedly in dental medicine during the last decades. So, a pleasant and attractive appearance is often connected with attributes such as a beautiful smile, white teeth and healthy gingiva.

Methods
Patient collective and clinical oral examinations
Workplace health examination was performed in a total of 89 persons of a real estate management company on a voluntary basis. All participants filled out a questionnaire before the clinical examination. The questionnaire included questions about physical activity, stress sensitivity, nutrition, health consciousness and oral hygiene behavior. It was also asked for the frequency of tooth brushing, the use of dental floss and mouthwash solutions and for tongue cleaning. Subsequently, 79 persons participated on a dental-oral examination: 57 women between 40 and 61 years (Mean value (MV): 50.4 ± 6.2 years, weight: 71.9 ± 12.9 kg, body height: 165 ± 6.1 cm, BMI: 26.4 ± 4.4, waist circumference: 89.3 ± 13.8 cm) and 32 men between 36 and 63 years (MV: 46.8 ± 7.58 years, 46.8 ± 7.6 kg, body height: 180.2 ± 6.1 cm, BMI: 26.6 ± 3.5, waist circumference: 95.4 ± 10.1 cm). The following parameters were measured: Gingival Index (GI: degree 0 - 3: no, slight or moderate or severe gingival inflammation), papillary bleeding index (PBI: degree 0 - 4: no bleeding, bleeding points, more bleeding points or blood line, filling of the interdental triangle with blood, strong bleeding after probing), Probing Pocket Depth (PPD), Periodontal Screening and Recording (PSR), visible plaque (PI: degree 0 - 3), number of teeth and wisdom teeth, presence of calculus and incisor crowding. The oral examinations were carried out by only one dentist. After finishing the examination, the patients were informed about the results and received an oral hygiene instruction, including the use of dental floss or interdental space brushes. All results were given in a power point presentation and it was especially indicated that chronic inflammatory stress in dental-oral diseases may have remote effects and systemic impacts on other organs and organ systems and may also be a factor in the development of arteriosclerosis. After 6.5 months a follow-up examination followed. 21 women and 8 men participated on the follow-up examination.

Statistics: Every statistical analysis was made with GraphPad InStat 3 (GraphPad Software Inc., California, USA). Student`s t-test and Chi-Square-Test was used. The following significances were set: $p \leq 0.05$ significant, $p \leq 0.01$ very significant, $p \leq 0.001$ markedly significant.

Results
In the first part, the results of the initial examination are presented together with gender differences. In the second part, the results of the follow-up examination of 21 women are compared with the first results. The success of the oral hygiene instruction and the informing about findings and diseases are documented in the second part, too.

I. Initial examination
Questionnaire
57 women (MV: 48.2 ± 9.4 years) and 32 men (MV: 45.1 ± 8.8 years) filled out the questionnaire about oral health. 8 women and 4 men were smokers. On average, both groups conceived a high or medium stress intensity (women: 2.3 ± 0.8 vs. men 2.4 ± 0.7). An overview of the information about tooth care can be seen in table 1. It was extremely significant that women used dental floss for interdental space cleaning rather than men ($p < 0.0001$). Concerning the other parameters, the differences in dental care behavior was not significant. Five women but no men reported that they have periodontitis.

Clinical examination/dental health
49 women between the age of 39 and 62 years (MV: 50.4 ± 6.2 years) and 30 men between the age of 37 and 63 years (MV: 46.8 ± 7.6 years) volunteered on the dental-oral examination. Table 2 shows the dental health of both groups, however, there were no significant differences. There were also no significant differences in the number of teeth, number and size of the fillings and the filling material. There was, however, a difference in the number of amalgam fillings, which, on average, was significantly higher in men ($p < 0.03$). In both groups the caries restoration degree was very high with 98 %. The mean MT value (missing teeth) amounted to two teeth and was not significant. Women and men of the group of 35 to 44 year olds had a mean of 0.5 missing teeth in total. Female and male participants between the age of 45 and 64 years had

an average of 2.34 ± 4.32 missing teeth. The mean FT value (filled teeth) showed no significant difference between men and women. All participants, separated by age groups of 35 - 44 years and 45 - 64 years, had mean FT values of 9.16 ± 4 and 9.56 ± 5.49.

Men showed significantly more plaque (PI) and calculus ($p < 0.02$). There were no significant differences in the localization of plaque between the groups (table 3).

Tab.1: Frequency of tooth cleaning (number/day), presence of self-detected tongue coating and gingival bleeding, use of dental floss and mouthwash solution, frequency of tongue cleaning and sensibility for xerostomia (all in %) in comparison between women and men.

	frequency of tooth cleaning n/day	coating of the tongue (%)	gingival bleeding (%)	use of dental floss (%)	mouthwash solution (%)	tongue cleaning (%)	Xerostomia (%)
women n = 57	2.0 ± 0.3	14	26	56	39	26	10
men n = 32	1.94 ± 0.4	18	24	12 $p < 0.0001$	21	12	6

Tab. 2: Presence of single wisdom teeth (%), number of teeth (n), anterior teeth crowding in the upper jaw (UJ) and lower jaw (LW) (%) and number of amalgam fillings, number of the missing teeth (MT) and filled teeth (FT) in the examined women and men.

	18 (%)	28 (%)	38 (%)	48 (%)	number of teeth (n)	anterior tooth crowding, UJ (%)	anterior tooth crowding, LJ (%)	number of amalgam fillings (n)	MT (n)	FT (n)
women n = 49	26.5	20.4	32.6	42.8	26.4 ± 4.3	22.4	38.8	3.18 ± 3.44	2.2 ± 3.8	9.1 ± 5.4
men n = 30	36.7	36.7	50	50	27.3 ± 4.9	23.3	50	5.43 ± 4.33 $p < 0.03$	1.7 ± 4.4	10.3 ± 4.6

Tab. 3: Plaque Index (PI), prevalence (%) of plaque: lingual, palatal, buccal in the upper jaw (UJ) and lower jaw (LJ) and calculus in the examined women and men.

	Plaque Index (PI)	Plaque, lingual (%)	Plaque, palatal (%)	Plaque buccal in the UJ (%)	Plaque buccal in the LJ (%)	calculus (%)
women n = 49	1.43 ± 0.76	92	69.4	22.4	30.6	33 ± 0.47
men n = 30	1.83 ± 0.83 $p < 0.02$	90	70	43.3	43.3	60 ± 0.50 $p < 0.02$

The number of teeth with papillary bleeding index (PBI) 3 (Filling of the interdental triangle with blood after probing) was in men significantly higher than in women ($p < 0.04$). There were no significant differences in the degrees 1, 2 and 4, or in the gingival inflammatory degree (MV below degree 1: slight inflammation). Actually, a moderate periodontitis was diagnosed in 10 female participants and a severe periodontitis in one woman. Only five of them had already known about it. In the other group, only one man had a moderate periodontitis of which he did not know. So, periodontitis was significantly more common in the female group ($p < 0.02$).

Tab. 4: Gingival Index (GI) and the number of teeth with Papillary Bleeding Index (PBI) 1 – 4 in the examined women and men.

	Gingivitis (GI)	PBI 1 (n)	PBI 2 (n)	PBI 3 (n)	PBI 4 (n)
women n= 49	0.75 ± 0.92	0.75 ± 1.02	4.0 ± 3.21	0.89 ± 2.19	0.23 ± 0.83
men n= 30	0.97 ± 0.96	0.5 ± 1.19	4.57 ± 3.95	2.0 ± 3.23 $p < 0.04$	0.13 ± 0.43

II. Results of the follow-up examination

21 of the 49 women from the beginning and 8 of the 30 men appeared to the follow-up examination. Based on the group size, a follow-up comparison could only be realized in the female group. The follow-up examination showed significantly lower dental plaque in the 21 women ($p < 0.04$) (table 5) and the oral health improved. The degree of gingivitis and the papillary bleeding index 2 were most significantly reduced (table 6).

Tab. 5: Plaque Index (PI), prevalence (%) of plaque: lingual, palatal, buccal in the upper jaw (UJ) and lower jaw (LJ) and presence of calculus in 21 women in the initial examination (E1) and in the follow-up examination (E2).

	Plaque-Index (PI)	Plaque, lingual (%)	Plaque, palatal (%)	Plaque, buccal in the UJ (%)	Plaque, buccal in the LJ (%)	calculus (n)
E1	1.43 ± 0.68	95.2	71.4	14.3	23.8	4
E2	1.02 ± 0.60 $p < 0.04$	85.7	47.6	9.5	9.5	3

Tab. 6: Gingival Index (GI), number of teeth with Papillary Bleeding Index (PBI) 1 - 4 and the number of diagnosed moderate periodontitis in 21 women in the initial examination (E1) and in the follow-up examination (E2).

	Gingivitis (GI)	PBI 1 (n)	PBI 2 (n)	PBI 3 (n)	PBI 4 (n)	Periodontitis (n)
E1	0.67 ± 0.86	0.71 ± 1.06	4.43 ± 3.49	0.57 ± 1.03	0.05 ± 0.22	2
E2	0.11 ± 0.30 $p < 0.004$	0.62 ± 0.74	2.05 ± 2.06 $p < 0.002$	0.24 ± 0.54	0.05 ± 0.22	2

Discussion

Basically, it can be assumed that the health consciousness of the population changed markedly within the last 20 years. Health and mobility have a very high significance for life quality, mind, social contacts and independence up until old age, especially because of the increasing life expectancy. The aim of this study was to control the oral health, including the general physical health, of employees of an upper medium-sized company, who were in their late thirties up to early sixties, to reveal deficits and, as a result, launch concepts for reasonable strategies concerning prevention, treatment and physical training.

Apart from the integration into physical training programs, the persons were intensively informed about their oral and general health to initiate a change in their health consciousness and motivate for more physical activity and oral hygiene. Aside from nutrition (weight reduction) and the realization of regular training, oral hygiene is the third column of preventive health care. The masticatory organ is decisive for digestion, speech sounds and nonverbal communication, for appearance but also for social life (self-confidence, attractiveness, life quality). Furthermore, oral health may impair general health significantly. For example, inflammatory heart valve diseases (endocarditis) may arise from population of bacteria in the oral cavity. A possible connection to arteriosclerosis and diabetes is also discussed [3, 4, 5, 8]. A severe periodontitis is a risk factor for early death as a consequence of cardiac infarction and renal dysfunction independent from diabetes and with a three-time higher risk in comparison with slight to moderate periodontitis and periodontium [10]. So, periodontitis is linked to the occurrence of other systemic diseases associated with the immune system and conjunctive tissue. Examinations of the psychological significance of teeth in 35 to 44 year olds and in 65 to 74 year olds showed that the appearance and functionality of the own teeth has a great value for mind and social contacts and, therefore, influences different areas of life [6]. Oral health has to be further promoted and the impacts of tooth and oral diseases on the general health and the psycho-social development have to be diminished. Periodontal diseases of the population have to be reduced in due consideration of risk factors such as smoking, insufficient and poor oral hygiene and stress and systemic diseases. In this study, the participants indicated an average stress level of high to average, 13 % (n = 4) of the men and 16 % (n = 8) of the women were smokers. The prevalence of periodontitis was much higher in the female group than in men. 20 % of the women had a moderate periodontitis, one had a severe periodontitis. Only one subject (non-smoker) of the male group had a severe periodontitis in the lower jaw incisor region. In Germany, about 30 million people have periodontitis [1]. 52.7 % of the 35 to 44 year olds have a moderate periodontitis and 20.5 % have a severe one. 14 % of the examined total collective had the moderate form and 20 % (n = 10, 2 female smokers) of women had a moderate periodontitis. Special risk factors for periodontitis are smoking and a low educational level. The adult group showed that smokers with a simple education had a risk 3.3 times higher in comparison with the average (DMS IV [2]). The examined collective consisted of persons with a good and high level of education and 15 % of the persons were smokers.

Oral hygiene

On average, men had significantly more teeth with papillary bleeding index 3, and also plaque and calculus were more common in men. Significantly more women than men used dental floss for cleaning interdental spaces, however, a

moderate periodontitis could be diagnosed significantly more often in women. Half of the women with periodontitis were already informed about their disease, for the other half the diagnosis was new. This may be a hint on poor concepts for periodontitis prevention and therapy. Nutrition counselling, reduction of periodontal diseases and tobacco prevention belong to the important work and task fields of dental specialists to stop and reduce the increasing prevalence of periodontal diseases. Oral hygiene of male study participants may be described as markedly poorer, a result that was confirmed by other studies [7, 9, 11]. The follow-up examination of women showed an improved oral health. In both examinations the dental-oral examination was not a surprise and it may be assumed that the subjects were appropriately prepared. However, many subjects indicated moderate plaque in lingual and palatal surfaces. The gingival inflammatory degree had significantly improved in women until the second examination. Unfortunately, only 8 men appeared to the second examination. A phenomenon recognized repeatedly in other own examinations. Maybe women are more interested in health improvement and infornations and maybe they are more open and willing.

Dental health

The study participants between the age of 35 and 44 years had a mean MT value (missing teeth value; number of missing teeth) of 0.5 teeth; participants between the age of 45 and 64 years had a MT value of 2.3 teeth. The mean MT value in the examined persons older than 44 years may be equated with the value of DMS IV with 2.4 teeth in 35 to 44 year olds. This may originate from the very high

quality level of tooth restoration, regular dental check-ups and high social state of this group. In total, the number of still existing teeth in adults and elderly people has been increasing since 1997.

With 5.4 amalgam fillings on average, men had significantly more amalgam fillings than women. For all participants, separated into age groups of 35 to 44 years and 45 to 64 years, the values of FT (filled teeth; number of fillings) amounted to 9.16 ± 4 and 9.56 ± 5.49. According to DMS IV, the number of fillings in 35 to 44 year olds amounts to a mean of 11.7 fillings. So the participants had better mean values what may also be attributed to the choice of participants.

Overall, the analysis of the prosthetic restoration showed a trend towards high quality replacement as it was also seen in the DMS IV. Tooth loss was mainly treated with a fixed solution; 10 % of men and 12.2 % of women were supplied with dental implants. One man had a removable dental prosthesis in his upper and lower jaw, 4 women (8 %) had a removable dental prosthesis in their lower jaw. In the male group (n = 30) and female group (n = 49) a total of 9 implants existed.

Regarding the number of teeth with fillings, the dental treatment and the loss of teeth, the results of the examination were markedly better than in the national average. This may rather be attributed to the selection of the study collective and possible cohort effects than to preventive precautions. Generally, it is observed that tooth loss becomes more common at an older age, based on a rather restrained extraction behavior (DMS III).

Summary

First results of a long-term prospective study on health promotion in public and private enterprises in Saxony (Germany) showed significant deficits in the oral health of men and women. An increased risk for orally induced metabolic and cardiovascular diseases can be concluded from this. These first results showed that the oral health as third column of preventive medicine needs to be extensively and permanently strengthened in work-place health promotion.

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Address for correspondence: Dr. med. dent. Antina Schulze
University of Leipzig
Institute of sports medicine and prevention
Marschner Str. 29a
04109 Leipzig, Germany

a.schulze@uni-leipzig.de