

Prevalence and simultaneous occurrence of periodontitis and dental caries

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Abstract

Aim: The aim of the study was to evaluate the prevalence and simultaneous occurrence of periodontal disease and dental caries in Finnish adults. Material and Methods: The study was performed as part of the nationally representative Health 2000 Survey. The study population was 5255 subjects aged 30 years and older. Probing pocket depth (PPD) and untreated dentinal caries were recorded by tooth. Teeth with PPD 4 mm and deeper indicated periodontal disease, and teeth with PPD 6 mm and deeper indicated a severe periodontal disease. Results: Sixty-four percent of persons had periodontal disease, 21% had a severe periodontal disease, and 29% had dental caries. Persons having periodontal disease had significantly more often dental caries (33%) compared with those without periodontal disease (23%). This was even more evident in persons having severe periodontal disease (44%). Accordingly, persons having dental caries had significantly more often severe periodontal disease (31%) compared with those without dental caries (16%). The mean number of teeth with dental caries or periodontal disease per person was greater when the mean number of teeth with the other disease was also greater. **Conclusions:** These data indicate that especially severe periodontal disease and dental caries tend to accumulate in the same subjects.

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Findings concerning the simultaneous occurrence of periodontal disease and dental caries are contradictory. Positive association (Brandtzaeg & Jamison, 1964, Albandar et al. 1995), negative association (Sewon et al. 1988), or no association (Skier & Mandel, 1980, Frentzen et al. 1990, Kinane et al. 1991) have been detected. Positive association may relate to the microbiological

Conflict of interest and source of funding statement

The Health 2000 Survey was organized by the National Institute for Health and Welfare, formerly the National Public Health Institute, of Finland, and partly supported by the Finnish Dental Society Apollonia and the Finnish Dental Association. The authors declare that they have no conflict of interests. aetiology of both diseases (Albandar et al. 1995). However, the typical bacterial species responsible for these diseases differ largely from each other. On the other hand, plaque and biofilm formation are related to both diseases (Rosan & Lamont, 2000). Furthermore, both diseases share many social and behavioural background factors in common, which have been related to their aetiology (Tervonen et al. 1991, Hobdell et al. 2003). Negative association, besides differences in the bacteriological spectrum, may be related to the demineralization processes seen in the development of caries as opposed to mineralization processes seen in calculus formation associated with the aetiology of periodontal diseases (Sewon et al. 1988). It is important for the evaluation of dental treatment needs and for the planning of comprehensive treatment and preventive strategies, to know the prevalence of dental caries and periodontal disease, as well as to what extend these common diseases accumulate in the same individuals. Thus, the aim of the present study was to evaluate simultaneous occurrence of periodontal disease and dental caries in the Finnish population aged 30 years and older.

Material and Methods

The present study is a part of the nationwide Health 2000 Health Examination Survey in Finland, carried out in 2000– 2001 by the National Institute for Health and Welfare (the former National Public Health Institute of Finland). The survey used a stratified two-stage cluster sampling of 8028 subjects aged 30 years and older; a total of 6335 (79%) participated in the clinical oral health examination, of them 5401 (85%) were dentate (Aromaa & Koskinen, 2004, Suominen-Taipale et al. 2008). The present study included those dentate subjects with complete recordings for dental and periodontal status (n = 5255). Additional information about the Health 2000 Survey is available at http://www.terveys2000.fi/indexe.html.

The clinical oral examinations were conducted by five field teams, each including a dentist and a dental nurse (Suominen-Taipale et al. 2008). Examinations were conducted with a portable unit, headlamp as the light source, and using a dental mirror, a WHO periodontal probe, a fibre optic light, and a letter scale. Teeth identification and clinical examination were performed according to the recommendations of the WHO (1997). A reference dentist took the parallel measurements (n = 269) on several visits to each field team.

All teeth surfaces were examined, but observations were recorded by tooth. The presence of teeth included all teeth and tooth remnants visible and tactile in the mouth. The teeth were blown dry, and the status of each tooth surface was diagnosed and combined into one recording, by tooth, as follows: sound, decayed, filled (no caries), fractured, residual root (with or without caries). A tooth was recorded as decayed if there was evidence of caries lesion clearly extending to dentin. The caries lesion was to be cavitated, to have penetrated the fissure and undermined the enamel, or the dentine walls were to have clearly softened. The percentage of agreement between the examiners and the reference examiner was 93% (κ 0.87) in dental status by tooth (Suominen-Taipale et al. 2008).

The probing pocket depth (PPD) was measured in all teeth excluding third

Table 1. The percent of study subjects having at least one tooth with a probing pocket depth (PPD) of at least 4 mm, with a PPD of at least 6 mm, or with dental caries among dentate Finnish adults aged 30 years and older

Persons having teeth with PPD at la 4 mm, prevalence (%) (mean number teeth with PPD at least 4 mm, mean		th with PPD at least %) (mean number of ast 4 mm, mean ± SD)	Persons having teeth with PPD at least 6 mm, prevalence (%) (mean number of teeth with PPD at least 6 mm, mean \pm SD)	Persons having teeth with dental caries, prevalence (%) (mean number of teeth with dental caries, mean \pm SD)		
Whole stu	dy population					
All	64 (4.2	\pm 10.4)	$21~(0.7\pm2.4)$	$29~(0.7\pm1.9)$		
(n = 5255))					
Men	72 (5.3	± 9.8)	$26~(0.9\pm2.8)$	$36~(0.9\pm2.0)$		
(n = 2473))					
Women	57 (3.2	\pm 6.6)	$16 (0.4 \pm 1.6)$	$22 (0.4 \pm 1.3)$		
(n = 2782))					
Age group	o 30–44 years					
All	57 (3.5	\pm 7.8)	$12 (0.3 \pm 1.5)$	$26~(0.6\pm1.7)$		
(n = 2115))					
Men	65 (4.4	\pm 8.2)	$15~(0.5\pm2.0)$	$33~(0.8\pm1.9)$		
(n = 997)						
Women	48 (2.5	\pm 4.9)	$8 \; (0.2 \pm 0.8)$	$19 \ (0.4 \pm 1.0)$		
(n = 1118))					
Age group	0 45–54 years					
All	69 (4.9	(± 8.2)	$24 (0.8 \pm 2.2)$	$30(0.7 \pm 1.8)$		
(n = 1496))					
Men	76 (6.2	\pm 8.2)	$30(1.1 \pm 2.6)$	$37(0.9 \pm 1.9)$		
(n = 722)			17 (0.5 + 1.0)	22 (0.5 + 1.2)		
Women	62 (3.6	(± 6.0)	$17(0.5 \pm 1.8)$	$22(0.5 \pm 1.3)$		
(n = 7/4)	55 CA					
Age group	0 55-64 years		20(1.0 + 2.0)	21(0(1+15))		
All	69 (4.6	$\pm 6.8)$	$29(1.0 \pm 2.9)$	$31(0.6 \pm 1.5)$		
(n = 896)	76 (5 5	- (7)	25(14+22)	2(0.9 + 1.6)		
(m = 420)	/0 (3.3	± 0.7	$35(1.4 \pm 5.5)$	$30(0.8 \pm 1.0)$		
(n - 450)	60 (2 7	(5 2)	$22(0.6 \pm 1.0)$	26(0.5 + 1.2)		
w official	02 (5.7	$\pm 5.5)$	$25(0.0 \pm 1.9)$	$20(0.5 \pm 1.2)$		
(n - 400)	65 74 years					
Age group	70 (4 5	+ 6.4	31(11 + 28)	$34(0.7 \pm 1.6)$		
(n = 484)	70 (4.5	± 0.4)	$51(1.1 \pm 2.6)$	$34(0.7 \pm 1.0)$		
(n - + 0+) Man	77 (5 7	+70)	30(14 + 32)	$46(11 \pm 18)$		
(n = 221)	11 (5.1	± 7.0)	57 (1.4 ± 5.2)	40 (1.1 ± 1.6)		
Women	64 (3 5	+50	25(08+23)	23(04+10)		
(n = 263)	04 (5.5	± 5.0)	$25(0.0 \pm 2.5)$	$25(0.4 \pm 1.0)$		
Age grour	75 years and older					
All	68 (4.0	(+4.7)	$30(08 \pm 16)$	39(09+14)		
(n = 264)	00 (110	±)				
Men	74 (4.4	+4.8)	$39(1.0 \pm 1.9)$	$49(1.1 \pm 1.5)$		
(n = 103)		=				
Women	65 (3.8	\pm 4.6)	$25~(0.6 \pm 1.3)$	$32 (0.8 \pm 1.4)$		
(n = 161)		/				

Subjects having teeth with a PPD of at least 6 mm are also included in the group of subjects having teeth with a PPD of at least 4 mm. The mean number of teeth with these diseases are given in parentheses.

964 Mattila et al.

Table 2. The percent of study subjects having at least one tooth with dental caries in subjects having no teeth with a probing pocket depth (PPD) reaching 4 mm, having teeth with a PPD of at least 4 mm, or having teeth with a PPD of at least 6 mm among dentate Finnish adults aged 30 years and older

	The percent of subjects having dental caries (%) (mean number of teeth with dental caries, mean \pm SD)		
	in subjects having no teeth with PPD at least 4 mm	in subjects having teeth with PPD at least 4 mm	in subjects having teeth with PPD at least 6 mm
All $(n = 5255)$	23 (0.4 ± 1.1)	33 (0.8 ± 2.0)	44 (1.1 ± 4.3)
Men $(n = 2473)$	$30~(0.6\pm1.3)$	$39~(1.0\pm 2.2)$	$48~(1.2\pm2.7)$
Women $(n = 2782)$	$16~(0.3\pm0.9)$	$26~(0.6\pm1.4)$	$37~(0.9\pm2.3)$
Age group 30–44 years ($n = 2115$)	$19~(0.3\pm1.7)$	$31~(0.7\pm1.9)$	$46(1.1 \pm 1.7)$
Age group 45–54 years ($n = 1496$)	$24~(0.4 \pm 1.1)$	$32~(0.8\pm1.9)$	$43 (1.1 \pm 2.5)$
Age group 55–64 years ($n = 896$)	$24~(0.4\pm0.9)$	$34~(0.7\pm1.7)$	$37~(0.9\pm1.8)$
Age group 65–74 years $(n = 484)$	$24~(0.4\pm0.8)$	$38~(0.9\pm1.6)$	$49~(1.2\pm2.0)$
Age group 75 years and older $(n = 264)$	$28 (0.6 \pm 1.0)^*$	$43 (1.1 \pm 1.5)^*$	$54~(1.4\pm1.8)$
Subjects with 1–8 teeth $(n = 539)$	$30~(0.5\pm1.0)$	$50~(1.1\pm1.8)$	$54~(1.3\pm1.8)$
Subjects with 9–16 teeth $(n = 463)$	$31~(0.7\pm1.5)$	$50~(1.5\pm2.4)$	$60~(1.8\pm2.1)$
Subjects with 17–24 teeth ($n = 1082$)	$29~(0.6 \pm 1.3)$	$39~(1.1\pm2.0)$	$48~(1.4\pm2.3)$
Subjects with 25 teeth and more $(n = 3171)$	$17~(0.3\pm0.8)$	$26~(0.5\pm1.5)$	$35~(0.7~\pm~1.6)$

Differences in the percent of subjects having dental caries between subjects with or without periodontal disease were statistically significant as defined by the Pearson Chi-Square test in all cases; p < 0.01 except the values marked with asterisk (*). The mean number of teeth with dental caries are given in parentheses.

The mean number of teem with demar cartes are given in parentneses.

Table 3. The percent of study subjects having at least one tooth with a probing pocket depth (PPD) of at least 6 mm in subjects having no teeth with dental caries or in subjects having teeth with dental caries among dentate Finnish adults aged 30 years and older

	The percent of subjects having teeth with PPD at least 6 mm (%) (mean number of teeth with PPD at least 6 mm, mean ± SD)		
	in subjects having no teeth with dental caries	in subjects having teeth with dental caries	
All $(n = 5255)$	16 (0.5 ± 1.9)	31 (1.1 ± 2.9)	
Men $(n = 2473)$	$21~(0.7\pm2.3)$	$35(1.2 \pm 3.2)$	
Women $(n = 2782)$	$13 (0.3 \pm 1.4)$	$26~(0.8\pm2.1)$	
Age group 30–44 years ($n = 2115$)	$8 (0.2 \pm 1.0)$	$21~(0.7\pm2.1)$	
Age group 45–54 years ($n = 1496$)	$19 (0.6 \pm 1.9)$	$34(1.1 \pm 2.7)$	
Age group 55–64 years $(n = 896)$	$26(0.9 \pm 2.6)$	$35(1.4 \pm 3.1)$	
Age group 65–74 years $(n = 484)$	$24(0.8 \pm 2.2)$	$46(1.6 \pm 3.6)$	
Age group 75 years and older $(n = 264)$	$23~(0.5\pm1.3)$	$42 (1.1 \pm 2.0)$	
Subjects with 1–8 teeth ($n = 539$)	$15 (0.4 \pm 1.1)$	$27 (0.6 \pm 1.4)$	
Subjects with 9-16 teeth $(n = 463)$	$19(0.6 \pm 1.9)$	$37(1.2 \pm 2.7)$	
Subjects with 17–24 teeth ($n = 1082$)	$25(0.9 \pm 2.3)$	$40(1.4 \pm 3.3)$	
Subjects with 25 teeth and more $(n = 3171)$) $14(0.4 \pm 1.6)$	$26~(1.0\pm2.9)$	

Differences in the percent of subjects having teeth with PPD at least 6 mm between subjects with or without dental caries were statistically significant as defined by the Pearson Chi-Square test in all cases; p < 0.01.

The mean number of teeth with a PPD of at least 6 mm are given in parentheses.

molars. Probing was performed at four surfaces (distobuccal, mid-buccal, midoral, and mesio-oral) using a standardized force of 20 grams. The measuring force was calibrated every morning using a letter scale. For each tooth, the deepest pocket was recorded in one of three categories: "no deepened periodontal pocket", "4–5 mm pocket", or "6 mm pocket or deeper" (Suominen-Taipale et al. 2008). The percentage of agreement between the examiners and the reference examiner was 77% in dental status by tooth (κ 0.41) in recordings of pocket depth measurements (Suominen-Taipale et al. 2008).

The dental status of the subjects was described as the number of teeth, and as the number of decayed teeth (DT). Prevalence of caries was defined as percentages of those subjects with one or more teeth with caries (DT>0), and as mean

values of DT. The proportional number of teeth with dental caries (DT/number of all teeth) was also used in the analyses.

The periodontal status of the subjects was described according to the maximum recording of PPD per subject, and as numbers of teeth with a PPD of at least 4 or 6 mm. Teeth with a PPD of 4 mm and deeper indicated periodontal disease, and teeth with a PPD of 6 mm and deeper indicated a severe periodontal disease. The prevalence of periodontal disease was defined as the percentage of those having one or more teeth with a PPD of at least 4 or 6 mm, and as the mean number of such teeth. In addition, the proportional number of teeth with a PPD of at least 4 mm was calculated (number of teeth with a PPD of at least 4 mm/number of all teeth). For further analyses, those subjects having both dental caries and periodontal disease (n = 1152) were divided into quintiles, separately according the proportional number of their teeth with these diseases.

The STATA statistical package was used to take into account the two-stage cluster sampling. The design effects were taken into account using the SVY-TAB and SVYMEANS procedures. The effect of non-response was corrected by corresponding weights. The calibration of original design weights was carried out using the SAS-macro CALMAR (Sautory 1993). Descriptive statistics included mean values and their standard deviations for numbers of diseased teeth in subjects, and percentages of subjects with such teeth. The differences in frequencies between groups were defined by the Pearson Chi-Square test. Adjustment for multiple comparisons was carried out using Dunn–Sidák correction. With $\alpha = 0.05$, and n = 5 (the highest number of groups to be tested), it gives $1 - (1 - \alpha)^{1/n} \approx 0.0102$. A *p*-value of <0.01 was considered to be statistically significant.

Results

Altogether, 64% of the dentate Finnish population, aged 30 years and older, had periodontal disease (PPD at least 4 mm), 21% had a severe periodontal disease (PPD at least 6 mm), and 29% had dental caries (Table 1). All of these findings were more prevalent in men than in women.

Persons having periodontal disease had significantly more often dental caries than those without periodontal disease (33% versus 23%; p<0.01) (Table 2). The mean number of teeth with dental caries was also greater in persons having periodontal disease (0.8 versus 0.4; p < 0.01). This difference was true separately for men and women, for all studied age groups, and for the subgroups according to the number of teeth. The differences in caries prevalence were even more evident when comparing persons without periodontal disease to those having a severe periodontal disease (23% versus 44%; p<0.01). Accordingly, persons having dental caries had significantly more often severe periodontal disease compared with those without dental caries (31% versus 16%; p < 0.01) (Table 3).

The greater the number of teeth with a PPD of at least 4 mm, the greater was the number of teeth with dental caries (Fig. 1). Accordingly, the greater the number of teeth with dental caries, the greater was the number of teeth with a PPD of at least 4 mm (Fig. 2).

The proportional number of teeth with a PPD of at least 4 mm was higher in persons that had a greater proportional number of teeth with dental caries (Fig. 3). Accordingly, the proportional number of teeth with dental caries was greatest in persons that had the highest proportional number of teeth with a PPD of at least 4 mm (Fig. 4).

Forty-five percent of the subjects in the quintile with the highest proportional number of teeth with a PPD of at least 4 mm also belonged to the quintile with the highest proportional number of teeth with dental caries (Table 4).

Discussion

The present study indicates that periodontal disease and dental caries tend to accumulate in the same subjects. This was seen in the dentate Finnish adult population, aged 30 years and older, regarding men and women, all age groups, and all groups divided according to the number of teeth present.

The prevalence of dental caries in the present study population was clearly lower than that in a previous nationwide Finnish population survey carried out in 1978–1980 (Suominen-Taipale et al. 2008). Both studies were performed in adult subjects, aged 30 years and older. The prevalence of dental caries in the present study population was also lower than that in a more recent UK



Fig. 1. The number of teeth with a probing pocket depth (PPD) of at least 4 mm (mean \pm SD) in subjects divided in subgroups according to their number of teeth with dental caries in Finnish adults aged 30 years and older (n = 5255).



Fig. 2. The number of teeth with dental caries (mean \pm SD) in subjects divided in subgroups according to their number of teeth with a probing pocket depth (PPD) of at least 4 mm in Finnish adults aged 30 years and older (n = 5255).



Fig. 3. The proportional number of teeth with a probing pocket depth (PPD) of at least 4 mm (number of their teeth with a PPD of at least 4 mm/number of all their teeth) (mean \pm SD) in subjects divided in subgroups according to their proportional number of teeth with dental caries in Finnish adults aged 30 years and older (n = 5255).



Fig. 4. The proportional number of teeth with dental caries (number of their teeth with dental caries/number of all their teeth) (mean \pm SD) in subjects divided in subgroups according to their proportional number of teeth with a probing pocket depth (PPD) of at least 4 mm in Finnish adults aged 30 years and older (n = 5255).

population survey carried out in 1998 (Kelly et al. 2000). However, the study population in the latter was wider, concerning subjects from 16 years of age.

The prevalence of periodontal disease in the present study population was slightly lower than that found in the 1978–1980 population survey (Suominen-Taipale et al. 2008), but higher than that in the 1998 UK survey (Kelly et al. 2000). These trends seem to indicate a favourable tendency in the dental caries situation, but a less favourable tendency in the periodontal health situation of Finnish adults. In this context, the history of dental treatment may also be of importance, probably more often neglecting the required periodontal treatment.

The probability of having dental caries was higher in those who had periodontal disease. The bacteriological aetiology of both diseases, as well as many possible background factors in common may explain this finding. Living habits (Sakki et al. 1994, Sakki et al. 1995), social factors (Tervonen et al. 1991, Hobdell et al. 2003), and dental health behaviour (Axelsson et al. 1991) have been depicted as possible background factors for both of these diseases.

The association between the occurrence of dental caries and periodontal disease was even more apparent in subjects with deep periodontal pockets. Accordingly, the mean number of teeth with dental caries, and the mean number of teeth with periodontal disease per person were greater when the mean number of teeth with the other disease was also greater. Both these observations indicate a positive association between the occurrence of dental caries and periodontal disease.

The results of the present study are in accordance with incidental findings of a study evaluating a nationally representative cross-sectional survey of the US population, conducted between 1988 and 1994 (Hyman & Reid 2003). In that study, periodontitis was determined as loss of attachment at mesiobuccal and mid-buccal sites of the teeth in two selected quadrants. A positive association was found between the mean loss of attachment, and the mean number of decayed surfaces, especially among individuals with a great number of decayed surfaces.

The simultaneous occurrence of periodontal disease and dental caries should be kept in mind also when defining associations between dental diseases and other diseases. In addition to the behavioural and bacteriological background variables in common, host response-related factors also may be involved. Furthermore, the simultaneous occurrence of periodontal problems and active caries lesions should be taken into consideration in the context of a modern cause-related dental therapy and preventive approach.

Because of the cross-sectional data, no conclusions regarding causal relationship between periodontal disease and dental caries, or regarding incidence of these dental diseases can be drawn on the ground of the present study.

This study indicates that there is a major need for treatment of periodontal

Table 4. Subjects having teeth with dental caries, and teeth with a probing pocket depth (PPD) of at least 4 mm (n = 1098) divided into quintiles according the proportional number of their teeth with these diseases (number of teeth with the disease/number of all teeth)

	Number of subjects in each category and the proportional number of subjects in columns (%)							
	proportional number of teeth with PPD at least 4 mm (%)							
	0.1–12.0	12.1–27.3	27.4–45.3	45.4–72.0	72.1–	Total		
Proportional	number of tee	th with dental ca	aries (%)					
0.1-3.8	73	58	62	31	20	244		
	33%	27%	28%	14%	9%			
3.9–6.7	56	43	39	36	23	197		
	25%	20%	18%	17%	11%			
6.8–11.1	43	52	42	34	34	205		
	20%	24%	19%	15%	16%			
11.2-24.0	35	35	44	58	42	214		
	16%	16%	20%	27%	19%			
24.1-	14	27	36	63	98	238		
	6%	13%	16%	28%	45%			
Total	221	215	223	222	217			
	100%	100%	100%	100%	100%			

disease in dentate Finnish adults, and that the occurrence and treatment need for especially severe periodontal disease and dental caries tend to accumulate in the same individuals. These results should be kept in mind when accomplishing comprehensive treatment and preventive strategies.

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Clinical Relevance

Scientific rationale for the study: Previous findings concerning simultaneous occurrence of periodontal disease and dental caries are contradictory. We evaluated this matter as a part of a large population survey. Institute B12/2004. Available at http://www.ter veys2000.fi/julkaisut/baseline.pdf.

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Practical implications: The probability of needing treatment for periodontal disease or dental caries is high in persons who have the other one of these diseases. This should be kept in mind in the planning of treatment and preventive strategies. This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.