Periodontal status among male industrial workers in southern Finland with or without access to subsidized dental care

Jari Ahlberg, Risto Tuominen and Heikki Murtomaa
Departments of Dental Public Health and Public Health, University of Helsinki, Helsinki Finland

Ahlberg J, Tuominen R, Murtomaa H. Periodontal status among male industrial workers in southern Finland with or without access to subsidized dental care. Acta Odontol Scand 1996;54:166–170. Oslo. ISSN 0001–6357.

The association between subsidized dental care and periodontal status was studied in male industrial workers in southern Finland in 1994. Clinical examinations and a multiple-choice questionnaire were completed for 325 workers (age, 38–65 years) with access to subsidized dental care and 174 controls without access. The CPITN scores based on full-mouth recordings were analyzed, using both the individual and sextant as units of analysis. Overall, 6% of the subsidized group and 2% of the control group had no periodontal treatment need ($p < 0.05$). Deep pockets ≥6 mm were found in 5% of the subsidized workers and 11% of the controls ($p < 0.05$). In the logistic regression analyses the probability of calculus was negatively associated with access to subsidized dental care. Smoking was the strongest independent factor affecting periodontal status. Our findings show a positive relationship between access to subsidized dental care and periodontal status. □ *Community Periodontal Index of Treatment Needs; multivariate analysis; periodontal status; subsidization*

Jari Ahlberg, Department of Dental Public Health, P.O. Box 41, FIN-00014 University of Helsinki, Finland

Periodontal evaluation of large populations has generally shown positive relationships between age and the severity of periodontal disease (1–3). According to Abdellatif & Burt (4), however, age was an insignificant factor in determining periodontal disease when oral hygiene status was controlled for. The importance of oral hygiene status and quality of preventive self-care has been confirmed in several studies (5–7). Smoking has also been found to be a major risk factor for periodontal disease (8–13).

Few attempts have been made to assess the impact of subsidized dental care on periodontal status, and usually the effects of subsidization have only been slight (14–16). According to Holst (16), Norwegian male workers eligible for subsidized dental care had no better gingival and periodontal health than the referents. On the other hand, subsidized dental care programs have repeatedly improved periodontal conditions among adult Swedish populations (5,17) and rural Norwegians (18).

The aim of the present study was to investigate the association between subsidized dental care and periodontal status among male industrial workers in southern Finland with or without access to such care.

Materials and methods

All male workers, born before 1956 (age, 38–65 years), at an oil refinery in southern Finland (Neste Ltd., Porvoo, Finland) were invited to participate. The control group was formed on the same basis from other industrial workers at three companies in the same area (Enso Gutzeit Ltd. Tolkkinen Saw Mill, Ensto Ltd., and Norpe Ltd., all in Porvoo, Finland). These companies are located in an area where the dentist to population ratio is about 1:1100 (19).

The oil refining company (Neste Ltd.) provides comprehensive occupational health services to its employees, including subsidized dental care since 1965 (20). Neste has had a dental clinic at its occupational health center in Porvoo since 1978, but the employees have freedom to attend any dental clinic. The entire costs of all dental treatment are paid directly to dentists from the employees' sickness fund. In the case of a new prosthesis, the employee repays 25% of the costs to the fund over the following 6-month period. It is compulsory for refinery workers to be contributing members of the sickness fund, although no prior dental rehabilitation is required. Membership of the sickness fund costs employees 1% of their gross wages. Dental visits are allowed during working hours. The chosen treatment provider and pattern of attendance affect neither the extent of subsidization nor the route of payment.

The employees in the control group have to finance their own treatment without any reimbursement from their employer or the state. They also have to make their dental visits outside working hours.

The refinery workers totalled 403, and the controls 254. In February 1994 an offer was mailed to all subjects to participate in a dental check-up free of charge. They were also sent a multiple-choice questionnaire covering the following items for the present study: 1) age in years, 2) education, 3) current employment in years, 4) time since last dental visit, 5) reason for last dental visit, 6) frequency of toothbrushing, and 7)

Table 1. Classification of the background variables used in multivariate models

Variables	Category	Value	*n*
Education	Elementary or occupational	0	436
	Higher education	1	46
Access to subsidized dental care	Control	0	168
	Refinery	1	315
Last dental visit	More than 2 years ago	0	56
	In past 2 years	1	426
Reason for last dental visit	Acute problem	0	187
	Recall or check-up on own initiative	1	293
Toothbrushing	Less than once a day	0	85
	At least once a day	1	397
Smoking	Non-smoker	0	299
	Smoker	1	180
Age	In years		

current smoking habits (cigarettes, cigars, pipe, snuff). Subjects who had stopped smoking during the past 6 months were regarded as smokers. Variables from the questionnaire data were classified for the multivariate analyses used in the present study (Table 1).

The subjects were examined at their workplaces during a 3-month period from March to June 1994. Examinations were completed on 325 of the refinery group (81%) and 174 of the controls (69%). All 483 (97%) dentate subjects were included in this study.

A mobile dental unit with conventional lighting and compressed air flow was used at all workplaces to ensure equivalent conditions. One of the authors (J. Ahlberg) examined all subjects, using a mouth mirror and a WHO periodontal probe and explorer; the clinical data were recorded by a trained dental assistant. All subjects were examined for gingival bleeding, dental calculus, and pocket depths on the mesial, buccal, distal, and lingual surfaces of all remaining teeth, including erupted third molars. Recordings of approximal surfaces were made from the buccal aspect. Gingival bleeding was assessed after gentle probing of the pockets; supragingival and subgingival calculus (including retention when probing due to a faulty dental restoration) were recorded as calculus; pocket depth was measured as the distance (mm) from the gingival margin to the bottom of the pocket. These periodontal recordings were used to complete the Community Periodontal Index of Treatment Needs (CPITN) coding (21). A sextant was given a code whenever two or more teeth were present. If no index teeth were present in a sextant, it was excluded from further analysis. The CPITN codes were analyzed, using both the individual and the sextant as the unit of analysis. The CPITN score for the individual was determined as the highest code given to any sextant in that individual.

Student's *t* test for group means, the chi-square test for proportions, and the trend test (22) were used for statistical analyses. The effects of the studied background variables on the probability of having periodontal pockets ≥4 mm (obtained using the individual CPITN codes) were investigated by using a logistic regression model (23). The effects of the same background variables on the probability of having calculus were studied among subjects having no periodontal pockets. Odds ratios (OR) were calculated as:

$$OR = e^{\beta},$$

where β is the logistic regression coefficient. The corresponding 95% confidence intervals (CI) were calculated as:

$$95\%\ CI = e^{\beta \pm 1.96\ (SE)}.$$

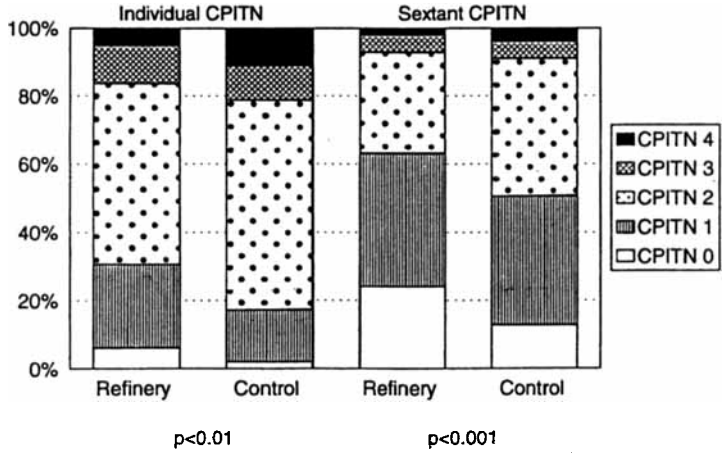

Fig. 1. Frequency distribution of the individual and sextant Community Periodontal Index of Treatment Needs (CPITN) scores in refinery and control groups. Statistical evaluation based on the trend test.

Table 2. Descriptive data on the study populations plus statistical evaluations of differences between the refinery and control groups

	Refinery group, $n = 315$	Control group, $n = 168$	Probability, $p <$
Mean (SD)			
Age	46 (6)	47 (6)	NS
No. of teeth	20 (8)	21 (8)	NS
Percentages with			
Elementary or occupational education	91	91	NS
Five years or more in present employment	99	93	NS
Smoking	41	30	0.05
Toothbrushing at least once a day	83	82	NS
Last dental visit in past 2 years	92	82	0.01
Recall or dental check-up initiating last dental visit	66	52	0.01

Statistical evaluations based on t statistics (mean values) and chi-square test (proportions).

Results

On the basis of highest individual CPITN score, 6% of the refinery workers had no need for periodontal treatment, compared with 2% of the control group ($p < 0.05$). Deep pockets ≥6 mm were found in 5% of the refinery workers and 11% of the controls ($p < 0.05$). Calculus (CPITN code 2) was the commonest highest score in individuals of both groups. However, on the sextant basis, bleeding after probing appeared to be the refinery workers' commonest CPITN score (Fig. 1).

The two study groups were very similar in number of teeth, age distribution, education, and the frequency of toothbrushing. The refinery workers had had their last dental visit within the past 2 years significantly more often, and they had also had a recall or check-up visit on their own initiative significantly more frequently than among the controls (Table 2).

According to the logistic regression model, the probability of calculus was negatively associated with access to subsidized dental care and to toothbrushing at least once a day and positively associated with smoking (Table 3). The probability of having periodontal pockets (≥4 mm) was negatively associated with recall or self-initiated check-up as the reason for the last dental visit and positively associated with smoking (Table 4). The number of subjects with deep pockets (≥6 mm) was too small to enable more detailed analysis.

Discussion

Since the Primary Health Act of 1972, Finnish municipalities have been obliged to organize free-of-charge dental care for all children and adolescents under 19 years. Additionally, some costs of dental treatment are reimbursed to young adults using private dental services through the National Sickness Insurance scheme; this extension of subsidization was introduced in 1986. Finns born before 1956 have not been eligible for any nationwide subsidized dental care in their adulthood. Although small Finnish municipalities may be capable of organizing subsidized dental care for their entire population, in large cities most adults are obliged to use private practices. Thus, some employers have voluntarily initiated dental care for their employees, or they subsidize dental care by contributing to employees' sickness funds. However, dental care as comprehensive as that at Neste is rare.

All workers born before 1956 were included, rather than randomized samples, to ensure large enough study groups. It has been suggested that assessing the impact of subsidized dental services on the dental health of those eligible for them requires a clinical examination of two comparable groups that differ only in their exposure to subsidized dental services (16). The groups in our study were similar in age, education, and environmental factors, but only one had access to subsidized dental care. The refinery employees work in

Table 3. The regression coefficients of the studied background variables on the probability of having calculus among subjects with no periodontal pockets, obtained with a logistic regression model*

	β	SE	OR	95% CI
Education	0.083	0.39	1.1	0.5–2.3
Access to subsidized dental care	−0.804	0.26	0.5	0.3–0.7
Toothbrushing at least once a day	−1.334	0.39	0.3	0.1–0.6
Last dental visit in past 2 years	−0.103	0.42	0.9	0.4–2.1
Recall or dental check-up initiating last dental visit	0.050	0.25	1.1	0.6–1.7
Current smoking	0.710	0.26	2.0	1.2–3.4
Age	0.005	0.02	Not applicable	$p = 0.799$

* OR = odds ratio; CI = confidence interval.

Table 4. The regression coefficients of the studied background variables on the probability of having periodontal pockets ≥4 mm, obtained with a logistic regression model*

	β	SE	OR	95% CI
Education	0.038	0.42	1.0	0.5–2.4
Access to subsidized dental care	−0.332	0.25	0.7	0.4–1.2
Toothbrushing at least once a day	0.343	0.34	1.4	0.7–2.7
Last dental visit in past 2 years	0.268	0.40	1.3	0.6–2.9
Recall or dental check-up as reason for last dental visit	−0.508	0.25	0.6	0.4–1.0
Smoking	0.718	0.25	2.1	1.3–3.5
Age	0.038	0.02	Not applicable	$p = 0.083$

* OR = odds ratio; CI = confidence interval.

three shifts, and if a subject was off duty for some unexpected reason during the 2-week examination period, it was sometimes difficult to rearrange their appointment. Considering this, the rate of participation among the refinery group was good. Some controls had to use time outside working hours to attend the examination, which explains their lower rate of participation.

In the present context the hierarchical assumptions of the CPITN (24) imply that maintenance and improvement of periodontal conditions require less treatment by dentists in the refinery group than in the control group. The CPITN has been criticized for overestimating the severity of periodontitis among younger age groups and underestimating it among elderly subjects (25, 26). It has also been claimed that persons presenting with more severe periodontal conditions will be overlooked when partial recordings of the CPITN are performed (27). Several factors have been accused of contributing to the discrepancy between the CPITN score and the components used to allocate it (28–31). However, the CPITN has been used as a measure of periodontal treatment needs in a wide range of communities; almost 100 surveys from more than 50 countries for the 35- to 44-year-old age group are stored in the WHO Global Oral Data Bank (32). Using full-mouth recordings for the CPITN coding also enabled us to analyze our study groups using the sextant as the unit of analysis, which showed that the refinery workers had less overall treatment need.

This lower treatment need was found even though smoking was significantly more common in the subsidized group. This could be explained by their greater frequency of dental visits, which may have partly disclosed the negative effects of smoking on periodontal tissues at earlier stages of the disease. In this study the independent and significantly detrimental effect of smoking on periodontal status underscores the value of taking patients' smoking habits into account when planning prevention and periodontal treatment for an individual.

The multivariate analysis enabled us to investigate the effects of one variable at a time on the probability of calculus while simultaneously controlling the effects of other variables (23, 33). Thus, the logistic regression analysis shows that among those with no periodontal pockets toothbrushing at least once a day was a strong independent determinant of not having calculus, whereas it was insignificant in determining the probability of having no periodontal pockets. This may indicate that calculus is effectively prevented among those who for any reason have adopted proper skills in toothbrushing. Moreover, the development of periodontitis may be promoted by the lack of effective brushing irrespective of an acceptable frequency of brushing. However, the more regular check-ups may be a natural explanation for the overall lower treatment need among the refinery workers. Dental check-ups are usually part of an on-going treatment plan designed to prevent more operative measures. Removal of retentive factors for bacteria, oral health care guidance, motivation, and instruction in use of self-care aids are more likely at a check-up than during less systematic visits.

According to Listgarten et al. (34), established chronic gingivitis does not necessarily lead to periodontitis, even when untreated. On the other hand, Löe et al. (35) showed that in the absence of dental treatment and preventive self-care the progress of periodontal disease is uneven but continuous. In the study of Caton & Quinonen (36) calculus and other retentive factors for bacteria were associated with the development of adult periodontitis. However, chronically inflamed deep periodontal pockets frequently become an acute problem, which may develop into a risk factor for general health (37). Recent reports from Finland and the USA indicate that progressive periodontitis is associated with a high risk of cardiovascular disease (38–40).

We conclude that the refinery workers in this study may have less risk of developing severe periodontitis and that having less deep periodontal pockets may mean fewer foci for severe general infection. Our study

findings demonstrate a positive relationship between subsidized dental care and periodontal status.

Acknowledgements.—This study was supported by the Finnish Work Environment Fund, the Yrjö Jahnsson Foundation, and the Finnish Dental Society.

References

1. Miller A, Brunelle J, Carlos J, Brown L, Löe H. Oral health of United States' adults, National findings. Bethesda (MD): NIH, 1987. NIH Publication No. 87–2868.
2. Shei O, Waerhaug J, Lovdal A, Arno A. Alveolar bone loss as related to oral hygiene and age. J Periodontol 1959;30:7–16.
3. Miyazaki H, Hanada N, Andoh M, Yamashita Y, Saito T, Sogame A, et al. Periodontal disease prevalence in different age groups in Japan as assessed according to the CPITN. Community Dent Oral Epidemiol 1989;17:71–4.
4. Abdellatif H, Burt B. An epidemiological investigation into the relative importance of age and oral hygiene status as determinants of periodontitis. J Dent Res 1987;66:13–8.
5. Axelsson P, Lindhe J. Effect of controlled oral hygiene procedures on caries and periodontal disease in adults. Results after 6 years. J Clin Periodontol 1981;8:239–48.
6. Ariaudo A, Arnim S, Greene J, Aarhus H. How frequently must patients carry out effective oral hygiene procedures in order to maintain gingival health? J Periodontol 1971;42:309–13.
7. Manson J, Eley B. The prevention of periodontal disease. Dent Update 1989;16:189–95.
8. Ismail A, Burt B, Eklund S. Epidemiologic patterns of smoking and periodontal disease in the United States. J Am Dent Assoc 1983;106:617–21.
9. Sintonen H, Tuominen R. Exploring the determinants of periodontal treatment costs: a special focus on cigarette smoking. Soc Sci Med 1989;29:835–44.
10. Telivuo M, Kallio P, Berg M-A, Korhonen H, Murtomaa H. Smoking and oral health: population survey in Finland. J Public Health Dent 1995;55:133–8.
11. Lang W, Ronis D, Farghaly M. Preventive behaviors as correlates of periodontal health status. J Public Health Dent 1995;55:10–7.
12. Söder P-Ö, Jin L, Söder B, Wikner S. Periodontal status in an urban adult population in Sweden. Community Dent Oral Epidemiol 1994;22:106–11.
13. Beck J, Koch G, Rozier R, Tudor G. Prevalence and risk indicators for periodontal attachment loss in a population of older community-dwelling blacks and whites. J Periodontol 1990;61:521–8.
14. Barenthin I. Dental insurance and equity of access to dental services. Community Dent Oral Epidemiol 1976;4:215–20.
15. Todd J, Walker A. Adult dental health, Vol I. England and Wales 1968–1978. London: Her Majesty's Stationery Office, 1980.
16. Holst D. Third party payment in dentistry [thesis]. Oslo: University of Oslo, 1982.
17. Söderholm G. Effect of a dental care program [thesis]. Malmö: University of Lund, 1979.
18. Helöe L. Evaluation of a subsidized dental program among rural Norwegians. Community Dent Oral Epidemiol 1974;2:40–9.
19. Widström E. Dental care and oral health in Finland. Helsinki: National Research and Development Centre for Welfare and Health, 1995.
20. Talvi A, Järvisalo J, Knuts L-R, Kaitaniemi P, Kalimo R. Health promotion for working-age people. Health promotion needs as recognized by the occupational health service of Neste Oy in 1988–1991 (in Finnish). Turku: Social Insurance Institution, 1991. Publications of the Social Insurance Institution, ML:131.
21. Ainamo J, Barmes D, Beagrie G, Cutress T, Martin J. Development of the World Health Organization (WHO) community periodontal index of treatment needs (CPITN). Int Dent J 1982;32:281–91.
22. Nurminen M. Analysis of trends in proportions with an ordinally scaled determinant. Biom J 1986;28:965–74.
23. Afifi A. Clark V Computer-aided multivariate analysis. Belmont (CA): Lifetime Learning Publications, 1984:287–308.
24. Cutress T, Ainamo J, Sardo-Infirri J. The Community Periodontal Index of Treatment Needs (CPITN) procedure for population groups and individuals. Int Dent J 1987;37:222–33.
25. Baelum V, Manji F, Wanzala P, Fejerskov O. Relationship between CPITN and periodontal attachment loss findings in an adult population. J Clin Periodontal 1995;22:146–52.
26. Gaengler P, Goebel G, Kurbad A, Kosa W. Assessment of periodontal disease and dental caries in a population survey using the CPITN, GPM/T and DMF/T indices. Community Dent Oral Epidemiol 1988;16:236–9.
27. Baelum V, Fejerskov O, Manji F, Wanzala P. Influence of CPITN partial recordings on estimates of prevalence and severity of various periodontal conditions in adults. Community Dent Oral Epidemiol 1993;21:354–9.
28. Takahashi Y, Kamijyo H, Kawanishi S, Takaesu Y. Presence and absence of bleeding in association with calculus in segments given Code 2 in the Community Periodontal Index of Treatment Needs (CPITN). Community Dent Oral Epidemiol 1988;16:109–11.
29. Grytten J, Holst D, Gjermo P. Validity of CPITN's hierarchical scoring method for describing the prevalence of periodontal conditions. Community Dent Oral Epidemiol 1989;17:300–3.
30. Holmgren C, Corbert E. Relationship between periodontal parameters and CPITN scores. Community Dent Oral Epidemiol 1990;18:322–3.
31. Lewis J, Morgan M, Wright F. The validity of the CPITN scoring and presentation method for measuring periodontal conditions. J Clin Periodontol 1994;21:1–6.
32. Miyazaki H, Pilot T, Leclercq M, Barmes D. Profiles of periodontal conditions in adults measured by CPITN. Int Dent J 1991;41:74–80.
33. Kingman A. Statistical management of periodontal data. Periodontol 2000 1993;2:46–56.
34. Listgarten M, Schifter C, Laster L. 3-year longitudinal study of the periodontal status of an adult population with gingivitis. J Clin Periodontol 1985;12:225–38.
35. Löe H, Ånerud A, Boysen H, Morrison E. Natural history of periodontal disease in man. Rapid, moderate and no loss of attachment in Sri Lankan laborers 14 to 46 years of age. J Clin Periodontol 1986;13:431–45.
36. Caton J, Quinonen C. Etiology of periodontal disease. Curr Opin Dent 1991;1:17–28.
37. Syrjänen J, Peltola J, Valtonen V, Iivanainen M, Kaste M, Huttunen J. Dental infections in association with cerebral infarction in young and middle-aged men. J Int Medicine 1989;225:179–284.
38. Syrjänen J. Vascular diseases and oral infection. J Clin Periodontol 1990;17:497–500.
39. Mattila K, Nieminen M, Valtonen V, Rasi V, Kesäniemi Y, Syrjälä S. Association between dental health and acute myocardial infarction. Br Med J 1989;298:779–81.
40. DeStefano F, Anda R, Kahn H, Williamson D, Russell C. Dental disease and risk of coronary heart disease and mortality. Br Med J 1993;306:688–91.

Received for publication 15 July 1995
Accepted 21 September 1995