Does caries prevention correspond to caries status and orthodontic care in 0- to 18-year-olds in the free public dental service?

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The aim of the study was to evaluate the coverage of and time used for caries preventive actions by patient and by dentist's characteristics in relation to caries status and orthodontic treatments in patients from birth to 18 in public dental care in Helsinki City Health Department, Finland. Data on caries prevention for the age groups 0- to 18-year-olds in 1999 were analyzed in relation to patient age, caries status, orthodontic care, and dentist's characteristics. Our study comprised a total of 48,040 patients treated by 140 dentists. Main outcome measures were the coverage of and time used for repeated caries prevention performed during visits following the check-up visit. Nine percent of those under age 6 received repeated caries prevention, 29% of the 6- to 15-years-olds and 24% of the 16- to 18-year-olds. Nineteen percent in the no-caries group (DMFT/dmft = 0) and 36% in the high-caries group (DMFT/dmft > 0 and DT + dt $\geq$ 3) received repeated caries prevention. The average time a dentist used in repeated caries prevention was 3.6 min (*s* 3.1; median 2.8; range 0.2–15.4 min) for those in the no-caries and 8.1 (*s* 6.2; median 7.3; range 0.0–31.8 min) for those in the high-caries group. In each category of caries status, the average time used for repeated caries prevention was shorter for those not under orthodontic treatment. In conclusion, the variation in dentists' caries-preventive treatment practices is wide showing both over- and underuse of caries-preventive actions as judged by needs of patients. □ *Caries status; dentists' characteristics; free public dental service; orthodontic care; prevention*

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During the past few decades, caries preventive actions have been widely adopted in everyday practice. For example, in the USA, an obvious increase in the percentage of patients receiving preventive dental procedures was evident during the period 1959 to 1990 from 20% to 39%, simultaneously with a dramatic reduction of caries (1). In 1987, almost 30% of all dental procedures performed in the USA were reported to be preventive (2). In Finland, in Helsinki public dental care, the share of prevention was 25% as calculated on the basis of the market price of the items of service (3). Despite the rapid decrease in caries occurrence in children and adolescents (4, 5), caries-preventive treatments are still mainly conducted under policies established at a time when caries was a widespread public health problem (6).

It has been questioned whether caries prevalence has become so low that it is waste of time and money to carry out caries prevention (6). The mean values of DMFT and DT indices are lower than ever, each age cohort showing, however, a strong polarization of caries (7). Caries prevention should therefore be targeted at these high-caries groups. Previous studies have indicated that at the beginning of the 1990s, caries-preventive procedures were poorly targeted (8–10).

In 1993, the Helsinki City Health Department gave new instructions for caries risk assessment, individual recall intervals and caries preventive actions (11). The dentists were encouraged to individualize their treatment practices according to patient needs. All dentists received written detailed instructions. These require assessment of the patient's risk of caries on a three-level scale at each full dental examination. Dentists were trained in implementation of the new instructions at meetings carried out during working hours in 1993. The new instructions were in full use by 1994.

Despite the marked reduction in caries prevalence among children and adolescents, many teenagers develop new caries (4, 12, 13) as a consequence of their increased risk for caries due to the tightening of approximal contacts after the eruption of permanent teeth. Another caries risk factor is the use of orthodontic appliances (14), in particular among 6- to 15-year-olds, 23% of their treatments being orthodontics (15).

According to our hypothesis, more caries prevention is given to patients with more past and present caries and to those receiving orthodontics. The aim of the present study was to evaluate the coverage of and time used for caries-preventive actions by patient and by dentist's characteristics in relation to caries status and orthodontic treatments in those under 18 receiving free public dental care in Helsinki, Finland.

Materials and methods

In Finland in 1999, all inhabitants under the age of 19

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Table 1. Distribution (%) of 0- to 18-year-old patients ($n = 48,040$) by caries status and age

	Patient age groups (years)			
Patient categories by caries status	Under 6 $n = 8,243$ %	6 to 15 $n = 33,804$ %	16 to 18 $n = 5,993$ %	0 to 18 $n = 48,040$ %
No caries: DMFT = 0, dt + DT = 0	83.5	54.4	18.9	54.9
Past caries: DMFT > 0, dt + DT = 0	2.3	14.7	32.4	14.8
Low caries: DMFT > 0, dt + DT = 1–2	8.2	23.2	32.5	21.8
High caries: DMFT > 0, dt + DT = 3- >	6.0	7.8	16.3	8.5
	100.0	100.0	100.0	100.0

Statistical evaluation by chi-square test; differences by age group: $P < 0.001$.

were entitled to free comprehensive public dental care the utilization rate being around 95%. Public dental services follow the detailed guidelines and instructions given by the National Board of Health (16) for diagnoses and treatment decisions. In Finland, oral health manpower includes 4,700 dentists, 70% are female. Half of the dentists are employed by public sector, females predominating (17). In Helsinki, data on dental status with DT and DMFT indices and details of visits and procedures are recorded in municipal automatic data processing (ADP) files on an online network. Recordings for each patient are made by visit, always including the identification code for the dentist in question. Each item of treatment has an individual code showing the type of service and time estimated for it. Based on each dental examination, the data system suggests a corresponding treatment plan that the dentist in question can accept or change at will.

The preventive treatments recorded in ADP files are fissure sealing and general caries prevention, the latter including topical fluoride application, cleaning of teeth, oral home care instruction, and advice on diet, on use of fluorides and on tooth brushing. Basic caries prevention must be performed at the check-up visit for full dental examination, but is not recorded separately, since it is included in its code (18). The full dental examination always includes oral health indices and the proposed check-up interval. Separate codes are used for occasional check-ups, e.g. in cases of pain, trauma or orthodontic treatment, but these codes include no prevention. According to each dentist's decision, caries prevention can be repeated at further visits, then being recorded as performed (18). Caries-preventive treatments can be carried out by dentists, dental hygienists, or chairside dental nurses.

Repeated caries prevention is recorded in Finland in four separate codes including all other caries prevention except for sealing, which has an individual code. The four codes in prevention describe the real time used, here categorized into two: short (estimated time 12 min) and long (25 min). Dentists are instructed to give more and longer preventive actions to caries-risk patients than given to those without risk. Repeated caries prevention was evaluated in three categories: not given, given once or more than once, or as time used for it according to caries status and for 6- to 15-year-old children and adolescents by orthodontic treatment received.

In the analyses, the patient's dental state was categorized into four groups: NC = no caries (DMFT/dmft = 0 and DT + dt = 0), PC = past caries (DMFT/dmft > 0 but DT + dt = 0), LC = low caries (DMFT/dmft > 0 and DT + dt = 1–2), HC = high caries (DMFT/dmft > 0 and DT + dt $\geq$ 3).

Patient age was categorized into three groups (under 6, 6 to 15, or 16 to 18 years) in order to separate those with primary dentition, those of school age, and those after school age but still receiving free dental care. Dentists who performed at least 50 check-ups in 1999 for 0- to 18-year-old children and adolescents were included, totalling 140 dentists and 48,040 check-ups. A dentist's clinical work and its caries-preventive approach were described by

Table 2. Repeated caries prevention* given to and sealants made in % of 0- to 18-year-olds ($n = 48,040$) by caries status

	Patient categories by caries status**			
Types of caries preventive actions	NC $n = 26,374$ %	PC $n = 7,110$ %	LC $n = 10,473$ %	HC $n = 4,083$ %
Repeated caries prevention				
Once	15.7	21.8	24.9	24.5
More than once	3.7	5.8	7.8	11.4
Fissure sealing	19.3	16.6	20.5	17.2

* Basic caries prevention is performed at each dental check-up.
** NC: DMFT = 0, dt + DT = 0; PC: DMFT > 0, dt + DT = 0; LC: DMFT > 0, dt + DT = 1–2; HC: DMFT > 0, dt + DT = 3->.
Statistical evaluation by chi-square test; differences by dental state for both repeated caries prevention and for fissure sealing: $P < 0.001$.

Table 3. Repeated caries prevention* given to % of 6- to 15-year-olds (n = 33,804) by caries status and orthodontic treatment

	Patient categories by caries status**			
Caries-preventive actions by orthodontics	NC %	PC %	LC %	HC %
Any orthodontics given	n = 4,094	n = 1,380	n = 1,723	n = 424
Repeated caries-prevention				
Once	21.1	25.7	26.3	31.4
Twice or more	6.4	10.6	13.1	17.5
No orthodontics given	n = 14,168	n = 3,552	n = 6,055	n = 2,178
Repeated caries-prevention				
Once	18.9	22.7	26.1	25.8
Twice or more	4.5	5.8	7.7	12.0

* Basic caries prevention is performed at each dental check-up.
** NC: DMFT = 0, dt + DT = 0; PC: DMFT > 0, dt + DT = 0; LC: DMFT > 0, dt + DT = 1–2; HC: DMFT > 0, dt + DT = 3->.
Statistical evaluation by chi-square test; differences by caries status and orthodontics ($P < 0.001$). Data missing for 230 cases.

aggregating patient-based data by dentist covering the entire year 1999. The following indicators were aggregated to describe each dentist's clinical work among 0- to 18-year-old children and adolescents: number of all check-ups, mean number of D + d teeth, mean time (min) used for repeated caries prevention for all patients, and separately for no-caries patients or high-caries patients. Based on dentist's identification code data on his/her age and gender were given by dental authorities. Dentists' mean age was 40.6 years (s 9.5, median 38.8). Male dentists (n = 18) were younger than female (n = 122); mean age 35.5 versus 41.3 years ($P < 0.01$). Mean number of patients was 343 (s 181), the maximum being 695 for female and 990 for male dentists. Female dentists' patients had more D + d teeth than did male dentists' patients (0.7 versus 0.6, $P < 0.05$).

Statistical evaluation was performed by means of the chi-squared test for differences in frequencies, and the t-test and ANOVA for comparison of means in various subgroups. A linear regression model was used to explain dentists' variation in time used for repeated caries prevention.

This study was approved by the ethics committee of the Helsinki City Health Department.

Results

The patients' distribution by caries status is given in Table 1. Under 6 years of age, the vast majority of the patients belonged to the no-caries group, of those aged 16 to 18 years, one-fifth. Of all patients, 54.9% belonged to the no-caries group and 8.5% to the high-caries group (DT + dt $\geq$3), while 21.8% had one to two carious teeth. The older the patients, the larger the high-caries group.

Repeated caries prevention was given once to 19% of patients and twice to 6%. Of those under 6 years of age, 9% received repeated caries prevention, 29% of the 6- to 15-year-olds and 24% of the 16- to 18-year-olds. Fissure sealing was most common among 6- to 15-year-olds, given to 26% of them, being 39% in 6- to 8-year-olds and 31% in 12- to 14-year-olds.

Table 2 shows coverage of repeated caries prevention by caries status. The worse their dental state, the more these patients received repeated caries-preventive actions: In the no-caries group, 19.4% (5117 patients) and in the high-caries group 35.9% (1466 patients) received repeated caries prevention leaving 64.1% (2617 patients) in the latter group without it. As regards fissure sealing, the differences between caries groups were small.

Table 4. Time (min) used for repeated caries prevention* among 6- to 15-year-olds (n = 33,804) by caries status and orthodontic treatment

	Time (min) for repeated caries prevention Orthodontic treatment			
	Yes		No	
Patient groups by caries status	n	Mean (s)	n	Mean (s)
No caries: DMFT = 0, dt + DT = 0	4,094	5.5 (11.5)	14,168	4.1 (9.9)
Past caries: DMFT > 0, dt + DT = 0	1,380	7.9 (14.2)	3,552	5.5 (11.6)
Low caries: DMFT > 0, dt + DT = 1–2	1,723	8.7 (14.3)	6,055	6.6 (12.3)
High caries: DMFT > 0, dt + DT = 3->	424	12.2 (17.7)	2,178	9.0 (16.8)
Total	7,621	7.0 (13.2)	25,953	5.4 (11.5)

* Basic caries prevention is performed at each dental check-up.
Statistical evaluation by ANOVA; differences between the subgroups by caries status and orthodontics: $P < 0.001$; Data missing for 230 cases.
s = standard deviation.

Table 5. Variation in dentists' mean time used for repeated caries prevention for high-caries cases among 0- to 18-year-old patients as explained by means of a linear regression model. Original patient-based data (n = 48,040) aggregated to describe the dentists' (n = 140) clinical work

Independent variables	Regression	*s*	t	Beta coefficient
Dentist's gender (1 = F, 2 = M)	−2.212	1.412	−1.567	−0.120
Dentist's age	−0.030	0.050	−0.585	−0.045
No. of all check-ups	0.002	0.003	0.734	0.055
Mean DT + dt of all patients	3.512	1.901	1.847	0.139
Time used for repeated caries prevention for no-caries cases	1.010***	0.153	6.597	0.491

Constant = 5.13 (s = 3.21); R^2 = 0.281; *** $P < 0.001$.
F = female, M = male.
s = standard deviation.

Among the 6- to 15-year-olds, 23% received orthodontic treatment, 22% in the NC group and 16% in the HC group. Table 3 shows the coverage of repeated caries prevention in this age group by caries status and by orthodontic treatment or none. In each category of caries status, repeated caries prevention was given more frequently to patients receiving orthodontics compared to those who were not. For the high-caries patients, the figures were 48.9% and 37.8%. Similarly, the average time used for repeated caries prevention in each category of caries status was longer for those undergoing orthodontic treatment (Table 4). The corresponding time estimates were 12.2 and 9.0 min for the high-caries patients and 5.5 and 4.1 min for those with no caries.

By dentist, the average time used in repeated caries prevention per patient was 4.9 min (s 3.3; median 4.3; range 0.5–18.5 min) for all 0- to 18-year-old children and adolescents, 3.6 (3.1; median 2.8; range 0.2–15.4 min) for those in the no-caries, and 8.1 (6.2; median 7.3; range 0.0–31.8 min) for those in the high-caries group. No difference in the mean values existed by dentist's gender or age. The maximum values of average time used for repeated caries prevention were higher among female than among male dentists: for all patients 18.5 min by female dentists and 14.3 by the males; and for high-caries patients, 31.8 and 17.8.

Table 5 indicates the variation in average time dentists used in repeated caries prevention for their high-caries patients. The linear regression model utilized data aggregated by each dentist to describe his/her clinical work. A dentist's average time used for repeated caries prevention in the high-caries group was best explained ($P < 0.001$) by the average time the dentist in question used for repeated caries prevention for no-caries patients.

Discussion

A positive finding in the present study was that targeting of caries prevention corresponded well with the dental condition of the 0- to 18-year-old children and adolescents: the worse it was, the higher coverage of and the more time used for repeated caries prevention. Compared to previous findings (10) showing only a slight tendency toward targeted caries prevention among 6-, 13-, and 15-year-old high-caries patients in Helsinki, the present results indicate a clear positive development in targeting of caries prevention.

Another positive finding was that orthodontic patients received more caries prevention than did those with no orthodontics. In this case, the numerous visits for orthodontics (15) were utilized also for caries prevention. The dentists thus seemed to be well aware of the increased risk of caries due to orthodontic appliances (14), or this may have easily been recognized, e.g. as an increased accumulation of dental plaque. A further explanation may be the increase in visits allowing dental personnel to perform more caries-preventive actions. On the other hand, a previous report in the Finnish public dental service states that orthodontics and prevention steal resources from each other (19).

Sealants were placed almost as often for no-caries and high-caries patients (17.2% versus 19.3%), possibly due to the smaller number of sound molars in the latter group. The coverage of repeated caries prevention cannot, however, be considered adequate for high-caries patients, since 64.1% of them were left without it. This indicates dentist emphasis on a filling-orientated approach which ignores caries-preventive actions despite the numerous visits that high-caries patients must make to get their cavities filled (10). Even if the effectiveness of dental health education has been questioned lately (20, 21), it would be unethical to leave high-caries patients without such procedures.

An alarming finding was that one-fifth of the no-caries patients received repeated caries prevention (Table 2). Some of them may have shown signs of increased caries risk not included in the ADP recordings but visible to the dentist, e.g., enamel lesions or dental plaque (22). The possible overuse of resources for 5117 no-caries patients' repeated caries prevention accounted for twice the estimated need for full coverage of the 2617 high-caries patients' repeated caries prevention, now been left without it. More accurate targeting of caries prevention resulting in full coverage of repeated caries prevention in the high-caries group could thus have been carried out with the resources and staff available.

In the present study, we focused on repeated caries

prevention, because each patient receives the basic caries prevention together with his/her dental check-up, as required overall in the Finnish oral health service (18). In the code for a check-up also are combined basic prevention and a written treatment plan. Performance of repeated caries prevention thus indicates the ability and willingness of dentists to target caries prevention to those in need.

According to our results, dentists' age and gender had no impact on time used for repeated caries prevention. However, some female dentists showed a tendency to much longer average times, in particular for high-caries patients. This is in line with a report showing female dentists to be more attentive to caries prevention (9). On the other hand, male dentists have been reported to perform active measures of caries prevention more than the females do, the latter being more interested in performing passive prevention (23). In the present study the linear regression model showed that a dentist's average time used for repeated caries prevention for no-caries cases best explained the average time for high-caries cases (Table 5). This indicates caries prevention being more related to a dentist's preventive-orientated working profile and less to patients' caries status.

The present results suggest that coverage of and time for repeated caries prevention remained insufficient in high-caries patients, but in general caries prevention tended to be targeted according to caries status and to patients receiving orthodontics. Since 0- to 18-year-old patients receiving public dental care in Helsinki account for about 10% of the respective population in the whole of Finland, the present findings can be considered a good estimate of caries-preventive practices in Finland.

In conclusion, variation in dentists' caries-preventive treatment practices is wide, showing both over- and underuse of caries-preventive actions as judged by the needs of patients. This indicates the need for further continuous education and more training in calibration to allocate resources adequately. With the help of automatic data processing and a computer-aided program it may be possible in the future to guide the dentists to more accurate dental prevention.

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References

1. Brown LJ, Lazar V. Demand-side trends. J Am Dent Assoc 1998;129:1685–91.
2. Manski RJ, Moeller JF, Maas WR. Dental services: use, expenditures and sources of payment, 1987. J Am Dent Assoc 1999;130:500–8.
3. Vehkalahti M, Helminen S. Outcome of public oral health services in relation to treatment mix. Acta Odontol Scand 1994;52:1–6.
4. Hugoson A, Koch G, Hallonsten A-L, Norderyd J, Åberg A. Caries prevalence and distribution in 3–20-year-olds in Jönköping, Sweden, in 1973, 1978, 1983, and 1993. Community Dent Oral Epidemiol 2000;28:83–9.
5. Marthaler TM, O'Mullane DM, Vrbic V. The prevalence of dental caries in Europe 1990–1995. ORCA Saturday Afternoon Symposium 1995. Caries Res 1996;30:237–55.
6. Burt BA. Prevention policies in the light of the changed distribution of dental caries. Acta Odontol Scand 1998;56:179–86.
7. Vehkalahti M, Tarkkonen L, Varsio S, Heikkilä P. Decrease in and polarization of dental caries occurrence among child and youth populations, 1976–1993. Caries Res 1997;31:161–5.
8. Källestål C, Holm A-K. Allocation of dental caries prevention in Swedish teenagers. Community Dent Oral Epidemiol 1994;22: 100–5.
9. Kärkkäinen S. Karieksen ehkäisykäytäntö Suomessa 1990-luvun alussa (summary in English) [PhD thesis]. Acta Universitatis Ouluensis D434; 1997.
10. Varsio S. Caries-preventive treatment approaches for child and youth at two extremes of dental health in Helsinki, Finland [PhD thesis]. University of Helsinki; 1999.
11. Helsinki City Health Department. Uudelleenarviointiprojekti. Circular; 1993.
12. Bjarnason S. High caries levels: problems still to be tackled. Acta Odontol Scand 1998;56:176–8.
13. Bowen WH. Dental caries: is it an extinct disease? J Am Dent Assoc 1991;122:49–52.
14. Batoni G, Pardini M, Giannotti A, Ota F, Giuca MR, Gabriele M, et al. Effect of removable orthodontic appliances on oral colonisation by mutans streptococci in children. Eur J Oral Sci 2001;109:388–92.
15. Vehkalahti MM, Helminen SKJ. Treatment-mix and visits in free public oral health service, Finland. Abstract no. 484. Abstracts of 37th Annual Meeting of the Continental European Division of the International Association for Dental Research, 5–8 September 2001, Rome, Italy; 2001.
16. National Board of Health. Instructions on Public Oral Health Services for Patients Born After the Year 1960. NBH regulation 6/85; 1985.
17. Statistical Yearbook of Finland. Keuruu: Tilastokeskus; 2000.
18. Social Insurance Institution. Sairausvakuutus. Hammashuolto. Ohjeet 1.10.1997. Kansaneläkelaitos; 1997.
19. Läärä M, Widström E, Mattelmäki U, Meriläinen T. Dental treatments in municipal health centres in Finland. Stencils of the Ministry of Social Affairs and Health 2000;17:2000 (summary in English).
20. Kay EJ, Locker D. Is dental health education effective? A systematic review of current evidence. Community Dent Oral Epidemiol 1996;24:231–5.
21. Sheiham A, Watt RG. The common risk factor approach: a rational basis for promoting oral health. Community Dent Oral Epidemiol 2000;29:399–406.
22. Winston AE, Bhaskar SN. Caries prevention in the 21st century. J Am Dent Assoc 1998;129:1579–87.
23. Helminen SE, Vehkalahti M, Lammi R, Ketomäki T-M, Murtomaa H. Dentists' decisions as to mode of preventive treatment in adolescents and young adults in Finland. Community Dent Health 1999;16:250–5.

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