Analyses of the caries decline and incidence among Norwegian adolescents 1985–2000

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Since most studies of caries decline are descriptive time-trend analyses, the purpose of this article was to identify factors statistically associated with the caries decline among Norwegian adolescents after 1985. The DMFT scores for the age groups 12 and 18 years reported annually by 19 counties were analysed. The average caries-free proportions of 18-year-olds increased from 2% to 15% between 1985 and 2000, while the DMFT declined by 49%; 10.2 ± 0.75 to 5.2 ± 0.78. The decline for the 12-year-olds was 53%. The mean DT at the dentinal level remained at about 0.8 for 12-year-olds and 1.5 for 18-year-olds throughout the observation period. There was no significant difference in DMFT increment from age 12 to 18 between the birth cohorts 1973 (3.8 ± 0.46) and 1982 (3.0 ± 0.52) when controlling for counties. The variables migration and children per dentist were significantly associated with the DMFT decline in multivariate analyses. The caries decline for 18-year-olds was significantly steeper before than after 1990. The decline among the 18-year-olds may be attributed to fluoride and more restrictive criteria for placement of fillings in teenagers in the 1980s and fewer filled teeth before the age of 12 years in the 1990s.
□ *Adolescents; caries; epidemiology; fluorides*

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Most experts consider fluoride toothpaste to be a very important factor behind the caries decline in the Western world during recent decades (1). A review of the reviews from six international conferences during the past decades shows the complexity of the issue, but identifies fluoride in different forms as the main reason for the decline (2). Detailed analyses have shown that the caries decline in Norway started in the rural north several years before fluoride toothpaste was available over-the-counter (3). Age-specific analyses revealed that the initial caries decline was statistically evident primarily in the age groups participating in the school-based fluoride rinsing and brushing programmes (4). The continual decline, however, may be related to many factors, including fluoride toothpaste (3–5).

For the planning of future preventive programmes and to maintain a low caries activity, the impact of different factors believed to contribute to the caries decline is important (1). Most studies of the caries decline are descriptive time-trend analyses. In only a few studies has the decline been statistically analysed (3, 4, 6, 7). There is therefore a general lack of statistical assessment of factors associated with the caries decline in the Western world. Annually reported data from the Public Dental Services in Norway are amenable to statistical analyses. The purpose of this study was to assess the possible impact of certain factors believed to be associated with the caries decline among Norwegian adolescents after 1985.

Material and methods

Dental care and caries data

Two public systems have provided free dental care to children and adolescents in Norway; the School Dental Service (SDS) and the Public Dental Service (PDS). The former was mainly established in cities and central areas. The PDS, being more comprehensive than the SDS, replaced the latter in all 19 counties in 1984.

Before 1984, the PDS reported annually the number of surfaces filled in the permanent teeth of children 6 to 17 years of age. The system was changed to report data for 5-, 12-, and 18-year-olds from 1984. At the county level, the caries-free proportions and the DMFT scores as well as the DT and FT components are reported (8). Caries-free means neither carious lesions in need of fillings nor fillings or teeth lost due to caries. This study reports DMFT data for 12- and 18-year-olds from 1985 to 2000, i.e. children born 1967 to 1988. The 1984 data were excluded because they were incomplete. No subject level data are available.

All carious lesions in the permanent teeth requiring a filling were assumed to be treated. Since the 1960s, bitewing radiographs have generally been used at the yearly examinations. There is no indication that the indications for radiographic examination have changed over the years. Use of fissure sealants has not been routine. Extraction of permanent teeth due to caries declined until 1983 (4, 5), when the extraction rate was 0.3 teeth per 100

Table 1. Background characteristics for 19 Norwegian counties

Variable	Period/year	Average	Range
Percentage 18-years-olds treated	1985	73.9	40–91
	1990	80.3	64–90
	1995	80.1	43–91
	1999	74.3	41–87
Children per dentist[1]	1990	1,112	555–1,858
	1993	1,186	700–2,058
	1998	1,122	520–1,947
Net migration (%)	1985–98	1.25	−10.6–8.2
Percentage with university[2]	1985	10.0	7.3–18.5
or college education	1992	16.4	12.8–29.2
Infant mortality per 1000	1971–75	12.0	9.2–16.0
	1991–95	5.5	3.6–9.7
Children (per 1000) in receipt of social support	1987–99	21.5	16.2–28.8
Medicine, % of national average[3]	1996		
Antidepressants		100	47–143
Anxiolytics		100	52–158
Hypnotic and sedatives		100	45–136
Opioids		100	73–139
Use of fluoride tablets (%)[4]	1976	28.3	16.3–60.4
	1985	37.9	25.5–75.9
	1995	38.9	28.7–59.7

[1] 0–18 years.
[2] Persons 16 years of age or older.
[3] DDD/1000 inhabitants/day.
[4] Children below 15 years of age.

children 6–17 years old. Provided the 1983 level persisted, it would have little impact on the reported DMFT scores.

The nine counties along the western coast, from Rogaland in the south to Finnmark in the north, were termed the 'coastal counties'; the remaining 10, the 'central counties'. This grouping was done for several reasons; the PDS was first implemented in the northern counties and along the western coast. The socio-economic conditions are generally less favourable in the coastal counties (9). The population to dentist ratio has been stable in recent decades. The dentists in the PDS in the coastal counties provided care to adults to a greater extent than in the central counties. There was wide variation between counties in the number of children treated per dentist (Table 1).

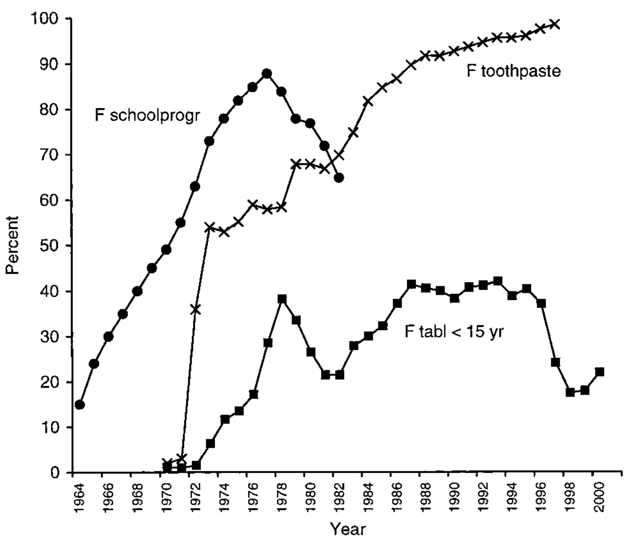

Fig. 1. Sale of fluoride tablets in DDD/100 children under 15 years of age. Percentage of 7–14-year-old schoolchildren participating in fluoride mouth rinsing and/or brushing programmes, and percentage of fluoride toothpaste of the total toothpaste sale by year.

The number of children born in Norway decreased from 66,453 in 1967 to 51,453 for the birth cohort 1983. The treatment rate for the 18-year-olds has varied markedly between counties, but was significantly different between the coastal and the central counties only in 1985. The average treatment rate has been 73.9% or higher during the last 15 years (Table 1) (8).

Background information

The higher infant mortality and lower percentage with completed university or college education indicate a less favourable socio-economic level in the coastal counties (9). These factors have improved concurrently in all counties during recent decades (Table 1). Several other variables show wide inter-county variation and less favourable conditions in the coastal counties. In the former, a lower proportion of the population used neuroleptic drugs (10) and people moved from the coastal counties to the central counties during the period of observation (Table 1) (9). Migration measures primarily the moving between counties.

Several fluoride vehicles became available in the 1960s and 1970s (Fig. 1) (4, 5, 11, 12). The yearly sale of fluoride tablets varied over the years, but around 1990 it

Table 2. Summary of the main analyses and statistical tests carried out at county and cohort level

Study design	Statistical analyses/tests
Prevalence–increment	
DMFT at ages 12 and 18 years	Paired *t* test
DMFT increment age 12–18, cohorts 1973–82	Two-way analysis of variance
Time trend	
DMFT changes 1985–00	Paired *t* tests
Bi- and multivariate analyses	
DMFT, DMFT increment, DMFT changes versus other variables	Spearman's rho and linear regression

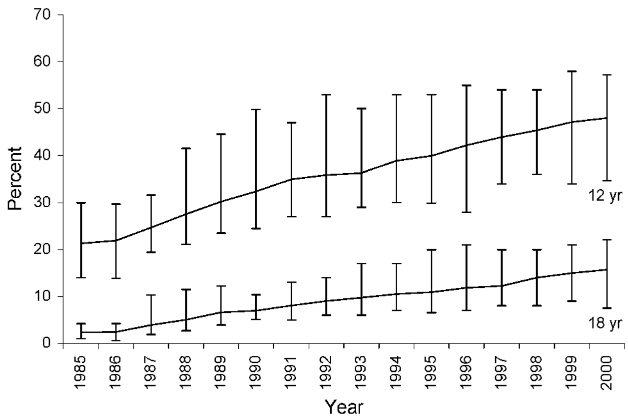

Fig. 2. Mean and inter-county range of percentage caries-free children (D_3MFT) 12- and 18-year-olds in 19 Norwegian counties according to year of examination.

corresponded to use by 40% of children below 15 years of age (Fig. 1) (10). Primarily, chewable lozenges, containing sodium fluoride, were used according to an age-defined dosage. County data for fluoride tablets were only available for some years in the 1970s, 1981, 1983, 1985 and the late 1990s (10, 13). There were great variations between counties in the sale of tablets (Table 1). About 80% of children 7–14 years of age participated in supervised fluoride mouth rinsing or toothbrushing programmes in the early 1980s (Fig. 1) (12). There are no data showing participation in the programmes after 1981. Toothpaste with 0.1% fluoride was released for over-the-counter sale in 1971. Subsequently, sales have increased to a level where it has more or less taken over the market (Fig. 1) (14).

The consumption of 'sweets' adjusted for import and export, has increased continually; from 4.6 kg per capita in 1960 to 10.9 kg in 1980 and to 13.4 kg in 2000 (14). Concurrently with the increasing consumption of 'sweets', the sale of carbonated soft drinks has increased; from 58 litres per capita in 1980, reaching 87 litres in 1990 and 115 litres in 2000 (14). The sugar-sweetened varieties comprised about 77% of the market in the 1990s (14). Despite the increasing consumption of 'sweets' and soft drinks, the total annual consumption of sugar has remained at about 42 kg per capita since the 1960s.

Analyses

The comparisons and the statistical tests used are summarized in Table 2. Paired within-county comparisons were carried out for dental and other variables. In the comparison of DMFT increments from 12 to 18 years of age between the cohorts and within the counties, two-way analyses of variance were carried out. In the time-trend analyses the earliest information was regarded as baseline. The mean DMFT scores were regressed on the whole period of observation as for the 1980s and 1990s, separately. To compare the slopes for the different periods of time (Fig. 3), 95% confidence intervals were used. In order to test a relationship between the baseline DMFT for the 18-year-olds and the magnitude of the decline, the following analysis was applied: the 19 county averages of the baseline and final scores ((1985 + 2000)/2) were regressed on the declines (15).

The bivariate associations between dental variables (DMFT at age 12 and 18 years, DMFT increment from 12 to 18 years of age for birth cohorts, inter-county changes in DMFT scores for the 12- and the 18-year-olds for the period 1985–2000) and background variables were assessed using Spearman's rho (Table 4). In the cohort analyses, the background data for the calendar year 2000 or when the subjects were 18 years old were used. The linear multivariate regression analyses were restricted to a maximum of 4 independent variables because of the small

Table 3. Average DMFT and DT with standard deviation ($\pm s$) for two age groups and DMFT increments from age 12 to 18 for selected birth cohorts. Paired comparison at county level ($n = 19$)

	12 years		18 years		
Year of birth	DT	DMFT	DT	DMFT	12–18 years DMFT increment
1967	—	—	1.5	10.2 ± 0.75	—
1973	0.9*	3.4 ± 0.36*	1.6	7.2 ± 0.65*	3.8 ± 0.46
1977	0.9	2.6 ± 0.38*	1.5	6.5 ± 0.72*	3.9 ± 0.46
1980	0.8	2.2 ± 0.37	1.4	5.6 ± 0.70	3.4 ± 0.47
1982	0.8	2.1 ± 0.36	1.4	5.2 ± 0.78	3.0 ± 0.52
1988	0.7*	1.6 ± 0.33	—	—	—

* Significant, $P < 0.02$.

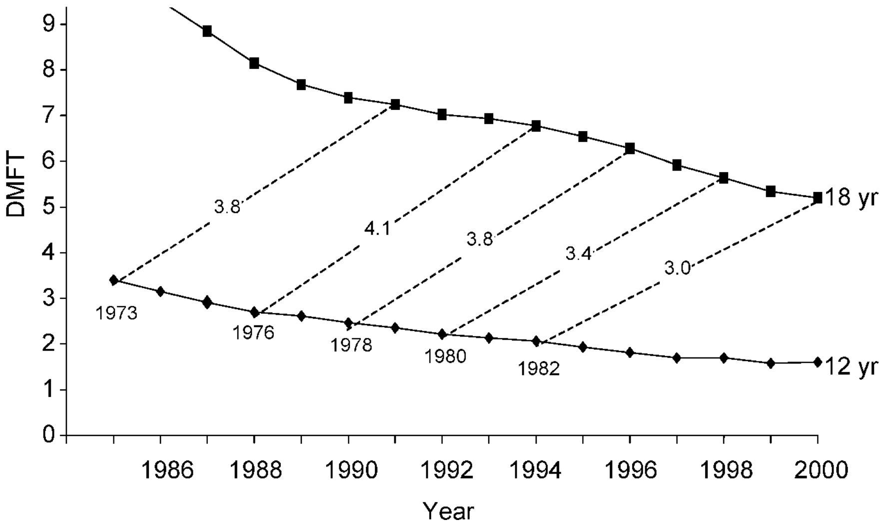

Fig. 3. County DMFT averages for 12- and 18-year-olds by year of examination. Caries increments from 12 to 18 years of age for the birth cohorts 1973, 1976, 1978, 1980, and 1982.

sample size (19 counties) (15). In these analyses, the enter option was used. The 9 coastal counties were coded 1 and the 10 central counties 2.

Since the data are aggregated, statistical significance tests should be interpreted with caution. A *P*-value of 0.05 indicates significance for the background variables and a *P*-value of 0.02 was used for the dental variables.

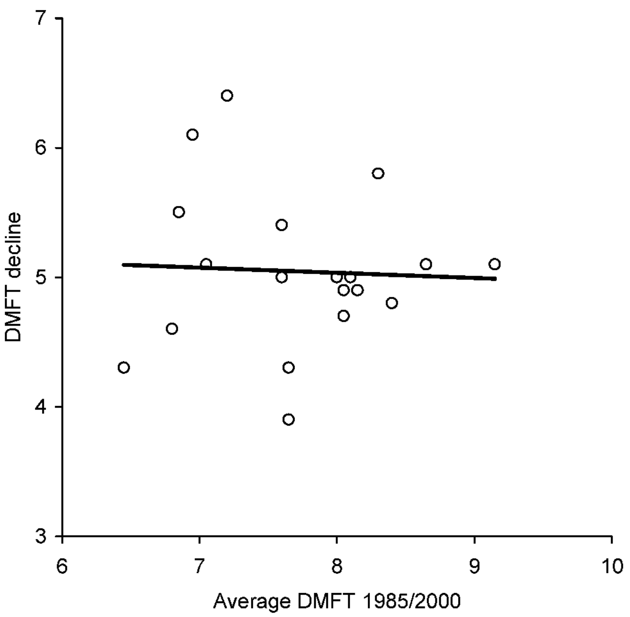

Fig. 4. Regression of the DMFT decline for 18-year-olds from 1985 to 2000 on the average county mean DMFT scores at age 18 in 1985 and 2000 ($n = 19$ counties).

Results

Descriptive analyses

The percentage of caries-free 12- and 18-year-olds increased continually in all counties; the range of caries-free at age 18 in 1985 was 1–4% compared to 8–22% in 2000 (Fig. 2). The DMFT scores at age 18 were significantly higher in the coastal counties throughout the period of observation (1985: 10.7 ± 0.54, $n = 9$ versus 9.9 ± 0.73, $n = 10$; 2000: 5.7 ± 0.47 versus 4.7 ± 0.70), whereas the decline was not significantly different between the two county groups (4.9 ± 0.47, $n = 9$ versus 5.1 ± 0.80). The DT scores for the 12- and 18-year-olds were about 0.8 and 1.5, respectively, throughout the period of observation (Table 3). Only the DT score for the 12-year-olds in 2000 was significantly lower than the DT in 1985. The DMFT scores decreased gradually, whereas the caries increments varied by about 1 DMFT (Table 3, Fig. 3). The DMFT increments from age 12 to 18 (Fig. 3) for children born in 1973 and 1982 were not significantly different when controlling for variation between counties by the background variables education ($P = 0.20$) or infant mortality ($P = 0.04$).

Regression analyses showed no significant association between the DMFT averages at age 18 in 1985 and 2000 on the one hand, and the magnitude of the declines in the different counties on the other ($r = -0.046$, $b = -0.039$, $P = 0.85$, Fig. 4). The average improvements from 1985 to 2000 correspond to 53% and 49% reduced DMFT scores at ages 12 and 18, respectively (Table 3). These improvements translate into compound annual reduction rates of 5.2% and 4.6%, respectively. The DMFT decline for the 12-year-olds was fairly even throughout the period of observation (regression coefficient = -0.12, Fig. 3). The

Table 4. Spearman's rho between DMFT at ages 12 and 18, changes in DMFT scores for 12 and 18-year-olds for the period 1985–2000, DMFT increments from 12 to 18 years of age and some selected predictor variables analysed at county level ($n = 19$ counties)

Variable	DMFT 12 1985–00	DMFT 18 1985–00	Increm. 12–18 coh. 1982	DMFT 12 1994	DMFT 18 2000	Child/dentist[1] 1990	Child/dentist 1998	% treated 18 years 1985	Migration[2] 1981/85–98	County groups[3]
DMFT 18 years 85–00	0.18									
Increment 12–18	0.17	−0.25								
DMFT 12:94	0.17	−0.36	0.63*							
DMFT 18:00	0.27	−0.39	0.85*	0.90*						
Child dentist 90	−0.07	0.29	−0.31	−0.56*	−0.52					
Child dentist 98	−0.02	0.47	−0.54*	−0.74*	−0.71*	0.78*				
% treated 18 years 85	0.20	−0.22	0.28	0.49	0.40	−0.28	−0.31			
Migration	−0.16	0.01	−0.59*	−0.60*	−0.61*	0.75*	0.68*	−0.43		
County groups	−0.26	0.11	−0.73*	−0.56*	−0.62*	0.44	0.46	−0.46	0.79*	
Opioids[4]	−0.01	0.15	−0.26	−0.43	−0.48	0.57*	0.45	−0.38	0.76*	0.84*

* Significant, $P < 0.02$.
[1] 0–18 years.
[2] Net migration (%).
[3] Coastal and central counties.
[4] Percent of national average in DDD/1000 inhabitants/day.

decline for the 18-year-olds was significantly steeper in the 1980s than in the 1990s (Fig. 3): the regression coefficient was −0.57 (95% CI: −0.697 to −0.452, $n = 6$) for the 1980s and −0.23 (CI: −0.257 to −0.203, $n = 10$) for the 1990s. The corresponding compound annual reduction rates were 6.8% and 3.6% for the late 1980s and the 1990s, respectively. The DMFT decline for the 12-year-olds continued after 1994 (Fig. 3).

Factors associated with the decline

Bivariate correlation analyses found neither the DMFT decline in the 12-year-olds nor in the 18-year-olds from 1985 to 2000 to be significantly associated with any of the selected background factors (Table 4). The DMFT at ages 12 and 18 and the increment from 12 to 18 years of age for birth cohort 1982 were significantly associated with the background variables migration, county group and children per dentist. The DMFT scores as well as the increments were significantly associated (Table 4). Some variables were highly correlated: children per dentist and the background variables migration, county group, and sale of opioids (Table 4). The background variables included in Table 4 showed, generally stronger association with the dental variables than the remaining variables in Table 1. Sale of fluoride tablets was not significantly correlated with the DMFT scores.

Multivariate regression analyses showed a significant independent effect of migration ($P = 0.005$) and children per dentist ($P = 0.001$) on improvement of the DMFT scores at age 18 years between 1985 and 2000 when controlling for county groups. The explained variance was 53.7% in this model. Neither the DMFT scores at ages 12 and 18 years nor the DMFT increments for the 1982 birth cohort were related to any background variable in multivariate analyses. The explained variance varied between 40.7% and 43.7% in these models.

Discussion

Methodological comments

Methodological problems arise in retrospective analyses of aggregated data lacking test and control groups (16), but aggregated county data have been found suitable for measuring the caries decline in Sweden between 1985 and 1994 (17). The paired comparisons at county level and for cohorts should reduce the effect of inter-county variations and improve the validity compared to descriptive time-trend analyses. Few of the background variables were reported according to age, and the data on fluoride toothpaste and 'sweets' were not available by either age or county, which is a common problem in ecological studies (e.g. 7, 18, 19).

The average yearly treatment rate was 73.9% or higher. Intervals exceeding 12 months may partly explain the treatment rate rather than drop-outs. Only 12% of the

Table 5. Summary of the main findings among the 18-year-olds in two periods of time and possible reasons for the observations

Period of time	1985–1990		1990–2000		
Birth cohort	1967–1972		1972–1982		
Findings		*Findings*			
Compound DMFT reduction rate per year (%)	6.8		3.7		
FT annual reduction rate (%)	8.5		4.7		
DMFT increm. 12–18 years	No information		'Stable'		
Reasons		*Reasons*			
Increasing F exposure since 1972 (Fig. 1)		'Fairly stable' F exposure from birth cohort 1972			
Increasing length of preschool F exposure, i.e. age 5 for cohort 1967		Difference birth cohorts 1973–82			
More restrictive criteria for fillings since the early 1980s		DMFT at age 18 years			2.0
Equal annual decline in 19 years: annual compound rate 5.4% 1971–1985 and 6.2% until 1990		FT at age 12 years	1.3		
		FT increm. 12–18 years	0.6		
		DT at age 18 years		0.1	
			2.0		2.0
		Fewer filled teeth at age 12 explains most of the caries decline at age 18 years in the 1990s			

total number of dental appointments were either missed or cancelled in a group of Norwegian children followed from the age of 12 to 18 years (20).

Filled teeth constitute the main DMFT component in adolescents in Norway (21–26), and these, rather than decayed lesions, reflect geographical variations in caries experience (27). The decayed component measures lesions in need of operative treatment and represents the yearly increment. Because initial carious lesions are omitted, the caries-free proportions are overrated, whereas the extent of caries is underestimated (26–28). The DMFT score at age 12 consists of the DT at this age and the FT after the restorative treatment in the past; similarly for the DMFT score at age 18.

Compound annual reduction rates were used to compare the decline in different periods of time. Provided an equal annual decline, the compound rate increases with an increasing period of observation. Lower baseline values, on the other hand, give a higher rate; the rate for filled teeth was 8.5% compared to the 6.8% for the DMFT scores at age 18 years in the late 1980s (Table 5).

There were significant linear relationships between several dental variables and some background variables (Table 4). Thus, the assumption for multivariate analyses was satisfied. Migration was significantly associated with the DMFT decline in the multivariate analyses, although the correlation coefficient was only 0.01 and insignificant in the bivariate analyses (Table 4). Migration showed the greatest inter-county variation of the background variables (Table 1). This may partly explain its effect in the statistical analyses. Migration may reflect the socio-economic situation and could only have an indirect effect on caries. Fluoride tablets had a higher correlation coefficient (rho = 0.33) than migration (rho = 0.01), but it was insignificant in the analyses. Owing to the aggregated nature of the data, the statistical analyses are indicative of an effect rather than explanatory.

Comments on the findings

The most striking findings in the present study were: the magnitude of the caries decline, the different annual compound rates in the 1980s and 1990s, the relatively stable caries increments between 12 and 18 years of age, and the reported stable DT scores for the different cohorts. The decline between 1985 and 2000, 53% and 49% for the 12- and 18-year-olds, respectively, continued the observed decline in surfaces filled before 1984 (3–5, 29). For the long-term comparisons, the DMFT score of 17-year-olds in 1971 (30) was used, since this estimate seems to reflect the caries prevalence of adolescents in Norway around 1970 (24, 31, 32). The DMFT of 18.4 for the 17-year-olds (30), compared to the FT for the 18-year-olds in the present reporting system, indicates a caries decline of 77% for the coastal counties and 79% for all counties up to 2000 (FT = 3.8). This is equivalent to a compound annual reduction rate of 5.6% over a period of 29 years. The decline until 1985 was equal to 52% or a compound rate of 5.4% per year. These rates are all within the 'modal class' of 4% to 6% (16).

The DMFT declines among the 18-year-olds were independent of the baseline caries score (Fig. 4), but significantly associated with some county variables (migration and children per dentist) in multivariate analyses. The relationship between the background variables and the caries decline in multivariate analyses indicates that the decline to some extent may be related to county factors. The DMFT decline may be attributed to long-term use of fluorides, changed criteria for filling carious lesions, and other factors. Excepting the use of fluoride tablets, information on the use of fluorides is not available at county level. The possible reasons for the decline are summarized in Table 5.

Use of fluorides. The caries decline in Norway before 1984 has been statistically related to use of fluorides (3, 4).

Children under the age of 4 years were discouraged from using fluoride toothpaste before 1983. The proportion of children under 7 years of age who used fluoride tablets was twice that of 7–15-year-olds both in the 1970s and the 1980s (33, 34). Accordingly, the sale of tablets (Fig. 1) indicates regular use by about 50% of children under the age of 7 years from the mid-1980s. The use of fluoride among schoolchildren varied in the mid-1970s. Fluoride toothpaste was used by 75–82% (22, 33) and more than 70% participated in the school-based fluoride programmes (12). The oldest participants (birth cohort 1967; Tables 3 and 5, Fig. 3) in the present study were 4–5-years-old when fluoride use became common in the early 1970s (Fig. 1).

Criteria to fill carious lesions. A shift towards more restrictive criteria for filling carious lesions occurred between 1978 and 1983 (35) and studies have confirmed that enamel lesions in the proximal surfaces were rarely filled in the 1980s (24, 36–38). The restrictive trend seen for proximal carious lesions (39, 40) may have been delayed for the occlusal surfaces. When the number of filled proximal surfaces of the first molars of 14-year-olds decreased by 79%, the corresponding decline for the occlusal surfaces was only 36% (24). A restrictive attitude towards restorative treatment has also been reported from other countries during the past two decades (41–47).

The average DT scores at ages 12 and 18 remained stable throughout the period of observation (Table 3). This statement seems valid even after controlling for caries-free subjects; the DT scores were 1.1 and 1.3 for the 12-year-olds with caries in 1985 and 2000, respectively. The DT scores reflect treatment need. The unchanged DT scores and stable DMFT increments indicate no continuing trend towards more restrictive criteria for filling teeth in teenagers. A continuing decline of the caries activity would have decreased the DT and DMFT scores as well as the increments from 12 to 18 years of age. There thus seems to be neither a marked change in the criteria to fill carious lesions in teenagers nor a decrease in the caries activity in the 1990s.

The compound rates of 5.4% per year between 1971 and 1985 and 6.2% until 1990 indicate an equal annual caries decline throughout the period of 19 years (Table 5). The initial decline has been statistically associated with fluorides (3, 4). A combined effect of fluoride and restrictive criteria for restorative treatment may be reflected in the steep DMFT decline in the late 1980s (Fig. 3). A significantly slower rate of decline started around 1990 (Fig. 3), when all cohorts presumably had been exposed to fluoride throughout life (Table 5). The slower decline and the lower annual compound rate in the 1990s than in the late 1980s (4.7 versus 8.5) may be ascribed to a levelling off of the effect of fluoride and restrictive filling criteria in teenagers. The fairly stable caries increments, on the one hand, and the continuing caries decline in 18-year-olds in the 1990s, on the other, may primarily be explained by fewer filled teeth before the age of 12 years (Table 5). Firstly, the caries decline in 18-year-olds between 1990 and 2000 was significant and amounted to 2.0 DMFT (Tables 3 and 5). Secondly, the corresponding decline in filled teeth for these birth cohorts at age 12 years was also significant (1.3 FT), but there was an insignificant difference in increment of only 0.6 FT between the ages 12 and 18 years for cohort 1973 and 1982 (Tables 3 and 5). The continuing DMFT decline at age 12 after 1994 signals a further decline at the age of 18 in the future (Fig. 3).

Other reasons. The bivariate analyses indicated statistical significance of variables reflecting the socio-economic conditions at county level (Table 4). Different socio-economic levels could reflect oral hygiene, use of fluorides and consumption of 'sweets' (48). More than 90% of Norwegian teenagers claimed to brush their teeth daily with fluoride toothpaste and about 30% used dental floss in the 1980s (49). The lower DMFT score seen in Norwegian adolescents with less gingivitis (50) may reflect a combined effect of fluoride and lower level of cariogenic plaque. The consumption of 'sweets' and soft drinks has increased throughout the three decades with caries decline (14). A fairly high caries activity among adolescent Norwegians is indicated by the caries scores recorded on radiographs from 20-year-old military recruits born in 1973–74. The average number of enamel and dentinal lesions was 13.3 (8.6 in enamel, 4.7 in dentin) when the FT amounted to 6.5 (27). The FT at age 18 for these cohorts was 5.6 (Table 3). The number of carious lesions strengthens the need for preventive activities among adolescents. During recent decades, preventive efforts have been focused on caries active children rather than on everybody (23), an approach also used in Sweden (51). The effect of this strategy is neither documented in Norway nor in Sweden, but it gave favourable results in a Danish study (52) and disappointing results in two studies in Finland (53, 54).

Conclusions

The average caries-free proportions of 18-year-olds increased from 2% to 15%, while the DMFT scores declined by 49% between 1985 and 2000. The corresponding decline at age 12 years was 53%. The mean DT at the dentinal level remained at the same level for each of these age groups and there was no significant difference in DMFT increments from ages 12 to 18 between the birth cohorts 1973 and 1982. The variables migration and children per dentist were significantly associated with the caries decline in multivariate analyses. The caries decline at age 18 was significantly steeper before than after 1990. The steep decline may be attributed to use of fluoride as well as restrictive criteria for fillings in teenagers. The slower decline in the 1990s seems primarily to be attributable to fewer teeth being filled before the age of 12, since the DMFT increments from the age of 12 to 18 were not significantly different.

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