Community Dent Oral Epidemiol 2006; 34: 446–454

Community Dentistry and Oral Epidemiology

Secular trends of dental status in five 70-year-old cohorts between 1971 and 2001

Tor Österberg[1,2], Cecilia Johanson[1], Valter Sundh[2], Bertil Steen[2] and Dowen Birkhed[1]

Departments of [1]Cariology and [2]Geriatric Medicine, Sahlgrenska Academy at Göteborg University, Göteborg, Sweden

Österberg T, Johanson C, Sundh V, Steen B, Birkhed D. Secular trends of dental status in five 70-year-old cohorts between 1971 and 2001. Community Dent Oral Epidemiol 2006; 34: 446–454. © Blackwell Munksgaard, 2006

Abstract – *Objective:* The aims of this study, which are part of the gerontological and geriatric population studies in Göteborg, Sweden (H70), were to describe cohort differences and trends in dental status and utilization of dental care in 70-year-olds. The study is based on five cohorts examined in 1971/72, 1976/77, 1981/82, 1992/93 and 2000/01 (called cohort I, II, III, V and VI, respectively). The total number of participants was 2290 and varied between 386 and 583 in the different cohorts. The proportion of dentate 70-year-olds changed gradually from 49% in the first to 93% in the last cohort. The mean number of teeth in the dentate 70-year-olds was 14 in cohort I and 21 in cohort VI. The proportion of subjects with 20 or more teeth changed from 13% in cohort I, to 20% in cohort III, and to 65% in cohort VI. In cohort I, 76% of the 70-year-olds had some kind of removable denture; 37% in cohort III, but only 17% in cohort VI. About 20% of all 70-year-olds in cohort I reported regular yearly visits to a dentist. The corresponding figures in cohort III and cohort VI were 50% and 80%, respectively. Even though positive cohort trends were observed in all studied subgroups, factors such as low education, smoking, being un-married, having high waist circumference and being physically inactive were negatively associated with dental status at the end of the study period as well as at the beginning.

Key words: cohort differences; dental health; elderly; epidemiology; lifestyle; socio-economic; teeth

Tor Österberg, Department of Cariology, Faculty of Odontology, Box 450, SE-450 30 Göteborg, Sweden
Tel: +46 31 773 3161
Fax: +46 31 825 733
e-mail: birkhed@odontologi.gu.se

Submitted 21 June 2005;
accepted 18 January 2006

Epidemiological studies show that dental health has continuously improved in adult and elderly populations in industrialized countries. National surveys in Scandinavia, Great Britain and USA indicate a marked decrease in the prevalence of edentulism during the last 20 years (1–8). In repeated cross-sectional studies on a national basis in Sweden, it was shown that the proportion of dentate persons in the age group 65–74 years increased from 45% in 1975 to 71% in 1988/89, and 85% in 1996/97 (5). In other community-based population studies, an increased number of remaining teeth among the dentate inhabitants was also observed (9–11). As the demand of oral health care among edentulous persons is low, and the need for regular dental care and prevention is different in dentate compared with edentulous persons, the positive development which has taken place is of great importance for organization and services of dental care (1, 12–14).

In many of the industrialized countries, the improvement of dental health occurs in parallel with an increase in life expectancy and life span. Sweden has a high proportion of elderly in the population and the majority of the elderly are today dentate. The consequences of these demographic and dental health changes for the organization of dental care have been incompletely analysed. There is a need for continuing research to describe the present situation and identify possible problems in oral health care of the increasing proportion of dentate elderly in the future. One way to analyse dental health over time is to compare groups (cohorts) of individuals of the same age but born in different years. Few such studies have been conducted in the elderly.

The present study was performed within the frame of the gerontological and geriatric population studies in Göteborg, Sweden (H70). These investigations have been going on for three decades and allow both cross-sectional and longitudinal studies (15–19). The main purpose of the present study was to describe cohort differences in dental status, prevalence of removable dentures and the use of dental care among subjects in subgroups with different characteristics between 1971 and 2001.

Materials and methods

Population

Five birth cohorts (here called I, II, III, V and VI), born in 1901/02, 1906/07, 1911/12, 1922 and 1930, respectively, living in Göteborg at the time at age 70 were included in the present study. Another cohort (IV) was not included because they were only examined at age 75 and 80. The cohorts (I–VI) were examined in 1971/72, 1976/77, 1981/82, 1992/93 and 2000/01, respectively. Göteborg is an industrialized and university city, with more than half a million inhabitants situated at the west-coast of Sweden. The general procedure, sampling and response rate have been described previously for the four first-born cohorts (15–18). The studies include medical, dental, psychological and nutritional examinations and socioeconomic data. Dental investigations were performed in representative sub-samples of 40% of the cohorts I and II. In the cohorts III, V and VI, the total samples were examined (15–19).

The number of participants and participation rate in the odontological studies of the samples from the five cohorts are presented in Table 1. The number of participants varied between 386 and 583 in the different cohorts. The participation rate decreased from 84% in the first to 62% in the latest examined cohort. In all cohorts, the response rate was higher for men than women. The nonresponders in the odontological samples in the first three cohorts did not differ from the responders (15–17). In cohorts V and VI, the nonparticipants were contacted and a short interview on telephone or by mail was performed. The results indicated that in cohort V, the prevalence of edentulism was significantly higher in both men and women ($P < 0.01$) in the nonparticipants than in the participants. This difference was not found in cohort VI. The prevalence of regular (yearly) visits to a dentist did not differ between dentate responders and dentate nonresponders in cohort V and VI. Only small differences were found concerning factors like prevalence of cancer, myocardial infarct, diabetes, drug-treatment for high blood pressure and smoking between nonparticipants and participants in cohort V and VI.

Investigations

The odontological studies were based on clinical and radiographic examinations and on interviews. In cohort III, no radiographic examination was performed. The interview included a large number of questions, but in this study only those focusing on utilization of dental care was used. The utilization of dental services was based on questions about time of the latest visit to a dentist and on regularity of visits to dentist. The reason for not visiting a dentist within the latest 5 years was also asked in cohort II, III and VI. The clinical investigation included examination of dental status, oral mucous, salivary secretion and signs of mandibular dysfunction (16). In this study, cohort comparisons are limited to dental status (number of remaining teeth, restored, crowned and endodontically treated teeth), prevalence of removable denture and utilization of dental services. The clinical examinations of the subjects in cohort I, II, III and V were performed by dentists. The subjects in cohort VI were, examined by three dentists and two dental hygienists. There were no significant differences in the odontological parameters between the dentists and dental hygienists who carried out the clinical examination in the

Table 1. Number of participants and participation rate, given as % within brackets, in the odontological studies of five 70-year-old cohorts (year of investigation). In the investigation of cohort V and VI the participation rate including drop-outs for whom nonresponse questionnaire were received*

	Cohort				
	I (1971/72)	II (1976/77)	III (1981/82)	V (1992/93)	VI (2000/01)
Female	199 (83%)	216 (77%)	304 (69%)	232 (60%) (87%)*	249 (61%) (75%)*
Male	187 (85%)	199 (85%)	279 (76%)	190 (63%) (90%)*	235 (63%) (82%)*
Total	386 (84%)	415 (81%)	583 (72%)	422 (62%) (88%)*	484 (62%) (78%)*

present study. The following characteristics of the 70-year-old subjects were related to dental status and the use of dental care: marital status (unmarried–married) education (elementary school–higher education than elementary school), smoking habits (nonsmoking, previous smoking, smoking), physical activity (not active–active), self-assessed health (feeling healthy–feeling not healthy), body height (quartiles), waist circumference (quartiles) and drug treatment (number of drugs).

Statistics

Fisher's exact test was used for testing difference in proportion between two groups. Two-sample *t*-test was used to test difference in mean between two groups. Regression models, univariate and multivariate, were used to test for cohort trend in dental status in subgroups with different characteristic. For continuous variables of dental status, linear regression models were used (Table 2). For dichotomies variables binary logistic regression were used (Table 3). Cohort is coded as year of birth (1901–1930), and unit is 1 year. Odds ratio estimate change in odds of being dentate and having 20 teeth or more, for each later year of birth.

To test if the importance of predictors of dental status change over time, the product between year of birth and the each other predictor is added to the regression models as interaction effects. In the multiple regression models following factors were including as independent variables: cohort, marital status, education, smoking habits, physical activity, self-assessed health, body height, waist circumference and drug treatment.

Results

The proportion of dentate subjects in the different cohorts changed gradually from 49% in cohort I to 93% in the last examined cohort VI (Fig. 1). In the first three cohorts, the prevalence of edentulism was significantly higher in females than in males, but in the last two cohorts there was no significant difference.

The prevalence of edentulism was more common in the maxilla compared with the mandible in all cohorts. In cohort I, 48% were dentate in the mandible and 31% in the maxilla, and in cohort VI 93% and 87%, respectively (data not shown).

Table 2. Mean number of remaining, restored, crowned and endodontically treated teeth in dentate persons in five 70-year-old cohorts (mean values are given with ± 95% CI)

Cohort	*n*	Remaining teeth	Restored teeth	Crowned teeth	Endodontically treated teeth
I					
Female	89	13.6 ± 1.6	9.7 ± 1.4	1.3 ± 0.6	2.8 ± 0.6
Male	100	13.6 ± 1.5	8.0 ± 1.3	1.6 ± 0.6	1.9 ± 0.5
Sex difference			*		*
II					
Female	126	14.0 ± 1.2	11.6 ± 1.1	4.2 ± 0.7	3.6 ± 0.6
Male	131	12.2 ± 1.4	8.2 ± 1.1	2.6 ± 0.6	2.4 ± 0.6
Sex difference			***	***	**
III					
Female	180	15.7 ± 1.0	12.3 ± 0.9	4.8 ± 0.6	
Male	204	13.4 ± 1.1	9.8 ± 0.9	4.0 ± 0.6	
Sex difference		**	***	*	
V					
Female	192	18.1 ± 1.0	15.0 ± 0.9	7.1 ± 0.6	4.5 ± 0.5
Male	161	18.1 ± 1.1	13.0 ± 1.1	6.4 ± 0.8	3.8 ± 0.5
Sex difference			**		*
VI					
Female	234	20.9 ± 0.8	17.0 ± 0.7	6.9 ± 0.6	4.3 ± 0.4
Male	215	20.8 ± 0.9	15.7 ± 0.8	5.6 ± 0.6	3.6 ± 0.4
Sex difference			*	**	**
Cohort trend expressed as change per birth year (regression coefficient with 95% CI)					
Female		0.27 (0.23–0.32)	0.24 (0.20–0.29)	0.16 (0.14–0.19)	0.05 (0.02–0.07)
Male		0.32 (0.27–0.37)	0.29 (0.25–0.34)	0.15 (0.12–0.17)	0.06 (0.04–0.08)
Adjusted for number of remaining teeth					
Female			0.03 (0.01–0.06)	0.13 (0.10–0.16)	0.02 (−0.01–0.04)
Male			0.07 (0.04–0.10)	0.12 (0.09–0.15)	0.04 (0.02–0.06)

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Table 3. Cohort trend of proportion of dentate subjects and proportions of subjects with ≥20 teeth in subgroups with different characteristics. Odds ratio (95% CI) for cohort trend in univariate logistic regression model is given with significance level (asterisk). Interaction tests for difference in cohort trend between characteristics

Population characteristics	Women			Men		
	n	Dentate	≥20 teeth	*n*	Dentate	≥20 teeth
Married	595	1.10 (1.08–1.13)***	1.11 (1.09–1.14)***	809	1.07 (1.05–1.09)***	1.09 (1.07–1.10)***
Un-married	604	1.09 (1.06–1.11)***	1.09 (1.07–1.11)***	281	1.08 (1.05–1.11)***	1.13 (1.09–1.17)***
Elementary school	855	1.09 (1.07–1.11)***	1.11 (1.09–1.13)***	700	1.07 (1.05–1.09)***	1.09 (1.07–1.12)***
Higher education than elementary school	301	1.06 (1.02–1.10)**	1.07 (1.04–1.10)***	291	1.05 (1.01–1.09)*	1.07 (1.04–1.09)***
Interaction			0.97 (0.94–0.99)*			
Nonsmoking	820	1.13 (1.10–1.15)***	1.12 (1.10–1.14)***	285	1.08 (1.04–1.13)***	1.10 (1.07–1.13)***
Previous and current smoking	369	1.07 (1.04–1.09)***	1.10 (1.07–1.13)***	803	1.07 (1.05–1.09)***	1.09 (1.07–1.11)***
Interaction		0.94 (0.91–0.98)***				
Physical inactive	248	1.10 (1.07–1.14)***	1.09 (1.05–1.14)***	149	1.07 (1.03–1.11)***	1.11 (1.06–1.17)***
Physical active	944	1.09 (1.07–1.11)***	1.10 (1.08–1.11)***	928	1.08 (1.06–1.10)***	1.09 (1.08–1.11)***
Feeling not healthy	332	1.08 (1.05–1.11)***	1.07 (1.05–1.10)***	268	1.08 (1.04–1.11)***	1.09 (1.06–1.12)**
Feeling healthy	840	1.09 (1.08–1.12)***	1.11 (1.09–1.13)**	796	1.08 (1.06–1.10)***	1.09 (1.07–1.11)***
Interaction			0.96 (0.94–0.99)*			
Drug treatment						
>4 drugs	227	1.12 (1.08–1.16)***	1.12 (1.08–1.16)***	149	1.08 (1.04–1.12)***	1.11 (1.06–1.16)***
≤4 drugs	977	1.09 (1.07–1.11)***	1.10 (1.08–1.12)***	945	1.07 (1.06–1.09)***	1.09 (1.07–1.10)***
Waist circumference						
Quartile 4	317	1.10 (1.07–1.14)***	1.10 (1.07–1.13)***	303	1.06 (1.03–1.09)***	1.09 (1.06–1.12)***
Quartiles 1–3	871	1.09 (1.08–1.11)***	1.10 (1.08–1.12)***	776	1.08 (1.06–1.11)***	1.10 (1.08–1-12)***

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

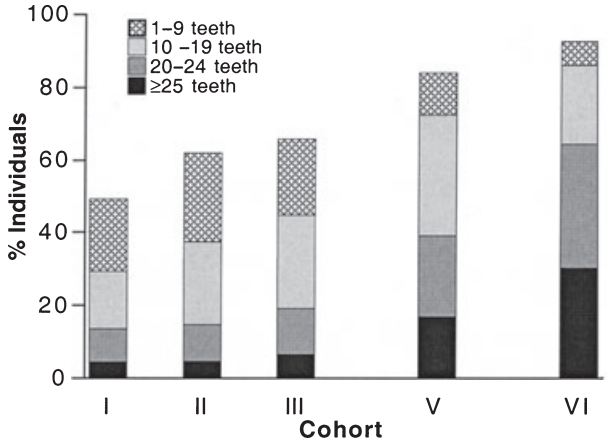

Fig. 1. Distribution of remaining teeth in five 70-year-old cohorts examined in 1971/72.

The mean number of remaining teeth in dentate 70-year-olds was 13.6, 13.4, 14.5, 18.1 and 20.9 in the five cohorts. The average cohort trend per birth-year 1901–1930 is an increase of 0.3 teeth per year, or 1.5 (95% CI 1.3–1.6) per 5-year period. The trend is the same for males and females (Table 2).

The distribution of remaining teeth in the different cohorts is presented in Fig. 1. The differences between the cohorts were most obvious in the proportion of persons with 20 or more remaining teeth in cohort III (19%) compared with cohort VI (65%). This cohort trend was the same in both gender.

For all variables, there were significant positive trends over time (or birth-year) in linear regression models (Table 2). When including total number of teeth in the models for restored teeth, crowned and endodontically treated teeth, the numeric values for cohort trend decreased but remained significant in all models except for endodontically treated teeth in females. In general, the trends were similar for females and males, with the exception of relative number of restored teeth (restored teeth/remaining teeth × 100), where the increase was significantly higher in males than in females: from 69 to 82 in females 1971–2001, and from 53 to 75 in males.

The sex differences regarding number of remaining teeth was only significant in one of the five cohorts, but in most other comparisons females had significantly higher values (Table 2). At the examination of the 70-year-olds in cohort I, 72% of the females wore removable complete denture and 11% partial denture. In males, the corresponding figures were 62% and 18%. In cohort VI, 12% in females and males had complete dentures and in 8% partial dentures. In cohort I, 76% of the 70-year-olds had any kind of removable dentures, but only 17% in cohort VI.

Yearly visits to a dentist during the last 5 years among the edentulous women were uncommon in all cohorts (Fig. 2). In dentate subjects of each cohort, the frequency of regular dental care increased with more remaining teeth. The trend was the same in men (data not shown). The cohort comparisons indicate a marked increase of regular visits to a dentist over time among the dentate persons independent of number of teeth. However, in cohort VI there was a slight decrease in regular visit compared with cohort V. In cohort I, about 20% of all 70-year-olds reported regular yearly visit to dentist, in cohort III about 50%, and in cohort VI about 80%. The difference between females and males concerning regular visit, observed in cohorts I–V, was not found in the last examined cohort VI. Among the dentate subjects in cohort I, 35% of the females and 54% of the males reported that they visited a dentist only for acute problems. Corresponding figures in cohort III were 13% and 27% and in cohort VI 4% and 8%, respectively.

About 75% of the edentulous subjects, that had not visited a dentist within the last 5 years, reported that they had no need for dental care. Almost 15% of the dentate persons in each of the cohorts II, III and VI, who did not visit a dentist regularly, reported fear as the reason for no visit.

Cohort trends in subgroups with different characteristics

The odds ratio in Table 3 indicate that there was a stable significant increase in the prevalence of dentate subjects and subjects with ≥20 teeth over the studied period in all subgroups with different characteristics. In women, the prevalence of dentate subjects increased more over the period in nonsmokers than among previous smokers and current smokers ($P < 0.01$). The cohort trend (odds ratio) concerning the prevalence of subjects with ≥20 teeth was also more marked in women with only elementary school compared with those with higher education ($P < 0.05$). This was also true in women with good self-assessed health compared with those with impaired health ($P < 0.05$). In men, no corresponding significant differences were found.

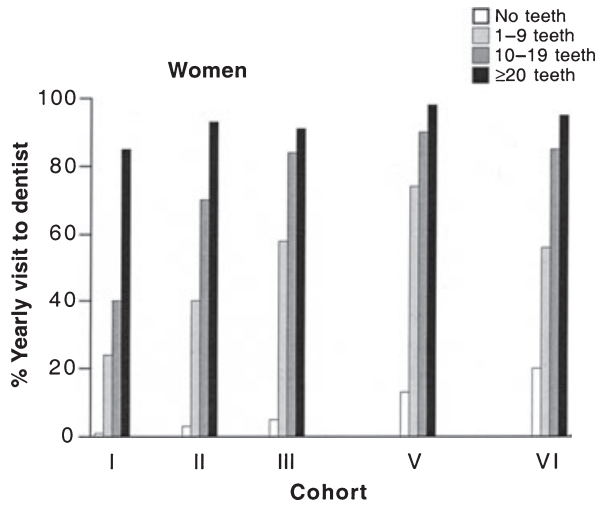

Fig. 2. The frequency of regular dental care (yearly) in persons with different dental status in five 70-year-old cohorts.

Figure 3 illustrates the positive cohort trend concerning proportion of subjects with 20 or more teeth in different subgroups. However, the marked differences between nonsmokers and previous smokers and current smokers and between subjects with only elementary school and those with higher education remained in the latest examined cohorts V and VI.

Logistic multiple regression analysis showed that higher education than elementary school was in both women and men positively associated with proportion of dentate subjects and to proportion of subjects with ≥20 teeth independent of birth year and other characteristics ($P < 0.01$) (Table 4). Other characteristics such as smoking ($P < 0.001$), higher waist circumference, being un-married and physical inactivity were negatively associated with the dependent variables in both genders ($P < 0.05$–0.001). In men, drug treatment (number of drugs) was also negatively related to number of teeth ($P < 0.05$; data not shown).

The positive cohort trend concerning regularity of dental care every year was more evident in the 70-year-old men with fewer teeth than 20 compared with those men with more remaining teeth ($P < 0.05$). Regularity of dental care every year increased more over the period among women with only elementary school compared with those with higher education ($P < 0.05$) and among those women who were not physically active compared with active women ($P < 0.05$).

Regression analysis indicated independent of birth-year that men ($P < 0.01$) and un-married subjects ($P < 0.01$) had a lower prevalence of regularity frequency of dental care. Number of teeth ($P < 0.001$) and higher education ($P < 0.001$) were positively associated with regularity of dental care.

Discussion

This study shows that the prevalence of edentualism at the age of 70 has changed markedly during

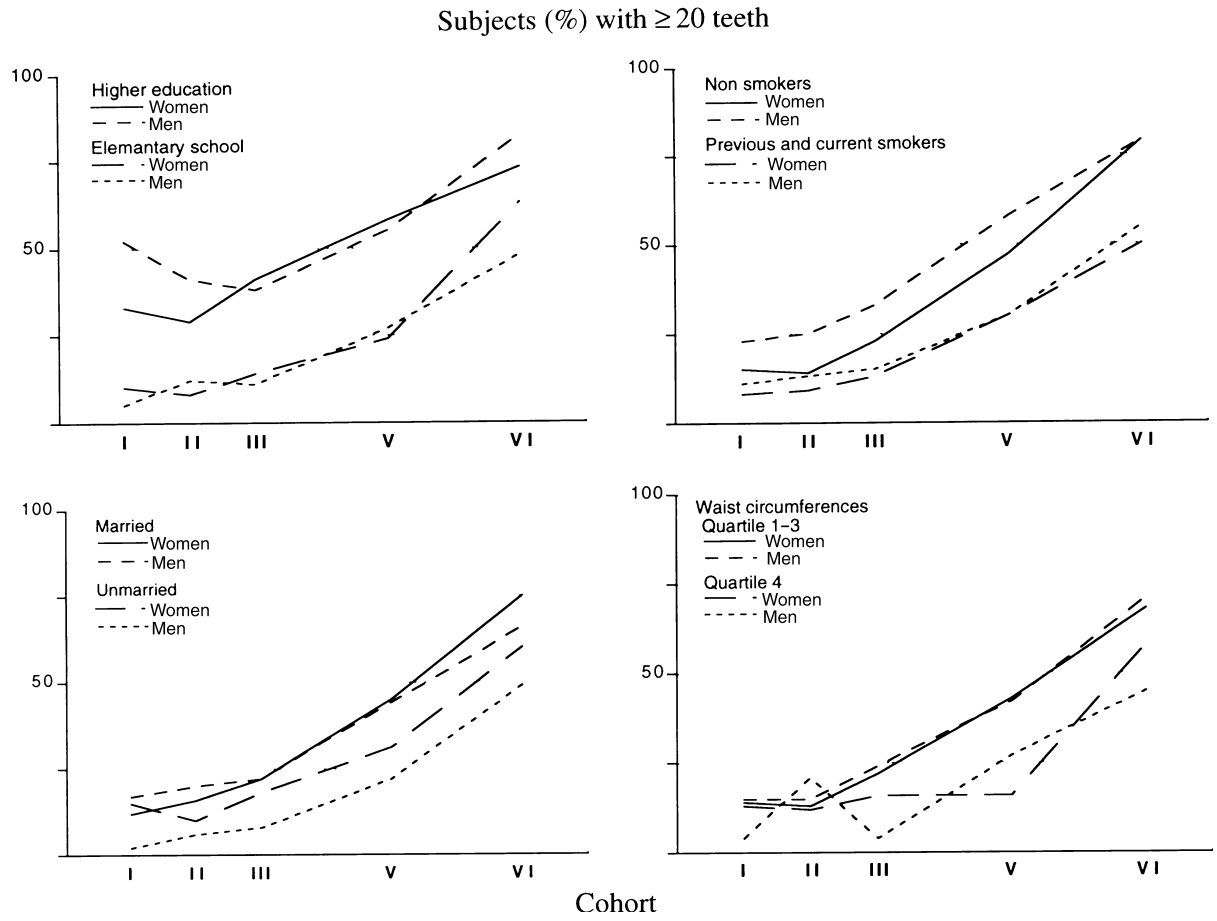

Fig. 3. The prevalence of subjects with 20 teeth or more in subgroups with different characteristics in five 70-year-old cohorts.

Table 4. Odds ratio (95% CI) and significance level for significant factors for the prevalence of dentate subjects and subjects with ≥20 teeth or more by stepwise logistic regression

	Women (n = 924)		Men (n = 1093)	
Significant factors	Dentate subjects	≥20 teeth	Dentate subjects	≥20 teeth
Cohort I (reference group)[a]	1.00	1.00	1.00	1.00
Cohort II	1.71 (1.12–2.60)*		1.69 (1.09–2.64)*	
Cohort III	2.35 (1.56–3.56)***	1.72 (1.01–2.93)*	2.12 (1.38–3.03)***	
Cohort V	5.86 (3.56–9.65)***	3.53 (2.08–6.03)***	3.17 (1.62–6.22)***	2.99 (1.52–5.08)**
Cohort VI	17.10 (9.06–32.3)***	17.02 (9.89–29.30)***	6.16 (3.40–11.17)***	13.08 (7.22–23.70)***
More than elementary school	4.93 (3.20–7.60)***	3.58 (2.57–5.00)***	3.90 (2.45–6.21)***	5.85 (4.01–8.54)***
Smoking habits	0.85 (0.77–0.94)***	0.71 (0.64–0.80)***	0.73 (0.66–0.81)***	0.69 (0.62–0.78)***
Waist circumference	0.98 (0.97–0.99)**	0.98 (0.97–0.99)*		0.97 (0.96–0.99)**
Un-married		0.72 (0.53–0.98)*	0.69 (0.49–0-99)*	0.42 (0.27–0.66)***
Physically inactive	0.48 (0.34–0.68)***		0.56 (0.36–0.87)*	

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.
[a]Reference group for cohort comparison.

the last 30 years. The decline was most obvious in females, from 55% in 1971/72 to 6% in 2000/01. The corresponding figures for males were 46% and 8%, respectively. It may be observed that in the last cohort, there were more edentulous males than females. In several western countries, similar trends have been seen, but the development seems to be faster and more extensive in Sweden than in most of the other countries (1–8). Thus, in the national survey in Sweden carried out in 1996/97,

15% of the participants in the age group 65–74 were edentulous (5). Corresponding figures in UK were 36% in 1998, and in USA 29% in 1991 (4, 7). The survey in Sweden shows, however, substantial regional differences in dental health among the elderly. In 1996/97, the prevalence of edentulism in the age group 65–74 years was about 10% in the three largest cities (including Göteborg) and 25% in rural areas. These figures correspond rather well to the prevalence of edentulism (7%) among the 70-year-olds observed in the present study in 2000/01.

The cohort comparisons also showed a marked change in the number of remaining teeth among the dentate subjects over the 30-year period, from a mean value of 14 teeth in 1971/72 to 21 teeth in 2000/01. These figures are somewhat higher than reported from other European countries (2). Besides the change in the number of teeth, the number of teeth with fillings and crowns and endodontically treated teeth increased over time. Lost teeth have in higher extent been restored with fixed partial dentures (bridges) than removable dentures in the later cohorts compared with the earlier cohorts. Similar trends of dental care panorama can be seen in statistics from the National Swedish dental insurance (20). In elderly, the amount of preventive and restorative modalities increased, while extractions of teeth and treatment with removable denture decreased over time (20–24). The estimated number of remaining teeth per 1000 individuals based on all individuals including edentulous persons was in 1971/72 6700 teeth, compared with 19 300 in 2000/01 (Fig. 4). The corresponding figures for restored teeth were 4300 and 15 200 teeth, respectively. In 1971/72, the estimated number of teeth with crowns was 700 and endodontically treated teeth 1100 compared with 5800 and 3700 in 2001/01. This increased number of teeth can be expected to be a potential increased risk for dental caries, and periodontal disease especially in premolars and molars. Many of the teeth are restored with fillings or crowns, resulting also in an increased risk for recurrent caries. In this context, it should be pointed out that 70-year-old subjects today live much longer than they did 30 years ago. In 1970, a 70-year-old subject survived an average of 15 years compared with 19 in year 2000. Because of the increased life expectancy and other demographic changes in Sweden, the number of persons 65+, are expected to increase with 12% and for persons 85+ with 16% during the period 2002–2010. The corresponding figures for the period 2002–2030 are 48% for persons 65+ and 69% for 85+. Sweden is among the countries, which have the oldest population in the world (25).

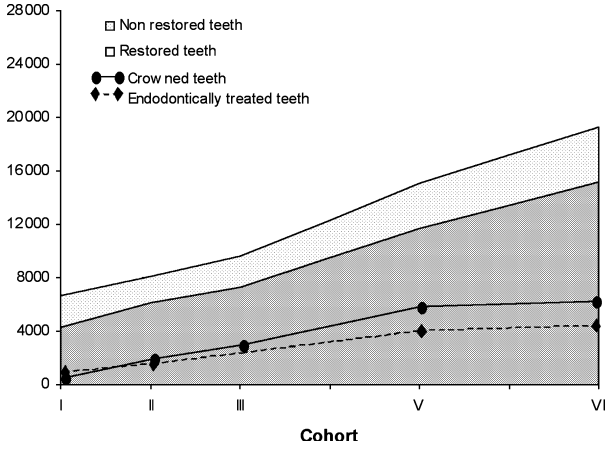

Fig. 4. The estimated number of remaining and restored teeth in five 70-year-old cohorts per 1000 individuals based on means of all individuals including edentulous persons.

Several studies, including studies based on data of 70-year-old subjects in Göteborg, have shown that dental status is a good marker for socioeconomic factors, lifestyle and social network factors, general health, functional capacity and mortality (3, 6, 16, 26–28). The results from the present study show that socioeconomic, social network and lifestyle factors are significant predictors for dental status over the period. In several of the studied subgroups with different characteristics, there were a positive cohort trend concerning both dental status and regularity of dental care. But in most of the subgroups, the difference in dental status, remain and did not levelled out during the period 1971–2001. Women with positive characteristics, as never smoked and feeling healthy, had a more positive cohort trend concerning proportion ≥20 teeth compared with those women with opposite characteristics. On the other hand, in women with only elementary school, the proportion of dentate subjects and regularity of dental care among dentate subjects showed a more positive cohort trend than those with higher education. The positive change of dental health indicates that environmental factors might have a great impact for this development.

The reason for this positive trend in dental status is multifactorial and is probably partly explained by improvement in living conditions, including economy, education, housing, general health, nutrition, medical and dental care. Thus, there may be

several reasons for the improved dental health observed in the present study. Differences of access and economical barriers to use of dental care between the cohorts have been changed during the observed period, which have probably contributed to the positive trend. Later cohorts born between 1920 and 1930 have had access to more extensive organized dental care in school and have had a subsidized dental care from the Swedish national dental insurance (introduced in 1974) during the middle aged and during a longer time compared with the cohorts born between 1901 and 1907. The insurance system led to an increased utilization rate of dental services (29–31). This is probably one explanation to the obvious difference in retained teeth between the later cohorts and the earlier.

The improved dental health has probably been attributed mainly to a better oral hygiene, use of fluoride toothpaste and increased regular care (9). During the last decades, there has been a marked change of attitude to retaining the teeth in mouth both among patients and dentists. Thus, extraction of teeth has become at present an infrequent therapy in Sweden, also in the elderly (29–31).

The cohort comparison in the present study showed that the proportion of restored teeth has increased more than the proportion of nonrestored teeth (Table 2). One reason for this difference may be that molars are retained to a greater extent in later cohorts. But it also indicate that the prevalence of caries has not changed as much as number of teeth with other word, the changes may be more due to changes in professional and patient preferences than to preventive outcomes.

The response rate was high (85%) in the first cohort (in 1971/72). Like in many other population studies throughout the world, there has been a tendency the last decades that the nonresponse rate increase. In 2000/01, the response rate was 63%. The reason for the increasing nonresponse rate is multifactorial. This development might partly be due to increasing public debate about participation in studies and where data are stored in computers. Analyses of nonresponse have been performed in the first cohorts and there were no significant differences between participants and nonparticipants, and also in the later cohorts such differences were small. Therefore, we conclude that the examined subjects are generally representative for the 70-year-old populations in the different examination years. The differences in the nonresponse between the cohorts may only to a small extent explain the obvious secular trend observed in dental health.

In the future, there will be both larger and more heterogenous groups of elderly in most countries. We have shown marked cohort differences in the population studies in Göteborg, for example regarding anthropometry, cognitive function, dietary habits and social factors (19). Changes regarding oral health are one of the most marked of such cohort differences observed. These ongoing secular trends will have an obvious impact on the demand and need in dental care. The cohort differences regarding the population of the dentate elderly and the oral disease panorama have also economical consequences in the planning of oral health care at the community level. As adults today are used to visit a dentist regularly, they will expect the dental health services to offer them care also in old age when incompensated diseases such as dementia and functional impairments become common.

The result of the present study indicates that the cohort trend is apparent in many dimension of background factors. Even if the positive cohort trends were observed in most of the studied subgroups, the pattern of risk indicators for impaired dental status seemed remain over time. Factors as low education, smoking, un-married, high waist circumference and physical inactivity seem to play a negative role for the dental status in the beginning as well as in the end of the 30-year period. This support our conclusion that the course of change in dental status is multifactorial.

Acknowledgements

The gerontological and geriatric population studies in Göteborg (H70) was supported by grants from the Ministry of Health and Social Welfare, Commission for Social Research, the Swedish Council for planning and Coordination of Research, the Vilhelm and Martina Lundgren Foundation, the Swedish Medical Research Council, Public Dental Service Goteborg, the Dr Felix Neubergh Foundation, and the Adlerbert Research Foundation through the Royal Society of Arts and Sciences in Göteborg. This part of the study was supported by grants from the Hjalmar Svensson Foundation.

References

1. Ainamo A, Österberg T. Changing demographic and oral disease patterns and treatment needs in the Scandinavian populations of old people. Int Dent J 1992;42:311–22.

2. Bourgeois D, Nihtila A, Mersel A. Prevalence of caries and edentulousness among 65–74-year-olds in Europe. Bull World Health Org 1998;76:413–7.
3. Suominen-Taipale AL, Alanen P, Helenius H, Nordblad A, Uutela A. Edentulism among Finnish adults of working age, 1978–1997. Community Dent Oral Epidemiol 1999;27:353–65.
4. Steele JG, Treasure E, Pitts NB, Morris J, Bradnock G. Total tooth loss in the United Kingdom in 1998 and implications for the future. Br Dent J 2000;189:598–603.
5. Österberg T, Carlsson GE, Sundh V. Trends and prognoses of dental status in the Swedish population: analysis based on interviews in 1975 to 1997 by Statistics Sweden. Acta Odontol Scand 2000;58:177–82.
6. Petersen PE, Kjoller M, Christensen LB, Krustrup U. Changing dentate status of adults, use of dental health services, and achievement of national dental health goals in Denmark by the year 2000. J Public Health Dent 2004;64:127–35.
7. Douglass CW, Shih A, Ostry L. Will there be a need for complete dentures in the United States in 2020? J Prosthetic Dent 2002;87:5–8.
8. Mojon P. The world without teeth: demographic trends. In: Feine JS, Carlsson GE, editors. Implant overdentures. The standard of care for edentulous patients. Chicago: Quintessence Publishing Company, Inc.; 2003. p. 3–14.
9. Hugoson A, Koch G, Bergendal T, Hallonsten AL, Slotte C, Thorstensson B et al. Oral health of individuals aged 3–80 years in Jönköping, Sweden in 1973, 1983, and 1993. II. Review of clinical and radiographic findings. Swed Dent J 1995;19: 243–60.
10. Schuller AA, Holst D. Changes in the oral health of adults from Trondelag, Norway, 1973–1983–1994. Community Dent Oral Epidemiol 1998;26:201–8.
11. Ahlqwist M, Bengtsson C, Hakeberg M, Hägglin C. Dental status of women in a 24-year longitudinal and cross-sectional study. Results from a population study of women in Göteborg. Acta Odontol Scand 1999;57:162–7.
12. Palmqvist S, Söderfeldt B, Vigild M, Kihl J. Dental conditions in middle-aged and older people in Denmark and Sweden: a comparative study of the influence of socioeconomic and attitudinal factors. Acta Odontol Scand 2000;58: 113–8.
13. Weyant RJ, Pandav RS, Plowman JL, Ganguli M. Medical and cognitive correlates of denture wearing in older community-dwelling adults. J Am Geriatr Soc 2004;52:596–600.
14. Österberg T, Lundgren M, Emilson CG, Sundh V, Birkhed D, Steen B. Utilization of dental service in relation to socioeconomic and health factors in the middle-aged and elderly Swedish population. Acta Odontol Scand 1998;56:41–7.
15. Rinder L, Roupe S, Steen B, Svanborg A. 70-year-old people in Gothenburg. A population study in an industrialized Swedish city. I. General design of the study. Acta Med Scand 1975;198:397–407.
16. Österberg T, Hedegård B, Säther G. Variation in dental health in 70-year old men and women in Gothenburg, Sweden. A cross-sectional epidemiological study including longitudinal and cohort effects. Swed Dent J 1983;7:29–48.
17. Eriksson BG, Mellström D, Svanborg A. Medical-social intervention in a 70-year old Swedish population. A general presentation of methodological experience. Compr Gerontol 1987;1:49–56.
18. Steen B, Djurfeldt H. The gerontological and geriatric population studies in Gothenburg, Sweden. Z Gerontol 1993;26:163–9.
19. Steen B. The elderly yesterday, today and tomorrow. Aspects on cohort differences from the Gerontological and geriatric population studies in Göteborg, Sweden (H70). Arch Gerontol Geriatr 2002;8 (Suppl.):359–70.
20. Sundberg H, Öwall B. Community dental health care system 1974–1985. Treatment procedures for different age groups in the private sector. Tandläkartidn 1989;15:1191–96.
21. Lewis DW, Thompson GW. Alberta's universal dental plan for the elderly: difference in use over 6 year by two cohorts. Am J Publ Health 1995;85:1408–11.
22. Ahacic K, Barenthin I, Thorslund M. Changes in Swedish dental health 1968–91. Swed Dent J 1998;22:211–22.
23. Kronström M, Palmqvist S, Söderfeldt B. Changes in dental condition during a decade in a middle-aged and older Swedish population. Acta Odontol Scand 2001;59:386–9.
24. Löfquist L, Bergendal B, Hugoson A. Fixed prosthodontics in adults in Jönköping, Sweden in 1983 and 1993. An epidemiological study of prevalence and choice of material. Swed Den J 2000;24:93–103.
25. Statistics Sweden. Population projection for Sweden 2002–2050. Örebro: Statistics Sweden; 2002: BE18SM0201.
26. Österberg T, Mellström D, Sundh V. Dental health and functional ageing. A study of 70-year-old people. Community Dent Oral Epidemiol 1990;18:313–18.
27. Avlund K, Holm-Pedersen P, Schroll M. Functional ability and oral health among older people: a longitudinal study from age 75 to 80. J Am Geriatr Soc 2001;49:954–62.
28. Avlund K, Holm-Pedersen P, Morse DE, Viitanen M, Winblad B. Social relations as determinants of oral health among persons over the age of 80 years. Community Dent Oral Epidemiol 2003;31:454–62.
29. Österberg T, Sundh V, Gustavsson G, Gröndahl HG. Utilization of dental care after the introduction of the Swedish dental health insurance. Acta Odontol Scand 1995;53:349–57.
30. Hugosson A, Koch G, Bergendahl T, Hallonsten AL, Slotte C, Thorstensson B et al. Oral health of individuals aged 3–80 years in Jönköping, Sweden in 1973, 1983 and 1993. I. Review of findings on dental care habits and knowledge of oral health. Swed Dent J 1995;19:225–41.
31. Palmqvist S, Söderfeldt B, Vigild M. Influence of dental care systems on dental status. A comparison between two countries with different systems but similar living standards. Community Dent Health 2001;18:16–9.