A 9-year longitudinal study of reported oral problems and dental and periodontal status in 70- and 79-year-old city cohorts in northern Sweden

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Before 1981 no representative studies of oral health in an elderly population in northern Sweden had been presented, and longitudinal studies of oral health in the aging person were in general rare. Thus the aim of this study was to investigate longitudinal changes in oral health in a representative sample of an elderly city population in northern Sweden. Reported oral problems and treatment needs were noted, and dental and periodontal status was registered in clinical examinations. The frequency of reported annual dental visits and of being called by the dentist increased in the younger but not in the older cohort during the 9-year period. In 1990 all the 79- and 88-year-olds with annual visits reported that they were recalled by the dentist. The clinical investigation showed an increasing amount of tooth loss, root caries, and periodontal disease with increasing age. Among dentulous persons 1.7 teeth per subject were lost from 1981 to 1990 in the younger cohort, compared with 2.6 teeth per subject in the older cohort. The number of sound teeth decreased very little in the younger cohort (from 3.44 to 3.34) but more evidently in the older cohort (from 3.47 to 2.65) during the 9-year period. The frequency of surfaces with attachment level >3mm increased statistically significantly from 1981 to 1990 in the older cohort. Subjects with annual visits had in general fewer oral problems. □ *Aging; elderly; epidemiology; oral; oral health; tooth loss*

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The proportion and the number of elderly people in the Swedish population are increasing (1). In 1960, 11.8% of the population was 65 years old or more (65+). By 1980 and 1990 the proportion of people aged 65+ had increased to 16.4% and 17.8%, respectively. The proportion of 65+ will remain fairly constant for the next 10 years. Thereafter the proportion will increase rapidly due to aging of the cohorts born in the 1940s, and demographic prognoses forecast a probable 21.2% (2.03 million people) 65+ in 2025. Up to 2010 the number of people aged 80+ is expected to increase by 83,000. A similar picture is found in all the Scandinavian countries (2) and, although not yet to the same extent, in most Western industrial countries.

A few odontologic investigations using representative population samples of elderly people in Sweden were performed during the 1970s and 1980s. Some reports were based on investigations comprising both an interview and a clinical examination (3–6). Österberg (7) concentrated on people 70 years old or more and also reported longitudinal studies of 70-year-old cohorts (8). In a study of oral health patterns in the elderly population within a county, a comparison was made between people living in densely populated and in rural areas (9).

Climate, commerce and industry, socioeconomic background factors, and dietary habits in northern Sweden differ somewhat from the middle and southern parts of the country, and official health statistics have shown different patterns of medical diseases in the south and the north (10). Longitudinal studies of oral health in representative samples of old people have not been performed in northern Sweden.

Thus the aim of this study was to investigate longitudinal changes in oral health in a representative sample of an elderly city population in northern Sweden. Reported oral problems and treatment needs were noted, and dental and periodontal status was registered in clinical examinations.

Materials and methods

The 1981 study

In 1981 there were 82,143 inhabitants in Umeå (statistical data from the local authorities), of whom about 16,000 were living in the central district (parish 1). The following procedure was used to obtain a representative sample of the city population: the total number of men and women in the age groups chosen were divided by the estimated number of people needed. The result of this calculation was that every third 70-year-old man and woman, all 79-year-old men, and every second 79-year-old woman were drawn in consecutive order from the national population register. A sample of 37 men and 37 women, all 70 years old, and 41 men and 41 women, all 79 years old—in all, 156 persons—was collected. In total, 127 subjects (81.4%), 32 men and 30 women from the 70-year-

olds and 35 men and 30 women from the 79-year-olds, agreed to participate.

The responders and non-responders in the original samples from 1981 have been compared in accordance with register data and found not to differ with regard to age, marital status, income, and inpatient care occasions or days in 1980 (11).

The longitudinal study

The 70- and 79-year-old samples from 1981 were re-examined in 1984, 1987, and 1990. Both the earlier participants and the non-responders were offered the opportunity to participate. During the 9-year study the samples were reduced because of an increasing death rate, especially among men but also in the older cohort of women. In 1990, 40.5%, 58.5%, and 46.3%, respectively, of the 79- and 88-year-old men and of the 88-year-old women had died, compared with only 8.0% of the 79-year-old women. The non-response among the survivors increased from 16.2% in 1984 to 19.5% and 24.2% in 1987 and 1990.

Seventy-one (31 men and 40 women) of the 127 subjects (67 men and 60 women) examined in 1981 participated in the 1990 investigation. The two cohorts are not separated on the basis of gender, and only results from 1981 and 1990 are shown. Statistically significant gender differences are shown in the text.

Study design

The oral health study was one part of a multi-disciplinary study that also consisted of a sociomedical interview and separate medical, psychologic, and dietary studies (12, 13). The various parts of the investigation were all allocated to one clinic, and four probands were examined every day between 0730 h and 1200 h. In a room furnished with the ordinary equipment used for oral examination, observations were made by means of an interview and a clinical examination.

In 1981 two probands were examined in their homes and one in the hospital. Three probands, 79 years of age (two men and one woman), died between the date they were selected and the date for the interview and examination. In 1984 and 1987 only a few patients were examined at home. However, in the 1990 study 27 patients were examined at home or in some kind of service house or institution. Sixteen of those 'home-visits' were to 88-year-old men and women, and most of these examinations were performed by G. Norström, assisted by a dental nurse.

In 1981 the study was performed by one examiner (G. Nordström), in 1984 by two (G. Nordström, J.-H. Wenslöv), in 1987 by three (G. Nordström, K. Borg, H. Nilsson), and finally in 1990 by two (G. Nordström, A. Tillberg). The different examiners were trained at the same dental school and worked as teachers and clinicians in the same prosthetic department at the dental school. To confirm definitions and calibrate clinical examination methods, G. Nordström examined 40 patients simultaneously with J.-H. Wenslöv in the 1984 study, and 20 patients each with K. Borg and H. Nilsson in 1987, and with A. Tillberg in 1990.

Clinical examination methods

The tooth surface was dried by use of cotton rolls and air. New plane mirrors and Maillefers 4/6 explorers were used for the examination of caries. The criterion for a positive clinical diagnosis of coronal caries was as follows: primary and recurrent caries was defined as a loss of tooth substance in which the probe with a little pressure stuck and required a definite pull for removal (14). Root caries was defined as an area softer than the surrounding tissue below the cementoenamel junction, with or without cavitation (15). Caries encompassing both the coronal and root parts of the same tooth/surface was registered as root and coronal (primary or recurrent) caries and was counted as one decayed tooth in the DMFT index. If a tooth had only root caries, it was scored in the same manner as a tooth with only coronal caries. The third molars were excluded from the DMFT sums. Root remnants without enamel were recorded as one decayed surface in the DMFT index. The incisors and the canines were, in congruence with premolars and molars, given the value of five surfaces. Thus, the DMFS index was calculated on 140 surfaces in a 28-tooth dentition.

The prevalence of periodontal disease was estimated by registering the Attachment Level (AL) (16) and the Gingival Bleeding Index (GBI) (17, 18), measured with a pocket probe (Michigan) inserted parallel to the axis of the tooth. Bleeding was registered at four sites on each tooth—mesial, buccal, distal, and lingual—10–20 sec after probing for the AL was performed. The AL was measured from the bottom of the gingival pocket to the cemento-enamel junction at five sites on each tooth—mesiobuccal, buccal, distobuccal, lingual, and mesiolingual—and AL >3mm were noted in the protocol. The measurements were made to the nearest millimeter. If the cementoenamel junction was covered by a crown or filling, the cervical border of the restoration was used as reference point. The percentage of bleeding surfaces and of surfaces with AL >3mm were calculated.

Dental status was also described with the functional index in accordance with Eichner (19). The index consists of three main groups, A, B, and C. Occluding teeth in the molar and premolar regions are registered. If there are occluding contacts in the premolar and molar regions bilaterally, a maximum of four supporting zones is obtained, and the person belongs to group A. Accordingly, group B has one to three supporting zones, and group C has no supporting zones in the premolar/molar regions. Occlusal contacts with fixed crowns and bridges, but not with removable dentures, were included in the index. Thus, a complete denture belongs to Eichner group C, those without supporting zones.

Table 1. Questions about earlier dental treatment asked in the 1981 study and in the follow-up study in 1990. The questions about feelings before a dental visit and knowledge of the Dental Insurance System asked in 1981 were not repeated in 1990

Question	Study year / Age cohort	1981–90 / 70–79 %	1981–90 / 79–88 %
How often do you visit a dentist?			
At least once a year		39–52	27–25
Never or only acute		61–42	74–58
No reply/don't know		0–6	0–17
Did the dentist call you for an appointment?			
Yes, the dentist called		37–50	24–26
No, I called		62–43	71–53
No reply/don't know		0–6	6–22
Do you know about the Dental Insurance System? What does it mean financially?			
Wrong answer		10	2
Correct answer		20	9
No reply/don't know		70	89
What do you feel about the prospect of an appointment with a dentist?			
Unaffected		74	82
Uneasy, scared		26	15
No reply/don't know		0	3
No. of subjects		62–40	65–31

Intraoral photography

At all examinations the subjects were also registered by means of intraoral photography with positive color film (Kodachrome 64), and the same photographic equipment (Nikon FM with Micro Nikkor 2.8/55mm and a 2X extender with two electronic flashes mounted on each side of the lens system) was used with standardized preset magnifying and aperture. These positive color photographs were afterwards studied together with the registrations in the forms, to correct obvious faults in the number of teeth, fillings, crowns, bridges, and material.

Statistical methods

For inference of differences between independent samples we used the chi-square and two-tailed *t* test for independent samples. To estimate the limits within which a variable would occur in the population, a 95% confidence interval (95% CI) was calculated. The results in two populations were regarded as different when there was no overlapping between the 95% CIs, which is indicated in the text as (95% CI) (20).

Results

Sociomedical background

When the U70 study started in 1981, 88 people of 127 (69%) stated that they had been living in Umeå for more than 30 years, and only 3% for less than 5 years. In 1990, 73% of the surviving subjects stated that they had lived in Umeå all their lives.

In 1981 most subjects (82.6%) reported having received a 6-year elementary school education or less, and the frequency had decreased to 76% of the remaining sample by 1990. There was no difference between men and women with regard to education.

Some important changes in marital status and in living conditions occurred during the observation period. In 1981 more 79-year-old men (71%) than women (23%) were married (95% CI). In 1990 less than one-fifth of the 88-year-old women (18%), compared with half the 88-year-old men, were still married. In the studies in 1984, 1987, and 1990 more than 70% of the 82-, 85-, and 88-year-old women were living alone. For each widowed 79-year-old man there were 14 79-year-old widowed women in the remaining sample in 1990.

The housing conditions did not differ between men and women, and in 1981 almost 95% were living in their own house or apartment. However, in 1990, at the age of 88 years, almost half the remaining samples of men and women were living in a service house or institution.

Dental care

There was a tendency for the frequency of reported annual dental visits and of being called by the dentist to increase in the younger but not in the older sample during the 9-year period (Table 1). A cross-tabulation of the questions 'How often do you visit a dentist?' and 'Did the dentist call you or did you call him?' showed that of the 70-year-old men and women studied in 1981 who claimed annual visits to a dentist, 75% were recalled by the dentist. Furthermore, all the 79-year-old men and 90% of the 79-

Table 2. Longitudinal changes in the answers to the questions 1) 'Do you have any problems in your mouth or jaws now?' and 2) 'Do you think that you need oral treatment now?', asked of the 70- and 79-year-olds in 1981 and of the re-examined subjects in 1990

	Study year	1981–90	1981–90
	Age cohort	70–79	79–88
		%	%
1) Have no oral problems		76–63	67–60
Have a loose filling/crown		3–0	0–3
Have a tender or itching tooth		3–8	5–3
Have pain from the mandibular joint		3–0	0–0
Have denture problems		15–22	27–23
No reply/don't know		0–6	2–10
2) Do not need oral treatment		55–63	52–76
Need oral treatment		42–31	40–10
No reply/don't know		3–6	8–13
No. of subjects		62–40	65–31

year-old women with at least one visit per year were also recalled in 1981. In 1990 this picture was still more unequivocal in that 100% of the 79- and 88-year-olds with at least annual visits reported that they were recalled by the dentist. Despite the increasing frequency of subjects being recalled, only 15% of the 70- and 79-year-old and none of the 88-year-old complete denture wearers were recalled by their dentist in 1990.

In 1981 a question was also asked about knowledge of the Dental Insurance System: 'Do you know about the Dental Insurance System? What does it mean financially?' (Table 1). By this time the economic rules were easy to understand and remember; the insurance covered half the total cost and the patient the rest. This question was asked in the sociomedical interview in 1981 but was not repeated in the later studies because the rules were changed from time to time and became more and more complicated. In 1981, 15% on average knew the economic rules for the

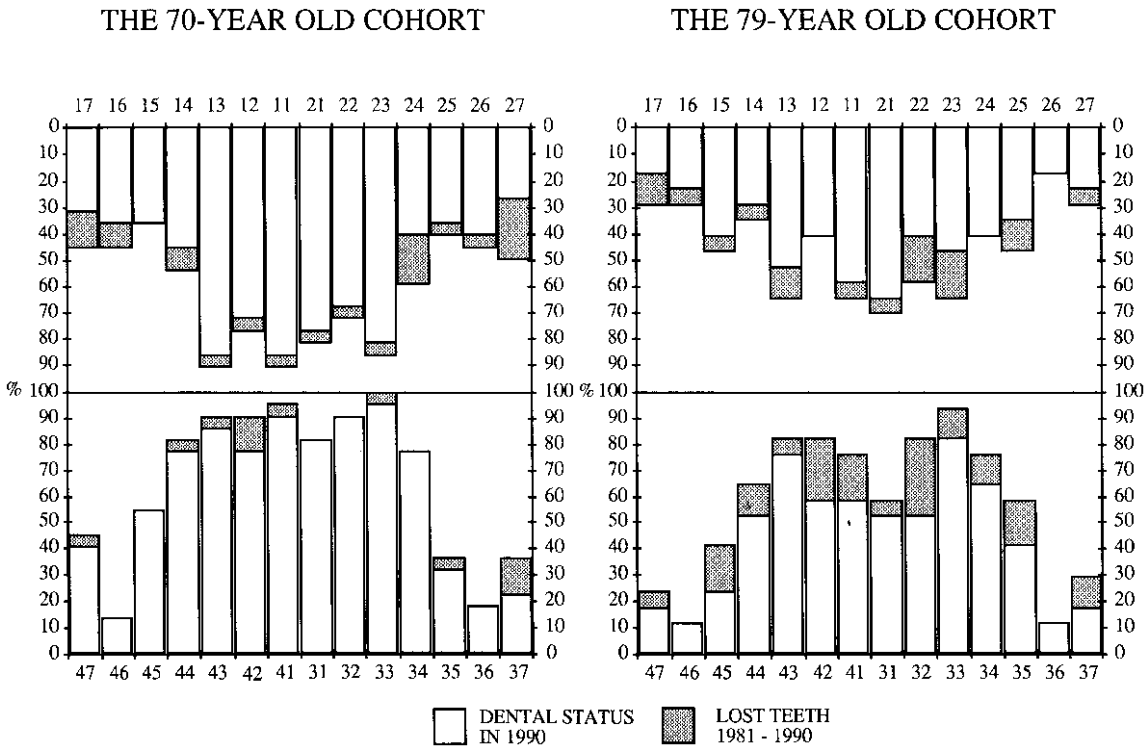

Fig. 1. Changes in the distribution of teeth in the dentulous 70- and 79-year-old subjects in 1981 who could be re-examined in 1990.

Table 3. Longitudinal changes in DMFT and DMFS and in the proportion of teeth with recurrent, primary, and root caries in the 23 dentulous 70-year-olds and 16 dentulous 79-year-olds examined in 1981 who could be re-examined in 1990. Percentage of the number and surfaces of present teeth in 1981 and 1990

Study year	1981–90	1981–90
Age cohort	70–79	79–88
	%	%
DMFT	87.7–88.0	87.6–90.5
DT	1.3–0.3†	4.7–3.6†
FT	80.2–80.9	76.1–77.2
DMFS	71.3–75.1	74.7–81.3
DS	0.5*–0.1†	3.1*–3.8†
FS	55.5–59.6	58.1–58.2
Recurrent caries	7.9–4.3	14.6–3.9‡
Primary caries	1.3–0.3	2.9–0.3
Root caries	0.2*–3.6‡	8.6*–6.8
Total no. of teeth	419–380	242–198

* Cohort difference in 1981: 95% CIs do not overlap.
† Cohort difference in 1990: 95% CIs do not overlap.
‡ Longitudinal change from 1981 to 1990: 95% CIs do not overlap.

Dental Insurance. A cross-tabulation showed that 23% of those who said that they visited a dentist less than 3 years ago knew the right answer, compared with 2% of the rest ($P < 0.01$). Of the nine 70-year-old men giving the right answer, eight had been to the dentist less than 3 years ago. There was no statistically significant difference in accordance with age, gender, or education.

The physician in the sociomedical interview in the study in 1981 also asked a single question about personal feelings before a dental appointment (Table 1). It showed that more than 20% of the subjects felt uneasy or scared before an appointment with the dentist. A cross-tabulation showed that uneasy feelings or fear was just as common among complete denture wearers as among individuals with their own biologic teeth. Moreover, there was no statistically significant difference on the basis of age, gender, frequency of dental appointments, reported dental or denture problems, chewing problems, or Eichner index. This question was dropped in the follow-up studies.

Subjective oral problems

In all studies the participants were asked: 'Do you have any problems in your mouth or jaws now?' and 'Do you think that you need oral treatment now?' There was very little change in the pattern of oral problems over time (Table 2). However, it should be noted that most of the problems were related to removable dentures and that the 'no reply/don't know' alternative seemed to increase with age and time. In 1981 there was no difference between the age groups with regard to oral treatment need, but in 1990 47% and 21% of the 79- and 88-year-old men stated that they needed treatment, compared with 15% of the 79- and none of the 88-year-old women (95% CI).

A cross-tabulation of the frequency of dental appointments and of reported treatment need in 1981 and in 1990 showed that the reported treatment need was statistically significantly more frequent among those with irregular dental appointments than among those who claimed annual visits ($P < 0.001$). It should also be noted that 13% of the 88-year-olds did not know/not answer (Table 2).

Dental status

In 1981, 31% and 34% of the 70- ($n = 32$) and 79-year-old ($n = 35$) men were edentulous, compared with 53% and 50%, respectively, of the 70- ($n = 30$) and 79-year-old ($n = 30$) cohorts of women. In 1990 the frequency of edentulousness had changed in the group of survivors compared with the examined sample in 1981, and 27% and 43% of the 79- ($n = 15$) and 88-year-old men ($n = 14$) and 48% ($n = 25$) and 47% ($n = 17$) of the corresponding age groups of women were now edentulous in both jaws.

The changes in the distribution of teeth among the 40 dentulous subjects in the 70- and 79-year-old cohorts examined in 1981 who could be re-examined in 1990 are shown in Fig. 1. Most dentulous subjects had lost only one or two teeth during the 9-year period, but one 79-year-old man had lost all his nine teeth in the lower jaw and became edentulous in both jaws. A 79-year-old women lost 5 teeth in her lower jaw but kept all her 11 teeth in the upper jaw throughout the 9-year observation period. The picture of the distribution of and the loss of teeth was similar among men and women but differed between the two age cohorts. In the older cohort the front region, especially in the lower jaw, was evidently reduced.

The incidence of tooth loss in 23 dentulous 70-year-old subjects followed up from 1981 to 1990 was 0.12 teeth/year in the upper and 0.07 teeth/year in the lower jaw, and the dentulous 79-year-olds ($n = 17$) lost 0.12 teeth in the upper and 0.22 teeth per year in the lower jaw during the 9-year period. Altogether 39 teeth (1.7 teeth/subject)

were lost in the younger cohort and 44 teeth (2.6 teeth/subject) in the older cohort from 1981 to 1990.

The Eichner index was registered in all studies (Fig. 2). In the younger cohort of women the proportion in group C seemed to decrease slightly and that in group B to increase similarly. In the older female cohort group C seemed to increase and formed more than 80% of the remaining 88-year-old female cohort in 1990. In both cohorts of men it seemed that the proportion of Eichner group A increased during the study period. The proportion of Eichner group A among 88-year-old men was three times that of 88-year-old women, but the 95% CIs did not indicate such a difference in the underlying population.

A cross-tabulation between functional status (Eichner index) and educational level on the basis of the results from 1981 showed that both the 70- and the 79-year-olds with more than 6 years of elementary school had a better functional status ($P < 0.01$) than most (83%) with 6 years of education or less. However, this difference was not found among the survivors after the 9-year period.

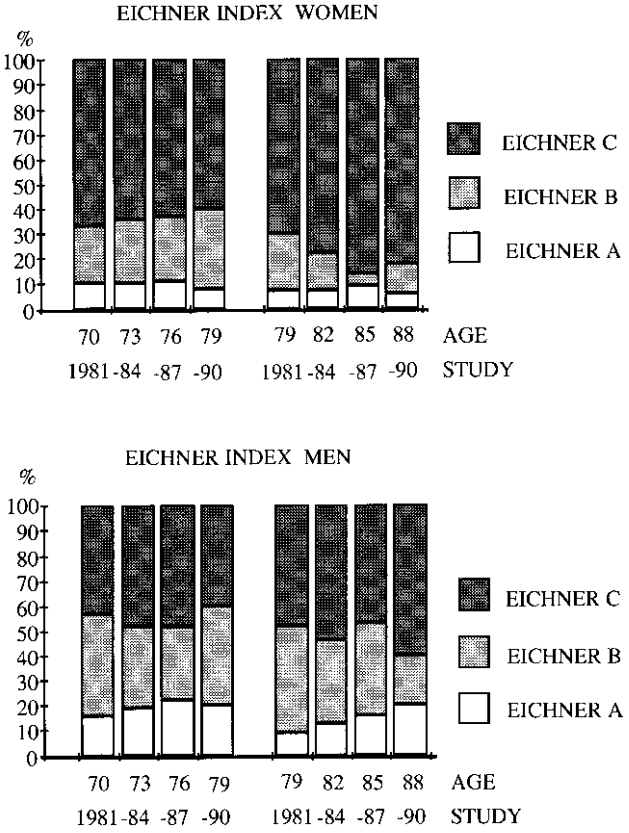

Fig. 2. Changes in the Eichner functional index from 1981 to 1990. The index was calculated on the remaining teeth, including fixed crown-and-bridge restorations. In 1981 a 70-year-old cohort of men ($n = 32$) and women ($n = 30$) and a 79-year-old cohort of men ($n = 35$) and women ($n = 30$) were examined. In 1990, 15 men and 25 women, now 79 years old, and 14 men and 17 women, now 88 years old, could be re-examined.

Table 4. Longitudinal changes in the proportion (%) of bleeding surfaces and of surfaces with an attachment level >3 mm in the dentulous 70-and 79-year-olds examined in 1981 who could be re-examined in 1990

Study year	1981–90	1981–90
Age cohort	70–79	79–88
	%	%
Bleeding	30.0*–24.0†‡	37.8*–37.4†
Attachment level	14.3*–16.6†	23.9*–40.3†‡
Total no. of teeth	395–361	229–193

* Cohort difference in 1981: 95% CIs do not overlap.
† Cohort difference in 1990: 95% CIs do not overlap.
‡ Longitudinal change from 1981 to 1990: 95% CIs do not overlap.

Caries

The DMFS showed that more than 80% of the 88-year-olds' tooth surfaces were missing, filled, or decayed, compared with about 75% of those of the 79-year-olds both in 1981 and in 1990 and 71% of the 70-year-olds (Table 3). The frequency of DS was higher in the 70-year-old cohort than in the 79-year-olds in 1981 (95% CI). DT and DS showed a statistically significantly higher frequency in the 88-year-olds than in the 79-year-olds in 1990 (95% CI). The decrease in the frequency of recurrent caries during the 9-year period in the older cohort was statistically significant (95% CI). The 79-year-olds showed a statistically significant higher frequency of decayed root surfaces than the 70-year-olds in 1981 (95% CI), but the younger cohort then showed a significant increase of root caries from 1981 to 1990 (95% CI). The number of sound teeth without fillings, crowns, or caries changed very little in the younger cohort (from 3.44 to 3.34) but showed a more evident decrease in the older cohort (from 3.47 to 2.65) during the 9-year period.

Bleeding and attachment level

Bleeding could not be registered in one and attachment level not registered in two 88-year-old bedridden dentulous subjects. The frequency of bleeding surfaces was higher in the older cohort both in 1981 and in 1990 (95% CI) (Table 4). However, bleeding decreased in the younger cohort during the 9-year period (95% CI). There was also a higher frequency of surfaces with an attachment level >3 mm in the older cohort in comparison with the younger cohort in 1981 and in 1990 (95% CI). The frequency of AL increased statistically significantly from 1981 to 1990 in the older cohort (95% CI).

Discussion

The study presents data from a 9-year investigation of oral health in representative samples of men and women from an elderly, stationary, city-living population in Umeå,

northern Sweden. The proportions of men and women in the samples were not equal to those in the population in these age groups. The proportional difference between men and women in the 70-year-old population was small, but there were about twice as many 79-year-old women as 79-year-old men in the population, and every 79-year-old man and every second 79-year-old woman were selected to obtain equally large groups for the sample. The main purpose of the study was to investigate longitudinal changes, and the results showed that there were in general larger differences in accordance with age than with gender. Because of this, men and women were not separated in the tables. Gender differences were continuously tested and, in case of interesting findings, also shown in the text. However, separate frequencies should not be compared with other investigations with other or unknown proportions between men and women.

A nationwide Swedish population study (21) showed that 83% of the population aged 70–79 years had received 6 years of school education or less, and 13% junior high school education or more. The corresponding figures in Umeå in 1981 were 83% and 16%. Thus, the educational level of the population sample in Umeå seemed to correspond with the country at large, and since educational level and sociomedical behavior are closely connected, such factors as the pattern of oral diseases, age-related changes, age and gender differences, and attitudes to and knowledge about dental care were probably very much like those in the rest of the country. Civil status, educational level, and living conditions in 1981 were similar to those reported in the H70 study in Göteborg (7). As in the H70 study, a strong correlation between educational level and Eichner index was seen in the U70 study in 1981 ($P < 0.001$).

More than 90% of the 70- and 79-year-olds in 1981 and of the 79-year-olds in 1990 were living in their own house or apartment. However, almost 40% of the sample from 1981 had died by 1990, and about 50% of the 88-year-old survivors had by 1990 moved to a service house or institution. Most of those who reported annual visits to a dentist in 1981 were recalled by the dentist, and in 1990 all of the 79- and 88-year-olds who claimed annual visits were recalled. However, only 15% of the 70- and 79- and none of the 88-year-old complete denture wearers were recalled by their dentist in 1990. Table 1 shows that the oldest people had the lowest consumption of dental services. In men this could partly be explained by the fact that more men in the oldest cohort had complete dentures and thus were not recalled by the dentist. In the cohorts of women no such difference in edentulousness could explain the difference in dental service consumption between the younger and older cohorts. However, it has been shown that there is a wide discrepancy among the elderly between, on the one hand, identifying symptoms of illness and, on the other hand, deciding whether to seek professional care (22). For example, of those who considered 'chest pain during light exercise or at rest' serious or very serious, 75% considered seeking professional care to be the most appropriate response. However, only half of those who had experienced such pain reported actually visiting a health care professional, and only 30% of those with painful teeth or gums and 11% of those reporting irritated tongue or mouth had actually responded to professional service. The longitudinal study also showed an increasing amount of medical disease with age (11), and this might be another reason for the low consumption of dental services among the oldest and corresponds to the increasing number of home visits among the oldest in 1990. The low consumption of dental services in the oldest cohort may partly also be a pure cohort effect, at least among men, because they showed low figures already in the first study in 1981.

Even though the financial rules for dental insurance were very simple in 1981, few of the elderly knew that the patient and the insurance shared equally the total costs for material and work. However, the rules for the insurance had been changed several times since the introduction in 1974, which might partly explain the low frequency of correct answers. When the insurance started, it was the regular patients who in the first place were given the opportunity to obtain more and cheaper dental care, and the results in the present study indicated that it was mainly the regular customers who knew about the insurance. Furthermore, many of the elderly in this study were complete denture wearers and had not seen a dentist for many years. It was not considered meaningful to repeat the question about dental insurance in the follow-up studies because the rules became more and more complicated with time.

More than 20% of the sample in 1981 felt uneasy or scared before a dental appointment, irrespective of age, gender, dental status, or earlier consumption of dental care. Investigations of dental phobia in representative populations in Sweden have shown a prevalence of 10%–15% in adult populations (23, 24). In general, phobias are commoner in women, and in clinical materials of people with dental phobias, women also dominate (25). Dental phobia has also been related to poor dental status with fewer natural teeth and more dentures (26). The reasons for fear and uneasy feelings before a dental appointment in the U70 study would appear to be of complex origin. For instance, there was no difference between those who visited their dentist regularly and those who visited for only emergency treatment, and the complete denture wearers and the dentulous subjects felt equally uneasy at the prospect of a visit to the dentist. The latter was in accordance with the findings in Jönköping (27) but contradictory to those of Locker & Liddell (28), who reported that dentally anxious subjects were more likely to be edentulous and to need prosthodontic treatment and, among the dentulous, to have more missing and fewer filled teeth.

The general pattern of tooth distribution was similar in the two cohorts, with more teeth in the anterior segments of the maxilla and mandible, even though the frequency of anterior teeth was lower in the older cohort at the start in

1981. In Fig. 1 it can be seen that the front region of the older cohort also showed a higher reduction of teeth during the 9-year observation period. A similar pattern of tooth distribution in elderly cohorts has been reported in other Swedish studies (6, 8, 9). In a nationwide study in the Netherlands (29) the oldest age group (65–74 years) was found to have fewer teeth in the posterior segments and a higher percentage of teeth with coronal caries in the anterior segments. In accordance with our study Chauncey et al. (30) measured caries prevalence at 3-year intervals of a lapsed time of approximately 10 years and reported that the anterior segments of the maxilla and the mandible in the 55+ group had the highest caries rate.

The DMFT index was once constructed to estimate changes in caries rate in young and adult subjects with a few tooth losses, mainly correlated with caries. It has been reported that tooth losses in subjects older than 25 years mainly were correlated with periodontal disease (31), but recent studies (32, 33) have indicated that dental caries also is of importance for tooth loss in the elderly. Consequently, the M part of the DMFT index used in elderly subjects should be considered an indicator both of previous periodontal disease and of caries. The DMFS index is well known and easy to register. However, the changed distribution of teeth in the elderly, with more edentulous molar and premolar regions, makes the anterior segments more important for the masticatory function. In consequence, the incisal part of the front teeth in many dentulous U70 subjects either were restored with crowns or fillings or were forming a mastication surface caused by increased occlusal wear. Decayed incisal surfaces were also found, and it is our opinion that a DMFS index based on 140 surfaces would better reflect the changed pattern of tooth distribution, the increased importance of the anterior segments for mastication, and the increased frequency and changed pattern of dental diseases in elderly subjects.

There was a high and increasing frequency of root caries during the 9-year period in the younger cohort. It has been reported in a study from Göteborg that root caries increases with age (34), and in another epidemiologic study in southern Sweden (6) 95% of the lesions in the oldest age group (>79 years of age) were root caries. An 8-year-long term study was conducted to evaluate several variables presumed to influence the root caries development on exposed root surfaces (35). It was concluded that root caries was far more prevalent when risk values of the variables were present, that the important variables differed considerably among the subjects, and no single variable was found to be discriminative in all subjects. In the present study the increased frequency of an attachment level exceeding 3 mm indicated a larger area of exposed root cement in 1990, which was considered to be the main explanation of the high frequency of lesions in the root cementum. To compare the results during the 9-year period, all results were calculated as percentage of the remaining teeth or surfaces.

Attachment level increased significantly in the older cohort, but bleeding was unchanged during the 9-year period (Table 4). In the younger cohort the frequency of bleeding surfaces was significantly decreased, and the attachment level unchanged during the same period. Bleeding and attachment level showed significantly higher frequencies in the older cohort than in the younger one both in 1981 and in 1990. It has been reported that periodontal destruction occurs in short bursts rather in a linear progression (36). Periodontal sites are considered to exist in two states, either disease-active or inactive. Since periodontal pockets once formed do not spontaneously disappear, recurrent bursts of activity result in more periodontal lesions in the elderly than in individuals who have not lived as long. Clinical measurements of periodontitis have been evaluated (37), and clinical measurements that have failed to show associations with episodic attachment loss include gingival redness, bleeding on probing, suppuration, supragingival plaque, and darkfield microscopic counts. Detection of disease activity appears central to the clinical measurement of periodontitis, and the only practical means to measure active disease is from differences between repeated attachment level measurements. Other authors (38) have also pointed out that bleeding on probing is dependent on the force used and that uncontrolled forces may result in a proportion of false-positive readings. Bleeding frequency does not seem to be correlated with the changes in attachment level in the present study, which corresponds with the mentioned reports. The increased attachment level in the oldest cohort also supports the opinion that periodontal disease and tooth loss in the elderly are correlated.

The proportion of Eichner group A among men, the subjects with the most intact dental status, showed a tendency to increase with time among the survivors. This might indicate a lower death rate among men in Eichner group A. It could also be mentioned that subjective chewing problems in the U70 longitudinal study increased with age, and a multiple regression analysis estimated a worse Eichner index, muscle pain, and poor subjective medical health to be the most important explanatory variables (39). A report from a study of functional aging (40) in the gerontologic population study in Göteborg concluded that a deterioration in dental state and dental function, measured with the Eichner index, was significantly associated with a lower capacity in cognition, visual ability, hearing ability, lung volume, heart volume, muscle strength, and bone mineral content and a lower self-assessment of health. These associations were more marked in men, and the survival rate between 70 and 79 years of age was higher among men with a well-preserved dental state at the age of 70 years.

The results in this study show that many dental and periodontal diseases increase with age. Experienced dentists know that regular dental appointments constitute a suitable way of maintaining good oral health and keeping in contact with the patient. The latter is probably of special importance for old people, because at that age it is more and more laborious to make new acquaintances.

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