Trends and prognoses of dental status in the Swedish population: analysis based on interviews in 1975 to 1997 by Statistics Sweden

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The aims of this study were to describe changes in dental status over the 22-year period from 1975 to 1997, and to make a prognosis of dental status based on these data for the years 2005 and 2015. The study is based on regular investigations of the living conditions performed by Statistics Sweden of samples varying between 11,582 and 14,964 participants and a response rate from 78% to 86%. The questions of the interview used in this study were focused on dental status and utilization of dental services. The prevalence of edentulism in the age group 25–74 years decreased from 19% in 1975 to 3% in 1996/97. The proportion of dentate persons increased from 75% in 1975 to 97% in 1996/97 in age group 45–64 years with similar trends in the other age groups. In 1996/97, 2.1% of the whole sample (16–84 years) reported that they had received implant-supported restorations. The rate was higher among the elderly and the edentulous subjects. The great regional differences in dental status found in the first part of the observation period remained only in the oldest age group in 1996/97. The prognosis predicts that 95% of the subjects in age group 65–74 years and 90% in age group 75–84 years will be dentate in the year 2015. The substantial increase of dentate subjects among the elderly that has occurred during the past few decades and its expected continuation in the coming years implies a great change in need and demand for dental care services. □ *Dental care service; dental health; edentulousness; elderly; epidemiology; oral*

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Dental health has rapidly improved in many countries during the latter part of the twentieth century (1–7). At the same time, the absolute as well as the relative number of elderly people is increasing in most countries, which will lead to great changes in the dental care panorama (8–11). However, the ongoing changes are not consistent and obvious differences in the dental state have been observed also in the seemingly similar and neighbor Scandinavian countries (12–16). Seen in a global perspective, dental health as well as attitudes and utilization of dental services show extreme variation (17, 18). These rapid demographic and dental health changes indicate a need for continuing research to describe the present situation, to identify possible problems in oral healthcare in the future, and to analyze the consequences of these changes for dental care in the future (19–21).

In a previous paper (10), we described changes in dental status in the Swedish population during the period 1975–1989 and made a prognosis based on these data for the year 2000. A subsequent investigation in 1996/97 has now been added to the mentioned series of studies analyzed previously. The aims of this paper were: (i) to describe the changes in dental status over the 22-year period from 1975 to 1997; (ii) to make a prognosis of dental status based on data from this time period for the years 2005 and 2015; and (iii) to compare the prognosis based on the early investigations with the results of the latest one.

Material and methods

Statistics Sweden investigates the living conditions of the Swedish population. The annual investigations, which started in 1974, are based on interviews about welfare components, such as health, occupation, education, housing conditions, and social network and support. The sampling and performance of the investigations have been presented previously (22). This study is based on investigations in 1975, 1977, 1980/81, 1988/89, and 1996/97, which contained odontological questions about dental status, utilization of dental services and chewing ability. The participation in this study is given in Table 1. The sampling was performed systematically from the register of the entire Swedish population in the age group 16–74 years in 1975 and 1977 and 16–84 years in

Table 1. Participants (*n* and % of original sample) in five investigations of living conditions in Sweden from 1975 to 1996/97

Time of investigation	Age group	Participants *n*	%
1975	16–74	11582	81
1977	16–74	11699	81
1980/81	16–84	14964	86
1988/89	16–	13309	80
1996/97	16–84	11698	78

investigations 1980/81 and 1996/97 and in all age groups above 16 years in 1988/89.

The interviews were performed by trained persons from Statistics Sweden. Information about dental status was based on the following questions: "Do you have only your own natural teeth or do you have removable dentures?" The answers were classified in accordance with one of the following alternatives: only own teeth; own teeth and removable dentures; edentulous with or without dentures. Utilization of dental services was based on questions concerning time for last visit to dentist and/or dental hygienist and regularity of utilization. The answers to the question when last visit for dental care occurred were classified as follows: less than 3 months ago, at least 3 months but less than 1 year ago, at least 1 year but less than 2 years ago, at least 2 years but less than 5 years ago, 5 years and more, never been to a dentist or dental hygienist. The answers regarding regularity of utilization were not used in this study. A question on dental implants was also asked. After a brief explanation of the principle of placing titanium screws into the edentulous jaw bone to be used as support for a prosthesis, the question was: Have you been treated with such dental implants?

Statistics

To calculate a prognosis of dental status up to the year 2015, logistic regression models using information from the ULF studies for the years 1975–1997 were employed to estimate average yearly change. A separate model was calculated for each gender and 5-year age group. The prognosis was then found by assuming that the same trend would continue during the prognosis period.

The logistic regression model has the form $\log(p/(1-p)) = a + b \times Y$. The variable Y in the model is the year, and a and b the estimated constant and intercept of the model. We had information available only on an aggregated level, by gender and 5-year age groups, for the years 1975, 1977, 1980/81, 1988/89, and 1996/97. This was adequate for our purpose, as we did not aim at statistical inference on an individual level.

Table 2. Example of data set used for modelling change in endentulousness in Sweden based on five investigations from 1975 to 1997. Males 65–69 years old

Year	Edentulous	Count
1975	1	428
1975	0	572
1977	1	423
1977	0	577
1981	1	388
1981	0	612
1989	1	217
1989	0	783
1997	1	142
1997	0	858

The dependent variable in this model was constructed by creating 1000 observations for each year, of which we had information of dental status and assigning 1:s and 0:s in proportion to the observed proportion for each year.

As an example, the proportions of edentulousness among males between 65 and 69 years of age were 42.8% in 1975, 42.3% in 1977, 38.8% in 1980/81, 21.7% in 1988/89, and 14.2% in 1996/1997. From this we constructed a data set with three variables and 10 observations (Table 2).

The result of this is the following linear part of the logistic regression model:

Linear score = LS = $143.6 - 0.0728 \times$ Year

Predicted proportion = exp(LS) / (1 + exp(LS))

This will give us predicted values that may be compared to the observed and extrapolated values up to the year 2015 (Table 3).

Table 3. Observed and model-predicted rate of endentulousness in Sweden 1975–2010 for the data presented in Table 2. Males 65–69 years old

Year	Observed %	Predicted %
1975	42.8	45.5
1977	42.3	41.9
1981	38.8	35.1
1989	21.7	23.2
1997	14.2	14.4
2000		11.9
2005		8.6
2010		6.1
2015		4.3

It should be noted that the significance of the model and the significance of its parameters are of no interest in this case. We only employ the regression model as a way of finding an estimate of the average change per year during 1975–97 in the Swedish population.

Results

The prevalence of edentulism in the age group 25–74 years decreased from 19% in 1975 to 8% in 1988/89 and to 3% in 1996/97. In the middle-aged and elderly persons, there was a substantial decrease of edentulism (Fig. 1). In the age group 45–64 years, 75% were dentate in 1975 and 97% in 1996/97. The corresponding figures for age group 65–74 years were 48% and 85%, respectively. The proportion of dentate persons with removable dentures decreased from 23% to 10% during the period in the age group 45–64 years. The corresponding figure for the elderly ($\geq$65 years) was about 25% and did not change much over time.

The rapid and stable decrease in prevalence of edentulism over the studied period was evident in both men and women (Fig. 2). At the previous investigations of the living conditions, women have shown higher prevalence than men. In the investigation 1996/97, the

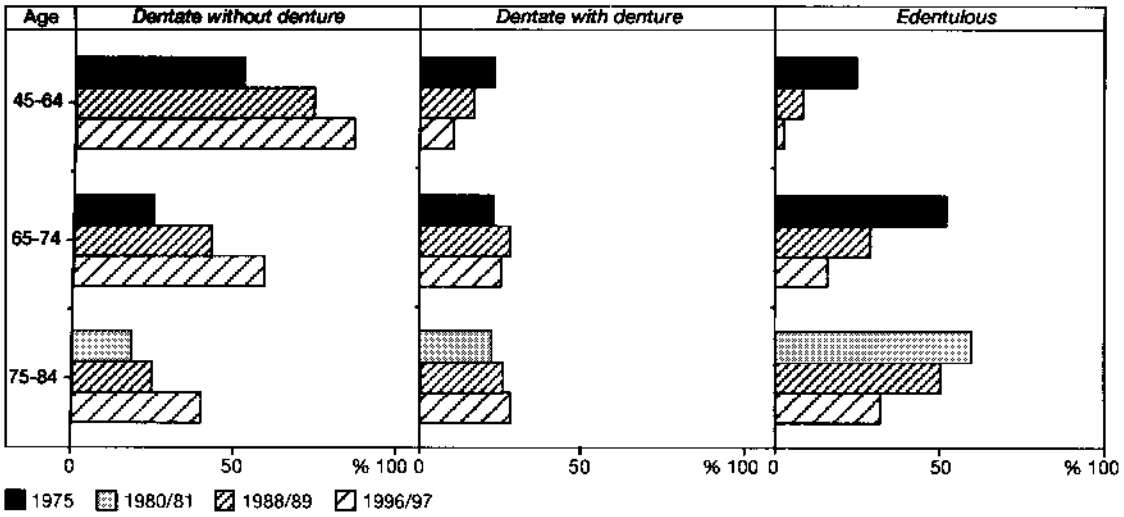

Fig. 1. Dental status in three age groups according to the investigations in 1975, 1988/89, and 1996/97. In 1975 the age group 75–84 years was not included and the values from the 1980/81 investigation are used instead.

prevalence of edentulism among the elderly (≥75 years) was still significantly higher ($P < 0.001$) in women than in men, although the gender difference in age groups below 65 years had disappeared in 1996/97.

The investigation in 1996/97 showed that in the Swedish population < 10% of the 60 to 65-year-old subjects, and < 30% of the 75 to 79-year-old ones were edentulous (Fig. 3). The prevalence of edentulism in 1996/97 was lower than the prognosis for the year 2000 for both genders, based on the investigations between 1975 and 1988/89, which indicated that the decline of level of edentulism has been more rapid than expected (Fig. 4).

The observed decrease showed that the annual change in proportion from 1975 to 1996/97 was about 10% in all age groups, but faster (12–15%) among the middle-aged women (in age group 45–64 years).

The great regional differences in prevalence of edentulism observed in 1975–88/89 and in the 1996/97 investigation were evident only in the age group 75–84 years (Fig. 5). In this age group, 85% of the inhabitants in big cities were dentate compared to 41% in the rural population.

The prognosis up to year 2015 predicts a further marked decrease of edentulism and a corresponding

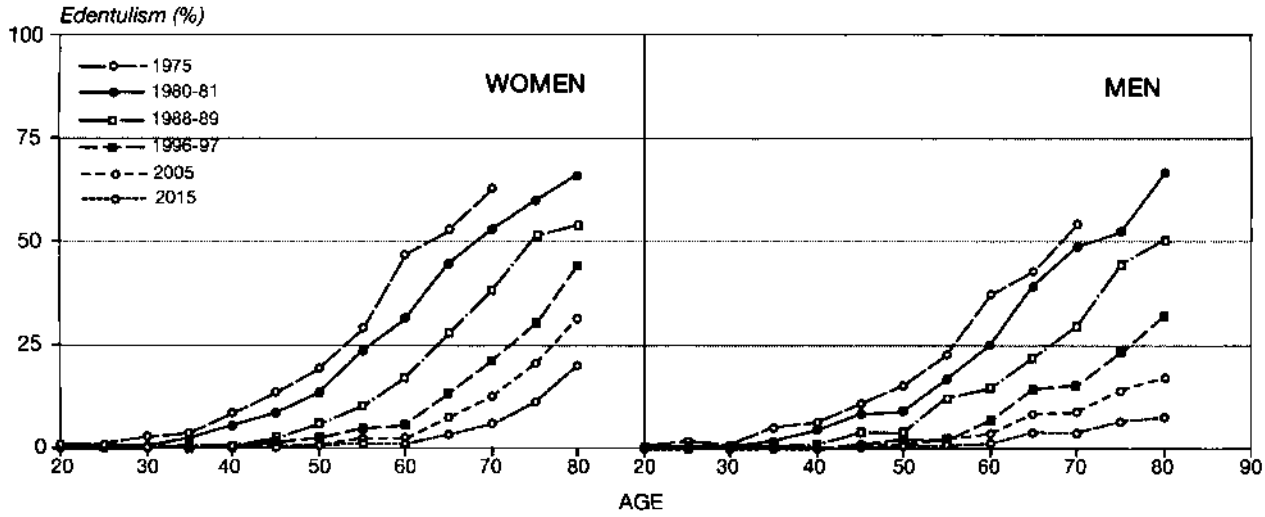

Fig. 2. Prevalence of edentulism (%) in women and men according to the investigations in 1975, 1980/81, 1988/89, and 1996/97, and prognosis for the years 2005 and 2015 based on these investigations.

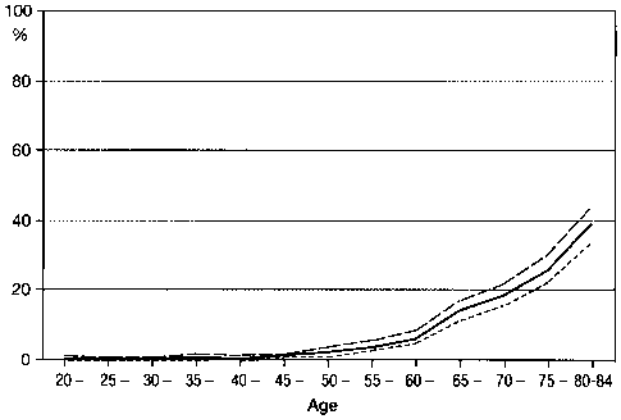

Fig. 3. Prevalence of edentulism (%) with 95% confidence interval in 1996/97 in 5-year age groups.

increase of dentate inhabitants. According to the prognosis for the year 2005, 90% of the subjects in the age group 65–74 years and 80% of those in the age group 75–84 years will be dentate. The corresponding figures for the year 2015 will be 95% and 90% (Fig. 2). In 2015, regional differences will remain only in the age group 75–84 years (Fig. 5).

In all age groups, a high frequency of the dentate subjects reported that they had visited a dentist and/or a dental hygienist during the last year (Table 4). The frequencies varied slightly between the age groups: it was highest (more than 80%) in age groups 45 to 74 years and slightly lower (about 70%) among the youngest and oldest age groups. The utilization rate was higher among the women than among the men for dentate persons ($P < 0.001$). About 60% of edentulous subjects reported no visit to a dentist during the last 5 years, increasing from 51% in age group 45–64 years, to 67% among the older elderly (75–84 years of age).

The prevalence of implant-supported restorations was 2.1% in the whole sample, 16–84 years old, about 1% in age group 16–44 years, and 5% in age group 65–84 years. Among the edentulous subjects, 8% reported that they had received implant-supported restorations.

Discussion

This study has clearly shown that the decrease of edentulism in Sweden has been extremely rapid over the last two decades of the 20th century. The results of the latest investigation 1996/97 were even more favorable than the prognosis for the year 2000 based on the results from 1975 to 1988/89, which we have presented previously (10). Our old prediction model based on the data of the investigations from 1975 to 1988/89 and the observed outcome in the 1996/97 investigation both indicate that this development will continue during the first 15 years of the new century (Figs 2 and 5). Edentulism will become a rare finding in Sweden in middle-aged and "younger elderly" individuals.

The design and performance of the investigation have secured samples that are representative of the Swedish population giving results that are reliable (10, 22). There are similar trends elsewhere (17, 23) but the development

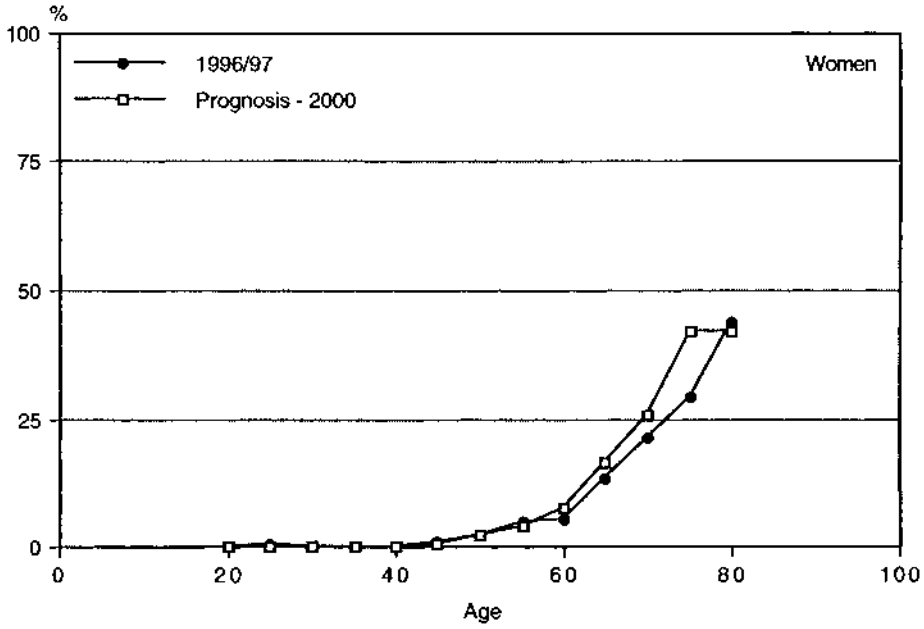

Fig. 4. Prevalence of edentulism (%) in women in 1996/97 and according to a prognosis for the year 2000 based on the 1975, 1977, 1980/81, 1988/89 investigations.

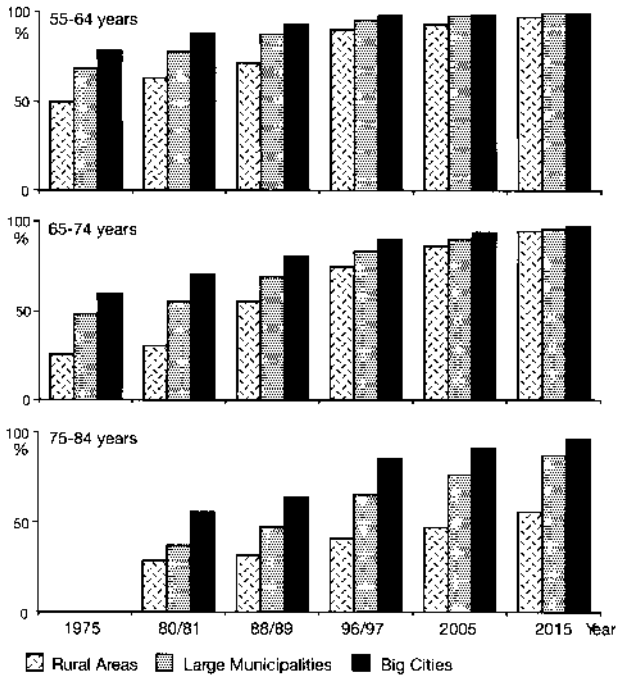

Fig. 5. Distribution (%) of dentate persons with respect to age-group and urbanization level.

of dental status in Sweden seems to be faster and more extensive than in comparable countries (12–14, 16, 19, 24).

The improvement in dental health in Sweden in the latter part of the 20th century can be attributed to factors such as a positive development of living conditions, including improved general health, economy, education, medical, and dental care (25). The national dental insurance scheme, introduced in 1974, aimed at making good dentistry available to all citizens. The dental health service has also become relatively well distributed over the whole country, which has facilitated the high utilization rate of dental services in Sweden. This is probably also closely related to the originally high allowances from the insurance. These factors have certainly contributed to the gradual reduction of earlier regional and socioeconomic differences in dental status (10, 20, 25–29).

The rapid improvement of dental health in Sweden occurs in parallel with an increase in life expectancy and life span (30). Sweden belongs to the countries with the highest proportion of elderly people in the population. A great majority of the elderly today are dentate with regular use of dental care. The prevalence of dentate people can be expected to increase further in the coming years. Four out of five dentate individuals at age 75–84 years had visited a dentist and/or a dental hygienist during the last year, and in a study in Göteborg, Sweden, 72% of 88-year-old dentate subjects reported regular visits to a dentist (20, 31). The utilization rate has traditionally been much lower among edentulous people (10, 18, 26), and this was true also in this study in 1996/97. In a recent study from the UK (18) it was reported that 43% of older people (≥60 years of age) were regular dental attenders. They found that "possessing a complete denture was associated with a 6-fold decrease in the likelihood of attending the dentist within the past year for a non-dental emergency".

Table 4. Percentage distribution of subjects according to reported time since last visit to a dentist and/or a dental hygienist in the investigation 1996/97

	Age group	Dentate	Edentulous	Total
<1 year	20–44	70	60	70
	45–64	82	21	79
	65–74	81	16	65
	75–84	73	12	47
>5 years	20–84	3	61	8

The decreased prevalence of edentulism is an important reason for the marked increase in demand for dental care among the elderly during the study period. In this context, it should also be observed that relatively many of the edentulous people (8%) reported at the 1996/97 investigation that they had been treated with implant-supported prostheses. It is well established that such treatment will require regular control and service. We have not found any official statistical data on the prevalence of implant treatment in Sweden up to now, but according to inquiries to the biggest implant manufacturers, the prevalence of 2.1% found in the adult population 4 years ago seems probable. The rate, however, is increasing rapidly and new information is warranted. In a recent study based on Statistics Norway's health survey in 1998, 2.8% of the Norwegian population above 16 years of age indicated having received dental implant treatment (32).

All these ongoing changes indicate that the need and demand for dental care among the elderly may increase further. However, the possible influence of changes in national and individual economy, including reduced allowances from dental insurance, on the utilization rate is difficult to predict and deserves to be studied.

When considering the consequences of the demographic and dental health changes for the organization of dental care, it is important to take into account also the fact that an increasing number of the older elderly will have uncompensated functional impairments, which will require special measures in treatment situations (30, 31, 33). An example is the increase of dementia among the older people: from a low prevalence at age 70, it increases to about 25% at age 85 (34).

It is evident from the results of the present study as well as from several of those referred to above that need and demand for dental care among the elderly are undergoing substantial changes and such changes can be expected to continue in the near future. These trends must be seriously analyzed for the policy toward dental care and the planning of dental health on both a national and community level.

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