Community Dent Oral Epidemiol 2004; 32: 374–84

Community Dentistry and Oral Epidemiology

Changes in dental status over 10 years in 80-year-old people: a prospective cohort study

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Hämäläinen P, Meurman JH, Keskinen M, Heikkinen E. Changes in dental status over 10 years in 80-year-old people: a prospective cohort study. Community Dent Oral Epidemiol 2004; 32: 374–84. © Blackwell Munksgaard, 2004

Abstract – *Objectives:* The aim of the present study was to follow-up the condition of the teeth over a sufficiently long period. *Methods:* Dental examinations were a part of a multidisciplinary 10-year cohort study on the elderly. These examinations were made in 1990 ($n = 226$), 1995 ($n = 90$) and 2000 ($n = 65$) for the entire population born in 1910 and living in Jyväskylä, Finland. The subjects were divided into two categories, dentate (one tooth or more) and edentulous. *Results:* The results showed that men had more intact teeth and lower DMF scores than women, but the differences diminished during the follow-up period. The number of remaining and filled teeth of those women who took part in all three phases of the present study was higher than that of those who died during the follow-up. In men the DMF scores showed the opposite trend. The most significant deterioration during the 10-year follow-up was found in the number of teeth and DMF scores in men and in the number of remaining and filled teeth in women. *Conclusion:* Among men, in particular, significant changes in oral health status could be seen even between 80 and 90 years of age. Hence, regardless of advanced age, a subject should be motivated by the oral health care team to seek regular dental treatment.

Key words: dental health; elderly; Evergreen project; gender difference

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Submitted 9 October 2003;
accepted 3 March 2004

The proportion of elderly people in the population has increased throughout the course of the 20th century, particularly in the western industrialized countries. In Finland, the proportion of dentate people also increased during the same period, although edentulousness continued to be a major problem (1). Many studies on the number of remaining teeth in elderly populations have been published worldwide, but only a few longitudinal studies have been published on cohorts born in the early years of the 20th century. The percentage of edentulousness has varied between 30 and 80 among the elderly, born during the first decade of the 20th century (2–7). The mean number of remaining teeth has varied between 9 and 20 depending on study cohort, country of origin and gender (4–9). However, differences between the sexes have been explored in only a few studies. It is a common observation that edentulousness is more prevalent among women than men (2, 6, 10). The study by Pajukoski et al. (6) showed that female gender (odds ratio 2.0) and age between 80 and 89 years (odds ratio 2.5) were the strongest risk factors for edentulousness.

Caries is the most common reason for tooth extraction (11) and hyposalivation caused by high amounts of medication among very old subjects is a well-known risk factor for caries lesions (8). The results of a recent study showed that about 60% of patients complained of dry mouth (12). Thus it is not surprising that dental health among older adults has not been found to be good: for example, in a study conducted in Sweden, more than 80–90% of teeth were reported to be missing, filled or decayed among a population born in 1910 (13); 51–57% of subjects have been reported to have

untreated coronal decay and 46–61% untreated root decay (2, 14–17). Men have numerically more decayed root surfaces than women and they also have a higher frequency of periodontal problems (2, 4). The average number of decayed teeth in the oldest octogenarian has been found to vary between 4.5 and 6.5 teeth (2, 7). The average number of filled teeth was 8.3 per subject in an Australian study on a 70-year-old population by Slade et al. (9). In this study, men had more caries, but fewer filled teeth than women.

During the last decade, the possible effect of oral health on general health status in elderly people has attracted growing interest. An association between poor oral health status, such as edentulousness, and cardiovascular diseases and even mortality has been reported in several studies (18–22). Increased risk for tooth loss has been reported to be associated with deteriorated general health (6, 20) and with certain specified clinical entities, such as systemic bone loss (23), insufficiency of calcium and vitamin D (24), and age-related hearing loss (25). The number of drugs used daily (6), smoking (26) and also low socioeconomic status (27) have been reported to correlate significantly with the loss of teeth, even among older people. It has been found that elderly people lose 1.4 teeth every 5 years (15) and 1.7–2.6 teeth every 10 years (4). Male gender and carious root surfaces are risk factors for tooth loss (28). To learn more about the changes in dental status among old people, however, it is important to follow-up the status of the teeth and other aspects of oral health for a sufficiently longer period. The present study reports 10-year longitudinal findings on the same persons in a single-age cohort recruited for a multidisciplinary study focusing on health and functional capacity in the town of Jyväskylä (pop. 85 000) in central Finland. It was hypothesized that oral health would deteriorate during the 10-year period and that elderly people would indeed lose their teeth in the course of time. In addition, we wanted to study the differences between the sexes. It was also assumed that those with the best oral health characteristics would be those who took part in all phases of the present study.

Material and methods

The study was part of a larger population-based prospective study, the Evergreen project, focusing on the functional capacity and health of the elderly residents of Jyväskylä (29). A description of the Evergreen project including the sampling strategy and guiding hypothesis has been published elsewhere (30). The target population of the present study cohort was selected on 1 January 1990 and consisted of all persons born in 1910 and resident in Jyväskylä. This population comprised 291 people [78 males (M)/213 females (F)] of whom 283 (76 M/207 F) were eligible (Fig. 1). The eight missing subjects were one man and five women who had died, and two subjects who had moved away from Jyväskylä before the examinations started. Of the eligible population, 92.6% took part in the interview, 72.4% in the medical examination and 79.9% in the dental examinations. The interviews were conducted in the participants' homes and the medical and dental examinations in the study centre. However, the dental examinations were also performed at home for those ($n = 21$) who were not able to attend the study centre conducted by the same experienced dentist and assistant. Thus more subjects took part in the dental than medical examinations. The study design was approved by the Ethical Committee of the University of Jyväskylä.

Of the eligible population, 21 subjects refused to participate in either the examinations or the interviews. The reasons for the refusals are not known. Another 57 subjects agreed to the interview, but not to the examinations in the study centre. On the basis of the interview data, these subjects did not differ from those who took part in the medical examinations with regard to gender or self-rated health; however, the number of chronic diseases was higher among the participants (2.3 ± 1.3 and 1.7 ± 1.4, respectively; $P < 0.05$).

During the next 5 years, 116 subjects died, reducing the eligible population in 1995 to 167 (40 M/127 F), of whom 88.6% took part in the interview, 57.5% in the medical examination, and 55.7% in the dental examination. In this second phase, the dental examinations were conducted in the study centre only, whereas at the baseline oral health status had also been assessed in the participants' homes. On the basis of the baseline examination and interview data, the subjects unable to attend the study centre did not differ from those who took part in the examinations with regard to dental status, self-rated health or the number of chronic diseases. Of those who took part in the dental examinations 43.0% were dentate.

The third and last follow-up examination was performed in 2000. By then, 197 people had died,

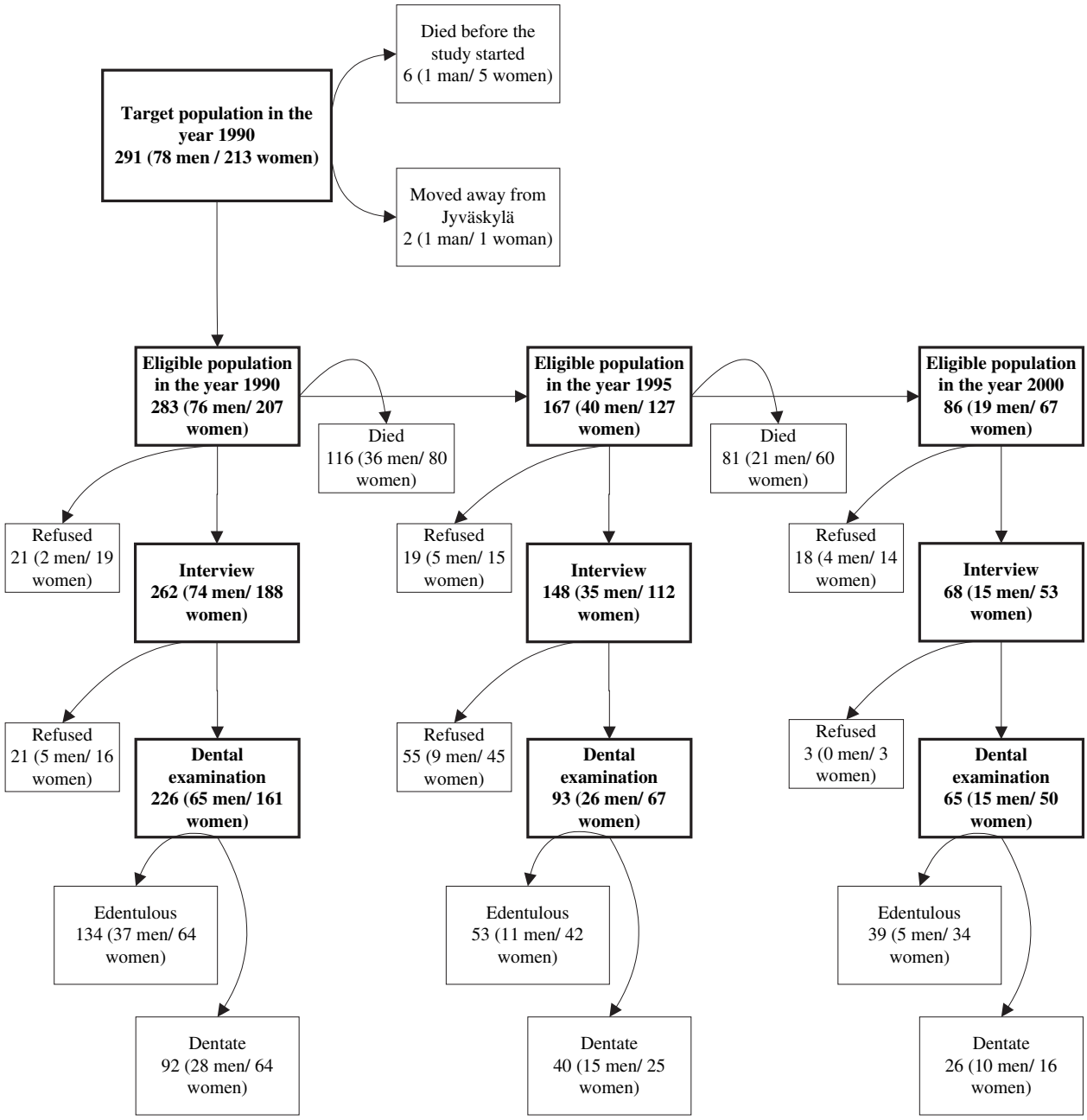

Fig. 1. The eligible population in different phases of the 10-year follow-up and the number of subjects who either took part in the interviews and dental examinations or refused. Numbers of deceased subjects are also given.

leaving an eligible population of 86 (19 M/67 F), of whom 79.1% took part in the interview, 48.8% in the medical examination, and 75.6% in the dental examination. Again the dental examinations were conducted at home for those ($n = 23$) who were not able to attend the study centre. On the basis of the interview and dental examination data at baseline, those subjects who refused the dental examination did not differ from those who took part in either the medical or dental examinations or both with regard to gender, self-rated health, or morbidity; however, among those who participated in the dental examinations, the number of intact teeth was higher (2.3 ± 4.5 vs. 0.6 ± 1.2, respectively) and DMF scores were lower (29.5 ± 4.6 vs. 31.4 ± 1.2, respectively). Of those who took part in the dental examinations 33.8% were dentate.

The fact that a subject survived beyond the age of 89 years did not necessarily mean that (s)he took part, in all the three dental examinations. Only 48 people (13 M/35 F) participated at all three time-points.

Medical examination

The medical examinations were conducted in 1990, 1995 and 2000 in the study centre, each examination lasting about half an hour. The five examining doctors were general practitioners familiar with geriatric problems. The medical examination has been reported elsewhere in detail (31). In brief, it consisted of a structured check-up, including heart and lung auscultation, palpation of breast and prostate gland, assessment of hip and knee joints, and inspection of feet. Medical examination included, in addition, blood analyses and the assessment of blood pressure. Chronic conditions and medication were also established. Participants were asked to bring along all their prescriptions and medical records from their doctor or hospital. The sum of the number of chronic conditions diagnosed by the physician was used as a general health indicator of morbidity. The scale was between 0 and 10.

The medical profile of the subjects is reported in details in Laukkanen et al. (31). In brief, at baseline, 8.0% of men and 1.5% of women had no chronic disease, and 52.0% of men and 72.7% of women had cardiovascular disease. Number of chronic diseases among the men was 2.4 ± 1.2 and among the women 2.9 ± 1.6.

Dental examination

The dental examinations, like the interviews and medical examinations, were conducted three times: at baseline, and 5 and 10 years thereafter. Throughout the study, the dental examinations were conducted by the same dentist assisted by a dental nurse who also filled in the records. The examination was a clinical examination; no radiographs were taken. Recording dental status and assessing the need for treatment were one part of the examination. Healthy teeth, carious teeth, teeth both carious and filled, filled teeth, prosthetic crowns, and missing teeth were recorded. For the diagnosis of the caries lesions WHO recommendations were followed throughout and a DMF was calculated (32). For certain analyses and calculations, the dental data were regrouped into two classes: dentate and edentulous subjects.

The dental examinations showed that nine people were found to be in urgent need of dental treatment at the baseline, 10 people at the 5-year follow-up and 14 subjects at the 10-year follow-up. They were referred for treatment as were those who were found to have either carious teeth or periodontal problems (66 subjects in 1990 and 27 in 1995).

Interviews

The questionnaire data were based on the interviews conducted in 1990, 1995 and 2000. Self-rated health was elicited by the question: 'How would you describe your health during the last year?' The scale used was as follows: 1, unusually good; 2, good; 3, moderate; 4, not so good, rather poor; 5, extremely poor. The majority (61.3%) of subjects assessed their health at baseline as moderate. The changes in self-rated health is described in detail elsewhere (33). In addition to the questions regarding health, socioeconomic status and life-style, the year of the most recent dental treatment was elicited by the question: 'When did you last visit a dentist (year)?'

Statistical analyses

The SPSS 11 program for Windows was used for the statistical analyses (SPSS, Chicago, IL, USA). All the subjects who took part in the baseline examinations in 1990 were included in the baseline analyses. The analyses of the 5-year follow-up data concerned those subjects who took part only in the baseline and 5-year follow-up examinations. Correspondingly, the 10-year follow-up data consisted of the subjects who took part in all three phases.

Among the dentate subjects the dental variables were distributed normally, as tested by the Kolmogorov–Smirnov test, except for the number of carious lesions. The *t*-test was used to analyse the differences in dental status between the sexes and to analyse whether the dental status of the deceased subjects differed from that of the survivors. The Levene test for similar variances was also used. For certain analyses related to edentulousness, cross-tabulation was used to calculate the odds ratios and 95% confidence intervals. The paired *t*-test was used to analyse the deterioration in dental status recorded on the three measurement occasions. This was carried out by using pairwise comparison between two time points. $P < 0.05$ was the criterion for statistical significance in all tests.

Results

Before the baseline examinations, the majority (77.6%) of subjects had last visited a dentist within the preceding 5-year period. At the 5-year

follow-up, 71.2% subjects had visited a dentist between the years 1990 and 1995; however, in 15.8% cases, the last visit was in 1990. At the 10-year follow-up, 85.4% of the subjects had visited a dentist between the years 1995 and 1999, the last visit in 12.5% of cases being in 1995. Dental care-seeking behaviour of survivors did not differ from those who died.

Before the baseline examinations, 73.3% of those who took part in every three examinations, had visited a dentist within the preceding 5-year-period. Five and 10 years later, the corresponding figures were 65.9% and 86.5%, respectively. These subjects indeed visited a dentist more often: the mean times of the last visit were 14.4 ± 8.7 years in 1990, 8.4 ± 3.1 years in 1995 and 3.8 ± 7.4 years in 2000.

Edentulousness

At baseline, the proportions of edentulousness were similar in both sexes: 56.9% of men and 60.2% of women were completely edentulous (Fig. 2). However, the longer the subjects were able and willing to take part in the examinations, the bigger the gender difference was. Among those who took part in the baseline and 5-year follow-up examinations, the corresponding percentages were 50.0 and 60.0, whereas among those who took part in both the follow-up occasions, the figures for men and women were 30.8 and 62.9, respectively.

Among those who took part in every phase of the study, the difference between the sexes was on the border of statistical significance at baseline (OR 3.81, 95% CI 0.950–14.88, $P = 0.050$). The gender difference was statistically significant both 5 (OR 4.31, 95% CI 1.10–16.96) and 10 years thereafter (OR 4.80, 95% CI 1.17–19.64). The deceased men tended to be more edentulous than those who survived (OR 0.361, 95% CI 0.118–1.104, $P = 0.063$).

Number of remaining teeth

At baseline, the number of remaining teeth in the dentate subjects was 14.0 ± 7.4 in men and 10.9 ± 6.8 in women. The men and women who took part in the 5-year follow-up study had 10.9 ± 7.1 and 8.9 ± 6.3 teeth, respectively, whereas those who took part in all three examinations had 18.2 ± 7.6 and 15.2 ± 7.1 teeth, respectively (Table 1; Fig. 3).

Among the dentate subjects, the gender differences in the numbers of teeth and lost teeth at the different phases were not statistically significant. During the 10-year follow-up, the number of teeth decreased significantly in both sexes ($P < 0.050$). The deceased women had a significantly smaller number of remaining teeth at baseline (9.5 ± 6.5 vs. 15.2 ± 7.1) than those women who took part in all three examinations ($P = 0.026$).

Number of intact teeth

Dentate men had 5.6 ± 5.6 and women 3.1 ± 3.4 intact teeth at baseline (Fig. 4; Tables 1 and 2). The men who took part in all three phases of the study had by far the best dental health. At the baseline, they had 9.9 ± 6.2 intact teeth, whereas the men who only took part in the 5-year follow-up examination had 4.0 ± 5.5 intact teeth. Among the women, similar differences between those participating in the different phases of the study were not found. During the follow-up, the number of intact teeth decreased among the men but remained the same among the women.

At baseline, the number of intact teeth was higher in men than in women. Again, the women who took part in all three examinations had fewer intact teeth than the men at baseline, but men lost more intact teeth during the follow-up ($P = 0.020$). The loss of

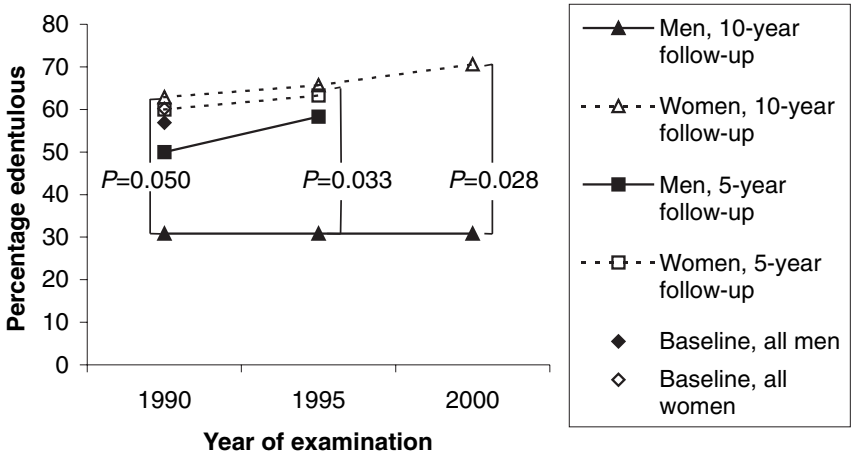

Fig. 2. Proportion of edentulous subjects in the different phases of the study (%). Significant gender differences are indicated (chi-squared test).

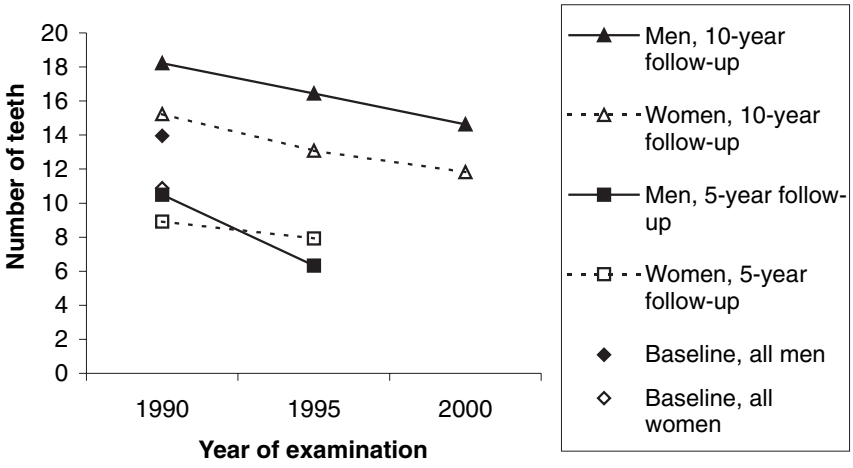

Fig. 3. Number of remaining teeth at baseline and the after the 5- and 10-year follow-up periods in men and women.

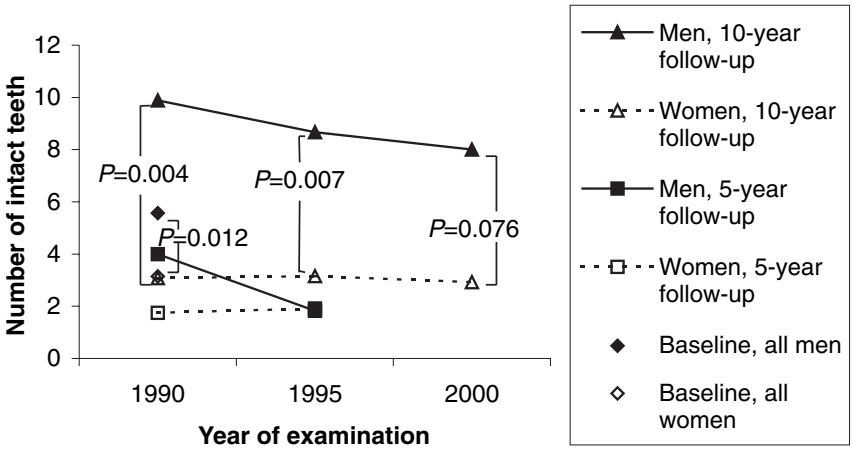

Fig. 4. Number of intact teeth at baseline and after the 5- and 10-year follow-up periods in men and women (%). Significant gender differences are indicated (*t*-test for independent samples).

Table 1. Dental indices (±SD)

	1990 (1) ($n = 18$)	1995 (2) ($n = 18$)	$P(1, 2)$	Baseline total ($n = 18$)
No. of teeth	9.4 ± 6.4	7.4 ± 5.8	0.020	11.8 ± 7.1
No. of intact teeth	2.5 ± 3.7	1.9 ± 2.6	0.305	3.9 ± 4.3
No. of decayed teeth	2.2 ± 3.1	1.4 ± 2.3	0.056	1.7 ± 3.0
No. of filled teeth	4.3 ± 5.0	3.3 ± 4.1	0.246	6.0 ± 5.8
DMF	29.2 ± 3.8	30.1 ± 2.5	0.084	28.0 ± 4.3

Differences within 5-year follow-up population have been calculated by *t*-test for paired samples.

Table 2. Dental indices (±SD)

	1990 (1) ($n = 22$)	1995 (2) ($n = 22$)	2000 (3) ($n = 22$)	$P(1,2)$	$P(1,3)$	$P(2,3)$
No. of teeth	16.5 ± 7.3	14.5 ± 7.8	13.0 ± 6.7	0.001	0.001	0.024
No. of intact teeth	5.9 ± 5.8	5.6 ± 5.1	5.0 ± 5.5	0.334	0.166	0.163
No. of decayed teeth	1.3 ± 1.5	1.2 ± 1.6	1.8 ± 2.1	0.486	0.619	0.156
No. of filled teeth	8.9 ± 8.0	7.9 ± 6.9	6.3 ± 7.8	0.181	0.003	0.049
DMF	25.8 ± 5.8	26.4 ± 5.1	27.0 ± 5.5	0.061	0.053	0.163

Differences within the 10-year follow-up population have been calculated by *t*-test for paired samples.

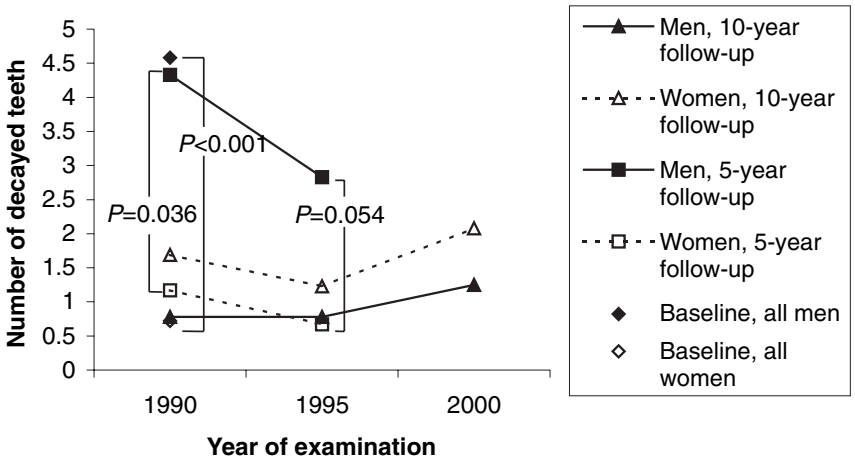

Fig. 5. Number of carious teeth at baseline and after the 5- and 10-year follow-up periods in men and women. Significant gender differences are indicated (*t*-test for independent samples).

intact teeth among men was almost significant during the 10-year follow-up ($P = 0.075$). The men who died during the follow-up had fewer intact teeth (3.9 ± 4.0) than those who survived (9.9 ± 6.2), but the difference was not significant.

Number of decayed teeth

Dentate men had more carious teeth (3.4 ± 4.6) than women (1.0 ± 1.6) at baseline and the numbers did not significantly change among those who took part in the 5-year follow-up examination (4.3 ± 4.6 and 1.2 ± 1.2, respectively) (for details see Tables 1 and 2 and Fig. 5). Among those who took part in all three phases of the study, the number of decayed teeth at the baseline was 0.8 ± 1.6 in men and 1.7 ± 2.3 in women. The men who died during the follow-up period had 4.1 ± 5.0 and the women 0.7 ± 1.0 carious teeth. There were no significant differences between the deceased and surviving subjects in this respect.

Among the dentate subjects, the ratio of decayed teeth to total number of teeth slightly decreased in men (from 0.27 ± 0.37 to 0.22 ± 0.36 to 0.20 ± 0.32), but increased in women (from 0.13 ± 0.24 to 0.21 ± 0.35 to 0.26 ± 0.28) when each phase was analysed cross-sectionally. The differences between the sexes were not significant.

Number of filled teeth

The number of filled teeth at baseline was 4.8 ± 4.5 in men and 6.5 ± 6.2 in women (n.s.). The men who took part in all three examinations had 6.6 ± 5.1 filled teeth, whereas in women the corresponding figure was 10.5 ± 7.9 at baseline (n.s.). Details are given in Tables 1 and 2 and Fig. 6.

The loss of filled teeth (from 10.5 ± 7.9 down to 6.8 ± 8.6) was statistically significant between the first and last examination in women ($P = 0.001$).

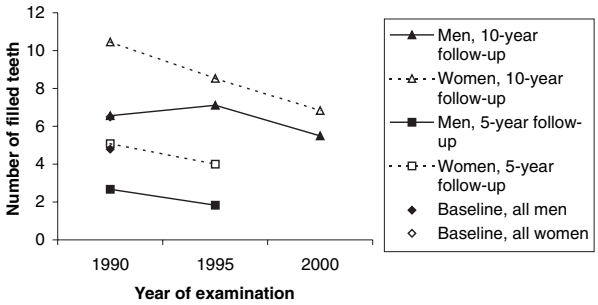

Fig. 6. Number of filled teeth at baseline and after the 5- and 10-year follow-up periods in men and women.

The women who died during the follow-up period had a smaller number of filled teeth (5.1 ± 5.4 vs. 10.5 ± 7.9) at baseline than those who took part in all three examinations ($P = 0.009$).

The ratio of filled teeth to total number of teeth decreased in both men (from 0.39 ± 0.32 to 0.34 ± 0.32 to 0.32 ± 0.33) and women (from 0.52 ± 0.34 to 0.51 ± 0.38 to 0.46 ± 0.38). The differences between the sexes were not significant.

DMF scores

The baseline DMF scores of the men were 26.2 ± 5.6 and that of the women 28.8 ± 3.4. The men who took part in all three examinations, had the lowest scores at baseline (21.3 ± 5.5) increasing during the follow-up period to 24.0 ± 6.6. The results are presented in detail in Table 1 and Fig. 7.

The DMF scores of men were lower than those of women ($P = 0.006$) already at baseline. Among the men who took part in all three phases the increase in the DMF between the different examinations was statistically significant ($P < 0.05$). The surviving men (21.3 ± 5.5) had lower baseline scores than the men who died during the 10-year follow-up

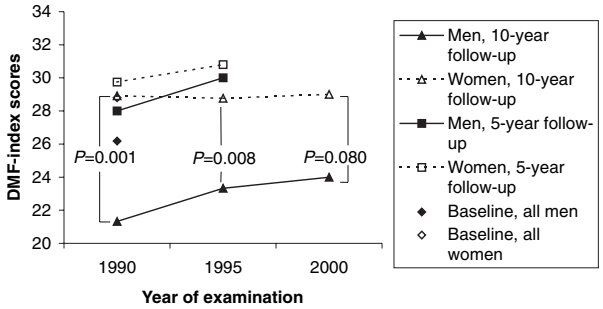

Fig. 7. DMF scores for men and women. Baseline and 5- and 10-year follow-up data. Significant gender differences are indicated (*t*-test for independent samples).

period (28.1 ± 4.0, $P = 0.023$). The men who took part in all three examinations showed lower baseline DMF scores than the women ($P = 0.003$), but the men's scores showed a greater increase during the follow-up ($P < 0.001$).

Discussion

This study showed that the most significant deterioration during the 10-year follow-up period in men was found in the number of teeth and DMF score, whereas in women the most significant change was observed in the numbers of teeth and filled teeth. The dental health of women was significantly worse than that of men. Edentulousness, the number of intact teeth and mean DMF scores reflected the differences between the sexes. These differences were most significant at baseline among the subjects followed up for 10 years, diminishing however, over the 10-year follow-up. During the 10-year period, the number of intact teeth decreased more in men than women and their DMF scores increased more than those of women. The number of teeth and filled teeth of the women who took part in all three phases of the present study was higher than those of the women who died during the follow-up. However, among men, those with lower DMF scores survived longer than those with higher scores.

The hypothesis that dental health would deteriorate during the follow-up period was borne out in the decreasing numbers of intact teeth in men and the decreasing numbers of filled teeth in women. The decreased ratios of filled teeth indicate tooth extractions. Among men, the decrease in the number of intact teeth could also indicate an increasing incidence of either caries lesions or periodontal problems, but the decreasing proportion of decayed teeth suggests that tooth loss is the only reason for this phenomenon. The stability of the DMF scores over time in women reflects the fact that every extracted or decayed tooth had been filled and, thus, none of the intact teeth were either extracted or decayed.

It has been a common observation, particularly among the lowest socioeconomic groups, that women tend to lose their teeth earlier than men (10) and, thus, elderly women are indeed more often edentulous than men. However, men also have higher numbers of intact teeth. Caries is known to be the most prevalent reason for tooth loss (11); hence, on the basis of these observations, the caries activity of men in past decades has to be lower than that of women. According to dental status and medical profile, the gender difference reflects the greater selectivity of the men surviving up to 80–90 years of age regarding their oral and general health than their female counterparts. However, the fact remains that these men have increased mortality compared with women in same cohort and their oral health deteriorates more steeply than that of women. Although an association between oral and general health status has been variously reported, a previous study on the present material showed that the dental variables did not correlate with the general health indicators except for the number of filled teeth, which correlated significantly with self-rated health (22). It is not known whether these associations run parallel with common underlying factors, such as socioeconomic position, nor whether there are any causal connections between oral and general health. Previous results from the Evergreen project reported by Rautio et al. (34) showed that until very old age a higher level of education was associated with better vital and cognitive capacity in men, whereas in women it was associated with all four indicators of functional capacity. It is also known that among women, those with a low socioeconomic position in particular have fewer teeth and a higher risk for mortality than those with a higher level of education. It might be suggested that subjects whose socioeconomic position was higher were more willing to take part in all three consecutive examinations, thereby presenting better functional capacity and survival as well as better oral health. However, this does not exclude possible causal relations between oral infections and mortality. Proving

this link would require more specific examinations.

The present study showed that the lower the DMF score man had and the higher the number of remaining and filled teeth a woman had, the higher was their probability of reaching over 90 years of age. A previous study of the present material similarly showed an association between a high number of remaining teeth and a longer lifespan (22). The present study only explored this issue among the dentate population. Although the method of analysis used in the present study was different from that employed in the previous one, the findings were similar, as expected. This association between oral health status and mortality may reflect an association between poor dental status, and general functional limitations, which are significant predictors of mortality (20). It has also been suggested that poor dental status leads to problems with nutrition intake thereby increasing mortality (21, 35). An additional potential mechanism explaining this association might relate to oral infections, which have biological consequences that may mediate the pathway between oral health status and mortality (36).

The results showed that during the second follow-up period, the proportion of subjects seeking dental services was the highest, although health care-seeking behaviour of survivors did not differ from that of those who died. It might be suggested that this reflects either a greater general positive attitude to health, or a more frequent need of dental services in old age. In Finland, dental care services are delivered by either community or private dentists. Most elderly people have used private services, because before the year 2002 communities set priority to young people (born 1956 or later). Part of the costs (35–40%) are covered by Social Insurance Institution.

Our study was an epidemiological, longitudinal cohort study. The examined population represented the whole age cohort born in 1910 in the town of Jyväskylä. The proportion of those who took part in the study was fairly high, making it possible to generalize the findings amongst urban populations in the same region and of the same age. Follow-up studies on cohorts born at the beginning of the last century are rare, which further emphasizes the value of the present findings.

The results of the present study showed the highest numbers of dental appointments were reported in 1990 and 1995. Hence, it might be suggested that an epidemiological cohort study of this kind mobilizes some subjects who have neglected their dental care and, thus, also includes an intervention dimension. This means that in consequence of the study some of those referred visited a dentist although they were not highly motivated before the examination. This study was thus not merely a follow-up study. The number of referred individuals who took care of their teeth is not precisely known. The trend towards a decrease in open carious lesions in men may also be caused by the intervention effect. However, the significance of this cannot be proved.

The very same people were followed up over a 10-year period. Mortality between 80 and 90 years of age was high: during the 10 years 150 of the 226 subjects died. This was a weakness in our study as, by the end of the investigation, the population had diminished to the extent that only 65 subjects took part in the last examination. The diminishing number of subjects was particularly emphasized when the data on the dentate subjects were analysed, as the oldest old people were mostly edentulous, as expected. However, the analyses of the data on the dentate subjects had to be conducted separately from the analyses of the edentulous, as the large number of the latter skewed the data, preventing the normal distribution required by most of the statistical methods used. Another weakness is the fact that conventional epidemiological analyses, such as increment in caries per month, could not be performed, as the exact history of dental treatment between the different data collection waves was not recorded. In particular, this produced inaccuracies in the results on decayed teeth: one subject may have last seen a dentist a few years ago, while another subject could have had a dental appointment 1 week before the examination.

The data may also be somewhat biased because 57 of the subjects who took part in the interviews, but refused the medical examinations at the baseline, had fewer chronic diseases than the 65 subjects who took part in all three phases of the study. It is understandable, however, that subjects with multiple diseases might be more motivated to attend medical examinations than those in good health. The data may also be somewhat biased because the subjects who refused to participate in the 10-year follow-up had a lower number of intact teeth and higher DMF scores at the baseline than those who took part in every measurement phase.

Among men, in particular, significant changes in oral health status could be seen even between 80 and 90 years of age. Hence, regardless of high age, a subject should be motivated by the oral health care team to seek regular dental treatment.

Acknowledgements

The Evergreen project has been supported financially by the Academy of Finland, Social Insurance Institution, Ministry of Education and Ministry of Social Affairs and Health, City of Jyväskylä, Association of Finnish Lions Clubs and Scandinavian Red Feather project. This study was partly supported by the Finnish Dental Society. We wish to thank Markku Kauppinen for statistical guidance and Michael Freeman for revision of the English text.

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