

ORIGINAL ARTICLE

Change in oral health status among the institutionalized Norwegian elderly over a period of 16 years

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Abstract

Objective. To assess the oral health status of elderly residents living in nursing homes, and to determine whether there have been any changes between 1988 and 2004. **Material and methods.** The dental, periodontal, prosthetic, and oral mucosal status was recorded for 155 elderly long-term residents in five nursing homes. The results were compared with those of an identical cross-sectional study from 1988, using the same nursing homes, examination procedures, and evaluation criteria. The participation rate was 89.6%. **Results.** Edentulism was less frequent in 2004 (43%) than in 1988 (71%), and the mean number of teeth among the dentate participants had increased from 10.7 to 14.6. The proportion of subjects with decayed teeth increased from 55% in 1988 to 72% in 2004, and the mean DMFT (decayed, missing, and filled teeth) increased from 19.4 to 23.2. The frequency of subjects with periodontal pockets of 4 mm or more increased from 43% to 65% during the 16-year period. More participants had crowns or bridges. Of the denture-wearing subjects, more were affected by stomatitis in 2004 than in 1988; however, a decrease in the degree of severity was evident. **Conclusions.** As more people retain their own teeth throughout life and the prevalence of oral diseases increases among the institutionalized elderly, their objective need for dental treatment is even greater than before. This underscores the necessity for developing effective oral care programs for the elderly.

Key Words: Dental caries, denture stomatitis, edentulism, epidemiology, periodontal disease

Introduction

The edentulous proportion of the population is a common and essential measure of oral health. A study of the oral health status among the elderly living in institutions in Norway's second largest city (Bergen) was carried out in 1988 [1]. This study showed, *inter alia*, that 71% of the residents were edentulous. The frequency of edentulism had not changed in this area since 1975 [2]. Since 1988, however, significant changes have occurred. The Norwegian Ministry of Health has published guidelines for preventive activities under the slogan: "Teeth for life". The aim of these recommendations, which have been revised periodically, was to enable the population to retain a functional natural dentition throughout life. From a health policy point of view, it is unacceptable that people end up with dentures. Wearing dentures is not only a physical problem, but may also represent a severe social and psychological burden, affecting both the quality of

life and particularly oral health-related quality of life [3]. It is also well established that a reduced dentition may induce poor nutritional status, the link being most pronounced among the edentulous [4]. "Teeth for life" is thus a strategy that it is hoped will contribute towards eradication of edentulism and dentures.

As the proportion of the population without teeth decreases, other indicators become ever more important to measure oral health and function, because the presence of teeth says nothing of their state of health. Hence, the prevalence of caries, periodontal disease, mucosal lesions, as well as the presence of dental prostheses should be used as key indicators of the oral health of the institutionalized elderly.

Many institutionalized elderly persons are physically, medically, and immunologically compromised. There is a growing body of evidence to suggest that poor oral health may have a detrimental effect on the

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general health of these subjects. Excessive bacterial flora in the oral cavity increases the risk of developing cardiovascular diseases, endocarditis, sepsis, and lung infections, and may also interfere with control of diabetes [5–8].

The aim of this study was to assess the oral health status of elderly persons living in nursing homes in Bergen, Norway, and to determine whether changes have occurred since 1988.

Material and methods

Participants in the 1988 study [1] included 147 elderly people residing in five nursing homes in Bergen. The five nursing homes had been randomly selected after stratification by the number of residents. To be able to compare our results with those of the previous study, the same nursing homes were chosen for the 2004 study. Each nursing home was contacted through its director and invited to participate in the study. The 173 long-term residents were informed about the aims and methods of the study, and those who agreed to participate were included. The information was made very simple, yet concise, so that even the mentally reduced would be able to understand. Some residents with severe dementia had very reduced communication skills. In these cases, the slightest sign of disapproval, non-verbal included, against a clinical examination or study participation was respected. Short-term residents were also offered a dental check-up, but were excluded from the analyses as they had not been included in the 1988 study. The examination was part of the routine annual screening assessment carried out by the public dental service, and any need for treatment detected was referred to the dentist responsible for the dental care of the residents. Reasons for non-participation included “refusal” ($n=13$), “illness” ($n=3$), and “not present” ($n=2$). This left 155 residents, i.e. a participation rate of 89.6%.

The study design has been approved by the National Committee for Research Ethics in Norway.

Clinical examination

The present study was performed using the same examination procedures and evaluation criteria as in 1988 [1]. A standardized procedure was followed, and to safeguard the participants’ integrity and privacy, the clinical examinations were carried out in the residents’ private rooms with the participant sitting in his/her own chair or lying in bed. All examinations were undertaken by one dentist (H.S.) in 2004. Prior to the study the examiner had been calibrated with a dentist with extensive clinical

experience, who also supervised some examinations at regular intervals.

The oral examination included the clinical parameters tooth loss, caries, periodontal, and mucosal status. The instruments used included a plain mouth mirror, an explorer, a periodontal probe, and an adjustable head-torch as the source of light. The teeth were not cleaned before the examination.

Dental status was recorded for each tooth based on the Method of Assessing Dental Caries recommended by WHO [9]. However, for comparative purposes, a modification for non-functional teeth was made. The code “root remnant” was used if caries had progressed to involve the pulp or if the tooth was non-restorable (i.e. less than 2 mm of tooth remaining above the gingival margin). If the tooth was non-functional due to periodontal disease or needed to be extracted for prosthodontic reasons, the tooth was coded “indicated for extraction”. Implants were not counted as teeth. Third molars were excluded, unless a first or second molar was missing. Only the remaining functional teeth were included in the 2004 DMFT (decayed, missing and filled teeth) score when comparing our findings with those from 1988.

Periodontal treatment need was recorded using CPITN (Community Periodontal Index of Treatment Needs) as suggested by WHO [9].

Oral mucosa was inspected for denture stomatitis according to Budtz-Jørgensen & Bertram’s recommendations [10]. Stomatitis was graded as type I–III as follows: I) simple localized inflammation, II) simple diffuse (generalized) inflammation, III) granular inflammation (papillary hyperplasia).

Information about date of birth and length of stay in the present institution was obtained from the patients’ records.

Data analyses

The data were computerized and proofread. SPSS® version 14.0 was used to calculate means, standard deviations, range, percentages, and for statistical significance tests. For skewed distributed variables (as tested by the Kolmogorov-Smirnov test), median scores were also used. Chi-squared and Mann-Whitney U-tests were used to assess the significance of differences between groups. Statistical comparisons were conducted between the genders and age groups, but the small number of males and participants under 80 years of age made it difficult to reach significance at the preset 5% level.

A random sample of 10 subjects was examined twice, two weeks apart, to assess the level of intra-examiner reliability. The kappa value for the test-retest DMFT registration was 0.89 at the single tooth level.

Results

Demographic information

Several distinct differences in demographic characteristics were observed between the two cohorts. The mean age of the nursing home residents increased significantly from 1988 to 2004, and there was a tendency towards an increasing proportion of women (Table I). In 1988, the age of the subjects ranged from 66 to 100 years, in comparison with 56 to 101 years in 2004. Of the total group of participants, 43% had spent 2 years or less in the institution in 1988, while the corresponding figure in 2004 was 59% ($\chi^2 = 7.57$, 1 df, $p < 0.01$) (Figure 1).

Dental status

In the 2004 cohort, 92 people had at least one natural tooth. Eighty-nine of them had remaining functional teeth, hence registered as dentate subjects. The teeth of three people were all non-functional.

The results indicate an improvement in dental status from 1988 to 2004. This was characterized by a decrease in the rate of edentulism (crude rates: 71% to 43%; directly age-gender standardized rates: 71.5% to 36.5%) ($\chi^2 = 24.33$, 1 df, $p < 0.01$), and an increase in the proportion of residents retaining all or most of their teeth. From 1988 to 2004 the percentage of subjects having 20–28 teeth had increased from 3% to 23% ($\chi^2 = 25.27$, 1 df, $p < 0.01$) (Figure 2). On average, each participant had 3.1 teeth (estimated) in 1988, compared with 8.4 (median: 5.0, range: 0–27) in 2004. Considering only the dentate participants, the mean number of teeth had increased from 10.7 (estimated) to 14.6 (median: 16.0, range: 1–27), over the 16-year period.

A substantial increase in caries prevalence was observed, at both individual and tooth level. The proportion of individuals with decayed teeth (DT) increased from 55% in 1988 to 72% in 2004, the increase being close to statistical significance ($\chi^2 = 3.76$, 1 df, $p = 0.052$). Whereas in 1988 17% (estimated) of the functional teeth present were decayed, this applied to 25% in 2004. Furthermore, a marked change in total caries experience over the 16-year period was observed, with an increase in the DMFT scores from 19.4 (estimated) to 23.2 (SD: 3.5, range: 13–28). The mean numbers of sound and

decayed teeth were 8.6 (estimated) and 1.9 (estimated), respectively, in 1988. The corresponding figures in 2004 were 3.7 (median: 4.0, range: 0–12) and 2.6 (median: 2.0, range: 0–10).

The total group of dentate subjects in 2004 had on average 12.3 (median: 11.0, range: 1–26) missing teeth (MT). There was a significant difference by age but not by gender (Mann-Whitney U-test: $p = 0.027$). The oldest age group had lost more teeth than the youngest. The mean number of filled teeth (FT) per person was 8.3 (SD: 6.3, range: 0–22), varying with age, where lower scores were recorded for the oldest subjects (Mann-Whitney U-test: $p = 0.009$).

Of the 92 people retaining some natural teeth, 34 (37%) had altogether 120 non-functional teeth. Of these, 115 teeth were non-functional because of gross caries (root remnants), 3 because of periodontal disease, and 2 owing to denture need. Root remnants were present in 36% of the subjects, with a mean of 1.3 teeth (median: 0.0, range: 0–18). The older age group had significantly more root remnants than the younger group (Mann-Whitney U-test: $p = 0.045$). In a strict sense, the 115 root remnants might as well be classified as part of the decayed component, which gives a mean number of decayed teeth (DT) of 3.8 (median: 3.0, range: 0–18) and a DMFT of 24.4 (median: 24.0, range: 16–28).

Periodontal status

Periodontal status was recorded for all dentate subjects where CPITN could be applied (i.e. those with functional teeth). A significant increase in the prevalence of periodontal pockets of 4 mm or more was observed from 1988 to 2004 ($\chi^2 = 5.83$, 1 df, $p < 0.05$) (Table II). The prevalence of periodontal pockets was similar in the age and gender subgroups in 2004.

Prosthetic aspects

Crowns, bridges, and implants were more prevalent in 2004 (74%) than in 1988 (60%), although not significantly ($\chi^2 = 3.02$, 1 df, $p = 0.08$), but the prevalence of partial dentures was lower, 19% and 37%, respectively ($\chi^2 = 5.07$, 1 df, $p < 0.05$). An overall statistical analysis (Table III) showed that the distributions of dental and denture status are statistically different in 1988 and 2004 ($\chi^2 = 40.79$, 3 df,

Table I. Age and gender distribution of participants in 1988 and 2004 in Bergen

	1988 ($n = 147$)				2004 ($n = 155$)			
	Mean age	<80 years	≥80 years	Total	Mean age	<80 years	≥80 years	Total
Male	82.4	10	23	33 (22%)	83.0	6	21	27 (17%)
Female	84.4	22	92	114 (78%)	87.3	14	114	128 (83%)
Both	83.9	32 (22%)	115 (78%)	147 (100%)	86.5	20 (13%)	135 (87%)	155 (100%)

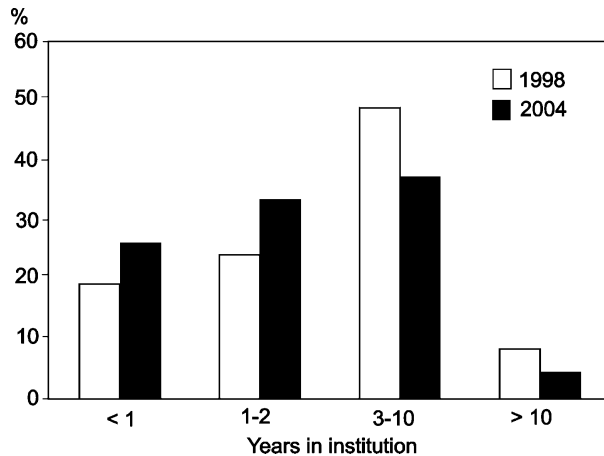


Figure 1. Distribution of subjects (%) according to time in an institution in 1988 ($n=147$) and in 2004 ($n=155$) in Bergen.

$p < 0.001$). Further analysis (Table III) revealed that more people relied solely on their own teeth in 2004 compared with in 1988 ($\chi^2 = 11.6$, 2 df, $p < 0.01$), and fewer had only dentures ($\chi^2 = 10.72$, 2 df, $p < 0.01$).

In the 1988 cohort, 5% of the 126 subjects with an edentulous upper jaw did not use a maxillary denture. Among the 107 subjects edentulous in the lower jaw, 23% did not use a mandibular denture.

Of all the subjects in 2004, 94 were edentulous in the upper jaw, and 17% of them did not use a maxillary denture, a significant increase from 1988 to 2004 ($\chi^2 = 7.68$, 1 df, $p < 0.01$). Edentulism in the lower jaw was observed in 67 subjects, and 28% of them did not use a mandibular denture, but the change was non-significant ($\chi^2 = 0.31$, 1 df, $p > 0.50$).

Oral mucosa

Stomatitis was found to affect 36% of the 90 denture wearers in 2004. The most common was type I, which accounted for 27%. Type II and III were registered in only 9% of the subjects. In 1988 stomatitis was registered in less than 20% of the

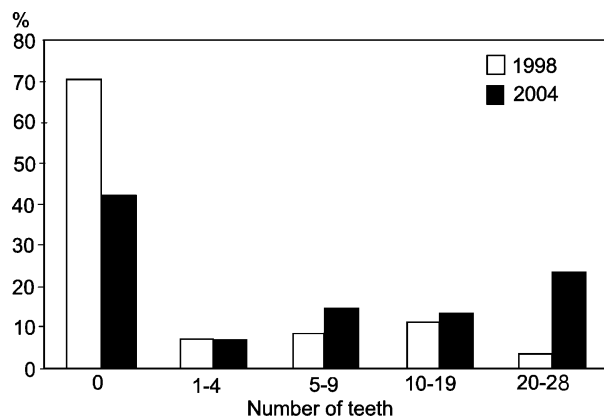


Figure 2. Distribution of subjects (%) according to number of remaining functional teeth in 1988 ($n=43$) and in 2004 ($n=89$) in Bergen.

Table II. Community Periodontal Index of Treatment Needs (CPITN) according to category in 1988 and 2004 in Bergen

CPITN categories	1988 ($n=40$)	2004 ($n=89$)
Healthy periodontal tissues	2 (5%)	0 (0%)
Bleeding	1 (2%)	6 (7%)
Bleeding and calculus	20 (50%)	25 (28%)
Bleeding, calculus, and shallow pockets (4-5 mm)	14 (35%)	38 (43%)
Bleeding, calculus, and deep pockets (6 mm or more)	3 (8%)	20 (22%)

denture wearers. However, all the cases were either type II or III.

Discussion

In 2004 we assessed the oral health status of elderly residents in nursing homes in Bergen, Norway, to detect whether or not there had been any shifts in oral health status during the past 16 years. Several distinct changes were observed in 2004 compared with 1988. The principal findings were that the frequency of edentulism had declined significantly, and that the mean number of functional teeth had increased. An increase was also observed in the prevalence of caries and periodontal diseases.

Jokstad et al. compared the oral health of institutionalized elderly persons from 1980 to 1993 and found the same trend concerning edentulism [11]. The decline in the rate of edentulous elderly observed during the past two decades is probably attributable to multiple factors. The increase in people's socio-economic status, educational level, and dental awareness during the second half of the last century is believed to have played a part [12,13]. There has also been a continuous rise in the use of dental services and a change in treatment philosophy from a predominately curative to a predominately preventive profile [14]. The elderly in the 2004 cohort have also benefited from the use of fluoride toothpaste for a longer period of their lives than members of previous cohorts. Furthermore, gerodontology units have been established at universities, to teach dental health personnel to be more aware of the needs of the elderly. Other historical events may also be important. During World War II, commercial production of penicillin began. Hence,

Table III. Dental and denture status in the 1988 and 2004 cohort in Bergen

	1988 ($n=147$)	2004 ($n=155$)
Own teeth only	12 (8%)*	53 (34%)*
Own teeth and dentures	31 (21%)	36 (23%)
Dentures only	98 (67%)*	54 (35%)*
No teeth and no dentures	6 (4%)	12 (8%)

* $p < 0.01$.

dental infections could be controlled, and restorative dentistry became a more common treatment alternative to tooth extractions. In addition, there is some speculation that people whose permanent teeth erupted during World War II benefited from reduced sugar consumption, thereby achieving better post-eruptive maturation [15,16].

Having 20 teeth or more is defined as a functional dentition [17]. The frequency of 23% with 20 teeth or more in 2004 corresponds fairly well with what was found in studies in Denmark and Finland, where the final figures were 17% and 18%, respectively [18,19]. A mean of 14.6 teeth also coincides with the Danish study, which reported a mean of 13.3 teeth. The Norwegian study by Henriksen [20] which showed a mean number of 12.3 teeth in 1996 confirms an ongoing improvement in dental status. Thus, the goal behind the "Teeth for life" strategy appears closer.

The prevalence of caries recorded in 2004 may seem high (72%), but several aspects must be considered. The average nursing home resident is older and probably more physically and mentally impaired than before. This may affect the ability to perform or receive oral care, reduce host defense mechanisms, and increase the prevalence of multi-medication therapies with accompanying hyposalivation. Furthermore, the increase in dental caries and periodontal disease may also be associated with the increased number of retained teeth [21]. However, the present results on prevalence of caries in 2004 are consistent with those in similar studies from Denmark (77%), Sweden (70%), and Australia (72%) [18,22,23].

An increase was observed in the proportion of edentulous participants not using dentures. This is probably due to reduced cognitive status, since around 80% of elderly people living in nursing homes in Norway suffer from dementia [24]. A corresponding association between cognitive impairment and edentulism without denture use was recently reported by Syrjälä et al. [25]. The majority of Norwegian nursing home residents receive regular dental treatment from the Public Dental Health Services. Having missing dentures is more likely a sign of difficulties with denture-wearing than lack of treatment. The fact that the greatest increase in missing dentures was seen in the upper jaw, despite better retention, and that it is considered less esthetically acceptable, supports the assumption that the reduced mental status of nursing home residents may be an explanatory factor.

Peltola et al. found that 25% of the denture wearers in a long-term hospital in Finland had stomatitis, while Budtz-Jørgensen et al. reported that stomatitis was found in 72% of those wearing dentures in a Swiss geriatric institution [19,26]. The most common predisposing factors suggested are inadequate denture hygiene, *Candida albicans* infec-

tions, trauma from ill-fitting dentures, systemic diseases, deficiencies of the immune system, and long-term medication [10,27]. In the present study (2004), a greater proportion of the denture-wearing subjects were affected by stomatitis than in 1988; however, a decrease in the degree of severity was evident. A possible explanation for these differences could be that more people are now prone to stomatitis due deterioration in their general health status and an increased use of medications, but the severity of the condition is partly controlled by improved oral hygiene.

When interpreting our results, several methodological aspects should be considered. The sample size was fairly small, and different dentists examined the subjects in 1988 and 2004. The data must therefore be interpreted with some caution, and the results may not be valid for elderly nursing home residents on a national scale. However, it is likely that the shift in oral health observed from 1988 to 2004 is valid in relative terms and may well have occurred in similar populations elsewhere.

It was not possible to analyze the non-participants' oral health, but the overall participation rate in the study was high (90%). However, the findings may be somewhat biased, since the physical and mental state of the non-participants seemed poorer than that of the study participants. Poor general health may impact on oral health [28]. Most of the non-participants also conveyed a negative attitude towards oral health. If their oral health status differed from that of the participants, it was most likely worse. The residents were examined sitting in their own chairs/wheelchairs or lying in bed, but the use of a mobile dental chair might have increased the accuracy of the examination. Hence, there is a risk that the reported prevalence of oral diseases in 2004 is lower than the actual situation. However, for comparative reasons, we tried to reproduce the conditions used for data collection in the 1988 study. The extensive presence of plaque and debris covering many of the tooth surfaces and the absence of radiographs may also have caused underestimation of caries. The consequence of the absence of radiographs was presumably minor, since most participants had reduced dentition with some spacing. Regarding periodontal disease, the measurement of pocket depths rather than attachment loss, recession, and alveolar bone loss will also tend to cause the severity of disease to be underestimated. Even though the CPITN index has been criticized [29] and revised, it was chosen in the present study to allow comparison with the results from 1988. Moreover, as both studies used identical criteria and adopted the same procedures, these factors are unlikely to have biased the observed changes in oral health status. Consequently, the methodological limitations of the present study have probably had only a minor impact on the prevalence estimates and

cannot account for the significant decrease in edentulism, the increase in the mean number of own teeth, caries, periodontal disease, and the need for treatment observed during the 16-year period of time between surveys.

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