

ORIGINAL ARTICLE

Oral health in the adult population of Skåne, Sweden: a clinical study

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Abstract

Objective. The aim of this study was to describe the oral health in the adult population of Skåne by clinical factors with special reference to age, gender, ethnicity and education. **Materials and methods.** Clinical examinations were performed on 451 randomly selected individuals, 20–89 years old, living in Skåne, Sweden. The clinical examination included a radiographic examination and a questionnaire. Clinical variables were put into cross-tabulations along with age, gender, educational level and ethnicity. **Results.** For all of the described clinical variables, except caries, the frequency increased with age. There were no differences in the clinical variables due to gender. The frequencies of missing teeth, caries, periodontal conditions and DMFT were higher among those with a lower educational level. More missing teeth, worse periodontal conditions, more apical destructions and less dental fillings were found in individuals who were not born in Sweden. **Conclusions.** The oral health in the adult population of Skåne was overall good, with low frequencies of oral disease and a large number of remaining teeth up to a high age. The patients' oral health status, as determined by a dentist's clinical examination, differed due to age, educational level and ethnicity, but not due to gender.

Key Words: dentistry, epidemiology, evaluated oral health, socioeconomic factors

Introduction

During the last decades, studies of adults' oral health in different regions of Sweden have been performed. These studies describe specific age groups (e.g. 14–41 year olds) and mostly focus on either the dentist's perception (clinical studies) or the patient's perception (questionnaires) of the patient's oral health [1–5]. According to these studies, the adult population of Sweden has improved its oral health during the last decades; adults living in Sweden are now missing fewer teeth than before and more seldom have removable dentures. Epidemiological studies in Norway, Finland and Germany show the same phenomena [6–8]. On the one hand these findings point to a decreased oral treatment need in the population but, on the other hand, the fact that more people retain a higher number of teeth into old age results in a potentially higher oral treatment need in the future. Approximately one third of the adult population in Skåne perceived a high treatment need [9], suggesting that not only clinical findings but also perceptions of oral health and oral treatment need

are related to socio-economical factors [10]. Several studies describe aspects of the influence of age, gender, ethnicity and education on general and oral health [2,11–16]. Based on previous studies, it could be expected that a worse clinical situation and thus a greater oral treatment need would be found in older females, individuals born abroad and those with a lower educational level.

Previously the perceived oral health of the adult population of Skåne was described by Lundegren et al. [9]. The aim of this study was to get a more comprehensive view of the adult population in Skåne's oral health describing clinical factors, i.e. the dental professions view on the individuals' oral health, with special reference to age, gender, ethnicity and education. This study contributes knowledge to the identification of risk groups for oral diseases and oral treatment need.

Materials and method

A randomly selected sample of 1000 adults living in Skåne, a county in the southern part of Sweden, were

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invited to participate in a clinical study of oral health. The individuals were 20–89 years old and registered as living in Skåne during 2007. The sample was obtained from SPAR (The Government's Person Address Register in Sweden) and included background variables such as gender, domicile, address and age in 5-year-intervals. The study design was approved by the Ethical Board at the University of Lund, Sweden. Of the original sample, 11 individuals had moved from the region, 14 had an unknown address and nine were deceased, thus leaving 966 individuals as the final sample. In total, 451 individuals were examined clinically, i.e. 47%, 232 (51%) women and 219 (49%) men. The clinical examinations were performed from March 2007 to November 2008 and took place at the Faculty of Odontology at Malmö University, Sweden, and at three clinics of the Public Dental Service in Helsingborg, Kristianstad and Ystad, in Skåne.

Questionnaire

All of the participants that were clinically examined, except one, answered a questionnaire. The questionnaire consisted of 58 questions concerning patient perception of oral health, oral healthcare need, pain, use of oral healthcare, dental materials and background factors [9].

Those not able to or not interested in being clinically examined were contacted by telephone in order to be part of a non-response analysis and 175 of these individuals answered the same questionnaire as the individuals participating in the clinical study. Of these, 97 (55%) were women and 78 (45%) men. The individuals who neither participated in the clinical examination nor answered the questionnaire were those who could not be reached by telephone or letter, were unable to take part due to bad health or old age or were simply not interested in participating in the study.

Clinical examination

Of the clinical examinations, 90.5% were performed by four of eight dentists, all employed at the Department of Oral Diagnostics, Faculty of Odontology, Malmö University. All patients were examined using standard examination procedures in standard surgeries. Digital bite-wings, picturing the distal surface of the canine to the mesial surface of the last molar (in general four bite-wings) and panoramic radiographs were exposed. The dentists were co-ordinated regarding the diagnostic criteria through comprehensive written instructions, practice and through discussing clinical cases. Patients were informed about the survey and signed a written consent.

Erupted or partially erupted permanent teeth, excluding the third molars, persisting primary teeth

and roots that could not be used for restoration, were registered as existing teeth. Caries lesions were determined using standard clinical criteria aided by mirror, probe (Hu-Friedy EXD57) and bite-wing radiographs. Cavitated lesions that extended into the dentine (D₃) were recorded as manifest caries.

Probing was performed parallel to the tooth with a periodontal pocket probe with 1 mm grading (Hu-Friedy PCPUNC157) and the deepest pocket ≥ 4 mm on four surfaces was registered. The marginal bone loss around each tooth was measured on the radiographs on a four-point scale as either none, less than one third, between one third to two thirds or more than two thirds of the root's length.

Teeth with a visible periapical radiolucens at the tip of the root, that was twice as wide as elsewhere on the root, were classified as an apical destruction and diagnosed as likely apical periodontitis.

Statistical methods

To test the hypothesis of an impact of age, gender, ethnicity and education, the clinical variables were put into cross-tabulations vs age, gender, ethnicity and education. The chi-squared test was used to measure statistical significance.

For the non-response analysis, cross-tabulations were made concerning study non-participation vs age and gender. A logistic regression analysis was performed with response/non-response as the dependent variable. Age and gender were used as independent variables.

Cross-tabulations and chi-squared tests (concerning age, gender, ethnicity, education, satisfaction with teeth, perceived oral treatment need and perceived number of remaining teeth) were also performed to compare participating individuals with individuals who did not participate in the clinical study, but answered the questionnaire for a non-response analysis.

Data analyses were performed using SPSS (Statistical Package for the Social Science) version 18. A p -value ≤ 0.05 was considered as significant.

Results

Non-response analysis

The logistic regression analysis showed that there were significant ($p = 0.002$) differences in participation in the clinical study due to age. Individuals in the age group 80–89 were less likely to participate (OR = 2.82). There were no significant differences between the genders ($p = 0.652$).

The individuals that did not participate in the clinical study, but answered the questionnaire for a non-response analysis, were well dispersed over the

age groups (Table I). Of those who did not participate in the clinical examination or the questionnaire, 48% were women and 52% were men. The largest non-participating group was men in the age group 30–39 ($n = 46$). Ten per cent stated that they were born in a country other than Sweden. Thus, fewer of the participants in the non-response analysis were born outside Sweden than in the clinical study. In the non-response group the number of university-educated individuals (24%) was lower than in the clinical study. More individuals in the non-response group (10.9%) stated that they had a high number of missing teeth (missing >10 teeth) than in the group of participants in the clinical study (3.8%). This difference was significant ($p = 0.014$). There were no significant differences between the non-respondents and the respondents concerning perceived treatment need and satisfaction with ones teeth.

Respondents

The age distribution was very similar to the age distribution of the population of Skåne, with the exception that fewer individuals in the age group 80–89 participated in the study (Table I). This age group was therefore excluded from the analyses and will not be described further. Of the respondents, 365 (81%) were born in Sweden and 86 (19%) were born abroad. Of the individuals not born in Sweden, 24% were born in the Nordic countries, 36% in other European countries and 40% in Asia, Africa or in America. Most of those born abroad moved to Sweden as adults (71%). Among the

participants in the clinical examination, 34% had an education at university level.

Age

Of the examined individuals, 44.6% had all their teeth left and 0.5% were edentulous, the rest had lost a varying number of teeth. The number of remaining teeth decreased significantly with increasing age ($p = 0.000$) (Table II). Teeth with manifest caries lesions (primary and secondary) were present in 31.4%. Few of the individuals had more than one tooth with a manifest caries lesion. A high prevalence of teeth with manifest caries lesions ($\geq$ six) was found in 1.8% of the individuals and 7.3% had three-to-five lesions. However, there were no significant differences in caries prevalence due to age (Table II). Periodontal pockets more than 5 mm deep were found in 21.0% of the individuals (Table II). A marginal bone loss at level 1 or 2 ($<2/3$ of the root length of the tooth, on at least one of the teeth) was found in 51.3% of the individuals and 8.7% had a marginal bone loss at level 3 ($\geq 2/3$ of the root length of the tooth, on at least one of the teeth) (Figure 1). Apical destructions on teeth with and without root fillings were found in 17.1% of the individuals. Apical destructions were found in 11.6% of all root-filled teeth. All the clinical signs of periodontitis and apical destructions increased significantly with age ($p = 0.000$).

The mean number of teeth with fillings was 9.8 (median 10). Teeth with artificial crowns, single or included in fixed partial dentures, were found in 41.2% of the individuals. Most individuals (22.8%)

Table I. Percentages and number of individuals in the different age groups of the adult population of Skåne in 2007, the study sample, the sample that filled in the questionnaire for non-response analysis and non-participants.

Age group		Population in Skåne 2007 ($n = 907\ 702$)	Participants in clinical study (study sample) ($n = 451$)	Questionnaire for non-response analysis ($n = 175$)	Non-participants ($n = 340$)
20–29	%	16.9	14.9	11.2	20.9
	n	153 402	67	20	71
30–39	%	17.8	19.5	9.0	19.7
	n	161 571	88	16	67
40–49	%	17.8	18.2	16.3	17.1
	n	161 571	82	28	58
50–59	%	16.6	16.9	20.2	14.4
	n	150 679	76	35	49
60–69	%	15.3	18.0	19.7	11.2
	n	138 878	81	34	38
70–79	%	9.6	10.0	12.4	8.8
	n	87 139	45	22	30
80–89	%	6.0	2.7	11.2	7.9
	n	54 462	12	20	27

Table II. Median, mean, min-max and standard deviation for remaining teeth, teeth with manifest caries lesions and periodontal pockets >5 mm deep in each age group and for the total number of individuals participating in the clinical study.

Age group	20–29	30–39	40–49	50–59	60–69	70–79	Total
<i>Remaining teeth</i>							
Median	28	28	28	27	26	22	25
Mean	27.3	27.1	26.6	26.0	24.3	20.0	27.0
Min–Max	22–28	22–28	3–28	15–28	0–28	0–28	0–28
SD	1.3	1.5	3.2	2.6	4.8	6.9	4.5
<i>Teeth with manifest caries lesions</i>							
Median	0	0	0	0	0	0	0
Mean	0.9	0.8	0.5	0.8	0.7	0.7	0.7
Min–Max	0–10	0–15	0–5	0–10	0–7	0–4	0–15
SD	1.9	2.2	1.0	1.5	1.2	1.2	1.6
<i>Periodontal pockets >5 mm deep</i>							
Median	0	0	0	0	0	0	0
Mean	0.1	0.2	0.5	1.1	1.1	0.9	0.7
Min–Max	0–1	0–7	0–19	0–15	0–17	0–9	0–19
SD	0.3	0.9	2.3	2.6	2.8	2.1	2.1

had one-to-four teeth with artificial crowns, but some individuals (4.8%) had more than 10 crowns. The mean for DMFT was 14.2. The number of teeth with fillings, the number of teeth with artificial crowns and DMFT increased significantly with age ($p = 0.000$) (Figures 2–4).

Partial or full removable dentures were only present in 11 individuals (2.4%). This was a low frequency and no further analysis was therefore done concerning differences regarding any of the reference factors (age,

gender, ethnicity or educational level). Except for one individual in the age group 40–49, removable dentures were not present until the age of 60.

Gender

There were no significant differences between the genders regarding the clinical characteristics described in this study ($p > 0.05$).

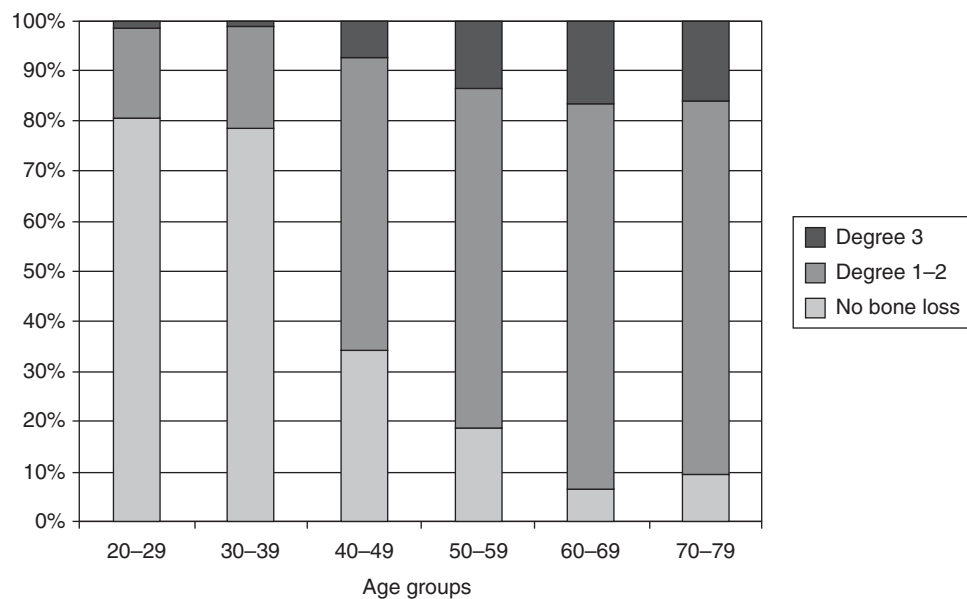


Figure 1. Percentage of individuals having different degrees of marginal bone loss in each age group^a. The bone loss was registered on radiographs. ^a Degree 1 = a marginal bone loss at no more than 1/3 of the root length, degree 2 = a marginal bone loss at more than 1/3 but not more than 2/3, degree 3 = a marginal bone loss at more than 2/3.

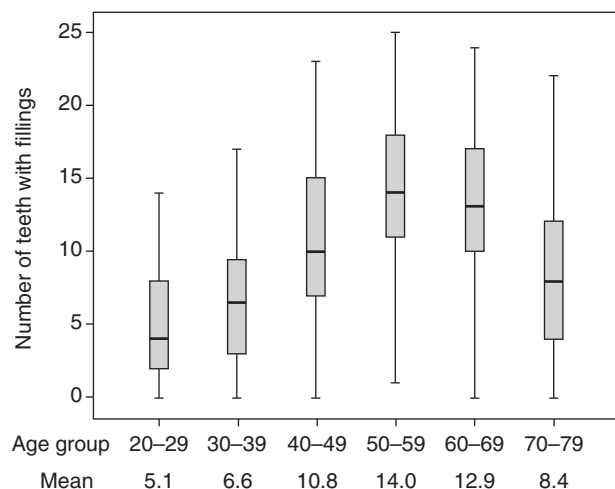


Figure 2. Boxplot^a showing the number of teeth with fillings, including temporary restorations and ceramic and gold onlays, in each age group. Mean values are displayed for each age group below the x-axis. ^a Displaying the median, the 25th percentile, the 75th percentile, minimum and maximum value.

Ethnicity

Concerning satisfaction with teeth and perception of oral treatment need, no significant differences ($p > 0.05$) were found between the individuals who moved to Sweden as children and those who moved as adults. These two groups will therefore be treated as one and the same in the following analyses.

Of the individuals born in Sweden, significantly fewer, 6.5%, were missing five-to-10 teeth, compared to 20.0% of the individuals not born in Sweden ($p = 0.000$). Individuals born in Sweden had significantly fewer gingival pockets than those born abroad, with no pathological pockets, i.e. less than 4 mm, in

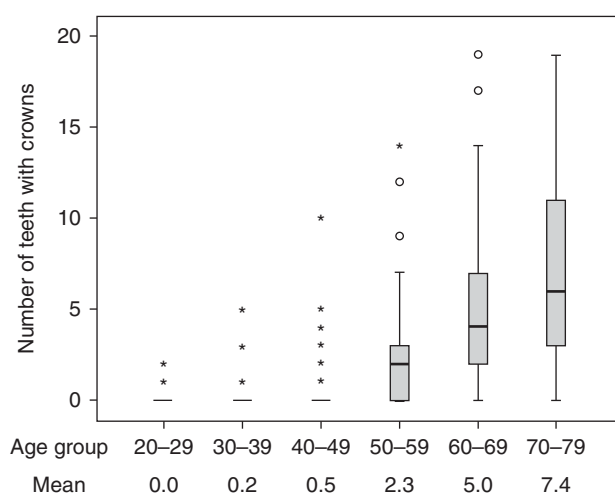


Figure 3. Boxplot^a showing the number of teeth with artificial crowns in each age group, including crowns in fixed partial dentures. Mean values are displayed for each age group below the x-axis. ^a Displaying the median, the 25th percentile, the 75th percentile, minimum and maximum value. Outliers are displayed as stars and circles.

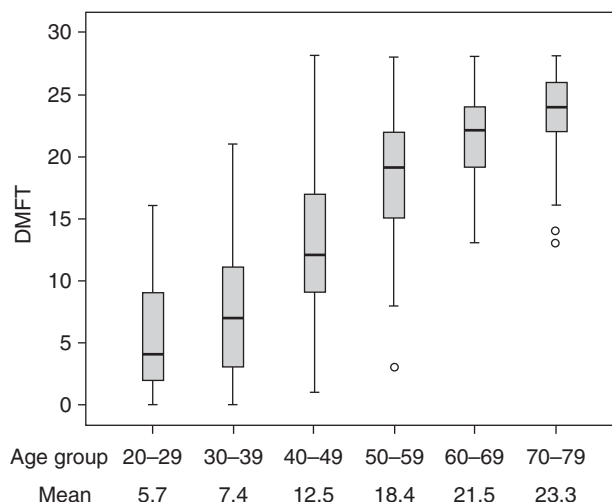


Figure 4. Boxplot^a showing DMFT (Decayed, Missing or Filled Teeth) in each age group. Mean values are displayed for each age group below the x-axis. ^a Displaying the median, the 25th percentile, the 75th percentile, minimum and maximum value. Outliers are displayed as circles.

82.2% in the former group compared to 65.9% in the latter ($p = 0.002$). Among the individuals born in a country other than Sweden, the number of individuals with a bone loss at level 3 was significantly higher, 17.6%, compared to those born in Sweden, 6.6% ($p = 0.006$). The number of apical destructions was also significantly higher among those not born in Sweden, 24.7%, compared to 15.3% ($p = 0.015$) in the group born in Sweden.

Individuals not born in Sweden had significantly fewer teeth with fillings (mean 8.1) than those born in Sweden (mean 10.2) ($p = 0.003$). However, the opposite was true for the age group 20-29, where the individuals born in Sweden ($n = 50$) had a mean of 4.4 teeth with fillings, compared to 7.5 teeth with fillings for those not born in Sweden ($n = 17$). Differences were all significant at the $p = 0.001$ level.

There were no significant differences between those born in Sweden and those born in another country concerning manifest caries, teeth with artificial crowns and DMFT ($p > 0.05$).

Educational level

Of the individuals with a university education, significantly fewer, 5.3%, were missing five-to-10 teeth compared to 10.8% of those without a university education ($p = 0.001$). The number of teeth with manifest caries was significantly lower ($p = 0.000$) in individuals with a university education compared to those without such an education; 82.0% of university-educated participants had no lesions at all compared to 61.7% of those who lacked a university education. Among the individuals with a university education, significantly fewer, 6.0%, had a bone loss at level

3 compared to 10.2% of those without such an education ($p = 0.050$).

There was a significant difference in DMFT, where a DMFT of 0 was found in 5.3% and of ≥ 21 in 24.0% of those with a university education, as compared to 2.1% and 32.8%, respectively, of those without such an education ($p = 0.003$).

There were no significant differences between those with and those without a university education concerning apical destructions, fillings and dental crowns ($p > 0.05$).

Discussion

Non-response analysis

In recent years decreasing response rates to questionnaires have been reported by several authors [1,9,17,18]. Low participation rates may be expected in clinical studies using randomized samples. A clinical study demands more of the individual in terms of effort and time. Furthermore, the possibility to compensate individuals for participation is limited due to ethical and financial reasons. Concerning the individuals that did not participate in this study, we only know age at 5-year-intervals, gender and address. Individuals who filled in the questionnaire as a non-response analysis were more likely to be born in Sweden, have a lower educational level and were missing a higher number of teeth than those participating in the clinical study. These differences can most likely be explained by the fact that the non-response group included more of the oldest individuals than the clinical study did.

The representability for this study concerning ethnicity and educational level was good. In Sweden, during 2007, 15.0% of the adults were born in another country than Sweden and the corresponding percentage for Skåne was 18.1%. Concerning educational level, 31.9% of the Swedish population and 32.7% of the population in Skåne had an educational level above upper secondary school.

Method

For the measurement of marginal bone height, the radiographic methods (both bite-wings and panoramic radiography) under-estimate the bone loss by a maximum of ~ 1 mm [19]. Periapical radiography would be more accurate in the reproduction of the bone level [19], but, if periapical radiographs were taken of the patient's entire dentition, the radiation dose would be much higher than with the chosen method. The gain of using periapical radiographs did not outweigh the increased radiation dose, especially when the radiographic findings are combined with clinical probing depth. The bite-wing radiograph is also the best radiograph for the detection of caries

lesions. It is impossible to determine if a tooth with an apical radiolucency in fact merits the diagnosis apical periodontitis or is a lesion that has healed or is healing if you don't examine previous radiographs, and this has not been done in this study.

Comparisons to other clinical studies

In the Jönköping study in 2003 [20], the mean number of caries lesions in 40-year-olds was 2.5. This was a higher prevalence than in the group of 40–49-year-olds in this study, even if including both manifest and initial caries lesions. The results from Jönköping were found to be very similar to epidemiological unpublished investigations from different parts of Sweden concerning caries status [20]. In a study of Danish adults, Kirkevang et al. [21] found a similar amount of caries lesions in adults. The median for all the studied age groups was one lesion/individual. However, this study was based on information from dental radiographs and the median number could in fact be higher due to caries lesions not detectable in the radiographs. Crocombe et al. [22] compared studies of oral health in Australia, the US, Germany and the UK performed from 1998–2006. In the age group 35–44, they found ~ 24–30% of individuals to have one or more decayed teeth, the only exception was the UK where 51% had one or more decayed teeth. The individuals in Skåne had a slightly higher caries prevalence (32.4%) than Australia, the US and Germany, but a lower prevalence than the UK.

Longitudinal studies show a trend of lower prevalence of periodontitis in recent years [20,23]. Hugoson and Koch [20] found that 6–8% of the adult individuals (50, 60 and 70-year-olds) in the Jönköping study had a marginal bone loss at more than 2/3 of the root length of the root. This was a slightly lower prevalence than in this study, where 8.7% had a marginal bone loss of this severity. Early loss of marginal bone was found by Papapanou and Wennström [24] to be a risk indicator for continued destruction.

Of all the root-filled teeth, 11.6% had apical destructions. A study by Kirkevang et al. [25] on a Danish adult population showed that 52.2% of the endodontically-treated teeth had apical periodontitis. These results show a higher number of apical destructions than in this study.

Regarding teeth with artificial crowns, Hugoson and Koch [2] found that 1.7% of the 40-year-olds had teeth with artificial crowns and 23.7% of the 60-year-olds. This difference between the age groups can also be found in this study.

Age

An individual's number of teeth reflects the history of dental diseases, e.g. caries and periodontitis. It also

reflects the quantity and type of oral care the patient has received. Up to the age of 70 most of the individuals had been able to keep most of their own teeth. This is a good testimony to the improved oral health in Sweden during the last decades. However, the high number of teeth may result in a large future treatment need when these individuals reach a higher age.

In the population as a whole, there are still some individuals with several manifest caries lesions, in need of large treatment resources. However, age did not appear as a relevant factor for detecting these individuals and even individuals in the oldest age group had very few manifest caries lesions. Dental fillings are also the result of previous disease and subsequent dental treatment; therefore it is not surprising that the number of fillings increased with age, from 20 to 49. However, the number of fillings decreased from the age 50 and onwards. This could be explained by the increasing number of prosthetic restorations, e.g. artificial crowns and fixed dentures, in this age group due to technical failures and/or -dentally-related complications such as caries. The high number of crowns and fixed dentures in the 50–79-year-olds may also be a product of the national dental insurance reimbursements which has favored extensive prosthetic constructions. The national dental insurance may also be the cause to the low frequency of removable dentures since the insurance made fixed partial dentures and regular dental care affordable for a larger number of individuals.

The frequency of apical destructions increased with age in the studied population. The same was found in a Danish population in 2001 [25]. Hugosson and Koch [2] found the percentage of root-filled teeth with periapical or juxtaradicular destructions to be 7.7–33.3% between the different age groups. This increase with age can also be explained by a longer exposure time to dental disease, various dental treatments and attrition. These are all factors which increase the risk of pulpal damage and infection [25].

The marginal bone loss measures previous periodontal illness, while the depth of the periodontal pockets describes an ongoing periodontal or marginal illness. The pocket depth and the marginal bone loss did increase with age. These findings can be explained by the natural course of exposure of the patient to the factors that are destructive to the periodontium, such as infection, smoking, etc. However, periodontitis is a disease with a slow progression rate in most individuals.

Gender

There were no differences between the genders regarding any of the clinical findings. This finding was surprising as several studies report differences between the genders regarding oral health. Lukacs and Largaespada [26] described that women are

usually found to exhibit higher caries prevalence rates than men and that this finding generally holds true for diverse cultures and time periods. Concerning marginal bone loss, Norderyd et al. [16] found female gender to be a risk factor for severe marginal bone loss in a longitudinal study of a Swedish population. However, there was no difference between the genders in a Danish study [27]. Artificial crowns have in previous studies also been found to be more common in women than in men [28,29]. In terms of general health, there is a tendency towards an equal health status between men and women in Sweden [11] and this tendency was clearly observed in this study regarding the oral health.

Ethnicity

An interview study conducted in 1996 found that members of ethnic minorities in Sweden have less access to dental care despite having a greater need for oral treatment than other residents of Sweden [13]. These findings are in agreement with this study where those born in a country other than Sweden had lost more teeth, had worse periodontal conditions and had more apical destructions.

In Sweden, extractions of teeth are rare unless the teeth have a bad prognosis; the exception being when the patient's economy does not allow for the more expensive alternatives such as root fillings and dental crowns. This might be one explanation to why those who were born abroad had lost more teeth. Hjernand and Grindeford [13] found irregular visiting patterns in individuals not born in Sweden. Bad periodontal conditions and presence of apical destructions can in part be explained by irregular visiting patterns to the dentist or dental hygienist.

Studies of adolescents in Sweden describe an equal prevalence of manifest caries in individuals born in Sweden and those born abroad [30,31]. A difference in marginal bone loss was found and the adolescents born in another country than Sweden had a higher percentage of bone loss [30].

Educational level

Other studies have found that caries prevalence is linked to the educational level, e.g. Paulander et al. [32] found caries prevalence and the DMFT to be significantly higher among those with a lower educational level. Several authors report a worse periodontal status among those with a lower education level, e.g. Siukosaari et al. [33] and Borrell and Crawford [15]. Apical destructions were not found to be associated with educational level in a previous Danish study [34]. The Danish study, however, was an analytic study where other factors such as clinical findings and dental visiting patterns were found to have a greater impact on the prevalence of apical

periodontitis than educational level. The present study only describes associations found after bivariate analyses. A review article on the prevalence of prosthetic restorations in Europe [35] found the prevalence of fixed prosthetic restorations to be more common among individuals with a higher education level, as were not the case in this study.

Conclusions

The oral health in the adult population of Skåne was overall good with low frequencies of oral diseases and a large number of remaining teeth up to a high age.

All of the clinical findings showed significant differences in occurrence due to age, except the frequency of caries. Higher age gave a higher prevalence and severity of oral diseases and more dental restorations. There were no significant differences between the genders regarding any of the clinical findings. Individuals with a lower educational level were missing more teeth, had more caries lesions and had worse periodontal conditions and a higher DMFT. Individuals not born in Sweden were missing more teeth, had worse periodontal conditions, more apical destructions and had received less dental fillings than those born in Sweden.

The hypothesis that a worse clinical situation and thus a higher oral treatment need would be found in older females, individuals born abroad and those with a lower education level was partially found to be true. The clinical variables were worse in individuals of a higher age, born abroad and with a lower education; however, women's oral health, measured clinically, was no worse than men's.

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