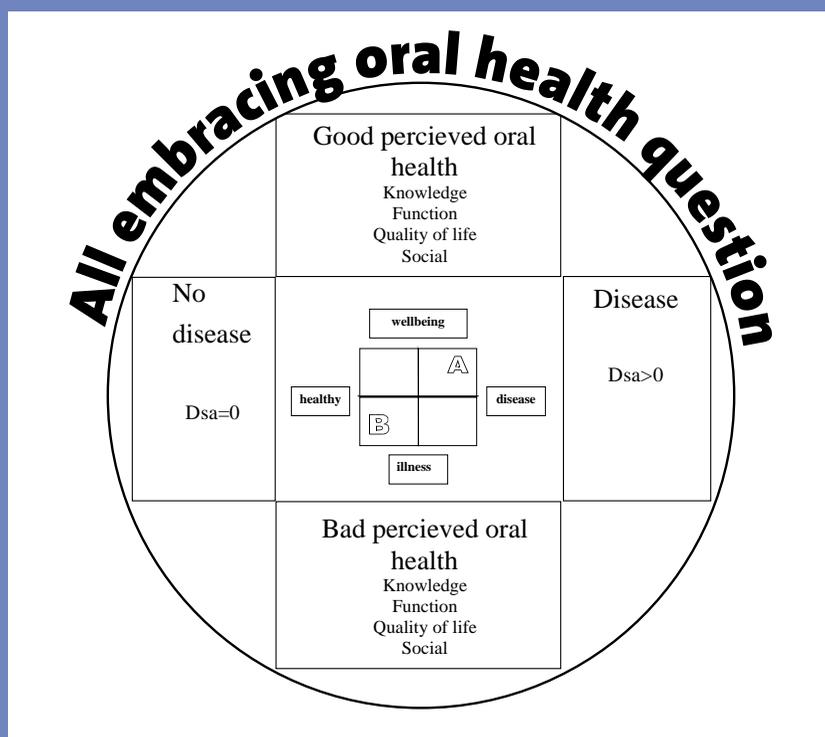


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Conceptual model of oral health

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Introduction

Swedish Dental Journal, the scientific journal of The Swedish Dental Association and the Swedish Dental Society, is published 4 times a year to promote practice, education and research within odontology. Manuscripts containing original research are accepted for consideration if neither the article nor any part of its essential substance has been or will be published elsewhere. Reviews (after consultations with the editors), Case Reports and Short Communications will also be considered for publication. All manuscript will be exposed to a referee process.

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Effect of Pilocarpine on impaired salivary secretion in patients with Sjögren's Syndrome

LARS JORKJEND¹, AXEL BERGENHOLTZ², ANN-KATRIN JOHANSSON³, ANDERS JOHANSSON⁴

Abstract

© The aim of this study was to analyze resting whole saliva (RWS) and stimulated whole saliva (SWS) flow rates before and after administration of Pilocarpine in secondary Sjögren's Syndrome patients. Fifty-one patients (49 women, 2 men, mean age 61 years, range 38-85), all with a resting saliva ≤ 0.1 ml/min, participated. Volumes of RWS and SWS collected over periods of 15 and 5 min, respectively, using standardized protocols were measured and the same procedure was repeated after oral administration of Pilocarpine (0.7 mg per 10 kg body weight). The sample was then divided into two groups, according to those in whom Pilocarpine stimulation had caused RWS flow to reach >0.1 ml/min (responders) and those who remained at values ≤ 0.1 ml/min (non-responders). All participants completed a questionnaire related to general and oral health status, as well as their subjective intraoral complaints before and after administration of Pilocarpine. Thirteen patients (25%) were classified as non-responders and the remaining 38 (75%) as responders. No statistically significant differences between the non-responders and responders were detected as regards general health parameters or intake of medicines with anti-cholinergic affect. As regards intraoral subjective complaints, no difference between the groups was found before Pilocarpine administration. After administration of Pilocarpine, complaints were significantly fewer among the responders ($p < 0.01$). Both groups exhibited a significant decrease of intraoral symptoms after administration of Pilocarpine (responders $P < 0.001$ and non-responders $P < 0.05$) compared to baseline. For the whole group, more severe intraoral complaints were significantly associated with a lower SWS ($P < 0.05$), but not a RWS, rate at baseline. It is concluded that a subgroup of Sjögren patients do not respond to Pilocarpine stimulation. The clinical implications of this finding need further investigation.

Key words

Pilocarpine, salivation, Sjögren's syndrome

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Effekt av Pilokarpin på nedsatt salivsekretion hos patienter med Sjögrens Syndrom

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Sammanfattning

© Målsättningen med studien var att analysera mängden av ostimulerad helsaliv (RWS) och stimulerad helsaliv (SWS) före och efter administrering av Pilokarpin hos patienter med sekundärt Sjögrens syndrom. Studien omfattade 51 patienter (49 kvinnor, 2 män, medelålder 61 år, range 38–85) som alla uppvisade en violsaliv ≤ 0.1 ml/min. Vid baslinjeundersökningen mättes RWS och SWS under 15 respektive 5 minuter enligt standardiserat protokoll. Detta upprepades efter oral administrering av Pilokarpin (0,7 mg per 10 kg kroppsvikt). Patienterna uppdelades därefter i två grupper: 1) de som efter Pilokarpinstimulering uppnådde en RWS på >0.1 ml/min (responders) och 2) de som kvarstod på ≤ 0.1 ml/min (non-responders). Deltagarna i studien fyllde i ett frågeformulär relaterat till allmän och oral hälsa. Dessutom noterades förekomst av intraorala subjektiva besvär före och efter Pilokarpin. Tretton patienter (25%) klassificerade som non-responders och de återstående 38 som responders. Inga statistiskt signifikanta skillnader mellan non-responders och responders upptäcktes avseende allmän hälsa och medicinintag med anti-kolinergisk effekt. Avseende förekomst av intraorala besvär noterades inga skillnader mellan grupperna före administrering av pilokarpin medan responders upplevde signifikant mindre besvär efter administrering av pilokarpin. Båda grupperna upplevde intraindividuell signifikant mindre besvär efter administrering av Pilokarpin jämfört med baslinjeundersökningen (responders $P < 0.001$ och non-responders $P < 0.05$). För hela gruppen var ökade intraorala besvär korrelerade till en mindre mängd av SWS vid baslinjeundersökningen. Konklusionen från denna studie är att en subgrupp av patienter med Sjögrens syndrom inte svarar på Pilokarpinstimulering. Det behövs ytterliga studier för att utvärdera den kliniska signifikansen av detta fynd.

Introduction

Sjögren's syndrome (SS) is an autoimmune disease with unknown aetiology (9). Henrik Sjögren described the disease as being characterised by xerostomia, kerato-conjunctivitis sicca with focal adenitis, and rheumatoid arthritis (26, 27). SS is further subdivided into primary SS (pSS) with only glandular involvement and secondary SS (sSS) with connective tissue disease such as rheumatoid arthritis, systemic lupus erythematosus, progressive systemic sclerosis and dermatomyositis (2). The exact mechanisms underlying the disease are not fully understood. Neither is it established why some subgroups of SS patients develop a more severe progression of the disease than others, including a greater impairment of saliva secretion (11).

The term xerostomia expresses a subjective feeling of dryness in the oral cavity and is one of the most important and common features in SS patients (7). Hyposalivation denotes a measurable decrease in salivary flow rate. In addition, salivary composition may be altered (19). The three terms are in many respects "interrelated, constituting not merely a dental but also a medical and social concern" (18). It has been suggested that a resting whole saliva flow rate (RWS) of ≤ 0.1 ml/min is highly specific for hyposalivation. Symptoms of mild dry mouth have been found to be correlated with a decreased RWS flow rate, and a more severe feeling of dry mouth with both decreased RWS and stimulated whole saliva (SWS) flow rates (31). It has also been postulated that measurement of RWS by standardized methods is a suitable method to use in diagnosing the oral component of Sjögren's syndrome (28). It has been concluded that RWS is the individually-specific diagnostic salivary marker of choice, and that xerostomia is more predictive of hyposalivation on a group basis (17).

Xerostomia is related to several dental disorders such as progressive dental caries and erosion, burning mouth syndrome as well as problems in chewing and swallowing (8). With this background, Norway and Sweden started subsidizing dental care for patients with Sjögren's syndrome in 1991. Qualification for the subsidy was based upon confirmation of a diagnosis of SS and demonstration of impaired salivary secretion (RWS < 0.1 ml/min and < 0.7 ml/min SWS) (15). Earlier studies have shown SS patients to have variability in flow rate over time, indicating a need for the rules for evaluating salivary gland function to be refined (13).

The response to Pilocarpine requires residual functional salivary gland tissue (20). Pilocarpine has previously been used to assess salivary gland function by allocating SS patients into responders or non-responders (25). It has also been shown that an increased salivary response to Pilocarpine can predict a positive treatment outcome for acupuncture in dry mouth patients (3).

The aim of the present study was to analyze RWS and SWS flow rates before and after administration of Pilocarpine in sSS patients in order to identify individuals with pronounced impairment of salivary secretion.

Material and methods

Patients

Fifty-six dry mouth patients diagnosed with sSS (54 women and 2 men) were initially selected for the study. Of these, 30 had participated in another investigation by the same authors (12), and the additional 26 patients were randomly selected from a list of 170 sSS patients referred to a private dental specialist practice in Skien, southern Norway, and examined by one of the authors (LJ) concerning signs and symptoms related to sSS. Patients who were suffering from asthma, glaucoma, or iridocyclitis, or were pregnant or using β -blockers were excluded from the study (1,22). As a result of the exclusion criteria, 1 patient was excluded because of asthma, and 4 more patients had a RWS of > 0.1 ml/min and were therefore also excluded from analyses of the data. Fifty-one patients comprised the study group (49 women, 2 men, mean age 61 years, range 38-85, SD 9.2).

In addition, 10 healthy patients (8 women and 2 men, mean age 63 years, range 31-74) were selected from the same dental practice as controls.

Diagnosis of sSS

All patients fulfilled the clinical criteria for sSS and underwent biopsies of minor labial salivary glands through healthy labial mucosa on the left side. The specimens were sent to the Faculty of Dentistry, University of Oslo, Norway for histopathological analyses and all patients satisfied the criteria for sSS.

Stimulation of salivary secretion with Pilocarpine

Pilocarpine hydrochloride was prepared by Rikshospitalets Apotek, Oslo, Norway, and stored airtight in dark capped vials in the refrigerator prior to administration. Durability was 60 days if stored below

25 C° (5). In case of adverse reactions, atropine sulfate was kept available throughout the investigation as an antidote to Pilocarpine.

The patients and controls were instructed to abstain from consumption of alcohol, tobacco or any sort of drink or food two hours prior to the investigation. The investigation took place between 09.00 hrs and 11.00 hrs at the private dental clinic (LJ). The test began by evaluating the RWS rate over a period of 15 mins, followed by collection of paraffin wax stimulated saliva over a period of 5 min (1,22). The patients were then given oral Pilocarpine dissolved in 20 ml water (0.7 mg Pilocarpine per 10 kg body weight) and asked to rest for 45 min before the salivary flow tests were repeated. On the basis of Pilocarpine stimulating a RWS flow of >0.1 ml/min (responders) or not (\leq 0.1 ml/min, non-responders), the sample was divided into two groups.

Questionnaire

All participants responded to a questionnaire comprising questions about general and oral health. Intake of medicines known to reduce salivation was noted. In addition, subjective intraoral complaints were graded before and after Pilocarpine administration using an ordinal scale: no complaints, minor, moderate, severe and very severe complaints. No distinction between different types of complaints was made. Complaints were defined, for example, as having symptoms of a subjective feeling of being unwell, dryness of the mouth, burning mouth, or problems with swallowing.

After the administration of Pilocarpine, any adverse reactions, such as feeling cold or warm, difficulty with breathing, sweating, headache, nausea, flushing, etc., were recorded.

All patients were given written and verbal information about the study including possible side effects of Pilocarpine as well as the right to terminate their participation in the study at any time. All patients were covered by dental insurance. The study was approved by the Norwegian Social Science Data Services, The Norwegian Medicines Agency, and The Ethical Committee for Medical Research, Region South.

Statistical analysis

Differences between groups (Sjögren's patients vs. controls and non-responders vs. responders) were analyzed by Mann Whitney U-test and Spearman correlation using the Statistical Package for the Social Sciences (SPSS ver. 15, Chicago, IL, USA). $P < 0.05$ was considered statistically significant.

Results

Mean volumes of RWS and SWS collected before and after Pilocarpine stimulation for patient and control groups are shown in Table 1. RWS and SWS before and after Pilocarpine were each significantly higher in the controls than the study group ($p < 0.01$). The increase in secretion rates after Pilocarpine compared to baseline was significantly greater in the controls for RWS ($p < 0.01$) but not for SWS.

© Table 1. RWS and SWS at baseline and after administration of Pilocarpine in Sjögren patients (n=51) and controls (n=10).

Group	n	RWS		SWS		
		mean ml/min	SD	mean ml/min	SD	
Sjögren	Baseline	51	0.03	0.03	0.96	0.68
	Pilocarpine	51	0.36	0.32	1.20	0.71
Controls	Baseline	10	0.35	0.27	2.16	0.98
	Pilocarpine	10	1.13	0.47	2.39	1.05

Thirteen patients (25%) were classified as non-responders on the basis that their RWS flow did not exceed 0.1 ml/min following Pilocarpine administration. The remaining 38 were responders, showing RWS flow of > 0.1 ml/min after Pilocarpine administration. Table 2 shows the significant positive correlation between baseline and Pilocarpine-stimulated secretion rates.

© Table 2. Correlation coefficient (Spearman's rho) between baseline and after Pilocarpine administration for RWS and SWS secretion rates (ml/min). * $p > 0.05$; ** $p > 0.01$

		Baseline RWS	Baseline SWS
Pilocarpine RWS	Coefficient	0.44	0.41
	p	**	**
	N	51	51
Pilocarpine SWS	Coefficient	0.33	0.76
	p	*	**
	N	51	51

Table 3 shows RWS and SWS flow at baseline and following Pilocarpine administration for the non-responder and responder sub-groups. No differences between non-responders and responders were noted as regards general health parameters. With regard to intraoral complaints, there were no differences between the groups before Pilocarpine administration, but there were differences after ($p > 0.01$, Table 4). At an individual level, however, both groups exhibited a significant decrease in intraoral symptoms after Pilocarpine administration (non-responders $P < 0.05$,

© **Table 3.** RWS and SWS at baseline and after Pilocarpine administration for responder and non-responder sub-groups.

Group	n	RWS			SWS			
		mean ml/min	Range	SD	mean ml/min	Range	SD	
Responders	Baseline	38	0.04	0.00-0.10	0.03	1.04	0.08-3.60	0.71
	Pilocarpine	38	0.47	0.16-1.56	0.30	1.35	0.14-3.30	0.68
Non-responders	Baseline	13	0.01	0.00-0.03	0.01	0.70	0.20-1.96	0.53
	Pilocarpine	13	0.04	0.00-0.10	0.03	0.78	0.15-2.20	0.67

© **Table 4.** Answers to the question "do you experience intraoral complaints" before and after administration of Pilocarpine among responders (n=38) and non-responders (n=13). ** p<0.01

		Before		After	
		n	%	n	%
Responders	No complaints	1	2.6	22	57.9
	Some complaints	7	18.4	8	21.1
	Moderate complaints	9	23.7	7	18.4
	Severe complaints	14	36.8	0	0
	Very severe complaints	7	18.4	1	2.6
			NS		**
Non-responders	No complaints	0	0	1	7.7
	Some complaints	2	15.4	4	30.8
	Moderate complaints	2	15.4	6	46.2
	Severe complaints	4	30.8	0	0
	Very severe complaints	5	38.5	2	15.4

responders $P<0.001$). For the whole patient group, increased severity of intraoral complaints was significantly correlated with a lower SWS baseline value ($P<0.05$), but this was not the case for a lower RWS value.

No correlation could be observed between intake of medicines with anti-cholinergic effect and salivary parameters before or after Pilocarpine. Neither did the total number of medicines taken or tobacco usage show any correlation with salivary secretion.

Minor adverse reactions, such as a warm or cold feeling, and occasional sweating, after administration of Pilocarpine were reported by 45% of the patients. One patient reported difficulty with breathing, but this disappeared within a short period of time and atropine administration was not necessary. The reason for the reaction was probably that the patient had asthma but had not informed us about this, even though he had specifically been asked about this. The patient was excluded from the study.

Discussion

Sjögren's syndrome is considered to be the most common of the chronic systemic inflammatory connective tissue diseases. Even though no fewer than nine different sets of classification criteria for the

disease have been introduced over the past decades, confusion about classification criteria still exists (16). SS affects women 9 times as frequently as men and the majority of patients are over 50 years of age (7). A similar pattern was noticed in the present study, where 54 of the 56 individuals in the original sample were women and the mean age was 61 years.

According to the European SS criteria, salivary secretion rate for RWS is defined as ≤ 1.5 ml in 15 minutes (i.e. ≤ 0.1 ml/min) (29). In the present material, 5 patients did not meet this defined pathologic level for RWS and were excluded from further analyses.

Dry mouth may cause difficulty in swallowing food, inability to speak continuously for any length of time, a burning sensation, and an increase in dental caries experience (8), as well as an increased risk for dental erosion (14). Since one of the cardinal features of SS is xerostomia, characterised by a subjective feeling of dryness of the mouth, it is important to evaluate the significance of increased RWS and SWS flow rate to an affected individual's functional comfort. The most common cause of xerostomia is reduced production of saliva, but the correlation is not clear since a reduction of salivary production and a perceived feeling of dry mouth are not synonymous. In our study, increased severity of intrao-

ral complaints was associated with a lower baseline SWS, but not a lower baseline RWS. It seems, therefore, that the ability to produce SWS could be an important factor in influencing subjective feelings of intraoral discomfort. Administration of Pilocarpine decreased the intraoral symptoms significantly more in the responder group compared to the non-responders, indicating that the productive ability of the salivary glands is essential for a reduction of intraoral complaints.

A common cause of reduced salivary production and dry mouth is intake of medications (18). In the present study, medications with anti-cholinergic effect or the total number of medicines used, showed no association with salivary parameters. It would seem, therefore, that it is more likely the disease itself, rather than the medication, that is responsible for the reduced salivary secretion. This could be an important finding in relation to the discussion about a system of subsidized dental care that is based on low salivary secretion rate and its possible interaction with anti-cholinergic medications.

Adverse effects after Pilocarpine administration may occur, e.g. sweating, headache, nausea, mild abdominal pain, rhinitis, flushing, increased lacrimation and palpitations (30). The number of adverse side effects in our sample was unexpectedly high (45%). On the other hand, the reactions were generally mild, and only in one patient was it considered serious. This contrasts with the findings of Rosas et al. who observed minor side-effects after Pilocarpine in only 3% of patients with sSS (25). In the latter study, a 5% Pilocarpine ophthalmic solution (0.1 ml = 5 mg) administered sublingually, as opposed to the tablet form taken orally first described by Rhodus and Schuh (23), was used. Several reports have described the use of Pilocarpine in various doses and routes of administration (6,21,24,30). In these studies, the same amount (5 mg) of Pilocarpine was administered irrespective of the patient's body weight, which is in contrast to our study where 0.7 mg per 10 kg body weight (corresponding to 4.9 mg Pilocarpine for a person of 70 kg) was administered. The high frequency of adverse effects in our study may have been due to the oral administration of Pilocarpine in water solution, giving a more rapid absorption.

Clinical experience to date suggests that Pilocarpine is safe and well-tolerated, with minimal serious side effects, tachyphylaxis, or drug-to-drug interactions of concern, if used with the aforementioned considerations (1). Even then, Pilocarpine should be used with caution.

Based on earlier results (13), salivary tests to be used as a diagnostic aid for SS diagnosis must be conducted on several occasions in order to give more accurate information about salivary gland function. It has been suggested that at least two of three tests should be equal or less than the stipulated values for RWS (0.1 ml/min) and SWS (0.7 ml/min) in order to validate presence of hyposalivation. For this reason, the regulations governing qualification of a SS patient for subsidized dental care in Sweden and Norway were suggested to be revised (13). In the present study, secretion rate was only measured on one occasion which contradicts to the above statement. However, as the purpose here was to study the response to Pilocarpine, it was not deemed necessary to perform repeated salivary tests, since a single measurement would probably detect those who do or do not respond to Pilocarpine.

Our results also indicate that, within the group of sSS patients with a documented low salivary secretion rate, there were 13 (25%) patients who appear to have an absence of residual functional salivary gland tissue. This finding can be compared to another study using Pilocarpine administration in pSS with low salivary secretion (≤ 0.1 ml/min) where non-responders amounted to almost 50%. In the same study, it was also shown that the non-responders had a longer duration of sicca syndrome evolution with more severe involvement of the salivary glands (25). In our study, only sSS were included, from which it could be inferred that pSS has a higher severity of salivary impairment.

Lymphoid organizations in the form of ectopic germinal centers (GC) have been detected in 33 of 130 (25%) consecutive minor salivary gland biopsies in patients suffering from pSS (10). GC occurs in a subgroup of SS patients and is characterized by local autoantibody production, progressive disease and increased Serum IgG. In addition, it has been shown that unstimulated saliva secretion is reduced in pSS patients in whom ectopic germinal centers are present (11). As the presence of GC is related to a lower salivary secretion, it could be speculated that the 25% non-responders in this study can in some ways be likened to those 25% forming GC. Thus, the 25% non-responders may have a higher risk of intraoral diseases and complaints than a "normal" (responder) sSS patient.

It is important that the diagnostic tests and features characterizing SS are further refined and universally standardized. For example, the results of a previous study would seem to question whether

the volume of rest saliva can be regarded among the reliable tests for SS diagnosis. Pilocarpine may well be used as a therapeutic measure for Sjögren's syndrome, but not as a diagnostic tool per se. However, in combination with measurement of salivary flow rates and lip glandular biopsies, administration of Pilocarpine could be used as an adjunctive tool to detect more severe salivary impairment. However, we tend to agree with Daniels & Whitcher (4) who suggest that focal lymphocytic sialadenitis is "the best criterion presently available for diagnosing the salivary component of Sjögren's syndrome".

In conclusion, in addition to our earlier proposal about repeated measurement of salivary flow (13), an additional Pilocarpine test could be carried out for the purpose of defining a patient's level of affliction with Sjögren's Syndrome. Such a measure could detect with a high degree of validity reduced salivary function in a subset of patients with Sjögren's syndrome and even more refine the type of preventive and dental management of patients with Sjögren's syndrome. This preliminary hypothesis must, however, be further tested.

Acknowledgment

On behalf of the late Professor Axel Bergenholtz, the authors wish to thank Professor Ridwaan Omar, Kuwait University, for his helpful comments and editorial assistance with this work. We regard this work as a small posthumous tribute to our very dear colleague and friend, Professor Bergenholtz, and we know that Professor Omar fully joins us in this.

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Thirty year trends in the prevalence and distribution of dental caries in Swedish adults (1973–2003)

ANDERS HUGOSON¹, GÖRAN KOCH²

Abstract

© The aim of the present investigation is to report on the trends in the prevalence and severity of dental caries and dental status in an adult Swedish population over a 30-year period (1973–2003). Four cross-sectional epidemiological studies in 1973, 1983, 1993, and 2003 were performed in Jönköping, Sweden. A random sample of individuals aged 20, 30, 40, 50, 60, 70, and 80 years were examined clinically and radiographically, a total of 2521 individuals. Diagnostic variables were edentulousness, number of teeth, initial and manifest caries lesions, restorations, fissure sealants, and quality of restorations (secondary caries and overhangs). The percentage of edentulous 40- to 70-year-old individuals decreased during the 30-year period from 16% to 1%. The distribution of individuals by DFS in the age groups 20–50 years showed a gradual shift towards a positively skewed distribution between the years 1973 to 2003. There was a steady decrease in mean number of DFS in the age groups 20–50 years. In the 20-year-olds the mean number of DFS decreased by 72% and for 50-year-olds, by 37%. In conclusion there has been a marked decrease in DFS in adults up to middle age and a marked reduction in edentulousness over a thirty year period. This shows that the decrease in caries levels in children and adolescents is also occurring among adults.

Key words

Dental caries, dental health, dental status, adults, trends

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Kariesförekomst hos vuxna i ett 30-årsperspektiv (1973–2003)

ANDERS HUGOSON, GÖRAN KOCH

Sammanfattning

© Föreliggande studie presenterar en ingående analys av förekomst och fördelning av karies i en vuxen svensk population under en 30-årsperiod (1973–2003). Fyra epidemiologiska tvärsnittundersökningar utfördes 1973, 1983, 1993 och 2003 i Jönköping. Materialet bestod av slumpvist utvalda individer i åldersgrupperna 20, 30, 40, 50, 60, 70 och 80 år; totalt 2 521 individer. Diagnostiska variabler var: tandlöshet, antal tänder, initial och manifest karies, fyllningar, fissurförseglingar och fyllningskvalitet (sekundära kariesskador och fyllningsöverskott). Antalet tandlösa minskade dramatiskt under 30-årsperioden: för åldersgrupperna 40–70 år från 16 % till 1 %. Medeltalet DFS minskade i åldersgruppen 20–50 år, för 20-åringar med 72 % och för 50-åringar med 37 %. Fördelningen av individer med avseende på DFS uppvisade en ökande positiv skevhet inom respektive åldersgrupp 20–50 år över tid. Sammanfattningsvis kan konstateras att samma trend avseende minskning av kariesförekomst som iakttagits bland barn och ungdomar också föreligger hos vuxna.

Introduction

The prevalence of oral diseases, and particularly dental caries, has changed markedly during the last 50 years. Nevertheless, the WHO concluded that dental caries is still a major problem in most countries, affecting 60–90% of schoolchildren and the vast majority of adults (19). However, whilst the epidemiological data showing the worldwide decrease in caries prevalence are very impressive for children and adolescents (1, 7, 15, 20), there are few reliable data for the adult population to substantiate the conclusion by the WHO. In addition, it has also been questioned whether the reduction of caries in younger ages will just mean a postponement of caries to older ages. To evaluate this assumption epidemiological studies on caries prevalence in adults over time are needed. Unfortunately, there are few contemporary sound studies that can be used to analyse the trends in caries development in adults. There was a marked decrease in DMFT among 20-year-old Swiss military recruits from 16.0 in 1970 to 4.8 in 1996 (17). On the other hand, a Norwegian study showed that there was an increase in DMFT between the ages 67–74 years and 75–84 years (4). *Crossner & Unell* (3) followed a Swedish cohort of individuals from 14 to 41 years of age. They found a very small increase of about 1.2 DMFT between 19 to 41 years of age for the total period. The prevalence and distribution of caries in 20–80-year-olds in Jönköping, Sweden over a 20-year period (1973–1993) has been reported earlier (8). This comprehensive cross-sectional study of random sample individuals of the adult population was conducted to portray the oral health status of these age groups over time. In this study, among others, a marked decrease was found in proximal DFS in 20–50-year-olds in 1993 compared to 1973. This is one of the few investigations presenting caries prevalence data in adults over time. Concurrently with this study, starting in 1973,

a preventive dental care programme (10) and continuing education and training of dental care professionals was initiated and implemented (12).

In 2003 a new study with the same age groups and diagnostic criteria was performed and a summary of the results on oral health and related factors have been published (5, 6). The aim of the present investigation is to report on the trends in the prevalence and severity of dental caries and dental status in an adult Swedish population over a 30-year period (1973–2003).

Material and methods

In 1973, a randomly selected sample of 600 individuals, 100 in each of the age groups 20, 30, 40, 50, 60, and 70 years, from four parishes in the City of Jönköping, Sweden, were examined clinically and radiographically to record edentulousness, removable dentures, implants, number of teeth, caries, restorations, quality of restorations (secondary caries and overhangs), oral hygiene, calculus, periodontal status, endodontic treatment, and periapical status. In addition to the clinical examinations, the individuals were asked about dental health care habits and knowledge of oral health. The sample was chosen based on date of birth (between March and May) and all subjects in each age group were listed in a chronological order so that each age group consisted of 140–170 individuals. The first individual on each list was invited to the examination and then the second and so on. In the event of non-attendance, the next individual on the list was invited until 100 participants in each age group was obtained. A total of 600 individuals were examined (10).

In 1983, 1993 and 2003 new random samples of individuals in the same age groups and the same four parishes were examined. Those samples included 80-year-olds. The samples consisted of 130 individuals in each of the age groups. Not all of the selected individuals participated in the study. The number of sub-

© **Table 1.** Number of examined subjects and edentulous individuals in the age groups 20–80 years in 1973, 1983, 1993, and 2003

Age group	No. examined				No. edentulous				
	1973	1983	1993	2003	1973	1983	1993	2003	
20	100	100	100	84					
30	100	98	102	92					
40	100	99	93	83	1				
50	100	103	97	91	5	4			
60	100	98	92	90	20	14	9	4	
70	100	99	100	88	37	29	23	1	
80		80	71	61		45	30	2	
Total	600	677	655	589	40–70 years	63	47	32	5
					80 years		45	30	2

jects are presented in Table 1. All participants were personally invited to take part in the study and informed about examination procedures. In total 677, 655, and 589 individuals were examined in the years 1983, 1993 and 2003 respectively. The reasons for not taking part were recorded.

The numbers of non-respondents were similar in 1973, 1983, and 1993, and ranged from 9–21% of those invited to participate. In 2003 29–36% of those asked to participate in each of the age groups 20–70 years declined to participate for various reasons. Among 80-year-olds, the percentage of non-respondents was 53%. Detailed information about number of non-respondents and reasons for not taking part in 1973, 1983, 1993, and 2003 have been published (5).

Clinical and radiographic examination

The clinical examinations were carried out by six calibrated dentists in dental surgeries with access to excellent dental equipment and optimal lighting. The radiographic examination was carried out using both extra- and intra-oral radiographs. In 1973 and 1983, full mouth intra-oral examinations were performed and consisted in 1973 of 16 periapical and 4 posterior bitewing radiographs (6 mA, 60–65 kV, exposure time 0.4–0.6 sec). The 1983 examination included also an orthopantomogram (7 mA, 60 kV, exposure time 18 sec.). Due to improved oral health and ethical considerations, the radiographic examination was then changed compared to previous studies in this series (6). In 1993, the same procedure was performed on all age groups except for the 20- and 30-year-olds whose intra-oral examination consisted of six bite-wing radiographs, two frontal and two each on the left and right sides and an orthopantomogram. In 2003, the radiographic examination in 20-, 30-, and 40-year-olds, consisted of an orthopantomogram and six bite-wing radiographs.. For the age groups 50 years and older, an orthopantomogram and a full-mouth, intra-oral radiographic examination including 16 periapical and 4 bite-wing radiographs was performed in dentate individuals. The radiographs were mounted in frames or masked and subsequently examined using a pair of observation binoculars using Mattson's criteria (16). When deep caries or root-filled teeth were observed on the orthopantomogram, an additional periapical radiographic examination was performed.

Diagnostic criteria

The prevalence of edentulous individuals and existing teeth were recorded with the exclusion

of the third molars.

Caries. All tooth surfaces were examined for caries according to the criteria described previously (13). They were: Initial caries: loss of mineral in the enamel causing chalky appearance but not clinically classified as a cavity. Manifest caries: carious lesions on previously unrestored surfaces that could be verified as cavities by probing and in which, on probing in fissures using light pressure, the probe stuck. Secondary caries: carious lesions according to the criteria for manifest caries but adjacent to restored tooth surfaces. In addition to clinical criteria the following criteria were used for detecting carious lesions radiographically on the proximal tooth surfaces not accessible for clinical examination. Caries was recorded when there was clearly defined reductions in mineral content as follows: Initial caries: a) the lesion was not deeper than 2/3 of the enamel or b) the lesion was deeper than 2/3 of the enamel but did not involve the dentine. Manifest caries: the lesion extended into the dentine. Secondary caries: carious lesions according to the criteria for manifest caries but on restored tooth surfaces.

In this paper, the term caries refers to the sum of initial and manifest lesions, unless otherwise stated.

Restorations. For each tooth surface, the presence of any of the following materials was also recorded: amalgam, silicate, glass ionomer, cement or composite material, gold inlays, or metal or porcelain crowns. Defective marginal adaptation of restorations (overhangs) were recorded from radiographs using a magnifier when there was an overhang on the proximal tooth surfaces. Overhangs were recorded as none, less than 0.4 mm and 0.4 mm or more.

Fissure sealants. The presence of fissure sealants on occlusal surfaces in permanent teeth were recorded.

Decayed and filled primary and permanent tooth surfaces. The number of decayed and filled permanent tooth surfaces (DFS) was calculated.

Ethical considerations

Throughout the study, the ethical rules for research described in the Helsinki Declaration were followed. The study was approved in 2003 by the Ethical Committee at the University of Linköping, Linköping, Sweden.

Data processing and methodological analysis

A computerized dental record system was used to compile a database for the study. The data were analysed using SPSS (version 13.0, SPSS Inc., Chi-

ago, IL, USA), and frequencies, mean values, and distributions were calculated. Before the 2003 study commenced, the examiners were calibrated in the methods used in the study by the two senior examiners, who had been involved in the earlier studies. Radiographs of 140 individuals from the 1983, 1993, and 2003 examinations were selected from the database by a statistician, representing 7840 proximal tooth surfaces that were healthy, carious, or filled. The radiographs from these individuals were examined by about 10 different examiners and re-examined by the two senior examiners. The tooth surfaces were diagnosed according to the criteria listed above. Agreement between the original examinations and the re-examinations was statistically significant. The Cohen's kappa value was 0.57 for 2003 and 0.79 for 1983 and 1993 (14). Comparisons of differences between the years for the respective age groups are expressed as mean values and 95% confidence intervals ($p < 0.05$) for number of teeth and number of DS and DFS.

Results

Number of edentulous individuals and number of natural teeth

The number of edentulous individuals in the age groups 40 to 70 years were 63 (16%) in 1973, 47 (12%) in 1983, 32 (8%) in 1993, and 5 (1%) in 2003. Among the 80-year-olds there were 45 (56%) edentulous individuals in 1983, 30 (42%) individuals in 1993, and 2 (3%) in 2003 (Table 1).

The mean numbers of natural teeth are presented in Table 2. There was an increase in the number of teeth in the age groups 40 to 80 years in 2003 compared to 1973, 1983, and 1993. Thus the 70-year age group had a mean of seven more teeth per subject in 2003 than in 1973. Statistically significant differences

were found between 1983 and 2003 for the 40-, 50-, 60-, 70-, and 80-year-olds.

Caries-free individuals (without carious and/or restored tooth surfaces)

In the age group 20 years there were 2% caries-free individuals in 1983, 3% in 1993, and 12% in 2003 respectively. Among 30-year-olds 1% in 1993 and 8% in 2003 were caries-free.

Caries and restorations

Decayed and filled teeth (DFT). For the 20-year-olds the mean number of DFT decreased from 17.3 in 1973 to 5.9 in 2003 (Table 3). There were also decreases in DFT in the age groups 30–50 years but in the 60–80-year-olds the mean number of DFT increased during the study period.

Decayed and filled tooth surfaces (DFS). Decay is the sum of clinically and radiographically verified initial and manifest caries.

The mean number of DFS decreased significantly in 2003 compared to 1973 for 20-year-olds. The reductions were 72% for 20-year-olds, 71% for 30-year-olds, 55% for 40-year-olds and 37% for 50-year-olds (Tables 4, 5).

The number of DFS in the age groups 60 years and older increased in 1993 compared to 1973 and 1983. For example, in the 70-year-old group the number of DFS increased in 1993 by 34% compared to 1983. The increase was statistically significant. After 1993 there was a non-significant decrease. For the 80-year-olds the number of DFS increased significantly between 1993 and 2003 (Table 4).

The distribution of DFS by tooth surfaces for the different age groups is displayed in Figure 1. The numbers of decayed or filled (DFS) occlusal

© **Table 2.** Mean number of teeth and 95% CI in 1983, 1993, and 2003 (excluding edentulous individuals) in the age groups 20–80 years in 1973, 1983, 1993, and 2003.

Age group	Number of teeth							
	1973		1983		1993		2003	
	Mean	Mean	95% CI	Mean	95% CI	Mean	95% CI	
20	27.2	27.4	(27.2–27.6)	27.3	(27.0–27.6)	27.4	(27.1–27.6)	
30	25.8	26.9	(26.6–27.2)	27.3	(27.0–27.6)	27.2	(26.9–27.5)	
40	23.2	24.8	(24.0–25.7)	26.6 *a	(26.2–27.1)	26.5 *b	(25.9–27.0)	
50	21.5	22.7	(21.8–23.7)	24.7 *a	(23.7–25.6)	26.1 *b	(25.5–26.8)	
60	18.2	18.6	(17.2–20.0)	21.7 *a	(20.4–23.0)	23.3 *b	(21.9–24.7)	
70	13.3	15.5	(13.8–17.1)	18.1 *a	(16.6–19.5)	20.7 *b	(19.3–22.0)	
80		13.7	(11.6–15.9)	15.7 *a	(13.4–17.6)	18.4 *b	(16.9–20.0)	

* $p > 0.05$, comparison between 1983 and 1993 (a), 1983 and 2003 (b), respectively

© **Table 3.** Mean number of decayed and filled teeth (DFT) in various age groups in 1973, 1983, 1993, and 2003.

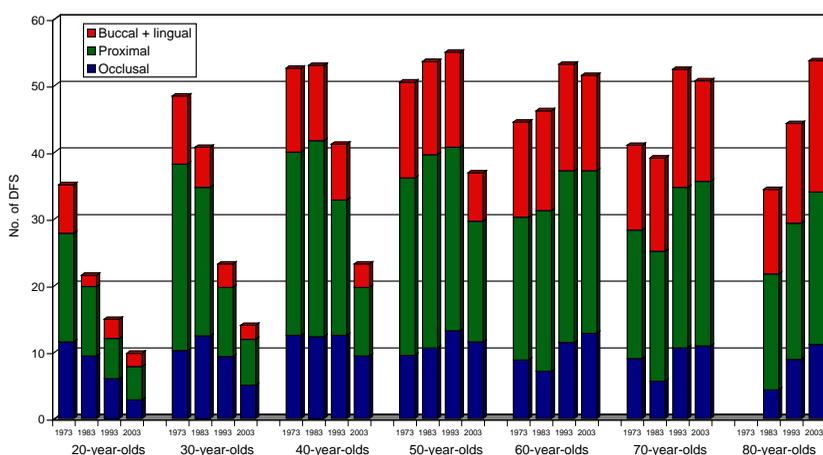
Age group Years	DFT			
	1973	1983	1993	2003
20	17.3	12.1	9.2	5.9
30	18.6	17.5	11.8	7.8
40	18.1	19.2	16.3	11.5
50	16.8	18.3	18.1	15.0
60	13.6	14.7	16.1	17.0
70	10.9	12.8	14.5	15.8
80		10.6	12.3	15.3

© **Table 4.** Mean number of decayed and filled tooth surfaces (DFS) in 1973, 1983, 1993, and 2003. 95% CI is given for 1983, 1993, and 2003.

Age group	Number of DFS							
	1973		1983		1993		2003	
	Mean		Mean	95% CI	Mean	95% CI	Mean	95% CI
20	35.1		21.5	(18.8–24.3)	15.7	(13.5–17.5)*a	9.7	(7.1–12.4)*b,c
30	48.4		40.7	(37.5–44.0)	23.3	(20.5–26.0)*a	14.0	(11.4–16.6)*b,c
40	52.6		53.0	(49.5–56.5)	41.2	(37.4–45.0)*a	23.3	(20.5–26.0)*b,c
50	50.5		53.6	(49.5–57.8)	55.2	(50.1–58.9)	37.0	(33.4–40.5)*b,c
60	44.5		46.2	(41.6–50.8)	53.2	(48.3–58.0)	52.5	(47.4–57.7)
70	41.0		39.1	(34.3–44.0)	52.4	(46.0–57.4)*a	51.0	(46.3–56.1)*b
80	-		34.4	(27.6–41.2)	45.2	(37.7–52.6)*a	53.8	(47.9–59.3)*b,c

* p>0.05, comparison between 1983 and 1993 (a), 1983 and 2003 (b), 1993 and 2003 (c), respectively

© **Figure 1.** Mean number of decayed and filled tooth surfaces (DFS) according to surface type for the different age groups in 1973, 1983, 1993, and 2003



surfaces decreased for 20- and 30-year-olds over the study period. The occlusal DFS was unchanged for the 40- and 50-year-olds and increased for the 60–80-year-olds over the period. The number of DFS proximal decreased for the age groups 20–50 years and was unchanged for 60–80-year-olds. For buccal and lingual DFS there was a decrease for the age groups 20–50 years and an unchanged mean number of DFS surfaces for the age groups 60–80 years.

The number of decayed tooth surfaces (DS) for the age groups 20, 30, and 40 years did not differ significantly over the 30-year-period (Table 5). However for the 50-,60- and 70-year-olds the numbers of DS were lower in 1993 and 2003 compared to 1973 and 1983. There was however an increase in the contribution that DS made to the DFS during the study period for the age groups 20, 30, and 40 years (Figure 2). In the 20-year-olds the percentage of DS proximal out of the total number of DFS proximal in 1973

was about 20% and in 2003 about 70%. The corresponding figures for the 30-year-old were about 5% and 50% respectively. On the other hand, there was a decrease in 2003 in number of filled proximal surfaces in the age group 20-50 years, an unchanged number in the 60-year-olds and an increase in the age groups 70- and 80-year-olds (Figure 2).

There was a steady decrease in percentage of restored tooth surfaces with secondary caries out of the total number of restored surfaces for all age groups between the period 1973 and 2003. In 2003 0.2–2.0% of the restored tooth surfaces had secondary caries compared to 8–12% in 1973.

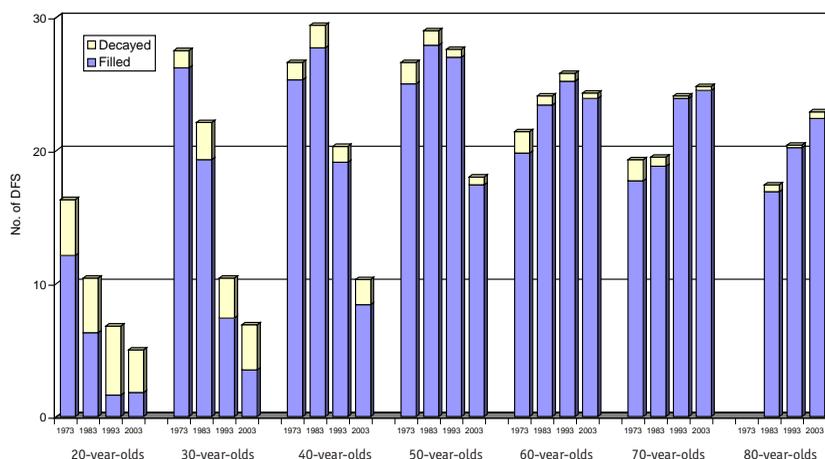
As for overhangs, around 90% of the restored proximal tooth surfaces did not have overhangs in 2003 compared to 50–60% in 1973. Detailed results on overhangs have been presented elsewhere (6).

Table 6 shows the percentage distribution of the proximal initial caries lesions (enamel lesions) out of

© Table 5. Mean number of decayed tooth surfaces (DS) in 1973, 1983, 1993, and 2003. 95% CI is given for 1983, 1993, and 2003.

Age group	Number of DS							
	1973		1983		1993		2003	
	Mean	Mean	95% CI	Mean	95% CI	Mean	95% CI	
20	6.5	4.5	(3.0-6.0)	6.7	(5.3-8.0)	5.2	(3.8-6.5)	
30	1.7	3.3	(2.4-5.7)	3.6	(2.8-4.3)	4.3	(3.1-5.4)	
40	1.9	2.4	(1.7-3.1)	1.5	(1.1-1.9)	2.5	(1.1-4.0)	
50	2.4	1.6	(1.0-2.2)	0.9	(0.5-1.2)	0.8	(0.5-1.2)	
60	7.8	1.3	(0.7-1.9)	0.8	(0.6-1.1)	0.6	(0.2-1.0)	
70	3.2	1.5	(0.7-2.3)	0.4	(0.2-0.6)*a	0.4	(0.1-0.6)*b	
80	-	1.5	(0.6-2.4)	0.6	(0.4-1.6)	1.0	(0.5-1.5)	

* p>0.05, comparison between 1983 and 1993 (a), 1983 and 2003 (b), respectively



© Figure 2. Mean number of decayed and filled proximal tooth surfaces in the different age groups in 1973, 1983, 1993, and 2003.

© **Table 6.** Carious lesions (DS) in proximal tooth surfaces. Percentage enamel lesions of all carious lesion in 1983,1993 and 2003.

Age group	Enamel lesions (%)		
	1983	1993	2003
20	86	82	86
30	69	74	73
40	63	73	79
50	52	68	79
60	31	58	80
70	29	42	88
80	11	0	80

the total number of DS proximal for the age groups 20–80 years for the examinations done in 1983, 1993, and 2003. For the 20- and 30-year-olds there were only minor differences between the examinations in proportion of enamel lesions of 70–85%. For the 40–80-year-olds the percentages of initial caries lesions increased between 1983 and 2003 and reached 80–90 % of the total DS proximal in 2003. This means that about 15–20% of the proximal caries lesions were into dentine.

Figure 3 shows the frequency distribution of individuals according to numbers of DFS for the different age groups. There was a gradual shift towards positively skewed distribution from 1973 to 2003 in the age groups 20–50 years. For the 60–80-year-olds there was a more or less similar distribution at all examinations. In the 70 and 80 years age groups there were polymodal distributions.

Fissure sealants

Fissure sealants were common in 20-year-olds but not in the older groups. In 2003, 72% of 20-year-olds had sealants whereas 34% of 30-year olds and 3% of 40-year-olds had sealants.

Discussion

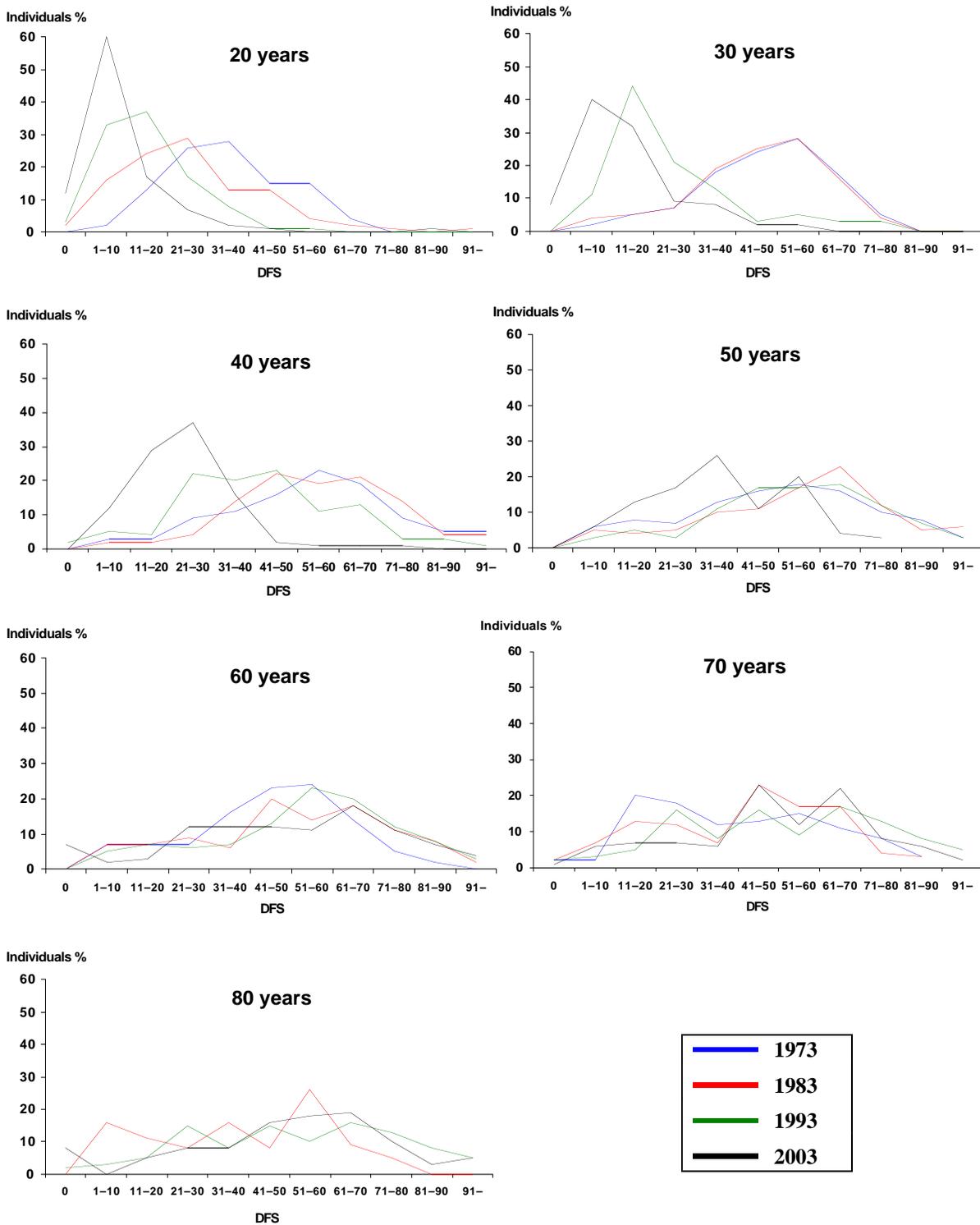
Epidemiology has been a central issue within health care and is an important tool for analysis of a population's health and evaluation of preventive behaviours, care received, and of quality in medical and dental care. An important rationale of the WHO Global Health Data Bank has thus been to provide epidemiological analysis of changing oral health status (18). Unfortunately, the databank does not have data from representative long-term epidemiological studies on dental caries in adults. That makes it difficult to make any reliable estimates of future treatment needs and manpower plans. The present investigation provides such data from a country with

a well organised dental care system. It is based on four separate cross-sectional detailed epidemiological examinations performed at intervals of 10 years and covering a 30-year period. Taken together, the studies can be viewed as a sequential study, which is an accepted method of analysis for this type of epidemiological data and trends over time (21).

The population examined constituted a random sample of individuals aged 20–80 years from Jönköping, a medium-sized town of around 125,000 inhabitants. Most of the individuals were born in Sweden, but about 10% were born abroad. In general, the ethnic compositions of all samples were similar to that of Sweden as a whole during the respective year (5)

The present series of studies show a continuing decrease in prevalence of dental caries in adults and also a general improvement in oral health over 30 years. There was a decreasing percentage of edentulous individuals, increasing number of natural teeth, better oral hygiene, and improved periodontal conditions (9). The improvement clearly shows an age cohort effect indicating that improved oral health in younger age-groups is carried through to better oral health in older ages. The results from the present study concerning edentulous individuals, number of teeth, restorations and caries status, were similar to those found in other epidemiological investigations from different parts of Sweden (2, 22, 23, 24). These findings justify the assumption that data from the present study can be used to draw more general conclusions. In Jönköping, the percentages of edentulous individuals in the older age groups drastically decreased over the 30 year study period. That decrease in levels of edentulousness was reflected in the steady increase in mean number of natural teeth in the age groups 40–80 years over the past 30 years. Because more teeth are at risk of decay it was not surprising to find an increase in the mean number

© **Figure 3.** Frequency distribution of individuals according to number of DFS in the different age groups in 1973, 1983, 1993, and 2003.



of DFS in these age groups. That in turn may lead to a greater need for complex restorative treatment and maintenance due to secondary caries. But in the present study a reduced need for complex restorative dental treatment was found among the young and middle-aged groups as exemplified by the decrease in number of crowns in the 50-year-olds. The percentage of crowned teeth in that age group was 25% in 1973 and 7 per cent in 2003 (6). This will have an impact on the future need for dental resources particularly a reduced need for restorative treatment and highlights the importance of preventive care in adults of all ages.

The marked decrease in proximal DFS seen in the 20-50-year-olds in 2003 compared to previous years of examination is in line with the findings from the children aged 3-15 years in the Jönköping studies carried out over the same time period (7). However there was an increased proportion of the proximal DFS that were carious (D) in the age groups 20-50 years (Figure 2). The possible explanations for that trend are that general dentists had overlooked proximal caries lesions that should have been restored or there was a shift in the diagnostic criteria for defining the indications for restorations. However, a more detailed analysis of the caries in proximal surfaces showed that the 80 to 90% of the lesions were restricted to the enamel. A new treatment strategy had been introduced suggesting that that early caries lesions located in the enamel should not be restored until preventive treatment methods have failed.

As it is not possible to analyze changes in disease patterns only by presenting mean values on caries data this study also presents frequency distributions of the individuals according to number of DFS. It is obvious that the distribution of individuals with caries has changed over time and indicates a dramatic change of the distribution curve to the left (Figure 3). However, a small percentage of individuals with a high disease burden still exists in Sweden. This can be explained by the high number of DFS, which characterized these groups as early as 1973. They had a high number of filled surfaces (Figure 2).

The present study has some limitations. The non-response rates in the 1973, 1983, and 1993 studies was 15-25% in some age groups. It was more difficult to convince the selected individuals to take part in the 2003 study than in previous years, and the non-response rate was 29-36% for the 20-70-year age groups. Reasons for declining to participation were usually 'not interested' or 'had no time'. The non-

response rate in this study was not likely to have significantly affected the results (5).

All clinical and radiographic studies on caries involve errors in diagnosis of caries. This error can increase depending on the diagnostic criteria, if several examiners are involved, and if the studies span several years. All examiners were calibrated each year for the diagnostic criteria against two senior examiners to minimize inter-examiner variability. The re-examinations by the two senior examiners and examiners revealed an acceptable inter-examiner agreement (7).

It is important to point out that the definition of carious lesions used in this series of studies includes both initial caries (caries restricted to enamel) and manifest caries (caries in the enamel and dentine), contrary to most epidemiological studies on caries prevalence which use the criteria only for manifest caries recommended by the World Health Organization (19). This series of studies therefore describes more accurately the total caries disease burden compared to most other studies, which thus underestimate caries prevalence. Identification of initial carious lesions is of utmost importance for planning, performance, and effect evaluation of preventive programmes.

In conclusion, it is obvious that the same trend concerning decrease in caries prevalence found in children and adolescents (7) between 1973-2003 is also true for Swedish adults. This positive change occurred in all age groups up to 50 years. This trend has great implications for the content of dental care and the need for dental resources in the future.

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A description of a contemporary human skull material in respect of age, gender, temporomandibular joint changes, and some dental variables

CECILIA MAGNUSSON¹, MALIN ERNBERG², TOMAS MAGNUSSON^{3,4}

Abstract

© Controversy exists concerning the etiological factors behind degenerative changes in the temporomandibular joints (TMJs). Occlusal factors, ageing, gender and genetics are some factors that have been discussed. The aim of the present study was to examine a contemporary human skull material in respect of gender, age, occlusal variables and form and surface changes in the temporomandibular joints. The material consisted of 259 human skulls, 170 males and 89 females, with an age range of 18-100 years. The over all dental status was poor, and 22% were edentulous. Both medio-lateral and antero-posterior dimensions as well as anterior and superior shape of the condyles were in good agreement with previous results. Form and surface changes of both the condyles and the temporal components were, however, more common in the present material compared to most previous studies. Men had on average more degenerative changes in the TMJs compared to women. In agreement with many previous studies, there was an increase of such changes with increasing age. Severe tooth attrition was a common finding, especially in men, but no correlation was found between this variable and the severity of degenerative changes in the TMJs. Abfractions were found in only 3 cases. Considering the common finding of severe tooth attrition, the rare occurrence of abfractions does not lend support to the hypothesis that abfractions are mainly caused by occlusal loading. In conclusion: Condylar dimensions and shape of the condyles were in good agreement with previously presented results. Severe tooth attrition and pronounced degenerative changes in the TMJs were common findings but no statistically significant association was found between these two variables.

Key words

TMJ, osteoarthritis, tooth attrition, human skulls.

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En beskrivning av ett nutida humant skallmaterial med avseende på ålder, kön, käkledsförändringar och olika dentala faktorer

CECILIA MAGNUSSON, MALIN ERNBERG, TOMAS MAGNUSSON

Sammanfattning

© Etiologin till degenerativa förändringar i käkleden är kontroversiell. Bakomliggande faktorer som diskuterats är mekanisk belastning orsakad av orala parafunktioner, födans konsistens, antal kvarvarande tänder, bettstöd, ålder, kön och genetik. Syftet med denna studie var att undersöka ett nutida humant skallmaterial med avseende på ålder, kön, olika dentala faktorer samt form och ytförändringar i käkleden. Materialet bestod av 259 skallar, 170 av dessa var av manligt kön och resterande 89 var av kvinnligt kön. Medelåldern var 44 år för männen (spridning: 20-82 år) och 40 år för kvinnorna (spridning: 18-100 år). De analyserade skallarna var i gott skick med undantag av att en del tänder hade förlorats post-mortem. Många tänder hade också förlorats pre-mortem, och inte mindre än 22% var helt tandlösa. Den troliga bakomliggande orsaken till den dåliga tandstatusen, samt det låga antalet fyllningar och kronor som fanns i materialet, är att större delen av skallarna kom från fattiga individer som troligtvis inte haft råd med, eller prioriterat, tandvård.

Både de medio-laterala och antero-posteriora dimensionerna och den anteriora och superiora formen på käkledskondylerna stämde väl överrens med tidigare presenterade resultat. Män hade statistiskt signifikant större medio-lateral dimension än kvinnor medan det inte förelåg någon skillnad i antero-posterior dimension mellan könen. Uttalade form- och ytförändringar i den temporala komponenten och i kondylen var dock mer vanligt i detta material jämfört med de flesta tidigare genomförda studier. Även här fanns en signifikant skillnad mellan könen där män hade mer degenerativa förändringar i käklederna än vad kvinnor uppvisade. I likhet med många tidigare studier ökade graden av degenerativa förändringar i käklederna med stigande ålder. Gravt tandslitage var ett vanligt fynd hos de inkluderade skallarna, framförallt hos män, men någon korrelation mellan graden av attrition och graden av degenerativa förändringar i käkled kunde inte påvisas. Abfraktioner registrerades i endast 3 fall. Med tanke på hur vanligt uttalat tandslitage var i materialet, stödjer detta fynd inte hypotesen att abfraktioner uppstår till följd av stor ocklusal belastning.

Slutsatser: Kondylernas form samt dimensioner stämde väl överrens med resultat som presenterats i tidigare studier. Både gravt tandslitage och uttalade form- och ytförändringar i käklederna var vanliga fynd i detta material, och var vanligare hos män än hos kvinnor. Såväl graden av degenerativa förändringar i käklederna som graden av tandslitage ökade med stigande ålder. Däremot kunde inget samband påvisas mellan dessa två variabler.

Introduction

Remodeling and degenerative changes of the structures of the human temporomandibular joints (TMJs) are common findings. The remodeling process represents an attempt of the joint to adapt to altered functional demands. When the physiological limits of remodeling are exceeded, pathological degenerative changes will develop primarily in the articular cartilage (31). Several terms have been used to describe degenerative joint disease such as osteoarthritis and osteoarthritis (5, 48), but in the following we will use the term degenerative changes. Development of degenerative changes is mostly a slow process, but the end result can be severe damage of the joint structures.

It is acknowledged that the TMJs are load-bearing in normal function (15, 17, 31). As a consequence, it can be assumed that the TMJs, as other load-bearing joints, will undergo change in response to increased functionally-induced stresses such as reduced tooth support, bruxism and tough food consistency. Furthermore it can be assumed that ageing will result in degenerative changes since "once functional stresses exceed physical limits, the remodelling processes are no longer adequate and degenerative joint disease sets in" (15).

Several studies of human skull materials have found correlation between the extent of tooth attrition and both remodelling and degenerative changes in the TMJs (3, 18, 37-39, 43), while other studies have not been able to find such a correlation (12, 25, 42, 44, 45).

Also the relationship between occlusal support and degenerative TMJ changes is contradictory in the literature. Some studies have found such a relationship (2, 3, 13, 19, 28, 32, 34, 44, 45), while other studies have not been able to find any such association (18, 46).

Some studies have found a decrease in size of the TMJs over time when skull samples from different time periods have been compared (7, 17), and this decrease in size has been attributed to a change from tougher to softer diet. Studies both in animals (22, 23, 41) and humans (16) have also shown that the consistency of the food has an impact on TMJ morphology, but a recent experimental animal study was not able to show any relationship between food consistency and degenerative TMJ changes (25).

The results presented in the literature on sex differences in respect of degenerative changes in the TMJs are also contradictory, where some studies have found such differences (1, 32, 37) while others

have not (2, 18, 46).

There is, however, overwhelming support for the opinion that ageing is closely related to degenerative changes in the TMJs (18, 28, 32, 33, 37, 38, 45, 46). Furthermore, there is growing evidence that genetic factors have a great impact on degenerative joint changes in general (6, 20, 24, 40) and thus most likely also for the development of such changes in the TMJs (31). Genetic differences can probably also explain the differences found in different cultures in respect of the prevalence of degenerative TMJ changes (34).

In summary it can be concluded that there is a lack of consensus in the literature in respect of possible relationship between degenerative changes in the TMJs and factors such as tooth attrition, occlusal support and gender. Further studies are thus warranted.

The aim of the present study is to present data from a contemporary human skull material with focus on form and surface of the TMJs.

Material and methods

In 1933 *Professor Joao Moreira da Rocha* at the anatomic department of the Federal University of Sao Paulo started to collect a human skull material. His aim was to perform anthropologic studies. The soft tissue was removed from the skulls by using an extremely gentle maceration technique that did not expose the bone tissue to any extrinsic trauma. The collection continued to 1973. The original material consisted of 511 skulls with an age range from foetus to 100 years. The material came mainly from bodies of poor people who no one claimed after their death, but some of the bodies had been donated to the hospital for research purposes.

A total of 77 skulls have disappeared over the years which means that the number of remaining skulls in the collection is 434. Another 175 skulls were excluded from our analyses because of insufficient data ($n=51$), missing mandible or other major defects ($n=40$), adolescents/children or new-born/foetuses ($n=59$ and $n=25$, respectively). Thus, a total of 259 skulls from adults, 18-100 years old, remained for the analyses. A series of photos were taken of each skull, including the excluded ones.

Of the analysed skulls, 170 were male (65.6 %) and 89 were female (34.4 %). The males were statistically significantly older than the females (mean: 44 years, range: 20-82, and mean: 40 years, range: 18-100, respectively. $P<0.01$). The age distribution, divided into 5 age-groups, is presented in Table 1.

© **Table 1.** Distribution (%) of 170 men and 89 women according to age groups.

Age group	Men	Women	Total
18 - 30	18	38	25
31 - 40	31	25	29
41 - 50	22	19	21
51 - 60	19	9	15
61 - 100	11	9	10

© **Table 2.** Registered cause of death in a total of 221 out of 259 skulls presented as percent of number of cases where the cause of death was registered.

Registered death causes	Percent
Heart attack/heart insuff.	27
Tuberculosis	25
Pneumonia	14
Other lung diseases	6
Renal disorders	5
Various cancer diagnoses	5
Toxic collapse	5
Arteriosclerosis	4
Aorta aneurysm	2
Other causes	7

A total of 129 (49.8 %) of the skulls were classified as “branca”, i.e. Caucasian, 53 (20.5 %) of them as “parda”, i.e. Mulatto, and 76 (29.3 %) as “preta”, i.e. Negroes. One skull had no classification. The cause of death was registered in a total of 221 cases (Table 2). The commonest death causes were heart attack/heart insufficiency (27%) followed by tuberculosis (25%).

All skulls were analysed by two examiners (CM, TM). If one examiner was uncertain how to register an individual variable, the other examiner was consulted, and a consensus was reached for the registration.

The morphology of the temporomandibular joints was studied by measuring the length and width of the condyle and by recording the anterior and superior shape of each condyle (32). Registrations of form and surface changes of the condyles and the temporal components were made according to scales described by *Wedel et al* (43), but when surface changes were estimated, a fifth step was added to the scale; compact layer broken up in areas > 6mm² (see below).

Measurements of the medio-lateral (m-l) and antero-posterior (a-p) dimension of the condyles were performed as follows:

The distance between the most prominent medial and lateral points in relation to the m-l axis of the condyle, and the distance between the most prominent points on the anterior and posterior surfaces of the condyle at right angles to the m-l axis were measured. These measurements were made with a pair of digital sliding calipers and read to the nearest tenth of a millimetre.

The superior medio-lateral outline of the condyles from an anterior view, and the horizontal outline of the condyles from a superior view were assessed according to *Öberg et al* (32).

Medio-lateral outline, anterior view (Figure 1):

- 1: Rounded or slightly convex
- 2: Largely plane/straight
- 3: Ridge-shaped/inverted V-shaped
- 4: Other shapes

Horizontal outline, superior view (Figure 2):

- 1: Oblong
- 2: Rounded to oval
- 3: Tapering laterally, pear-shaped
- 4: Tapering medially, pear-shaped
- 5: Other shapes

Change in form and surface of the condyles and temporal components were assessed according to the following scales (43):

Form changes (Figure 3 a, b):

- 0: Without any of the changes described under 1, 2 or 3
- 1: Slight remodelling/flattening
- 2: Marked remodelling
- 3: Deforming changes

Surface changes (Figure 4 a, b):

- 0: Without any of the changes described under 1, 2, 3 or 4
- 1: Uneven surface, unbroken compact layer
- 2: Marked irregular surface and/or local perforation <3mm² of the compact bone layer
- 3: Compact layer broken up in areas 3-6 mm² or largely distributed small perforations
- 4: Compact layer broken up in areas > 6mm²

The total sum for form and surface changes of the left and right condyle and temporal component were calculated and can thus range from 0 to 28. From this total score, a degenerative change index; DC-index, was created, where score 0-8 were classified as no or moderate TMJ changes, 9-16 as marked changes, and 17-28 as severe changes.

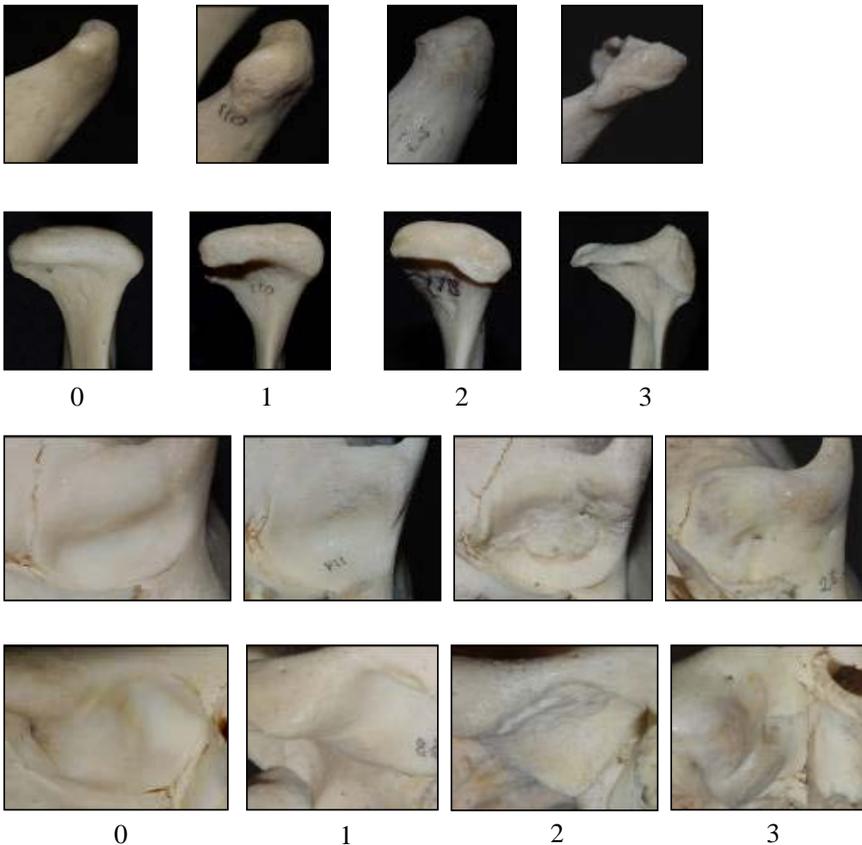
© **Figure 1.** The superior medio-lateral outline of the condyle; anterior view. 1: Rounded or slightly convex, 2: Largely plane/straight, 3: Ridge-shaped/inverted V-shaped, 4: Other shapes.



© **Figure 2.** The horizontal outline of the condyle; superior view. 1: Oblong, 2: Rounded to oval, 3: Tapering laterally, pear-shaped, 4: Tapering medially, pear-shaped, 5: Other shapes.

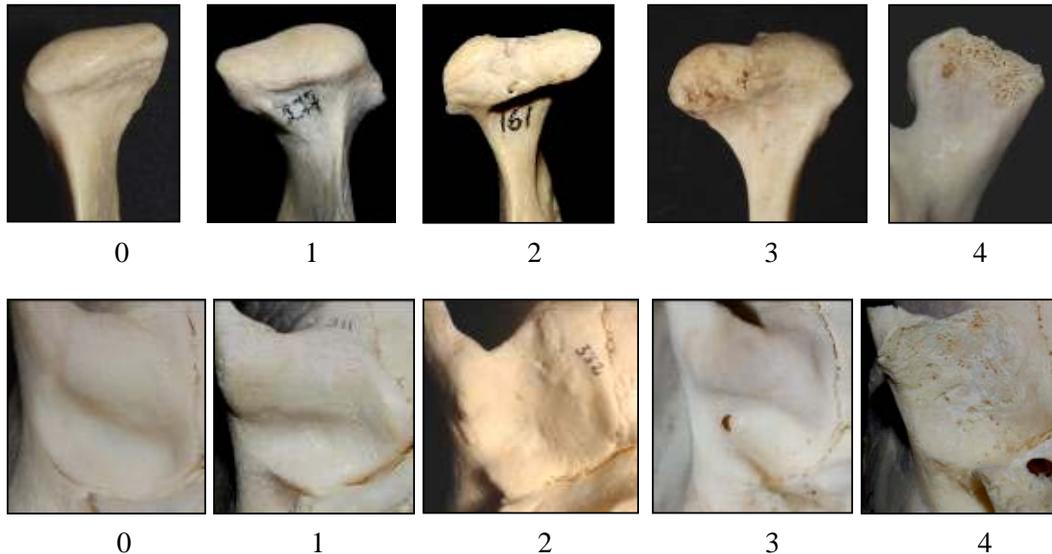


© **Figure 3a och b.** Grading of form changes of a) the condyle and b) the temporal component. 1: Without changes, 2: Slight remodelling/flattening, 3: Marked remodelling, 4: Deforming changes.



© **Figure 4a och b.** Grading of surface changes of a) the condyle and b) the temporal component.

0: Without changes, 1: Uneven surface, unbroken compact layer, 2: Marked irregular surface and/or local perforation $< 3 \text{ mm}^2$ of the compact bone layer, 3: Compact layer broken up in areas 3-6 mm^2 or largely distributed small perforations, 4: Compact layer broken up in areas $> 6 \text{ mm}^2$.



© **Figure 5.** Grading of the degree of tooth wear. 1: No or slight wear, 2: Wear of enamel only, 3: Wear into dentin on single spots ($< 2 \text{ mm}^2$), 4: Exposure of dentin in an area of more than 2 mm^2 , 5: Wear of more than $1/3$ of the clinical crown.



The degree of tooth wear was evaluated for the incisive, canine, premolar and molar regions where the most worn tooth in each region determined the classification.

The following scale was used (Figure 5):

- 1 = no or slight wear
- 2 = wear of enamel only
- 3 = wear into dentin on single spots ($< 2 \text{ mm}^2$)
- 4 = exposure of dentin in an area of more than 2 mm^2
- 5 = wear of more than $1/3$ of the clinical crown.

The individual total tooth wear score can thus range from 4 to 20. From this total score, a tooth wear index was created, where scores 4-9 were classified as minor tooth wear, scores 10-12 as moderate

tooth wear, and scores 13-20 as pronounced wear. Noncarious cervical lesions/abfractions were registered when obvious, shallow or wedge-shaped, loss of tooth structure was seen in the cervical area of a tooth. The number of present teeth was registered as well as the of estimated number of remaining teeth at death, where ante-mortem tooth loss was recorded when resorption of the socket, or bony growth within the socket, could be observed.

Finally the estimated occlusal support was classified according to the *Eichner index* (9):

A1: Antagonist contact in all four supporting zones. No tooth limited gap exists.

A2: Antagonist contact in all four supporting zones. Tooth limited gap exists only in one of the jaws.

A3: Antagonist contact in all four supporting zones. Tooth limited gaps exist in both jaws.

B1: Antagonist contact is present in three supporting zones.

B2: Antagonist contact is present in two supporting zones.

B3: Antagonist contact is present in one supporting zone.

B4: Antagonist contact is present in none of the supporting zones, tooth contact only in the frontal region.

C1: Teeth in both upper and lower jaw, but no antagonist contact neither in any of the supportive zones or in the front.

C2: Teeth only in one jaw.

C3: No teeth in upper or lower jaw.

Statistical method

The statistical program SPSS, version 13.1, was used. To test for statistical differences between variables and gender, the χ^2 -test and t-test were used. To test for correlations between variables, Spearman's rank correlation (r_s) was used. $p < 0.05$ was judged as a statistically significant difference.

Results

The mean value of the m-l dimension of the right and left condyles was 19.5 mm (range: 14.4-25.2 mm) and 19.4 mm (range: 13.6-24.5 mm). The corresponding values of the a-p dimensions were 8.3 mm (range: 5.2-13.6 mm) and 8.4 mm (range: 3.9-19.1mm). Both the right and left m-l dimensions were larger in men (20.0 mm and 20.0 mm, respectively) compared to women (18.4 mm and 18.4 mm, respectively, $p < 0.000$), while there was no statistically significant gender difference for the a-p dimen-

sions of right and left condyles (men: 8.4 mm and 8.5 mm, women: 8.2 mm and 8.2 mm, respectively)

The distribution of the material concerning the shape of the condyles in anterior and superior views is presented in Table 3. There was a statistically significant correlation both for anterior and superior shape between the right and left condyles ($p < 0.01$ and $p < 0.01$, agreement: 66.4% and 70.7%, r_s : 0.52 and 0.48, respectively). The only statistically significant gender difference found was that rounded to oval shape from a superior view was more common in women compared to men ($p < 0.05$).

The change in form and surface of the condyles and the temporal components is presented in Tables 4 and 5. On both sides, the form as well as the surface changes were statistically significantly more pronounced in the condyles compared to the temporal components ($p < 0.000$ for all measurements).

Both for males and females there was a statistically significant correlation between form and surface changes for the condyles and temporal components on both sides as well as between the right and left side (Form changes: $p < 0.01$ for all correlations, agreement: 64.1%-79.8%, r_s : 0.61-0.78. Surface changes: $p < 0.01$ for all correlations, agreement: 50.6%-62.9%, r_s : 0.52-0.80).

Nineteen percent of the men and 29% of the women had a DC-index of 1 (no or moderate TMJ changes), 49% and 32% had an index of 2 (marked TMJ changes), and 32% and 39% had an index of 3 (severe TMJ changes). According to this index, men had statistically significantly more degenerative changes in the TMJs compared to women ($p < 0.05$).

There was also a statistically significant increase of the DC-index with increasing age both in men and women ($p < 0.01$).

© Table 3. Distribution (%) of the material concerning the shape of the condyles; anterior and superior view. Men: n=170. Women: n=89.

Shape of condyle, anterior view	Right Condyle			Left Condyle		
	Men	Women	Total	Men	Women	Total
Rounded or slightly convex	51	56	53	45	51	47
Largely plane/straight	14	7	11	16	15	15
Ridge shaped/inverted V-shaped	23	24	23	23	18	21
Other shapes	13	14	13	16	17	16
Shape of condyle, superior view						
Oblong	62	60	61	64	58	62
Rounded to oval	4	14	7	2	11	5
Tapering laterally	11	7	10	12	10	12
Tapering medially	12	11	12	10	9	10
Other shapes	11	9	10	12	11	12

© **Table 4.** Distribution (%) of the material concerning change in form of the right and left condyles and of the right and left temporal component. Men: n=170. Women: n=89.

Changes in shape of: Condyle	Right			Left		
	Men	Women	Total	Men	Women	Total
No changes	9	15	11	7	9	7
Slight remodelling/flattening	32	24	29	31	24	28
Marked remodelling	40	42	41	40	42	41
Deforming changes	18	20	19	23	26	24
Temporal component						
No changes	25	35	28	24	35	28
Uneven surface	23	19	22	20	20	20
Irregular surface/local perforations	31	28	30	32	21	28
Perforations 3-6 mm ²	8	9	9	10	9	10
Perforations > 6 mm ²	13	9	12	14	15	14

© **Table 5.** Distribution (%) of the material concerning surface change in the right and left condyles and in the right and left temporal component. Men: n=170. Women: n=89.

Change in surface of: Condyle	Right			Left		
	Men	Women	Total	Men	Women	Total
No changes	17	20	18	14	16	15
Uneven surface	24	17	21	19	17	19
Local perforations	22	27	24	21	16	19
Perforations 3-6 mm ²	15	12	14	17	15	16
Perforations > 6 mm ²	22	24	23	29	37	32
Temporal component						
No changes	25	35	28	24	35	28
Uneven surface	23	19	22	20	20	20
Local perforations	31	28	30	32	21	28
Perforations 3-6 mm ²	8	9	9	10	9	10
Perforations > 6 mm ²	13	9	12	14	15	14

© **Table 6.** Distribution (%) of the material according to the estimated Eichner index.

Eichner index	Men n = 170	Women n = 89	Total n = 259
A1	5.9	2.2	4.6
A2	4.1	7.9	5.4
A3	1.8	4.5	2.7
B1	11.2	10.1	10.8
B2	11.8	11.2	11.6
B3	10.6	3.4	8.1
B4	18.2	11.2	15.8
C1	3.5	5.6	4.2
C2	11.2	20.2	14.3
C3	21.8	23.6	22.4

In the skulls with remaining teeth, the number of teeth in the upper jaw was 6.9. The corresponding figure for the lower jaw was 6.8. The estimated mean number of teeth ante-mortem was 9.1 in the upper jaw and 9.4 in the lower jaw. The distribution of the skulls according to the estimated Eichner index is presented in Table 6. There was no statistically significant difference between men and women.

The mean values of tooth wear for men and women in the incisor region were 3.5 and 3.0, in the canine region 3.3 and 3.1, in the premolar region 2.7 and 2.3, and in the molar region 2.4 and 2.1, respectively (all regions with a range: 1-5). A total tooth wear index could be calculated in 67 men and 34 women. The mean value of the total tooth wear index was 11.5 (range: 6-20). Minor wear was registered in 18% of the men and in 44% of the women, moderate wear in 34% and 38%, and pronounced wear in 48% and 18%, respectively. Men had statistically significantly more tooth wear compared to women ($p < 0.01$). There was a statistically significant increase of occlusal wear with increasing age ($p < 0.05$). No statistically significant correlation could be found between the tooth wear index and the DC-index either in the total sample, or when it was divided in men and women, respectively.

Restorations such as fillings and crowns were rare findings, and when present it was with few exceptions temporary fillings and composite/acrylic crowns. Cervical noncarious cervical lesions/abfractations were found in only 3 cases.

Discussion

When the results of the present study are interpreted, it should be kept in mind that this skull material is not representative for the average Brazilian population in the 20th century. Most of them came from a poor background. Due to this, the age at death and causes of death is not representative, and e.g. their dental status is likely much worse than for the general population. In the present sample, only 13% had occlusal support in all 4 supporting zones, and another 41% had no occlusal support. A reflection of their poor background is also the few findings of dental restorations. Another unknown factor is that we have no knowledge about how many subjects who have had removable partial or complete dentures, but most probably only few subjects have had such reconstructions.

Yet another weakness is that many teeth have been lost post-mortem, on average 5 teeth per skull with remaining teeth. In most cases, it was no problems to decide if teeth had been lost ante- or post-mortem, but it is not possible to know if the lost teeth have had antagonist contact or not, and this can have had influence on the estimation of the Eichner index.

The a-p and m-l condylar dimensions are in good agreement with the dimensions reported in other studies (Table 7). The intergroup differences found can partly be explained by the fact that some of the previous studies report the dimensions from autopsy specimen while others have made measurements on dry skulls, but the differences also reflect actual dif-

© **Table 7.** Condylar antero-posterior and medio-lateral dimensions in millimetres presented in different studies. n = numbers of condyles. Study (32) presents 2 cohorts and study (17) presents 3 cohorts.

Reference	Males			Females		
	n	a-p	m-l	n	a-p	m-l
Richards (36)	24	9.9	22.1	32/28	9.2	20.6
Richards (36)	17/16	10.0	20.4	13/11	9.0	18.8
Whittaker et al (44)	94/83	9.2	21.0	61/49	9.2	18.9
Whittaker et al (45)	34	8.3	20.5	55	7.8	18.5
Öberg et al (32)	63	9.8	20.3	39	9.8	19.1
Hinton (17)	49	9.1	21.5	32	8.7	18.9
Hinton (17)	14	8.4	20.6	6	8.1	-
Hinton (17)	49	8.3	20.2	35	8.0	18.4
Wedel et al (43)	32	8.0	21.4	13	7.9	19.1
Wedel et al (42)*	68	8.5	20.5			
Åkerman et al (1)*	44	9.2	20.5			
Present study	340	8.5	20.0	178	8.2	18.4

* Not divided in males and females

© **Table 8.** Percentage distribution according to shape of condyles seen in an anterior and superior view presented in different studies.

Anterior view: 1= Rounded/slightly convex, 2=Largely plane/straight, 3=Ridge shaped/inverted V-shaped, 4=Other shapes.

Superior view: 1=Oblong, 2=Rounded to oval, 3=Tapering, laterally, pear-shaped, 4=Tapering medially, pear-shaped, 5=Other shapes.

Reference	Anterior view				Superior view				
	1	2	3	4	1	2	3	4	5
Öberg et al (32)	55	20	11	14	44	36	7	1	11
Whittaker et al (44)	72	19	4	5	88	0	9	1	2
Whittaker et al (45)	21	46	31	3	52	1	23	19	6
Wedel et al (43)	51	29	14	6	62	6	6	5	18
Wedel et al (42)	49	29	19	3	52	20	6	9	13
Yale et al (47)	61	25	12	2					
Present study	50	13	22	15	62	6	11	11	11

© **Table 9.** Percentage distribution of form and surface changes in condyles and temporal components presented in different studies.

Form changes: 0=Without changes, 1=Slight remodelling/flatting, 2=Marked remodelling, 3=Deforming changes.

Surface changes: 0=Without changes, 1=Uneven surface, unbroken compact layer, 2=Marked irregular surface/local perforation, 3=Compact layer broken up in areas > 3 mm²/largely distributed small perforation.

Reference	Condylar form				Temporal form				Condylar surface				Temporal surface			
	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3
Whittaker et al (44)	19	48	28	5	49	43	6	2	19	48	28	5	46	41	12	2
Whittaker et al (45)	48	38	11	3	55	25	8	12	46	26	27	1	51	17	22	10
Wedel et al (43)	11	49	33	6	74	25	1	0	44	33	18	5	76	21	2	0
Wedel et al (42)	23	64	11	2	11	75	14	0	11	25	2	61	12	73	15	0
Present study*	9	29	41	21	20	49	29	3	16	20	21	42	28	21	29	22

*Grade 3 and 4 of surface changes have been pooled to allow comparisons with the other studies

ferences between the samples. It has been suggested that these differences is a result of different functional loading due to differences in diet composition (17).

The m-l dimension was larger in men compared to women, while there was no gender difference in a-p dimensions. This has also been found in several previous studies (Table 7). The larger m-l dimension in males is most likely explained by both larger overall cranial size and more intensive dental loading in males compared to females (17). The shape of the condyles in the present sample, both in anterior and superior view, also corroborate the findings in most previous studies, where rounded/slightly convex shape from an anterior view and oblong shape from a superior view is the most common (Table 8).

Men had statistically significantly more degenerative changes in the TMJs than women according to the DC-index. This is in line with one previous study (37), but several other studies have not found

any gender differences for degenerative TMJ changes (2, 18, 46), and some have reported more such changes in women (1, 32). From Table 9 it can be seen that marked and severe form and surface changes were much more common in the present study compared to most previous studies using the same scales. There are many plausible explanations to this difference such as e.g. possible differences in genetic factors, diet, dentition and age distribution between the different samples. Both form and surface changes were more pronounced in the condyles compared to the temporal components. This is in agreement with some studies (3,44, 45) but in contrast to other (43). The agreement between form and surface changes between the left and right condyles and temporal components was high. This corroborates previous findings (1, 14). In accordance with the results in many previous studies (18, 28, 32, 33, 37, 38, 45, 46), degenerative changes in the TMJs increased with increasing age in the present sample.

The degree of tooth wear in the present sample was in general very pronounced. The relationship between tooth attrition and occlusion is unclear (8), but it can be speculated that the poor occlusal support in the present material is one possible explanation to the severe attrition frequently recorded. Another contributing factor, uncontrolled in the present study, might be the food consistency. The finding that tooth wear was more pronounced in frontal regions and least pronounced in molar regions, is also in line with previous reports (30) as is the finding that the wear increased with increasing age, and men exhibited more wear than women (10).

No correlation could be found between degree of degenerative TMJ changes and the severity of tooth wear. This is in accordance with the results presented in several previous studies (12, 25, 42, 44, 45) but also contradicting the finding in many other studies (3, 18, 37-39, 43).

The concept of cervical noncarious cervical lesions/abfractions is controversial. For long it has been considered that the etiology of such lesions is toothbrush abrasion (27). Other authors have proposed a multifactorial etiology including occlusal wear, restorations, altered tooth position and tooth brushing (4), but also occlusal erosion has been found to be associated with cervical lesions (21). During recent years it has been claimed that the cause of abfractions is occlusal loading (29, 35) but this theory has also been questioned (11, 26). In the present material, noncarious cervical lesions were rare findings. This is logical if toothbrush abrasion is acknowledged as the etiologic cause, since it can be hypothesized that these subjects have not been great consumers of toothbrushes. On the other hand, the few recordings of such lesions contradict the opinion that they are caused by occlusal loading considering the pronounced tooth wear registered.

This material will be further analyzed, and the results will be presented in subsequent papers.

Conclusions

- Both the medio-lateral and antero-posterior dimensions, as well as anterior and superior shape of the condyles, were in good agreement with previous results.
- Severe form and surface changes both in the condyles and in the temporal component were common finding.
- There was a close correlation between age and degenerative changes in the TMJs.
- The dental status was on average poor and many

of the dentate subjects had pronounced tooth wear.

- No association was found between the degree of tooth wear and the severity of degenerative changes in the TMJs.
- Noncarious cervical lesions/abfractions were only registered in 3 cases. Considering the high frequencies of pronounced tooth wear, this finding does not support the hypothesis that such lesions are mainly caused by heavy occlusal loading.

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Self-perceived oral health among 19-year-olds in two Swedish counties

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Abstract

© The primary purpose of the present study, which focused on a census of 19-year-olds (2006) attending dental clinics in two Swedish counties, was to describe the frequency distribution of clinically- and self-perceived oral health indicators in terms of D_{Sa} (Decayed Surfaces approximal), four global dimensions of oral health and one 'all-embracing' oral health measure, according to county of residence and gender. A second purpose was to examine to what extent the clinical indicator of oral health and the global dimensions of self-perceived oral health contribute to the explainable variance of the global single-item indicator. Finally, the study examined whether or not the association of clinically- and self-perceived oral health indicators with the single global oral health indicator varied as a function of gender and place of residence. The study base was 46.5% (n=3658) of all children attending for dental checks (n=7866). The questionnaire included thirteen questions, divided into four global dimensions. These were Knowledge, Quality of life, Social and Function. There was also one 'all-embracing' oral health question, one question about gender and finally information about clinically-registered disease. The findings of this study were that females reported more serious problems than males in the Social and Quality of life dimensions and there were differences between counties in knowledge about oral diseases. The group with poor self-reported oral health in the 'all-embracing' oral health question had significantly more problems with all global dimensions, especially Quality of life and Social dimensions. Statistically-significant two-way interactions occurred between county and Knowledge and between county and Quality of life. This study supports the idea of one or several questions concerning self-perceived oral health to be used as a complement to the traditional epidemiological clinical registration of oral diseases.

Key words

Perceived oral health, questionnaire, dimension of oral health, all embracing oral health question, adolescents

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Oral hälsa hos 19-åringar i två svenska landsting

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Sammanfattning

© Utifrån en totalpopulation av 19-åringar i två landsting var ett syfte med följande studie att beskriva oral hälsa uppdelat på landsting och kön dels utifrån ett sammanfattande perspektiv (sammanfattande tandhälsofråga), dels från ett självupplevt perspektiv (enkätfrågor) och slutligen ifrån ett traditionellt perspektiv med användande av en kariessjukdoms-indikator (Dsa). Nästa syfte var att undersöka till vilken grad oral hälsa utifrån dels från ett självupplevt perspektiv dels ett sjukdomsperspektiv bidrog till att förklara den sammanfattande tandhälsofrågan. Slutligen var även syftet att undersöka om samband mellan oral hälsa (självupplevt perspektiv och sjukdomsperspektiv) och oral hälsa (sammanfattande perspektiv) varierar som en funktion av kön och landsting. Studiepopulationen bestod av samtliga 19-åringar i Örebro och i Östergötlands län. Andel ingående i studiebasen (n=3658) var 46.5% av alla barn som kom till undersökning hos de tandläkare som deltog i studien (n=7866). Enkäten bestod av 13 frågor kring självupplevd munhälsa uppdelat på fyra globala dimensioner. Dessa var Kunskap, Livskvalitet, Funktion, och Social. Dessutom fanns en sammanfattande tandhälsofråga, en fråga om kön samt en av behandlande tandläkare ifylld ruta med aktuellt Dsa-värde. Samtliga enkäter fylldes i anonymt. Ett fynd i denna studie var att en signifikant skillnad i kunskap fanns mellan landstingen. Ett annat fynd var den stora skillnad som fanns mellan män och kvinnor när det gällde den självupplevda tandhälsan och då specifikt inom de globala dimensionerna Livskvalitet och Social. Andel kvinnor som var missnöjda med sin oralt relaterade livskvalitet var 37.0% medan motsvarande siffra för män var 23.8%. Kunskapsmässigt fanns det också en stor skillnad mellan kunskap om karies och kunskap om parodontit. Av dem som besvarat den övergripande frågan fanns den starkaste samvariationen med den självupplevda hälsan och specifikt inom de globala dimensionerna Livskvalitet och Social. Signifikanta interaktioner fanns mellan landsting och Kunskap samt landsting och Livskvalitet. Resultatet stödjer en fortsatt utveckling mot att systematiskt uppvärdera värdet av att ställa samt registrera svaren på någon eller några frågor om tandhälsa som komplement till den kliniska registreringen.

Introduction

Dental care for children and adolescents in the Nordic countries has a long tradition of universality, right to service and equitable financing (14). Since 1938 the Public Dental Health Services (PDHS) in Sweden have had a responsibility to provide dental care (including specialist care) free of charge for children and adolescents 0-19 years of age (31). The counties are responsible for financing and providing this service, and several allow a free choice of caregivers, including both public and private practitioners (23). Epidemiological data have routinely been collected by the PDHS and private practitioners in terms of clinical measures for the purpose of estimating oral health status and treatment needs.

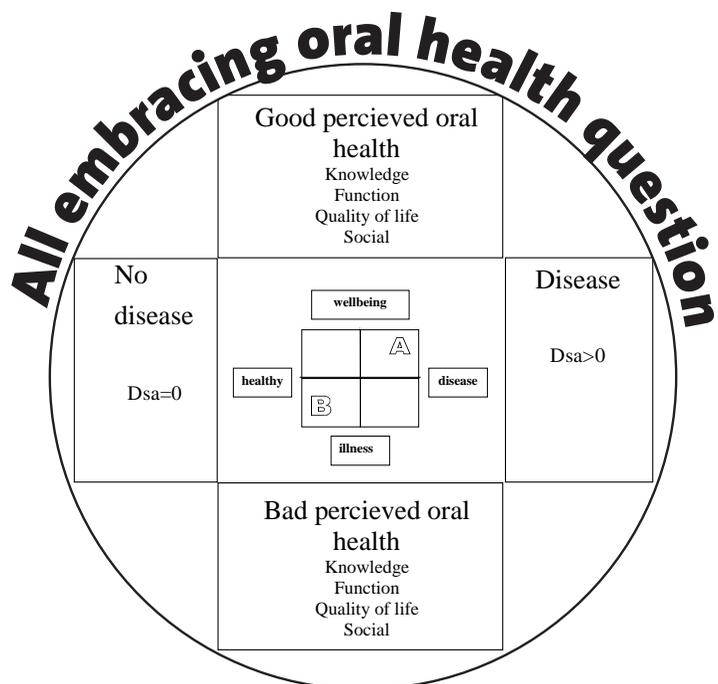
Clinical data are important for the identification of diseases and rely on dental professionals' judgement. Based on a biomedical approach, such data have traditionally been utilised in the assessment of individuals' oral health status (8). This approach has been criticised because of its restricted focus and for not taking into consideration functional, psychological and social consequences of oral diseases (5). Thus, a biopsychosocial approach has been increasingly recognised, suggesting that in addition to clinical indicators, functional, social and psychological outcomes and self-perceived measures of oral health should be considered in the evaluation of oral health status and need for dental care (4). As oral health is fundamental to general health and well-being, documenting variations in clinically-assessed as well as self-reported aspects of oral health will provide important information for the planning and evaluation of oral health care services (10). In Sweden, the first attempt to define and create a consensual definition of oral health based on a psychosocial rather than a strictly biomedical approach was made in 2003 (15).

A number of socio-dental indicators have been developed and validated to assess functional, psychological and social outcomes of oral problems, ranging from single-item global indicators such as satisfaction/dissatisfaction with oral health status to complex inventories and scoring systems, such as the Oral Health Impact Profile (OHIP) and Oral Impacts on Daily Performance (OIDP) (1, 26). These instruments have almost entirely been used for scientific purposes. There are a few examples where they have been applied as part of a routine procedure in oral healthcare services. Alongside the multi-item scales, single-item global indicators have been shown to be advantageous and have been widely used in oral

health research (20). When operational costs tend to increase, single-item indicators might be appropriate and even practical for regular use. Evidence suggests strong correlations between single- and multi-item scales (7).

A Swedish questionnaire to assess self-perceived oral health was recently developed and validated in 19-year-olds for use as a tool to assess the quality of dental care provided for this age group (2). The 19-year-olds were chosen because they are the oldest age group to be offered comprehensive and free dental care. The questionnaire should assist resource allocation and decision-making within the oral healthcare services in Sweden. It aimed to assess oral health using self-perceived oral health indicators (i.e. four global dimensions) and one single-item overall oral health indicator ('all-embracing' oral health question'), in addition to clinically-assessed dental caries mainly based on x-rays in terms of D_{Sa} (Decayed Surfaces approximal). This particular instrument (used with the 19-year-olds) for measuring oral health is based on a (modified) conceptual model from Statens folkhälsoinstitut (2004) (30) (Fig. 1). The validation process for the questionnaire has been described in detail elsewhere (2, 32).

© Figure 1. Conceptual model of oral health



The aim of this study was to investigate clinical-ly- and self-perceived oral health indicators among 19-year-olds attending dental clinics in the Swedish counties of Örebro and Östergötland.

Materials and methods

Sample and procedures

The ethical considerations employed in this study were in accordance with the principles of the declaration of Helsinki and all respondents were informed that participation was voluntary, and they were free to withdraw from the study without prejudice to their future treatment (33). All counties in Sweden have a responsibility to monitor the oral health of the inhabitants (31). The study population comprised all 19-year-olds who were invited for routine check-ups in Östergötland County and all 19-year-olds who were invited by the PDHS to receive dental care in Örebro County in 2006. Data were collected during 2006. The total populations of 19-year-old dental attendees, eligible sample and the study base are presented in Table 1.

Clinical examination and questionnaire survey

Clinical examination was conducted in fully-equipped dental surgeries by dentists using x-ray (bitewing) after individual indicators, which means that x-rays were not used if there was no clear advantage in doing so (18, 25). In the clinical examination caries was defined as manifest caries reaching the dentin (27).

To enable analysis of self-reported and clinical

oral health indicators pertaining to the same individual, a decision was made to mark the value of the decayed surface approximal (DSa-values) on each questionnaire form before it was handed to the participant for completion. After anonymous completion of the structured questionnaire containing thirteen oral health-related questions in addition to one 'all-embracing' oral health question and one questions about gender, subjects left the forms in a box at the clinic. The personnel in the dental clinics were given written instructions with respect to the questionnaire in order to ensure a high participation rate and a standardised collection of data.

DSa was coded between 0 and 12 and the cut-off point for dichotomisation was set between (0) 'free of caries' and (>0) 'with caries experience'. In order to decrease the risk of incorrectly-registered DSa-values, extreme values (1.9% of all completed forms with clinical data) were excluded from the analysis. The limit for extreme values was set to the same level as the highest value for DSa observed in the official statistics in Örebro County (DSa=12).

Measures

Perceived oral health (four global dimensions)

Four sub-scales (global dimensions) were applied to assess self-perceived oral health. Knowledge was assessed by five questions, Function by three questions, Quality of life by two questions and Social by three questions. The various items (questions), their response categories and the cut-off point for

© **Table 1.** Number of 19-year-olds attending dental care in Örebro and Östergötland county council, participating in the clinical examination, respondents of the questionnaire survey and the number of participants in both.

	Total		Örebro		Östergötland	
	n	%	n	%	n	%
Number of 19 yr olds invited to routine check up (study population)	9,089		3,544 (9,089)	39.0	5,545 (9,089)	61.0
Number of 19 yr olds invited for routine checkup by dentists participating in the study	8,854 (9,089)	97.4	3,309 (8,854)	37.4	5,545 (8,854)	62.6
Number of 19 yr olds invited to participate in the study (eligible sample)	7,866 (8,854)	88.8	3,077 (7,866)	39.1	4,789 (7,866)	60.9
Number of examined with filled out forms	4,382 (7,866)	55.7	1,796 (4,382)	41.0	2,586 (4,382)	59.0
Number of examined with filled out forms and clinical data (study base)	3,658 (7,866)	46.5	1,584 (3,658)	43.3	2,074 (3,658)	56.7

dichotomisation of each item are shown in Table 2. Four combined scores were constructed from the respective single items and labelled Knowledge (Cronbach's alpha 0.66), Function (Cronbach's alpha 0.44), Quality of life (Cronbach's alpha 0.70) and Social (Cronbach's alpha 0.65). The combined scores were constructed by use of the median category for the relevant questions for every single respondent in a step 1 and by creating frequency tables for each dimension in a step 2. The global dimension score of Knowledge was dichotomised into (0) 'some or good knowledge' and (1) 'no knowledge'. Function and Quality of life were dichotomised as (0) 'never problems' and (1) 'problems once or twice/several times a week'.

The global dimension Social needed a different scale as it contained questions considering both time and quantity. Thus it was necessary to construct a new global scale from a contingency-table with one

aspect on the X-axis and the other aspect on Y-axis. From this table an optional pattern was constructed. The result was a customised scale, created from a cross-tabulation between a question with time dimension and a question with quantity dimension. This new scale measured the dimension with a six-grade scale, with a cut-off point for dichotomisation between two and three. The global dimension Social was dichotomised into (0) 'No problems or small problems' and (1) 'Rather bad problems or very bad problems'. The scoring method was based on the theory and procedure described by Svensson (32).

Single global indicator 'All-embracing' oral health measure

'All-embracing' oral health was assessed by the question 'How satisfied are you with your teeth and mouth in general?' with the response categories: (1) completely satisfied, (2) satisfied in general,

© Table 2. The 13 questions covering the four global dimensions and the respectively cut points for dichotomization.

Global dimensions: Question	Categories of answers	Dichotomized cut points and values
Knowledge	No (a)	No knowledge (1)
Do you know the mechanism behind cavities?	Yes, in part perhaps (b)	Some or good knowledge (0)
Do you know how to avoid cavities?	Yes, (c)	
Do you know the mechanisms behind tooth loss/ periodontal disease?		
Do you know how to avoid tooth loss/ periodontal disease?		
Do you know that it is important to use fluoridated toothpaste?		
Function	No never (a)	No problems (0)
Difficulties chewing food due to problems with mouth?	Yes, once or twice (b)	Problems once, twice or your teeth or several times a week (1)
Headache due to problems with your teeth or mouth?	Yes, sometimes every month (c)	
Shooting pain from warm or cold food or drink?	Yes, sometimes every week (d)	
	Yes, several times every week (e)	
Quality of life	No never (a)	No problems (0)
Have you ever felt badly or been ashamed of your mouth?	Yes once or twice (b)	Problems once, twice or teeth or several times a week (1)
	Yes sometimes every month (c)	
Have you ever felt depressed due to your teeth or mouth?	Yes sometimes every week (d)	
	Yes several times every week (e)	
Social	No never (a)	No problems or small problems (0)
Have you ever avoided laughing due to your teeth or your mouth?	Yes once or twice (b)	Rather bad problems or very bad problems (1)
	Yes sometimes every month (c)	
Have you ever avoided normal socializing due to your teeth or mouth?	Yes sometimes every week (d)	
	Yes several times every week (e)	
Social	No I have not at all (a)	No problems or small problems (0)
Have you ever felt embarrassed due to your teeth or your mouth?	I have felt a bit embarrassed (b)	
	I have felt embarrassed rather a lot (c)	Rather bad problems or very bad problems (1)
	I have felt very embarrassed (d)	

(3) satisfied, (4) somewhat dissatisfied, (5) dissatisfied and (6) extremely dissatisfied. For analysis, this measure was dichotomised into (0) 'satisfied' (including the original categories 1, 2, 3) and (1) 'not satisfied' (including the original categories 4, 5 and 6).

Gender and County

Gender had respond category female (0) and male (1). County had respond category Östergötland County (0) and Örebro County (1).

Statistical analyses

Bivariate analyses were performed with the Chi Square test, Spearman's correlation coefficient and binary logistic regression analysis. Multiple logistic regression analysis was carried out to assess the effect of each independent variable after adjustment for the effect of all other variables in the model. All analyses were performed in Excel and the Statistical Package for Social Sciences (SPSS Inc., Chicago, USA, version 14.0 for PC). The level of statistical significance was set at 5%, i.e. $P \leq 0.05$.

© **Table 3.** Results on question level. Percentage distribution of each item of the global oral health by gender and county
Gender: Male (M), female (F). Counties: Östergötland county council (E), Örebro county council (T).

Questions	Category of answers	% Total	% Gender		% Counties	
			M	F	T	E
All embracing oral health question						
In general, how satisfied are you with your mouth and teeth?	Satisfied	87.5	88.0	87.0	86.3	88.5
Global dimension:						
Function						
Difficulties chewing food due to problems with your teeth or mouth?	No never (a)	58.7	59.6	57.7	58.5	58.6
Headache due to problems with your teeth or mouth?	No never (a)	82.2	89.6	74.2	81.4	82.8
Shooting pain from warm or cold food or drink?	No never (a)	14.8	16.2	13.2	14.9	14.5
Knowledge						
Do you know the mechanism behind cavities?	Some or good knowledge (b, c)	96.3	95.6	96.9	94.8	97.4
Do you know how to avoid cavities?	Some or good knowledge (b, c)	98.6	98.6	98.6	98.0	99.1
Do you know the mechanisms behind tooth loss/periodontal disease?	Some or good knowledge (b, c)	51.0	52.3	49.6	46.2	54.8
Do you know how to avoid tooth loss/periodontal disease?	Some or good knowledge (b, c)	51.4	56.1	46.4	47.2	54.7
Do you know that it is important to use fluoridated toothpaste?	Some or good knowledge (b, c)	90.9	88.1	93.8	88.6	92.6
Quality of life						
Have you ever felt badly or been ashamed of your mouth?	No never (a)	77.0	83.3	70.4	75.3	78.4
Have you ever felt depressed due to your teeth or mouth?	No never (a)	80.1	84.0	75.9	79.3	80.7
Social						
Have you ever avoided laughing due to your teeth or your mouth?	No never (a)	74.9	79.4	70.1	72.7	76.6
Have you ever felt embarrassed due to your teeth or your mouth?	No I have not at all (a)	74.0	79.7	67.9	71.7	75.8
Have you ever avoided normal socializing due to your teeth or mouth?	No never (a)	97.9	97.8	98.0	97.8	97.9

Results

Analysis of non-response

All data were collected during 2006. Of the total population of 19-year-olds from Östergötland County and all 19-year-olds who were attending the PDHS in Örebro County (N=9,089), 51.3% were males and 61.0% were residents of Östergötland County. In the group who formed the basis for analyses in the present study (n=3,685), the corresponding figures were 51.7% and 56.7%.

Consequently there was an underrepresentation of participants from Östergötland County in the study sample (Chi-square= 51.32, P=0.00). Nevertheless, the gender distribution of the participants in this study was similar to the corresponding distribution in the populations, which implies that they were representative of the population of 19-year-olds attending dental care in Örebro and Östergötland with respect to gender.

In Örebro County there was a chance to compare prevalence of caries in the study participants (DSa=0 = 83,5%) with that of the 19-year-olds in official statistics (DSa=0 = 85,4%), including 92,8% of all 19-year-olds in Örebro County. There was a difference

in excluded DSa-values (>12) between Östergötland County (2,8%) and Örebro County (0,7%). This indicates a more correct use of DSa among the dentists in Örebro compared with their colleagues' in Östergötland and could be one explanation of the differences in DSa between the counties.

There was only one reason for the difference between the study population and the eligible sample. They did not answer the invitation to come for a check-up even after a reminder. The bigger difference between the eligible sample and the number of those examined with completed questionnaire forms is more difficult to analyse because there were at least two reasons for that. Either the participants did not answer the questions or the dentists did not remember to give the form to the 19-year-olds.

Table 3 shows the percentage distribution of the 'all-embracing' oral health question and each item constituting the four global oral health dimensions (Knowledge, Function, Quality of life and Social) by gender and county of residence. Substantial, but varying, proportions of 19-year-olds reported 'no, never', when asked about oral health-related problems with function, quality of life and social concerns.

© **Table 4.** Percentage distribution and number (n) of the four global oral health dimensions and the "all embracing oral health question" by gender and county.

Dichotomized variables and their codes	Total N=3,658		Gender% (n)			County % (n)		
	%	n	Male	Female	p-value	Örebro	Östergötland	p-value
Knowledge								
Some or good knowledge (0)	92.6	3,381	91.2	94.0		90.1	94.4	
No knowledge (1)	7.4	272	8.8	6.0	0.002	9.9	5.6	0.000
Function								
Never problems (0)	55.1	2,001	59.3	50.5		56.4	54.1	
Problems once, twice or several times a week (1)	44.9	1,633	40.7	49.5	0.000	43.6	45.9	0.160
Quality of life								
Never problems (0)	69.8	2,547	76.2	63.0		67.7	71.5	
Problems once, twice or several times a week (1)	30.2	1,100	23.8	37.0	0.000	32.3	28.5	0.013
Social								
No problems or small problems, 1-2 in a scale of 6 (0)	93.4	3,394	94.5	92.3		92.4	94.2	
Rather bad problems or very bad problems, 3-6 in a scale of 6 (1)	6.6	238	5.5	7.7	0.008	7.6	5.8	0.033
All embracing question								
Satisfaction with oral health (0)	87.5	3,167	88.0	87.0		86.3	88.5	
Dissatisfaction with oral health (1)	12.5	451	12.0	13.0	0.359	13.7	11.5	0.05
Clinical dental indicator								
Dsa=0 (0)	78.0	2,836	76.3	79.9		83.5	73.8	
Dsa>0 (1)	22.0	798	23.7	20.1	0.01	16.5	26.2	0.000

Larger proportions of males than females and larger proportions of Östergötland than Örebro County residents reported no problems across items related to function, quality of life and social concerns dimensions.

Table 4 shows the percentage distribution of the sum scores of the four global oral health dimensions, the 'all-embracing' oral health question and caries experience (DSa-values) by gender and county. The majority of the respondents demonstrated good oral knowledge (92.6%), reported no functional problems (55.1%), no problems with quality of life (69.8%), no problems with social concerns (93.4%) and were satisfied with oral health (87.5%) ('all-embracing' oral health question). Females and participants from Östergötland County reported good knowledge more frequently than males and participants from Örebro County. On the other hand, a larger proportion of males than females reported no problems regarding function, quality of life and

social concerns. A majority of the 19-year-olds investigated was without caries experience (78%). Females and participants from Örebro County were more frequently without caries experience compared with their male and Östergötland County counterparts. The 'all-embracing' oral health question correlated statistically significantly with the four global oral health dimensions and with DSa-values (Spearman's rho in the range 0.09 to 0.48). In addition, Quality of life correlated relatively strongly with Social (Spearman's rho 0.63).

Table 5 shows the unadjusted and adjusted odds ratios (ORs) for self-reported satisfaction with oral health ('all-embracing' oral health question) according to sociodemographics (gender and county), the four global oral health dimensions and dental caries (DSa) in the total sample and separately for participants in Örebro and Östergötland County. Sociodemographics were entered in the first step, providing a model fit of Nagelkerke's $R^2=0.002$, model

© **Table 5.** Unadjusted and adjusted odds ratios (OR) and 95% confidence intervals (CI) of having satisfaction with oral health (the all embracing oral health question) according to gender, four global dimension and clinical dental indicator in the total sample and separately for Örebro and Östergötland counties.

Variables	Total		Örebro OR adjusted (95% CI)	Östergötland OR adjusted (95% CI)
	OR unadjusted (95% CI)	OR adjusted (95% CI)		
Gender				
Female (0)	0.9 (0.7-1.1)	1.3 (1.0-1.6)	0.94-1.85	0.90-1.67
Male (1)	1			
County				
Östergötland (0)	0.8 (0.7-1.0)	1.3 (1.0-1.6)		
Örebro (1)	1			
Knowledge				
Some or good knowledge (0)	1.5 (1.0-2.1)	1.6 (1.1-2.3)	0.64-1.94	1.36-3.98
No knowledge (1)	1			
Function				
No problems (0)	1.8 (1.0-2.1)	1.4 (1.1-1.8)	1.15-2.26	0.96-1.78
Problems once, twice or several times a week (1)	1			
Quality of life				
No problems (0)	7.2 (5.8-9.1)	4.8 (3.8-6.2)	4.64-9.78	2.66-5.19
Problems once, twice or several times a week (1)	1			
Social				
No problems or small problems (0)	13.1 (10.5-18.4)	6.8 (4.9-9.2)	4.37-10.6	4.46-10.9
Rather bad problems or very bad problems (1)	1			
Clinical dental indicator (1)				
Dsa=0 (0)	1.9 (1.5-2.4)	2.3 (1.8-2.9)	1.61-3.61	1.64-3.09
Dsa>0 (1)	1			

chi-square = 4.51, $df=2$, $p=0.105$. Entering the four self-perceived global oral health indicators in the second step improved the model fit to Nagelkerke's $R^2=0.25$, model chi square = 513.67 $df=5$, $p<0.000$. Entering the clinical indicator of dental caries in the final third step improved the fit of the model to Nagelkerke's $R^2=0.27$, model chi square = 546.77 $df=6$, $p<0.000$. In the final model, Knowledge, Function, Quality of life, Social concern, dental caries experience, gender and county varied systematically with satisfaction scores.

Statistically-significant two-way interactions occurred between county and knowledge, model chi square = 550.83, $df=8$, $p<0.000$, and between county and quality of life, model chi square = 553.52, $df=8$, $p<0.000$. In Östergötland, knowledge varied systematically with satisfaction, whereas function did not. In Örebro, function varied systematically with satisfaction, whereas knowledge did not (Table 5). Thus, knowledge was statistically-significantly more strongly associated with satisfaction in Östergötland than in Örebro, whereas function was most strongly associated with satisfaction in Örebro.

Discussion

The present population-based study investigated the association of dental caries and various indicators of self-reported oral health with a single-item indicator of overall self-reported oral health status in young Swedish adults. The study provides evidence regarding the concepts that Swedish 19-year-olds incorporate self-perceived oral health in their overall rating of oral health and the extent to which clinically- and self-perceived oral health indicators affect this overall 'all-embracing' oral health measure (22). The oral health instrument employed was developed for use among Swedish 19-year-olds through teamwork between statisticians and dentists, with suggestions as to what kind of analyses should be used. The instrument has been validated among Swedish 19-year-olds previously and has demonstrated satisfactory psychometric properties (2).

Örebro and Östergötland represent two Swedish counties with universities, industries and service industries covering both cities and rural areas. Owing to the relatively low response rate obtained in this study and the limited possibility of conducting a detailed non-response analysis, generalisation of the present results to the whole population of 19-year-olds should be made with caution. On the other hand, from the findings of non-response analyses, it might be assumed that the participants investigated

are fairly representative of 19-year-olds in Östergötland and Örebro Counties and might also reflect the variety of characteristics of 19-year-olds in similar Swedish counties. The prevalence of caries experience (22% with $DSa>0$) registered in the respondents seems to be in accordance with that obtained for the age group in Sweden generally as well as in other Nordic countries. Evidently, adolescents and young adults in Sweden and other Nordic countries have a low caries prevalence (29).

Although the 19-year-olds investigated had relatively good oral health, as evidenced by their clinical dentition status (78.0% $DSa=0$), the global oral health dimensions were still adversely affected owing to problems with teeth and mouth. With few exceptions, however, a majority demonstrated good oral health-related knowledge and reported no experience with problems related to the global oral health dimensions. Differences regarding knowledge of various oral diseases were noted, with participants being better informed about dental caries than about periodontal disease. This might be attributed to their lack of experience of periodontal disease. Only 0.5% of children and young adults in Sweden have some problem with serious periodontal disease (21). Compared with their experience with dental caries, with only 59% of 19-year-olds with $DFSa=0$, this is a low exposure (27). Interestingly, the participants seemed to be better informed with respect to the origins of, and how to avoid, caries than they were regarding the importance of using fluoridated toothpaste. This might be attributed to the fact that fluoridated toothpaste is commonly used in Sweden by 19-year-olds.

That females were less knowledgeable than males on how to avoid periodontal disease, and more knowledgeable than males about the importance of using fluoridated toothpaste is in accordance with previous findings in Swedish adolescents (13). Information as to the level and distribution of oral health-related knowledge has implications for the planning and implementation of caries-preventative strategies in Sweden. In spite of being significantly more knowledgeable about oral health and having less experience with dental caries than their male counterparts, females felt more ashamed and depressed because of problems with mouth and teeth and reported problems with social concerns more often (Tables 3 and 4). For instance, females reported most frequently that they had avoided laughing and that they had felt embarrassed owing to teeth problems. This is in accordance with similar studies

conducted previously in Sweden (28). In general sociodemographic differences in perceived health and oral health have received mixed support in the literature (11, 24). Age and sex differences in perceived oral health might be attributed to differences in expectations, with problems occurring whenever the actuality falls short of expectations regarding oral health (6).

In spite of Östergötland participants having better knowledge, less experience with problems related to social concerns and quality of life, and a greater probability of being satisfied with overall oral health, compared with Örebro residents, they had the greatest prevalence of dental caries (Table 4). Regional differences in perceived oral health reflect variations in severity of oral diseases but also variations in socioeconomic and cultural factors. The associations between dental caries and the various indicators of self-perceived oral health identified in this study were relatively modest and in line with other studies (19).

It should be noted that the four self-reported global dimensions measure problems with mouth and teeth in general and were not restricted to the social and psychological consequences resulting from dental caries. Thus the present discrepancy observed between normatively judged and self-perceived oral health might be attributed, among other things, to problems such as erosion (16). Moreover, in Sweden caries is addressed at an early stage and very few children perceive problems from caries before they receive treatment (22). This situation could make the relevance of assessing social and psychological consequences of dental caries in children, adolescents and young adults questionable (9). Results demonstrating relatively weak associations between professionally- and self-defined oral health status have been reported earlier (3, 22).

By examination of the relationships between all-embracing oral health and clinical and non-clinical variables in a multiple logistic regression model, it was possible to obtain a better understanding of the combined effect of those variables and to compare the influence of each. Although the amount of explained variance was low (27%), suggesting a possible omission of important variables, social variables and those related to the four global oral health dimensions explained 25% of the variance in all-embracing oral health, whereas clinical indicators of dental caries alone accounted for 2% explained variance. Whatever the explanation, these relationships support the theoretical propositions

inherent in contemporary oral health models, that people's overall evaluation of oral health is likely to be shaped by perceived functional, social and quality of life concerns with mouth and teeth, and by their cultural, behavioural and socioeconomic status, as well as by clinically-assessed oral diseases (12). In accordance with similar studies conducted in different sociocultural contexts, the present results suggest that 19-year-olds view their overall oral health status as a multidimensional construct (17).

Conclusions

Four self-perceived global oral health indicators and one clinical indicator of caries status were found to account for the variability in the responses to the overarching oral health indicator, suggesting that at this age social and emotional concerns seem to be important components of overall oral health perceptions. Males and females from different counties emphasised different preferences in this overall oral health perception. From the results of the present study it might be concluded that both clinically- and self-perceived oral health indicators should be considered in comprehensive assessments of the oral health status of 19-year-olds in Sweden.

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Who cares for the oral health of dependent elderly and disabled persons living at home?

A qualitative study of case managers' knowledge, attitudes and initiatives

MARIE-LOUISE HAGMAN-GUSTAFSSON¹, ANNETTE HOLMÉN², ELLA STRÖMBERG³, PIA GABRE¹, INGER WÄRDH⁴

Abstract

© In 1999 a new law in Sweden granted people receiving a certain level of supportive care from the community the right to receive a free, in-home oral health assessment. Subsequent appraisal has disclosed that far from all eligible people, especially those living at home, have undergone such an assessment. Of fundamental importance to the success of this scheme is the active involvement of case managers in identifying those who are eligible for assessment.

The aim of this study was to investigate case managers' knowledge of and attitudes to the oral health of their clients and the initiatives they take to ensure that dependent elderly and disabled persons living at home have access to oral health care.

In qualitative in-depth interviews, 24 case managers from three Swedish counties were questioned about their perceptions of oral health care for their clients. The transcribed text was analysed by manifest and latent qualitative content analysis. The manifest analysis was based on the three content areas *knowledge*, *attitudes* and *initiatives*. During this process a theme emerged which disclosed the case managers' perceptions of their role in oral health care among elderly and disabled persons, a latent analysis.

The case managers' age, education, experience and breadth of responsibilities varied. Their knowledge of the 1999 law was limited. In general there were no procedures in place to ensure that the oral assessments were undertaken and that records were kept. The case managers considered that they should not be responsible, although they could not suggest a more appropriate instance. The potential role of regular oral health assessment in prevention of oral diseases was not discussed at all in the interviews.

The current systems for monitoring oral health are tailored primarily to institutionalised care. In future many more dependent people will continue to live at home with support from community home care assistants and relatives. It is important that oral health care activities, as well as research, are modified accordingly.

Key words

Attitude, elderly, disabled persons, home support, oral health

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Vem sörjer för den orala hälsan hos omvårdnadsberoende äldre och funktionshindrade i eget boende? En kvalitativ studie av biståndsbedömares kunskap, attityder och initiativ.

MARIE-LOUISE HAGMAN-GUSTAFSSON, ANNETTE HOLMÉN, ELLA STRÖMBERG, PIA GABRE,
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Sammanfattning

© En lag om reformerat tandvårdstöd infördes i Sverige 1999. I en särskild tandvårdsförordning regleras landstingens ansvar för att omvårdnadsberoende personer erbjuds en avgiftsfri munhalsobedömning i hemmet. Utvärdering av lagen visar att långt ifrån alla berättigade individer, och då särskilt de som finns i ordinärt boende (kvarboende), har erhållit munhalsobedömning. Avgörande för att en munhalsobedömning skall komma till stånd är att biståndshandläggaren identifierar berättigade personer och överför informationen till tandvården. Syftet med denna studie är att undersöka biståndshandläggares kunskap om och attityder till munhalsovård för äldre och funktionshindrade samt vilka initiativ de tar för att tillförsäkra att personer i ordinärt boende får tillgång till munhalsovård.

I tre svenska landsting undersöktes 24 biståndshandläggares uppfattning om munhalsovård för klienterna genom kvalitativa djupintervjuer. De utskrivna intervjuerna analyserades genom en manifest och latent kvalitativ innehållsanalys. Den manifesta analysen uppbyggdes runt tre innehållsområden, *kunskap*, *attityder* och *initiativ*. Under processen framträdde ett tema som åskådliggjorde biståndshandläggarnas uppfattning om sin roll i munhalsovården för äldre och funktionshindrade personer, en latent analys.

Biståndshandläggarnas ålder, utbildning, erfarenheter och ansvarsområden uppvisade stor variation. De gav uttryck för en begränsad kunskap om lagen. Oftast hade man inga rutiner för att försäkra sig om att munhalsobedömningen utförs hos de omvårdnadsberoende individerna eller för att dokumentera handlingarna. Biståndshandläggarna hade uppfattningen att tandvårdstödet inte var en uppgift för deras yrkesgrupp, utan att ha förslag på lämpligare profession. Munhalsobedömningens möjlighet att förebygga munsjukdomar diskuterades inte alls i intervjuerna. Dagens rutiner är till stor del anpassade till omvårdnadsberoende personer som bor i särskilda boenden. I framtiden kommer fler av dessa individer att bo kvar i sina hem med stöd av hemvård eller anhöriga. Det är viktigt att rutiner för munhalsobedömningens genomförande och forskning- en anpassas till denna utveckling.

Introduction

Throughout the world the number of elderly people is rapidly increasing (25). While Sweden is no exception, it is also experiencing an increase in the number of people with disabilities such as psychiatric disorders, intellectual disabilities and chronic diseases (24). It was estimated that in 2005, 162,000 elderly and disabled individuals were in need of extended daily supportive care (19). In future, more dependent persons will be living at home, with support from relatives and community home care assistants (Fig. 1). Residential care facilities will be limited mainly to the terminally ill, for whom only emergency dental treatment is relevant.

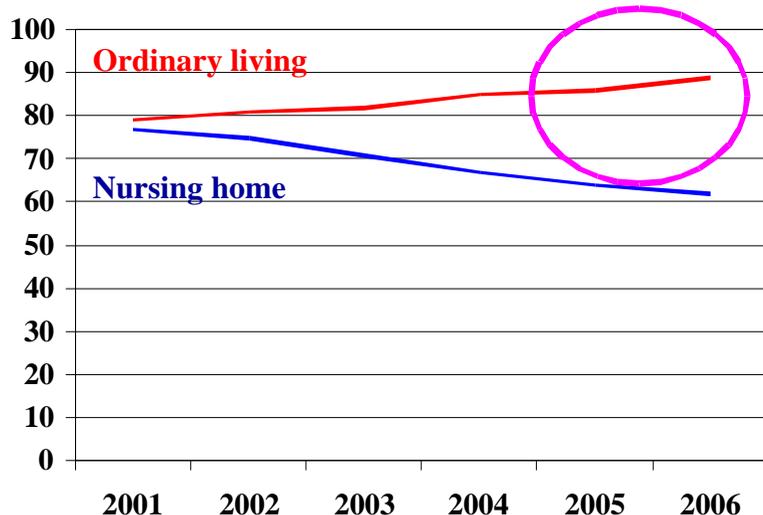
During the past few decades there has been an improvement in the oral health of the elderly. In a study of octogenarians by Hugoson et al (7), the proportion of edentulous individuals decreased from 56 % in 1983 to 3 % in 2003. The oral health of the people with disabilities is poorer than that of the normal population: a Swedish study disclosed that in all age groups, dysfunctional individuals needing daily supportive care had a lower mean number of remaining teeth than healthy individuals (15). Similarly, studies show that institutionalised and housebound elderly people have poorer oral health than active elderly (17). The medically compromised have the highest prevalence of dental problems (12).

As well as causing pain and infection, poor oral health may compromise chewing capacity and the inability to chew may in turn influence nutritional status (14, 16, 18). In 88-year-old Swedes living at home, 24 % reported oral complaints (13).

The need for oral health programmes for the elderly and disabled has been recognised by the WHO (21). Although nursing personnel claim to have a positive attitude towards the oral care of their patients, there seems to be a gap between knowledge and practice (27). Elderly people with dementia and others with cognitive impairments have limited ability to express their own need for dental treatment. In Sweden, legislation came into effect in 1999 giving disabled people receiving supportive care from the community the right to a free, in-home, oral health assessment (22-23). Eligibility was based on the level of supportive care required by the individual. The subsequent cost of meeting dental treatment needs disclosed by the assessment would be subsidised by the county council, with patients paying only a nominal sum, corresponding to the fee for a visit to a hospital outpatient clinic or a consultation with a general medical practitioner. In nursing homes, registered nurses are responsible for identify the eligible individuals, while individuals in ordinary livings mainly will be identified by a case manager. In a nursing home, practically all residents are eli-

Help with daily care

Number per 1000 inhabitants ≥ 65 year



© Figure 1. Number per 1000 inhabitants > 65 years old that receive help with daily care.

Statistics of the Swedish National Board of Health and Welfare 2007

gible but in ordinary livings only those with a high level of supportive care – three times a day and night overview – will be actual. This level has successively been decided to enable the interpretation process when the eligible individuals will be identified (21). However, appraisal of the scheme has disclosed that to date, far from all eligible individuals have received an oral health assessment. Compared with residents in nursing homes, fewer of those living at home have been assessed (24). This could be due to different education disciplines and different legislation prescriptions between registered nurses and case managers where the former follow the Law of Health and sickness and the latter follow the Law of Social welfare. Case managers act upon the expressed will from the individual that needs help and decide if the individual has legal right to have these wishes fulfilled. Registered nurses are educated to look for the whole individual and support a good life style and act to avoid sickness and diseases (1). This could influence the attitudes to oral health care as case managers in general have a social oriented education (2). It has been suggested that working with personnel's attitudes to oral health care probably gives more successful results than if these are denied (26). However, the concept of attitude can be divided into cognition (knowledge), affect (emotion) and behaviour (action) (8).

It is of fundamental importance to the success of the oral scheme that case managers employed by the municipal authorities identify those who are eligible for in home assessment and forward this information to the dental personnel.

The aim of this study was to investigate case managers' knowledge of and attitudes to the oral health of their clients and the initiatives they take to ensure that dependent elderly and disabled persons living at home have access to oral health care.

Material and method

Design

As this aspect of provision of oral health care is previously unexplored, we undertook a multi-centre interview study, designed to disclose case managers' perceptions of their role in the provision of oral health care for their dependent elderly and disabled clients living at home. We also needed to collect background information about the responsibilities and working conditions of case managers.

The qualitative research interview can be described as a dialogue between two participants (interviewer and respondent) who both have interests in

the issue in question (10). Individual in-depth interviews can be used to explore unknown areas or to drill down into a topic, seeking deeper answers to underlying questions and structures. A quantitative method would at this level of our project not have been suitable as we did not have necessary knowledge of the area to make a hypothesis or design a questionnaire (3).

The interview guide was constructed in two sections: the first part required descriptive answers about the respondents' working context and the second part contained open questions about individual perceptions of oral health care for their clients. The questions were structured both in the meaning of content and order but were open to allow the respondents' own choice of words and follow-up questions by the interviewees. The interviewees came from three counties in central Sweden and each interviewer conducted interviews in her own county.

Data collection

Before the data collection started, the local ethics committee approved the study. The three interviewees, 2 dental hygienists and a dental nurse, had experience of the dental reform. They undertook a refresher course in the field of study and training in interview techniques and interview data analysis. The interviewees began with strategic selection of eight case managers from each county, employed by eight different municipal councils and representing both urban and rural areas of varying population. After the subjects had received both written and verbal information and given informed consent, suitable places and times for the interviews were arranged. All but one of the interviews was conducted during working hours at the case manager's office; one interview was conducted in the case manager's home. The interviews, conducted during the spring and summer of 2006, were of about an hour's duration, and were tape recorded and then transcribed verbatim by a trained secretary who was otherwise not associated with the study.

Data analysis

The data on working conditions were analysed by a descriptive and quantitative content analysis, reported both in text and table form. The remaining data were analysed by manifest and latent qualitative content analysis. The manifest analysis comprised the three content areas *knowledge*, *attitudes* and *initiatives*, where each interview text, or unit of analysis, was

separated into these areas. The text was subsequently dissected into meaning units (a group of words or statements that bear the same central meaning). Each interviewer coded the data to this level.

One of the authors with experience in qualitative research (IW) made a continuing analysis and condensed the meaning units further to form codes (a form of label on the meaning units which helps to disclose new and different aspects of the meaning units). The codes were then compared and sorted into sub-categories (threads of meanings), and clustered in categories, which in this study were similar to the three content areas. An answer to the question "What" may be sought under the heading "Categories" (9).

Then followed two days of work involving the entire research group, in order to reach consensus about categories and subcategories and how they were compiled by the codes. All group members had in advance had access to one another's data and analyses. During this process a theme emerged which revealed the case managers' perception of oral health care in dependent elderly and disabled people living at home. Finding a theme is a way of linking together the underlying meanings in categories, or of finding a common strand through condensed meaning units, codes and categories, a latent analysis. The answer to the question 'How' is provided by the theme. All categories and the theme were grounded in the data by a selection of explorative text citations. Examples of the analysis process are given in Fig. 2 and Fig. 3.

© **Figure 2.** Examples of meaning units, condensed meaning units and codes.

Meaning unit	Condensed meaning unit	Code
The information came from different sources and it was different messages	Different messages from different sources	Different messages
It was hard to grasp the information while we do not know how the county is reasoning	Hard to grasp the county reasoning	Different reasoning

© **Figure 3.** Example of codes, sub-categories, categories and the theme.

THEME <u>Not the right instance for decisions about eligibility for dental assessments</u>					
CATEGORY Knowledge					
Sub-categories	Insight into client's dental needs	Confusing information	Lack of identification	Lack of knowledge about oral health assessments	Nutritional problems
Codes	Many natural teeth Staff gives oral care	Different messages Different reasoning	Unspecific mission Lack of knowledge	"Paper" worker Not health aware	Oral dryness Processed food

Saturation

In the common analysis by the total research group, saturation was discussed. The concept originates from the tradition of Grounded Theory (20) and means that continued data collection is no longer adding any further relevant information and can be discontinued. The expression is relative, as it is determined by the scope of the research question and the variation in the researchers' sampling. The research group concluded that much of the collected data was similar in the three counties and that continued collection was unlikely to add any worthwhile information. The study was considered saturated.

Trustworthiness

A key aspect in qualitative research is the process of establishing and assessing the quality of the research. The term trustworthiness is commonly used as a generic term to describe the quality of a qualitative study and consists of credibility, dependability, transferability and confirmability (4).

To achieve credibility, or how well the data address the intended focus, we tried to collect data from participants whose experience of organizing oral health care for elderly and disabled persons varied, but who were all legally responsible for deciding the eligibility of their clients for subsidised dentistry. We also tried to achieve credibility by performing the final analysis in the entire research group where we could share one another's experiences.

Dependability, or to what extent data changes over time and may alter the researcher's judgments, was addressed by minimising the interval between data collection and interpretation. We used the same interview guide and tried to conduct the interviews uniformly and during the same period of time, without excluding the option of comparing data and introducing follow-up questions when this might help to narrow the focus of the research.

Transferability, or to what extent research findings can be extrapolated to a different context, was achieved by clearly describing the research process and context so that the reader could follow the process and decide whether the findings are transferable to other contexts or whether the data might be open to alternative interpretations (5).

Confirmability comprises measures taken to ensure that personal values (bias) did not skew the research findings: it should be possible for other researchers to corroborate the results. This was achieved by carefully documenting each step of the research process.

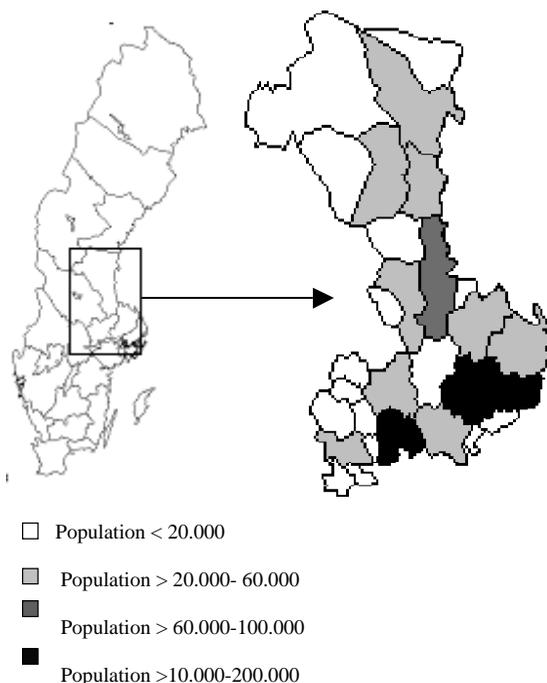
Results

With the exception of one man, all the interviewees were women. The man was younger than the female respondents (28 yr and 31-61 yr respectively). Their experience as case managers and their education varied markedly. A university degree in social work or in nursing was most common, but some also had older educational qualifications at less than university standard. Those lacking university education were older and worked for smaller municipal authorities than those with higher education (Fig. 4). The National Board of Health and Welfare does not stipulate a regulated, formal description of competence for a case manager, but 3-4 years study of social work at university level is recommended. The respondents' case loads varied from 5 to 400. However, some respondents reported only currently active cases as their case load, while others included all cases for which they had supervisory responsibility.

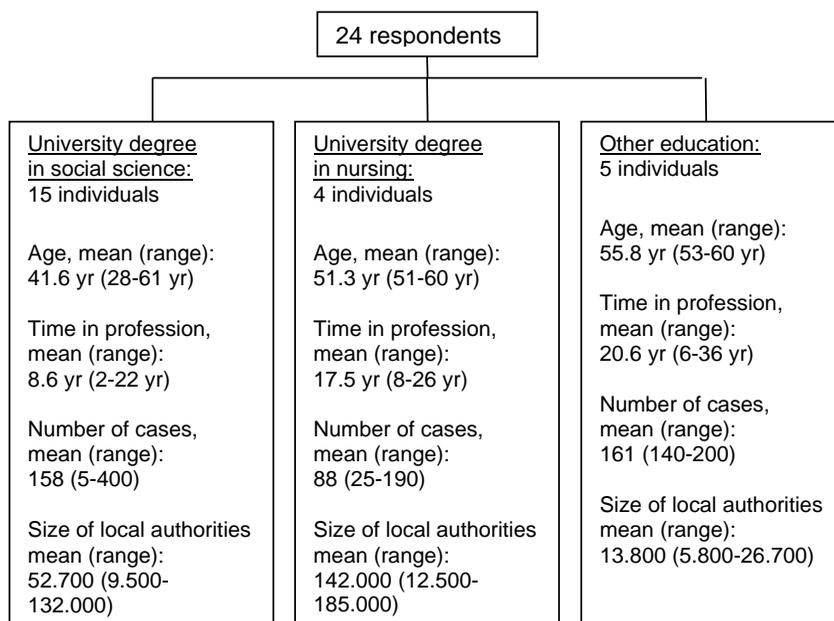
Common working tasks were planning of care, meeting disabled persons and relatives and visiting people who were in need of help on discharge from hospital. The case managers focussed on different groups: elderly with disabilities, intellectually disabled, people with psychiatric disorders etc. The three Swedish counties were divided into 27 municipalities with 10,000 to 190,000 inhabitants (Fig. 5).

In the qualitative manifest analysis process, we started with the three content areas *knowledge*, *attitudes* and *initiatives*, which also became the categories.

© **Figure 5.** A map of the 27 municipal authorities and the population density in the studied counties.



© **Figure 4.** The distribution of the respondents' education, age, years in profession, number of cases and size of the municipal authorities.



Knowledge

This category was built on the subcategories insight into client's dental needs, confusing information, lack of identification, lack of knowledge about oral health assessments and nutritional problems.

Insight into client's dental needs reflects an understanding of the value of the subsidised dental care scheme.

"...I am positive about dental care for the elderly!"

"...Many elderly people have previously cared for their teeth but in old age they are no longer able to do so."

Confusing information describes the problem of different principles involved in care of the elderly.

"We received information from two county representatives and it was very confusing. It's hard to absorb information when there is no consensus at county level."

Lack of identification describes how some respondents in fact excluded clients who qualified for the new dental scheme, simply because these clients lived at home.

"I hadn't realized that we should include those living at home. I was more concerned about those in special care facilities. This was news for me."

Lacking knowledge about oral health assessments deals with ignorance about the procedures involved in an oral assessment.

"I think the client receives information about the options available; I don't think they look in their mouths. I can't imagine that but I don't know. Do they?"

Nutritional problems describe the respondent's reflections over the relationship between oral health status and nutrition.

"...they get fungal infections and find it difficult to swallow and eat..."

"If someone is poorly, it's hard to look after a mouth with sores even though we understand that it's important to make sure the person is getting nourishment. Then you have to give them processed food for a while".

Attitudes

This category was built on the subcategories personal dental experiences, responsibility for the client's oral health, unfair remuneration and the integrity of the clients.

Personal dental experiences describe the respondent's reflection and concern about their own oral health if in future they should become dependent and thus find themselves in the same situation as their clients.

"I'm terrified for my own sake. Who will care for my teeth when I no longer can? I take such good care of my teeth today. This is in fact a very important issue for me".

Responsibility for the client's oral health reflects the respondent's opinions about both the individual responsibility of the nursing staff assisting a dependent person with daily oral hygiene and the overall responsibility for oral health within the dental service.

"Well, if they are receiving support from us and this has included "personal hygiene" then the carer is responsible for providing help but surely the county dental service has overall responsibility for their oral health?"

Unfair/badly constructed remuneration addresses the issue of eligibility: not all elderly and disabled clients can benefit from the new subsidised dental scheme, not only because of restrictive criteria for eligibility, but also due to the limitations of those who handle the cases.

"Some of our clients may not need help at night but need a lot of daytime help. Often there is a spouse living at home who sees to them at night and in that case the client isn't entitled to help from us at night. Only those receiving help from us day and night are eligible for the subsidised dental care."

"It would have been better if eligibility had been based on oral treatment needs".

"Those who nag will receive most benefits".

The integrity of the clients refers to the fact that daily supportive care provided by the municipal council is based on the clients' consent and preferences. The case managers can only provide information and offer help.

"People have quite different opinions about what constitutes a decent quality of life. My duty is to create a balance by offering and informing about available help".

"You can never force someone to accept help, even if you recognise the need. But you can try to create an acceptance and this is true also for oral care".

Some were also of the opinion that some clients might prefer to undergo oral assessment in a dental surgery.

"I think our clients should be able to choose whether they want to be examined at home or at the dental clinic. I think they should be allowed to travel to the dental clinic for examination if they want to and are able to."

"Some are not willing to accept the intrusion of being visited in their homes for oral examination".

Initiatives

This category was built on the subcategories *initiative in determining eligibility for the new dental scheme*, *oral health in nursing planning*, *responsibility and various record keeping procedures*.

Initiative in assessing eligibility for oral health assessments describes reluctance on the part of the respondents, where they prefer await a directive from someone else rather than being proactive or even making their own judgements about the potential benefit of the new scheme to individual clients.

"This offer isn't made routinely even when you are aware that the client is eligible. I must admit that we are bad at informing our clients, though it may come up later."
"Even if I know that they are eligible, I don't write a submission when in my opinion they won't benefit from the offer of oral care". (This excerpt is from a longer statement explaining why the case manager did not always submit an eligibility approval for clients.)

Oral health in nursing planning addresses the view that this topic is often overlooked and is regarded as belonging to daily hygiene routines.

"Oral care is not specified in the written nursing plan. Individual hygiene and oral health care are part of routine general nursing but there is no written description included".

Responsibility addresses the fact that the case managers make decisions and write submissions about eligibility for the subsidised dental scheme but are not responsible for following up and ensuring that assessments are actually undertaken.

"It's important to say that I'm the person to make the decision but I don't carry it out. This is a duty for the organiser of home care assistance".

Record-keeping procedures address the lack of uniformity in documentation about clients' oral health, without clearly defined procedures, or with local routines.

"When I approve a client's eligibility for subsidised dental care I always note this in the client's file, along with the date, the expiry date of the approval and the identifying number on the approval form."

"I do not have a system for keeping records about dental care decisions. I hope and believe that the district nurses write it in the patient journal".

Not the right instance for decisions about eligibility for oral assessments

This emerged as the theme in which all respondents to various degrees expressed negative attitudes towards a somewhat obscure task that had been added to their workload, without proper information

and training and clearly defined procedures.

"To be honest, at first I thought that it was a good idea, now I just see it as extra work without knowing exactly how to go about it".

"At the beginning we were trained to carry out this procedure in a certain way, but as time went by it became less and less clear".

"I wonder if it's right to impose this task on us, even though theoretically our work includes even clients living at home. These decisions aren't easy, there is a lot of discussion among ourselves and we phone you for advice".

"I can't understand why the municipal councils agreed to undertake this task".

The conclusion drawn from these confusing experiences was that someone else should be better qualified to deal with this matter.

"I wonder why we are the ones who have to decide who is eligible and write the approvals, but at the same time I can't suggest who else should be doing it".

"Case managers are wrong people to handle this; it ought to be the district nurses. We don't see the clients, other staff are more knowledgeable than we are".

Discussion

This study was mainly performed as a qualitative content analysis complemented with some quantitative, descriptive base data. The qualitative analysis was made in two parts, one manifest and one latent. A manifest qualitative analysis can be made in different ways but one method is to have predetermined categories where transcribed data will be put in (6). In our study we used three content areas; *knowledge*, *attitudes* and *initiatives* that we judged to be important for the studied phenomenon. These content areas were also present in the interview guide. As different interviewers; two dental hygienists and one dental nurse conducted the interviews, it was important to have a firm structure for the work. The latent part of the study took place when the theme was identified. At that time we all had a solid and as far as possible, similar ground to make consistent interpretations.

All three interviewees had extensive knowledge and experience in this field. The dialogue between the interviewees and the interviewers could have been influenced by pre-understanding, but at the same time this was a prerequisite for asking clarifying and follow-up questions during the interview. During a period before the study started, a critical appraisal of the practical outcome of the new law from 1999 was reported in several media in Sweden. The reports noted that few individuals had received an in-home

oral health assessment, although considerable financial resources remained unused. It is possible that the interviewees were aware of these media reports and prepared themselves before the interviews. Thus, without the media attention, knowledge among the case managers may have been even poorer.

The law from 1999 is administered by the municipal authorities but supervised and financed by the county councils. In the past 12 months, two of the counties have conducted information sessions for case managers in order to ensure that assessments are offered to eligible people. Despite the lack of knowledge disclosed by the interviews, it is probable that this initiative by the county council improved the case managers' knowledge and influenced their attitudes.

The education of the case managers differed in standard and in the field of study. A university degree, especially in social work, seemed to be more common among younger individuals. This is probably because the role of case manager is still evolving. Smaller municipalities tended to have elderly case managers with varying professional backgrounds. It was of interest to note that with respect to the importance of preventing oral disease, those with nursing education gave it no higher priority than those whose background was in social work. The issue seemed more closely related to personality and life experience than to educational background.

That oral disease might be prevented through regular oral health assessment was not mentioned at all in the interviews. Instead, some case managers stated that the absence of oral diseases was a reason for not offering the care-dependent person subsidised dentistry.

The case managers sometimes questioned the fairness of the law, expressing doubt that it identified the really needy individuals. These attitudes were similar to those encountered by Lewin (11) when evaluating a law granting disabled persons support and services. Lewin reported that the social workers reacted in three different ways; they actively supported the disabled persons' needs, ignored their needs or sometimes even counteracted the needs of the disabled individuals. It is crucial to be objective when deciding benefits for others and not to abuse the legislation. To cite one of the respondents: *"It is important that one undertakes a correct evaluation, not only on behalf of the client who has the right to receive this service, but also for the sake of those deemed ineligible, so that this decision is seen to be just, but it is not easy, and one wonders whether this service will continue, because that has not yet been decided, has it?"* The ramifications are greater

than just the right to an oral health assessment because treatment subsidies will also be available. Most people consider dental treatment to be very expensive and subsidised treatment may be come to be regarded as a special privilege.

Another opinion expressed by the case managers was that implementing this law was not an appropriate task for them. *"Case managers are the wrong people to handle this"*. At the same time they could not suggest alternative, more suitable personnel. There was an ambivalent view of the eligibility criteria: they were unclear and hard to interpret, and the interviewees asked for unambiguous rules. On the other hand the case managers thought that the rules were too rigid and did not take into account the real needs of individual clients. The case managers described several professional contacts and networks where difficult questions could be discussed. However, the ultimate decision about eligibility was the responsibility of the case managers alone.

Current systems for providing oral health care for dependent elderly and disabled persons are tailored primarily to meet the needs of those in institutions. It is important that oral health care services are modified accordingly. Future research must address improved access to oral health care for dependent elderly and disabled housebound people. An important step in this work would be the introduction of measures, education and/or improved organisation, to raise awareness among municipal health personnel of the importance of oral health care to the well-being of their clients.

In conclusion, the case managers acknowledged the importance of oral health in elderly and persons with disabilities and the avoidance of pain, infection and a negative influence on nutritional status caused by difficulty chewing and swallowing. However, they reported inadequate preparation for the task of assessing eligibility of clients for oral health assessments under the 1999 law and did not consider it appropriate that this responsibility had been delegated to case managers.

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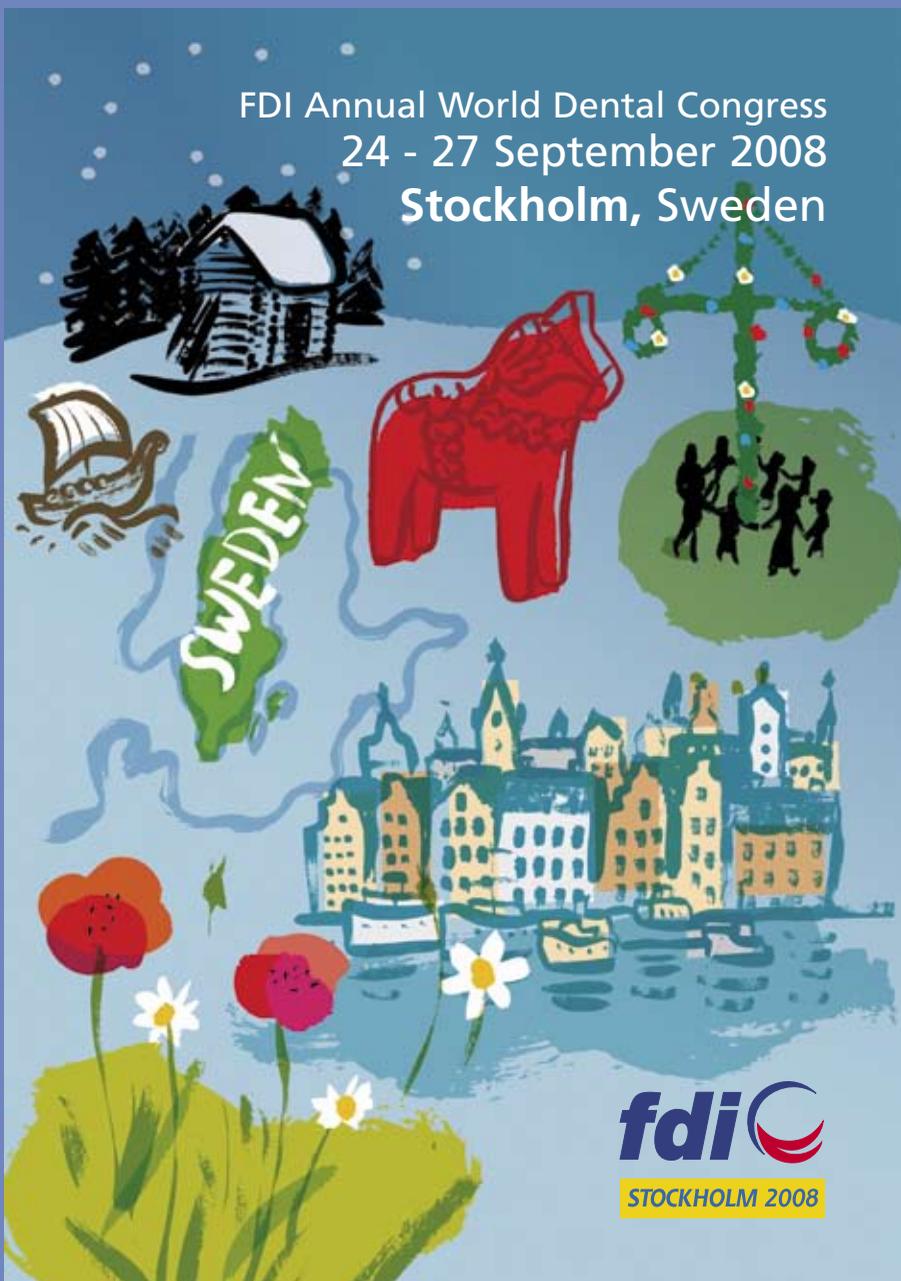
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