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Instructions to authors

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.

The Manuscript

Three complete copies of the manuscript should be sent to the Editor-in-chief Professor Göran Koch at the Editorial address (see beside). The paper should be in English using English spelling, be typed double-spaced with one-inch margins. The format of the manuscript should be arranged as follows:

Title Page, Abstract, Sammanfattning (in Swedish including title), Introduction, Material and Methods, Results, Discussion, Acknowledgements, References, Figures Legends, and Tables.

The letter attached to the manuscript should be signed by all the authors. When the paper has been accepted for publication the author will be asked to supply an updated final manuscript on disk together with two complete manuscripts.

The Title Page should contain in the following order: A concise and covering title, authors' full names (without titles), affiliation(s) of the author(s) including city and country, Key-words (according to Index Medicus and not more than 5), Running title and name and contact information of the corresponding author.

The Abstract should be short and concise and not exceeding 300 words. The Swedish Sammanfattning can be somewhat more extensive.

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In the reference list the references should be arranged in alphabetical order and numbered consecutively by Arabic numerals. Indicate references in the running text by using the Arabic numeral within brackets.

Abbreviations should follow "List of Journals indexed in Index Medicus". (http://www.nlm.nih.gov). Examples of references are presented below.

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Galley proof will be sent to the author and should be returned to the Editor without delay.

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Supplements can be arranged, the full cost beeing paid by the author.
Contact the Editor.

Editorial

The Swedish Dental Association has after thorough consideration, partly due to increasing costs for printing and distribution, decided that Swedish Dental Journal has to undergo some changes. Having had the privilege and pleasure to be the editor-in-chief for more than 40 years (1973-2015) I feel that this is a good opportunity for me to retire giving the new editorial team optimal possibilities to form the future for the journal. All manuscripts which already have been sent to the Journal will be handled in the same way as before and the new editor will be in touch with the authors.

The journal has a long history. It originates from Nordisk Tandläkare-Tidskrift established in 1900 which in 1908 changed to Svensk Tandläkare-Tidskrift. It was printed in Swedish and besides scientific papers it contained proceedings of the activities within the Swedish Dental Society and general information to its members. During the first decades there were some attempts to publish papers in English but with little success. In 1977, the fusion of the Swedish Dental Association and the Swedish Dental Society took place and the "new" organisation of The Swedish Dental Association was formed. Svensk Tandläkare Tidskrift became Swedish Dental Journal, the scientific journal of The Swedish Dental Association. From that time on the Journal was presented in English.

To edit and produce a scientific journal is a team work. Without a well-functioning collaboration and support by the Associate Editors, the Advisory Editorial Board, the Referees, the Editorial Assistant, The Dental Association, the printing office and not least the authors of the scientific papers, the production of SDJ had not been possible. I am deeply grateful to all for giving me continuous support.

The overall goal of SDJ has been to present good research produced by Swedish scientists to the members of the Swedish Dental Association and to an international forum. A strong expression for this strive is also the publication of about 250 Supplements which have been distributed all over the world. The impact factor has been around 1 through the years. This has to be considered good for a journal, with a limited number of published papers a year and presenting a broad spectrum of topics within odontology.

Finally I wish the new editor and team all the best for the future and hope that they will find the editorship as inspiring and rewarding as I have done.

Göran Koch
Editor

40 years is a long time. Equivalent to the whole professional life for most of us. For so long Göran Koch has been the primus motor, the engine of the Swedish Dental Journal. Neither I, nor most other dentist in Sweden, have ever experienced any other editor. As President of the Swedish Dental Association, I feel deep gratitude for the work Göran Koch and his team have devoted to Swedish dental care during all this time.'

The Swedish Dental Journal may be a small journal in an international perspective. But it has over the years been an important channel for Swedish research. The efforts of Göran Koch and Secretary Sylvia Johansson have been of crucial importance for the periodicals existence.

To find the successors for Göran and Sylvia has been challenging and still everything about the future is not fully determined.

In order to review our different options we push pause and suspend continuous operations and introduce a temporary last script date for July 1 st 2015. Manuscripts submitted before this date will be handled by a team appointed by the Swedish Dental association. The submitted manuscripts will be assessed and delt with as before and the Swedish Dental Journal is scheduled to be published as a periodical throughout 2015.

More information on what steps the Swedish Dental Journal will take the next years will be presented in future issues of the Journal.

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President of the Swedish Dental association

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Oral health of individuals aged 3–80 years in Jönköping, Sweden, during 40 years (1973–2013)

I. Review of findings on oral care habits and knowledge of oral health

Ola Norderyd[1, 2], Göran Koch[1], Apostolos Papias[1], Alkisti Anastassaki Köhler[1], Anna Nydell Helkimo[1], Carl-Otto Brahm[1], Ulrika Lindmark[3], Ninita Lindfors[1], Anna Mattsson[4], Bo Rolander[5], Christer Ullbro[1,6], Elisabeth Wärnberg Gerdin[7], Fredrik Frisk[1]

Abstract

◉The aim of the this study was to present data on oral care habits and knowledge of oral health in 2013, and to compare these data with results from a series of four previous cross-sectional epidemiological studies. All these studies were carried out in the city of Jönköping, Sweden, in 1973, 1983, 1993, 2003, and 2013. The 1973 study constituted a random sample of 1,000 individuals evenly distributed in the age groups 3, 5, 10, 15, 20, 30, 40, 50, 60, and 70 years. The same age groups with addition of a group of 80-year-olds were included in the 1983, 1993, 2003, and 2013 studies, which comprised 1,104; 1,078; 987; and 1,010 individuals, respectively.

A questionnaire about dental care habits and knowledge of oral health was used. The questionnaire contained the same questions in all the five studies, although some had to be slightly modernised during the 40-year period.

During the period 1973–2013, a continous increase of individuals in the age group 20–60 years were treated by the Public Dental Service amounting to about 50%. Almost 70% of the 70- and 80-year-olds were treated by private practitioners. In 2013, 10–20% of the individuals in the age groups 30–40 years did not regularly visit neither Public Dental Service nor a private practitioner. The corresponding figures for the individuals 50–80 years old were 4–7%. Similar number of avoidance was reported in the previous studies.

In the survey 2013, about 20–30% of the individuals in the age groups 20–50 felt frightened, sick, or ill at ease at the prospect of an appointment with the dentist. These findings were in agreement with the results from the surveys 1973–2003. Among the younger age groups, 10–15 years, a reduction in self-reported "ill at ease" was found in the surveys 2003 and 2013 compared to the previous surveys in this series.

In 2013, the knowledge of the etiology of caries was known by about 60% of the individuals which was similar to that reported 1973–2003. Twenty per cent of the individuals stated that they did not know which etiological factors that causes caries. This percentage was equivalent during the period 1973–2013. About 85% of the individuals in all age groups brushed their teeth with fluoride tooth paste at least two times a day. These frequencies have gradually increased during the 40-year period.

Around 40% in the age groups 50–80 years used toothpicks regularly in 2013. This is a about 1/3–1/2 less compared to 2003. In the age groups 20–40 years 3–14% used toothpicks for proximal cleaning in 2013.

In 2013, about 35% of the individuals never consumed soft drinks, in comparison with 20% in 2003. In the age groups 3–20 years about 20% were consuming soft drinks every day or several times a week, which is a reduction by half compared to 2013

Key words

Epidemiology, oral health survey, knowledge of oral health, dental care habits

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Tandhälsoförändringar hos 3–80-åringar i Jönköping under 40 år (1973–2013)

I. Resultat från enkätstudier om tandvårdsvanor och kunskap om tandhälsa och tandsjukdomar

Ola Norderyd, Göran Koch, Apostolos Papias, Alkisti Anastassaki Köhler, Anna Nydell Helkimo, Carl-Otto Brahm, Ulrika Lindmark, Ninita Lindfors, Anna Mattsson, Bo Rolander, Christer Ullbro, Elisabeth Wärnberg Gerdin, Fredrik Frisk

Sammanfattning

◉ Syftet med denna studie var att jämföra munvårdsvanor och kunskap om munhälsa i en serie av fem epidemiologiska tvärsnittsundersökningar. Dessa utfördes i Jönköpings stad 1973, 1983, 1993, 2003 och 2013. Undersökningen 1973 bestod av ett slumpvis urval av 1000 individer jämnt fördelade i åldersgrupperna 3, 5, 10, 15, 20, 30, 40, 50, 60 och 70 år. Samma åldersgrupper med tillägg av åldersgruppen 80 år inkluderades i undersökningarna 1983, 1993, 2003 och 2013 som totalt bestod av 1104, 1078, 987 respektive 1010 individer.

Ett frågeformulär om munvårdsvanor och kunskap om munhälsa användes. Formuläret innehöll samma frågor i alla fem delstudierna, men en del av frågorna hade moderniserats något under 40-årsperioden.

Under 1973 – 2013 sågs en fortgående ökning av individer i åldersgrupperna 20 – 60 år som behandlades inom den offentliga tandvården. Nästan 70 % av 70- och 80-åringarna behandlades inom privattandvården. Tio till tjugo procent av 30- och 40-åringarna gick inte regelbundet till tandvården 2013. Motsvarande siffror för 50 - 80-åringar var 4 – 7 %. Liknande tandvårdsundvikande beteende sågs även i de tidigare studierna.

I undersökningen 2013 upplevde 20 – 30 % av 20 – 50-åringarna rädsla, illamående eller obehag inför tandläkarbesök. Dessa fynd överensstämmer med resultaten 1973 – 2003. I de yngre åldersgrupperna 10 – 15-åringar sågs en minskning av självrapporterad känsla av obehag inför tandläkarbesök i undersökningarna 2003 och 2013 jämfört med tidigare.

Kunskap om kariesetiologi var god hos ungefär 60 % av individerna 2013, liknande resultaten från undersökningarna 1973 – 2003. Tjugo procent uppgav att de inte visste vilka faktorer som orsakar karies och detta var oförändrat 1973 – 2013. Ungefär 85 % i alla åldersgrupper borstade sina tänder med fluortandkräm två gånger dagligen. Denna frekvens har ökat gradvis över 40 år.

Omkring 40 % i åldersgrupperna 50 – 80 år använde tandsticka regelbundet 2013. Detta är en minskning med 1/3–1/2 jämfört med 2003. 2013 använde 3 – 14 % av 20 – 40-åringarna tandsticka regelbundet för approximal rengöring.

Ungefär 20 % av individerna drack aldrig läsk 2003 och 2013 var motsvarande siffra 35 %. Denna förändring var mest uttalad i de yngsta och de äldsta åldersgrupperna. 2013 drack ungefär 20 % av individerna läsk dagligen eller flera gånger i veckan vilket var en halvering jämfört med 2003.

Introduction

Repeated epidemiological surveys on oral health and oral health behaviour can properly performed and interpreted form the basis for an assessment of oral health development in a population. Based on epidemiological results, resource allocation for oral health promotion, preventive strategies, and oral care can be planned and organized to form effective dental care systems.

Oral health in a population depends on several factors. Microbial plaque and diet are important etiological factors for oral diseases such as periodontitis and caries. Also, salivary factors, use of fluorides, general health, environment, and genetic factors are all involved in the process of development of oral diseases. These factors are largely influenced by individual as well as public attitudes to oral health and oral health-related behaviour as well as knowledge. In addition, accessibility to dental care, clinical diagnostic levels, treatment planning and procedures, as well as financial and organisational factors have considerable influence on oral health in a population.

Before the introduction of systematic preventive measures in the early 1970s, the oral health situation in Sweden was poor, i.e. extensive caries, periodontitis, tooth loss, and wide-spread edentoulousness (15). Most of the resources were used in restorative treatment instead of being used for controlling the progression of caries and periodontitis.

Epidemiological studies have been performed in Jönköping, Sweden, since 1973. The studies were initiated in order to asses oral health in the population prior to implementing systematic preventive measures, and also to determine changes in oral health. In addition to clinical and radiographic examinations, questionnaires on dental care habits and attitudes, and diets have been used. The first study in 1973 covered the age groups 3–70 years. In 1983, 1993 and 2003, the studies covered the age groups 3–80. A remarkable improvement of oral health and decrease in dental diseases were observed between the years 1973 and 2003 (13).

In the surveys 1973–2003, dental care habits, dental behaviour, sense of coherence, quality of life, as well as knowledge of of oral health were studied by use of extensive questionnaires. This resulted in an increased knowledge of patient related factors that determine or influence oral health behaviour (12).

The aim of the present study was to evaluate oral care habits and knowledge of oral health in 2013 in a cohort of individuals age matched to the studies in 1973, 1983, 1993, and 2003 by use of the same questionnaires as in the earlier studies. A further aim was to study changes in oral health care habits and knowledge in the population during the period 1973–2013.

Materials and Methods

Jönköping is a medium-sized Swedish city with about 131,000 inhabitants in 2013. The population is somewhat younger than the Swedish population as a whole. About 14% of the inhabitants in Jönköping are born abroad, the majority in the other Nordic countries, Iraque, and in former Yugoslavia. The city is situated in southern Sweden and characterized as the administrative centre of the region as well as a centre for industry, commerce, transportation, and education.

In Jönköping, as in Sweden on the whole, dental care is provided by general dental practitioners, who are either employed by the Public Dental Service or work in private practices. Dental treatment is easily accessible and subsidized by a national insurance. However, while publicly employed dentists treat both children and adults, private practitioners treat mainly adults.

Sample

All invited individuals in this study were inhabitants in either of four parishes of Kristine, Ljungarum, Sofia, and Järstorp, in the city of Jönköping, Sweden. The same parishes were used for the selection of samples in the previous surveys in this series (1973, 1983, 1993, and 2003). In 1983, 1993, 2003, and 2013, 130 randomly selected individuals in each of the age group of 3, 5, 10, 15, 20, 30, 40, 50, 60, 70, and 80 years, were invited to an oral examination. In 1973 a random sample of subjects were invited resulting in 100 examined individuals in each age group (Table 1). In all studies, a number of invited individuals could not be reached or refused to take part in the examinations for different reasons and the situation in 2013 is shown in Table 2. To secure enough participants an additional sample had to be invited in 2013. For the age groups 3, 5, 10, 15, 30, 40, and 50 years, additional samples of 15, 15, 15, 55, 40, 40, and 50, respectively, were randomly selected and invited. The final number of the participants is presented in Table 1 for all five surveys.

All individuals selected for the 2013 survey received a personal invitation by letter and were, whenever possible, also contacted by phone. Concerning the age groups 3, 5, and 10 years the invitations were sent to the parents, and for the 15-year-olds both the child

◎ **Table 1.** Number of subjects examined and sex distribution in each age-group 1973, 1983, 1993, 2003, and 2013.

Agegroup	Number examined									
	1973		1983		1993		2003		2013	
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
3	49	51	59	42	47	53	59	37	40	61
5	47	53	42	66	58	49	45	51	46	46
10	48	52	46	65	67	47	58	58	37	58
15	55	45	55	52	51	51	51	45	49	52
20	60	40	55	45	50	50	38	46	52	23
30	49	51	46	50	63	39	50	42	49	47
40	52	48	52	47	54	39	36	47	49	46
50	60	40	60	43	45	52	50	41	59	45
60	60	40	47	51	50	42	45	45	42	40
70	52	48	51	48	36	64	47	41	53	39
80			50	30	34	37	40	21	39	38
Total 3–80	532	468	565	539	555	523	519	468	515	495

◎ **Table 2.** Individuals in each age group in 2013 who for various reasons declined to participate in the study.

Age group											Reasons
3	5	10	15	20	30	40	50	60	70	80	
14	10	14	26	22	54	52	42	20	3	4	Could not be reached by letter or telephone
							2	1			The time was inconvenient
5	8	4	1	25	15	3	2	1	1	2	Moved
				1	1		4	4			Could not leave work
	1				1	1			2	2	Dental anxiety
		5	4		1	2	7	1		1	Had recently visited his/her dentist
								1	1	2	Have no own teeth – therefore nothing to examine
	1					1	4	2	9	21	Seriously ill, handicapped, senile
										3	Deseased
										3	Does not speak Swedish
22	32	25	52	6	3	14	15	17	21	15	No special reason. Not interested. No time
41	52	48	83	54	75	73	76	47	37	53	Total number of non-respondents
28	36	33	45	42	44	43	42	36	28	41	%

and the parents received the invitation. All were informed of the purpose of the investigation, that an oral clinical and radiographic examination would be performed, and that they would be asked to fill in a questionnaire concerning oral care and related factors. If the individual recently had undergone a dental radiographic examination these radiographs were required from their own dentist. They were also informed that the examination would be free of charge and that the radiographs would be at the disposal of their dentist and that participation was voluntarily. Any oral disease found at the examination was informed verbally to the individual and if requested also communicated to their own dentist. If an individual was physically unable to come to the examination, suitable means of transportation were arranged. All documents and radiographs were handled as to guarantee anonymity for each individual.

No compensation was offered for participation.

The clinical examinations in 2013 were performed by eight dentists at the Departments of Paediatric Dentistry, Periodontology/Endodontics, Prostho-

dontics, Stomatognathic Physiology, and Oral Medicine at the Institute for Postgraduate Dental Education, and by three general practitioners from the Public Dental Health Service, in Jönköping, Sweden. In 1973, 1983 and 1993, the examinations started at the beginning of the year and were completed within two months. For the 2003 survey, examinations began in September 2003 and were completed in the beginning of 2004. The examinations for the latest survey were performed between autumn 2013 and autumn 2014.

Throughout the study, the ethical rules for research described in the Helsinki Declaration (5) were followed. The 2013 survey was approved in 2012 by the Ethic Committee at the University of Linköping, Linköping, Sweden (Dnr 2012/191-31).

Questionnaire

In connection with the clinical examination, the participants were asked to answer an web-based questionnaire including self-reported answers about demographics, oral care habits, and knowledge of oral health. The same questionnaires were used in all the five investigations. The questionnaires in 2013, were principally the same as those used in the previous four investigations in this series of surveys (12). A few queries were modified or removed in 2013 in order to keep the terms and theoretical background of the questionnaire updated. In this study, oral care habits, dental care visits (public or private), reason for visits, oral hygiene habits (toothbrushing frequency, toothpicks), dietary habits, and use of fluoride toothpaste, were covered. Also, questions concerning knowledge of oral health and disease; aetiology about caries, were asked. For the age groups 10–80-year-olds the questionnaire contained about 100 questions.

The questions were age adapted for children, adults, and edentulous individuals. The questionnaires for the 3- and 5-year-old children were answered by the children's parents. The queries were arranged so as to prevent, as far as possible, one question being influenced by the others. The response options were mainly close-end questions, multiple choice, scale questions, and a few open-end questions. The participants answered the questions undisturbed in a separate room.

Results

Respondents and non-respondents

Not all of the selected individuals who could be reached accepted to participate in the study. The overall participating rates were 77% in 1983, 75% in 1993, 69% in 2003 and 61% in 2013. In all, 1,010 individuals participated in the 2013 study. The number of subjects and sex distribution participating in each age group are presented in Table 1.

The number of non-respondents was similar in 1983 and 1993 and was higher in 2003 and 2013. The reasons for not participating were registered (Table 2). Detailed information about participants, number of non-respondents and reasons for not participating in 1983, 1993, and 2003 have been published earlier (10, 11, 12, 15).

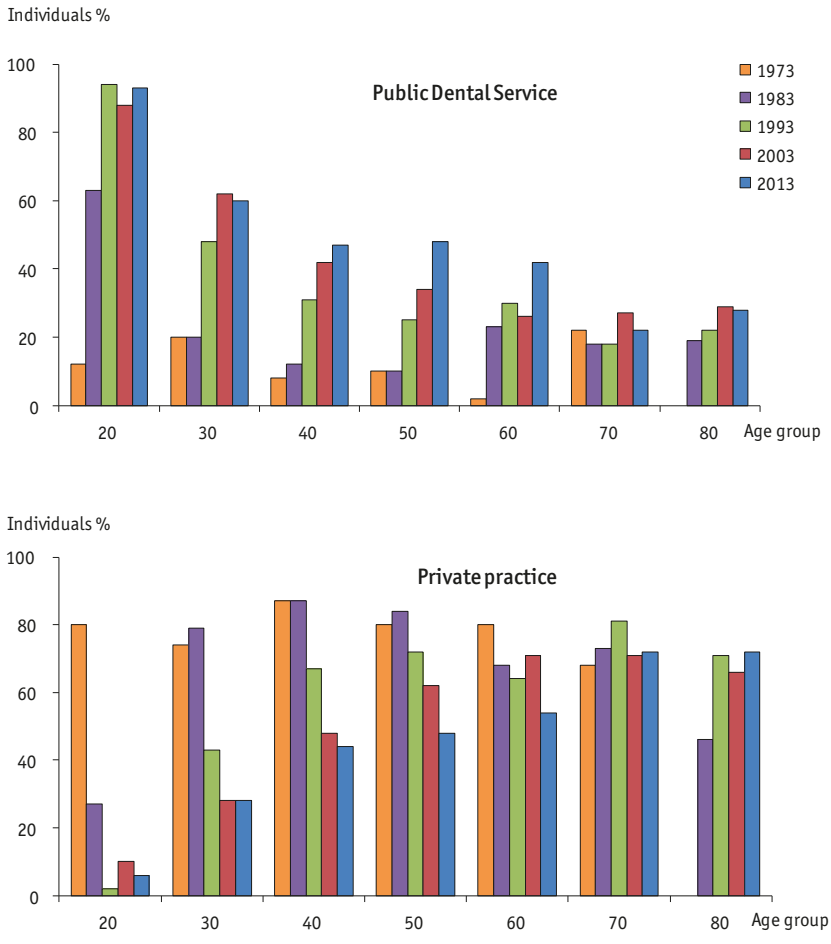
In the 2013 study, approximately 90% of the individuals in all age groups who answered the questionnaires were born in Sweden. About 32% of the mothers and/or fathers of the children in the age groups 3–15 years were born outside Sweden. These figures corresponds to findings in 2003.

Oral health habits

In 2013, almost all children aged 3–15 years received their dental care within the Public Dental Service. In Figure 1, the frequencies of dentate individuals 20–80 years who received dental care in the Public Dental Service and by private practitioners in 1973, 1983, 1993, 2003, and 2013 are presented. In the 20-year-old group, 14% of the individuals received dental care in the Public Dental Service in 1973 compared to 93% in 2013. An increase in percentage of individuals treated by the Public Dental Service was seen in the total adult population up to 60 years during the period 1973–2013 (Figure 1). Among 50- and 60-year-olds there is an increase of individuals treated by the Public Dental Service between 2003 and 2013. The majority of the adults from 60 years of age were treated by private practitioners. In 2013, 10–20% of the individuals in the age groups 30–40 years did not regularly visit a dental clinic. The corresponding figures for subjects 50–80 years were about 4–7%.

The percentage of subjects who *felt frightened* (2–17), *sick* (0–9), or *ill at ease* (10–47) at the prospect of an appointment with the dentist remained more or less unchanged during the 40 years covered by these surveys (Table 3). The only exception were in the younger age groups, 10- and 15-year-olds, where individuals feeling *ill at ease* at the prospect of an appointment with the dentist were reduced from more than 30% in 1973 to about 10% in 2013.About 30% of individuals in the age group 20–80 felt, in 2013, frightened, sick, or ill at ease at the prospect of visiting a dentist.

◉ **Fig. 1.** Question: Where do you receive dental care? Frequency (%) of dentate individuals in 1973, 1983, 1993, 2003, and 2013, receiving dental care in public dental service and private practice.



Knowledge about oral health and dental diseases

More than half of the subjects in 1973, 1983, 1993, 2003, and 2013 were aware of the fact that bacteria and sugar are the main sources for acid formation responsible for the development of carious lesions (Table 4). The number of individuals giving the wrong answer about this question or not knowing is 28–49% in the different age groups in 2013.

In Table 5, data on toothbrushing frequency in all age groups is presented. Oral health behaviour has improved since 1973 and in 2013 almost all of the subjects in the study were brushing their teeth once or twice a day and most of them answered that they used fluoride toothpaste.

In 2013, the overall regular use of tooth picks was about 30% (Figure 2). During the last 10-year period the regular use of tooth picks was reduced by about 20–50% in the age groups 50–80 years.

In-between-meal snackings are reported in Table 6. The frequency of snacking between meals was lower in 2013 compared to 2003 in the age group 3–20 years. In Table 7, the frequency of soft drink consumption in 2003 and 2013 is presented. In the age groups 3–20 years about 40% were consuming soft drinks everyday or several times a week in 2003. In 2013, the number of individuals 3–20 years consuming soft drinks regularly was reduced by half. The percentage of individuals in all age groups never drinking soft drinks increased between 2003 and 2013.

Table 3. Question: What do you feel at the prospect of an appointment with a dentist? (Possible to answer with several alternatives.)

Agegroup	Frightened (%)					Sick (%)					Ill at ease (%)				
	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013
10	9	5	8	7	8	0	2	2	1	1	35	28	28	12	11
15	7	6	2	4	3	2	2	0	1	0	32	24	20	11	10
20	14	13	9	8	8	9	5	2	5	4	40	35	23	24	24
30	9	14	15	9	17	1	6	2	3	9	39	47	34	33	37
40	14	14	8	12	9	4	7	7	5	8	43	37	39	37	19
50	7	13	10	10	7	3	3	4	4	3	30	37	46	33	23
60	3	6	8	7	10	1	1	3	2	2	30	23	30	34	17
70	3	4	7	4	4	2	0	3	2	2	22	13	13	27	27
80		6	3	11	7		3	0	0	0		9	8	18	16

Agegroup	Unaffected (%)					Full of expectation (%)					No answer (%)				
	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013
10	34	46	68	51	56	6	30	42	30	34	16	0	0	0	2
15	34	58	72	63	68	13	14	27	23	15	12	0	0	0	4
20	41	51	65	53	61	11	27	27	29	22	0	0	0	0	1
30	44	38	54	44	45	7	12	21	26	21	0	0	0	0	2
40	41	44	50	40	50	6	18	21	11	20	0	0	0	0	2
50	53	52	52	41	51	7	9	26	17	23	0	0	0	0	2
60	57	60	70	44	54	9	23	13	31	20	0	0	0	0	4
70	59	70	68	48	50	13	40	22	36	23	1	0	0	0	1
80		82	84	48	49		27	36	32	34		0	0	0	3

Table 4. Question: Is the acid that gives caries formed from food and saliva, saliva and sugar, or bacteria and sugar?

Agegroup	Food and saliva(%)					Saliva and sugar (%)					Bacteria and sugar (%)					Do not know (%)				
	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013
3	13	15	18	8	13	8	12	10	16	7	65	55	58	43	54	14	18	14	31	26
5	10	19	19	17	13	10	9	12	8	9	62	59	56	55	58	18	13	13	17	21
10	7	7	6	6	2	8	9	5	7	14	75	66	67	65	60	2	18	22	17	24
15	8	5	6	6	5	15	15	12	13	11	75	60	62	66	72	2	20	20	13	12
20	18	7	14	5	9	9	23	17	6	13	50	50	51	59	53	23	20	18	30	25
30	20	11	20	13	19	9	11	13	16	9	60	53	50	49	51	11	25	16	21	21
40	20	13	20	15	19	6	7	7	14	10	56	68	54	48	60	17	12	19	22	11
50	17	15	21	11	11	8	6	12	10	13	53	57	48	64	62	22	22	19	15	13
60	18	8	20	19	15	5	9	12	9	10	63	64	52	61	54	17	19	16	20	20
70	6	4	12	15	16	2	7	5	8	9	52	59	63	58	61	40	30	20	19	14
80		0	5	11	9		3	8	5	7		53	63	59	65		46	24	25	17

◎ **Table 5.** Question: How often do you (does your child) brush your (his/her) teeth?

Agegroup	Several times a day (%)					Twice a day (%)					Once a day (%)				
	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013
3	15	4	2	0	1	27	49	65	80	84	19	41	30	17	13
5	9	5	4	0	3	34	51	64	73	80	24	40	28	18	13
10	16	5	5	3	2	63	77	84	82	90	14	17	11	14	5
15	15	8	7	2	1	71	81	71	79	89	10	10	17	12	9
20	26	21	15	12	4	56	74	72	77	80	12	5	12	6	15
30	28	24	13	9	4	59	72	71	83	78	8	4	15	6	16
40	30	29	10	14	11	47	65	81	67	82	19	4	8	12	4
50	31	29	27	12	10	49	56	60	75	82	11	14	13	9	5
60	34	27	37	13	9	43	59	50	80	78	21	12	10	4	10
70	40	28	41	21	17	41	59	53	69	75	8	12	5	9	5
80		33	28	32	14		46	46	57	66		18	26	7	16

Agegroup	Now and then (%)					Never (%)					No answer (%)				
	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013
3	27	5	2	1	2	4	1	1	0	0	8	0	0	2	0
5	26	4	5	5	3	2	0	0	0	0	5	0	0	3	0
10	4	1	1	1	2	0	0	0	0	0	3	0	0	0	0
15	2	1	5	5	1	0	0	0	0	0	2	0	0	0	0
20	1	0	1	5	1	0	0	0	0	0	5	0	0	0	0
30	0	0	1	1	0	0	0	0	0	0	5	0	0	0	1
40	2	2	2	4	0	0	0	0	0	0	2	0	0	0	3
50	1	1	0	2	0	2	0	0	0	0	6	0	0	0	3
60	2	2	4	0	0	0	0	0	0	0	0	0	0	0	4
70	3	1	0	1	0	0	0	1	0	0	8	0	0	0	2
80		3	0	0	0		0	0	2	0		0	0	0	4

◎ **Fig. 2.** Question: Do you use toothpicks regularly? Positive answer.

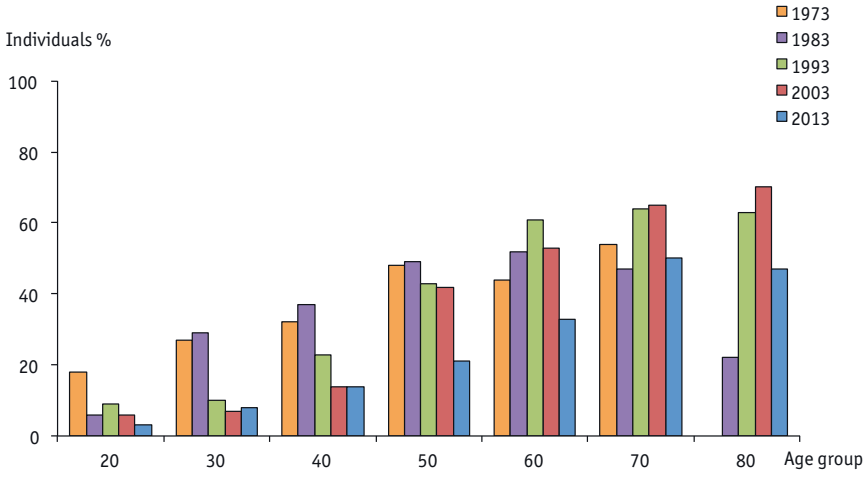


Table 6. Question: Do you eat buns, biscuits etc. between the main meals?

Agegroup	Every day (%)					Often (several times/week) (%)					Sometimes (%)					Never (%)				
	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013
3	10	4	4	3	1	4	9	19	30	19	77	79	74	63	77	8	8	3	2	1
5	5	6	3	4	1	7	12	23	22	11	78	77	73	72	84	8	2	1	2	3
10	3	6	8	6	1	3	13	25	20	17	78	76	61	65	76	14	5	6	7	4
15	7	10	10	12	3	18	19	21	34	18	66	69	65	49	70	9	2	4	3	8
20	5	8	13	11	1	13	22	33	30	22	79	68	52	55	61	2	2	2	2	16
30	11	8	11	6	7	9	26	29	19	20	68	61	57	70	69	10	4	3	4	5
40	13	22	16	9	5	5	14	23	19	17	67	58	58	62	71	11	4	9	7	7
50	12	21	19	7	4	1	17	13	20	21	58	56	59	67	62	28	6	10	6	10
60	10	17	7	7	7	2	12	13	12	6	64	56	66	68	65	24	15	13	9	20
70	13	17	25	21	5	3	9	4	13	19	37	59	62	56	61	37	12	9	11	14
80		18	18	14	21		6	10	23	17		50	59	55	51		21	13	5	11

Table 7. Question: Do you drink soft drinks?

Age group	Every day %		Often (several times/week) %		Sometimes %		Never %	
	2003	2013	2003	2013	2003	2013	2003	2013
3	2	0	25	6	60	73	11	21
5	7	2	18	4	70	71	5	23
10	3	1	17	11	70	69	9	20
15	11	8	34	16	47	60	6	15
20	16	4	30	22	49	59	4	13
30	4	7	18	9	64	55	12	28
40	5	3	16	7	49	59	26	31
50	1	4	4	5	53	38	39	50
60	2	2	1	5	60	27	34	62
70	4	1	5	2	61	29	31	65
80	4	1	5	3	55	44	34	51

Discussion

The present study is the fifth in a series of epidemiological investigations within the population of the city of Jönköping, the first of which was performed in 1973. The individuals in the study constituted a random sample of the inhabitants where the majority of the individuals were born in Sweden. The ethnic composition of the sample is similar to that of the Swedish population as a whole (31). The studies from 1973 to 2013 cover a 40-year period and provide the opportunity to analyze changes over time in oral health as well as dental care habits and knowledge of oral health and disease. Several epidemiological studies have been presented in Sweden in recent decades (3, 6, 7, 8, 9, 14, 20, 21, 22, 25, 26, 30, 34, 36, 38, 39). No investigations, however, has repeatedly covered all ages from 3 to (70) 80 years during a 40-year period.

In 2013, the non-respondent rate was higher than in the earlier surveys. 1973–1993, the non-respondent rate was 15–25% but had in 2013 increased to 28–45% depending on age group. This is a problem which can violent the representativity of the material. The found unwillingness to take part in time consuming clinical/interview investigations is unfortunately a wide spread problem in modern society. There is a trend among people not to answer telephone calls from unfamiliar numbers suspecting telephone sales companies. There also seems to be a tendency of being bored of inquiries and requests to take part in different investigations. This has been documented

in other investigations (6, 20). At the same time we have to accept these facts in today's clinical research. However, the effect on the outcome in the present study is considered to be limited as most of the other variables and tendencies seems to be constant during the 40-year period.

The present study is based on self-reported questionnaires covering items on perceived oral health, knowledge, attitudes, and oral behaviour. It is generally agreed that self-rated health is valid (4). The validity of self-reports has also been demonstrated in previous studies on oral conditions (27, 37).

During the 1970s and 1980s, the resources and capacity of the Public Dental Service increased. In addition to treating children, increasing numbers of adults could also be taken care of. In 1993, 2003, and 2013, a further increase in the number of adults being treated by the Public Dental Service could be seen in the age groups 20–50 years (Figure 1). This change in relation to number of patients treated within the Public Dental Service can be explained by improved oral health in children and adolescents, which has made more resources for the treatment of adults in the Public Dental Service available. In the younger adults 20–40 years in 2013, it was shown that a higher percentage of those individuals are treated within the Public Dental Service. Among the 50-year-olds an equal percentage of patients can be seen treated either within the Public Dental Service or by private practitioners. There is an increase of 60-year-olds treated within the Public Dental Service and a corresponding reduction in patients treated in private practice in this age group. The increasing interest for Public Dental Service could be explained by a new payment system with the fees based on oral health levels. However, the majority of adults 60 years of age and older are being treated by private practitioners.

Although oral health has dramatically improved since 1973, there is still a high percentage of individuals in the age groups 20–80 who feel frightened, sick, or ill at ease at the prospect of visiting a dentist, in the 2013 survey. This is a challenge for the dental profession and more efforts should be made to improve this situation. Research and education in the field of dental anxiety and behaviour management are thus important.

It is remarkable that the knowledge of the etiology of caries has not increased during the 40-year study period despite all professional information given in schools and at dental visits. This may reflect the limited perceived need for knowledge when good oral health behaviour has been established. Oral health behaviour has improved since 1973, and almost all of the individuals in the study in 2013, were brushing their teeth once or twice a day and most of them used a fluoride toothpaste. However, the results from the present study are presented at general level and do not reveal information on subgroups in society.

In 2013, a reduction in regular use of toothpicks in the age groups 50–80 years was noted compared to 2003, while in the younger age groups, 20–40 years, only a limited number of the individuals (3–14%) used toothpicks for proximal cleaning. Unfortunately, there was no question about proximal tooth cleaning with interdental brushes, which individuals today frequently are advised to use. This could explain the low percentage of individuals who answered that they performed proximal cleaning.

The frequency of snacking between meals was lower in 2013 compared to 2003 in the age groups 3–20 years. Also, the number of individuals 3–20 years regularly consuming soft drinks were reduced in 2013 compared to 2003. This could be a reflection of the multidisciplinary work within health care concerning healthy dietary habits. It is a positive change in health-related behaviour since a high soft drink comsumption pattern has been regarded as an additional risk for the development of dental caries and dental erosions (18, 19, 23, 33).

In conclusion, changes over 40 years in a well-defined population regarding a number of variables on oral care habits and knowledge of oral health have been presented and discussed. Most of the examined individuals attend dental care regularly. A high percentage of the individuals feel dental anxiety in the prospect of dental treatment. The level of knowledge of oral health has not increased. Less individuals consume soft drinks regularly. Oral health behaviour has improved since 1973, and in 2013 almost all of the individuals in the study were brushing their teeth once or twice a day. In a subsequent paper, the clinical findings will be presented.

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Oral health of individuals aged 3–80 years in Jönköping, Sweden during 40 years (1973–2013)

II. Review of clinical and radiographic findings

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Abstract

◉ The aim of this epidemiological study performed in 2013 was to analyze various clinical and radiographic data on oral health and compare the results to those of four cross-sectional studies carried out 1973–2003. In 1973, 1983, 1993, 2003, and 2013 random samples of 1,000; 1,104; 1,078; 987; and 1,010 individuals, respectively, were studied. The individuals were evenly distributed in the age groups 3, 5, 10, 15, 20, 30, 40, 50, 60, 70, and 80 years. Eighty-year-olds were not included in 1973. All subjects were inhabitants of the city of Jönköping, Sweden.

The clinical and radiographic examination assessed edentulousness, removable dentures, implants, number of teeth, caries, restorations, oral hygiene, calculus, periodontal status, and endodontic treatment.

The frequency of edentulous individuals aged 40–70 years was 16, 12, 8, 1, and 0.3% in 1973, 1983, 1993, 2003, and 2013, respectively. No complete denture wearer younger than 80-years old was found in 2013. During the 40-year period, the mean number of teeth in the age groups 30–80 years increased. In 2013, the 60-year-olds had nearly complete dentitions. Implants were found in all age groups from 30 years of age. The total number of individuals with implants was 36 in 2013. This was higher than earlier surveys, 4 in 1993, and 18 in 2003.

The percentage of children and adults without caries and restorations increased during the 40-year period. It was found that the percentage of caries-free 3- and 5-year-olds were 79% and 69%, respectively, of the individuals in 2013. In the age groups 10–20 years, the percentage of caries-free individuals increased between 2003 and 2013. In 2013, 43% of the 15-year-olds were completely free from caries and restorations compared to 20% in 2003. In all age groups 5–60 years, DFS was lower in 2013 compared to the earlier examinations. There was no major change in DFS between 2003 and 2013 in the age groups 70 and 80 years. The most obvious change was the decrease in number of FS over the 40-year period of time. Regarding crowned teeth the most clear changes between 1973 to 2013 were the decrease in percentage of crowned teeth in the age goups 40 and 50-year-olds. The percentage of endodontically treated teeth decreased between 1973 and 2013 in all age groups.

In age groups 10–30-year-olds a major reduction from about 30% to 15% in mean plaque score was seen between 1973–2003. Only a minor change in plaque score was seen during the last decade. For the age groups 40 years and older, a decrease in the percentage of surfaces with plaque was observed between 2003–2013. The percentage of tooth sites with gingivitis was for 20 years and older about 40% in 1973. In 2013, the percentage was about 15%. The frequency of sites with gingivitis was generally lower in 2013 compared with the other years, 1973–1993.

The percentage of individuals with probing pocket depths >4mm increased with age. Between 2003–2013 a clear reduction was seen in all age groups in frequency of individuals with probing pocket depth >4mm. Over the 40-year period an increase in the number of individuals with no marginal bone loss and a decrease in the number of subjects with moderate alveolar bone loss were seen.

The continuous improvement in oral health and the reduced need of restorative treatment will seriously affect the provision of dental helath care and dental delivery system in the near future.

Key words

Epidemiology, oral health, dental caries, periodontal disease, endodontics

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Tandhälsoförändringar hos 3–80-åringar i Jönköping under 40 år (1973–2013)

II. Resultat från kliniska och röntgenologiska undersökningar

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Sammanfattning

◎ Syftet med denna epidemiologiska studie utförd 2013 var att analysera kliniska och röntgenologiska data om oral hälsa och jämföra resultaten med fyra tvärsnittsstudier utförda 1973 till 2003. Ettusen, 1104, 1078, 987 och 1010 slumpvis utvalda individer undersöktes under respektive år1973, 1983, 1993, 2003 och 2013. Individerna var jämnt fördelade i åldersgrupperna 3, 5, 10, 15, 20, 30, 40, 50, 70 och 80 år. 1973 var inga 80-åringar med. Alla studiedeltagare bodde i Jönköpings stad.

Vid den kliniska och röntgenologiska undersökningen registrerades tandlöshet, avtagbar protetik, dentala implantat, antal tänder, karies, fyllningar, munhygien, tandsten, parodontalt status, utförd endodontisk behandling och apikalstatus.

Frekvensen av tandlösa individer 40-70 år var 16 %, 12 %, 8 %, 1 % och 0,3 % under respektive år 1973, 1983, 1993, 2003 och 2013. Det fanns inga helt tandlösa protesbärare yngre än 80 år 2013.

Under hela 40-årsperioden från 1973 ökade antalet tänder i åldersgrupperna 30-80 år. 2013 hade 60-åringar nästan kompletta dentitioner. Implantat fanns i alla åldersgrupper från 30 år och uppåt. Trettiosex individer hade implantat 2013. Detta var signifikant fler än vid de tidigare undersökningarna med fyra 1993 och arton 2003.

Antalet karies- och fyllningsfria barn och vuxna ökade under hela 40-årsperioden. Kariesfria 3- och 5-åringar ökade till 79 % respektive 69 % 2013. I åldersgruppen 10-20 år ökade antalet kariesfria individer mellan 2003 och 2013. Antalet karies- och fyllningsfria 15-åringar 2013 var 43 % jämfört med 20% 2003. I alla åldersgrupper 5-60 år var DFS lägre 2013 jämfört med tidigare undersökningar, medan DFS i åldersgrupperna 70 och 80 år var oförändrad. Den mest uttalade förändringen var minskningen i antalet fyllda ytor, FS. Bland 15-åringarna registrerades 17,8 FS 1973 jämfört med 0,9 2013. Bland 40-åringarna var motsvarande siffror för FS 50,8 respektive 13,1.

Avseende andelen kronförsedda tänder var den mest uppenbara förändringen den procentuella minskningen i åldersgruppen 50 år från 24 % till 4 %. Andelen rotfyllda tänder minskade mellan 1973 och 2013 i alla åldersgrupper.

I åldersgrupperna 10-30 år sågs en stor reduktion av medelvärdet av plack 1973 – 2003. Endast en mindre förändring sågs den senaste 10-årsperioden. För åldersgrupperna 40 år och äldre observerades en minskning av tandytor med plack mellan 2003 och 2013.

Frekvensen av gingivit var generellt lägre 2013 jämfört med undersökningsåren 1973-1993. Ingen förändring i gingivitmedelvärde noterades mellan 2003-2013 förutom en mindre ökning bland 20-åringarna.

Procenten individer med tandköttsfickor $\geq$ 4 mm ökade med ålder. Mellan 2003 och 2013 sågs en tydlig minskning i alla åldersgrupper med fickdjup 4 mm eller mer. Bland 50-åringar var andelen individer med tandköttsfickor $\geq$ 4 mm 76 % 2003 och 38 % 2013. Över hela 40-årsperioden minskade antal individer med måttlig marginal benförlust och antalet individer utan marginal benförlust ökade.

En jämförelse av de fem studierna visar på en stor generell förbättring i oral hälsa över 40 år. Detta kommer innebära betydande förändringar för tandvården.

Introduction

To cope with the need for a better oral health in Sweden, considerable resources began to be assigned about 50 years ago. The oral health has since then underwent a remarkable transformation, according to earlier epidemiological studies (10, 15). Similar changes have also been reported for other industrialized countries (7, 23, 27).

In 1974 a New Dental Act was introduced in Sweden, which made Swedish counties responsible for providing full dental service free of charge for all children and adolescents up to the age of 20 years. In addition, the 1974 National Dental Health Insurance Act instituted an insurance system for the adult population. Prior to these laws were introduced, a cross-sectional dental epidemiological survey was initiated in 1973 in the city of Jönköping in order to provide a representative picture of the dental health of the city's population (17). Repeated cross-sectional studies were then performed in 1983, 1993, and 2003 and the results have previously been reported (15). It was shown that the oral health status of the general population had gradually improved during the 30-year period of time.

Forty years after the initial survey in this series, in 2013, a further cross-sectional study was performed aiming to investigate further changes in oral health over the past decade. The findings from this study on oral care habits and knowledge of oral health have been published elsewhere (22).

The aim of the present paper was to describe the oral health status of the examined population in 2013 with regard to the prevalence of caries, periodontitis, restorations, number of teeth and edentulism. Further objective was to compare the findings from the present investigation to those from the previous ones in 1973, 1983, 1993, and 2003 in terms of changes in oral health.

Materials and Methods

All invited individuals in this study were inhabitants in either of four parishes of Kristine, Ljungarum, Sofia, and Järstorp, in the city of Jönköping, Sweden. The same parishes were used for the selection of samples in the previous surveys in this series (1973, 1983, 1993, and 2003). In 1983, 1993, 2003, and 2013, 130 randomly selected individuals in each of the age group of 3, 5, 10, 15, 20, 30, 40, 50, 60, 70, and 80 years, were invited to an oral examination. To secure enough participants an additional sample was invited in 2013. For the age groups 3, 5, 10, 15, 30, 40, and 50 years, additional samples of 15, 15, 15, 55, 40, 40, and 50, respectively, were randomly invited. The final number of the participants is presented in Table 1 for all five surveys.

As in the earlier studies, all subjects received a written personal invitation to take part in a dental health examination. They were informed of the purpose of the investigation, of the details of the examination procedures, and about a questionnaire concerning dental care and dental health care that they would be asked to fill in at the clinical examination (11).

All individuals participating in the study were ex-

Table 1. Number of subjects examined and sex distribution in each age-group 1973, 1983, 1993, 2003, and 2013.

Agegroup	Number examined									
	1973		1983		1993		2003		2013	
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
3	49	51	59	42	47	53	59	37	40	61
5	47	53	42	66	58	49	45	51	46	46
10	48	52	46	65	67	47	58	58	37	58
15	55	45	55	52	51	51	51	45	49	52
20	60	40	55	45	50	50	38	46	52	23
30	49	51	46	50	63	39	50	42	49	47
40	52	48	52	47	54	39	36	47	49	46
50	60	40	60	43	45	52	50	41	59	45
60	60	40	47	51	50	42	45	45	42	40
70	52	48	51	48	36	64	47	41	53	39
80			50	30	34	37	40	21	39	38
Total 3–80	532	468	565	539	555	523	519	468	515	495

amined clinically and radiographically to determine the state of health of the teeth and jaws as well as the presence of dental implants and removable dentures. The examinations in 2013 were performed by eight dentists from the Department of Paediatric Dentistry, Periodontology/Endodontics, Prosthodontics, Stomatognathic Physiology, Oral Medicine at the Institute for Postgraduate Dental Education, and by three general practitioners from Public Dental Health Service, in Jönköping, Sweden. The examinations for the survey were performed between autumn 2013 and autumn 2014.

The reasons why individuals selected for the study did not participate were registered. Adult non-respondents who could be reached by telephone were asked about number of teeth, if they were edentulous and , if they had any type of implants or prosthesis. Details regarding the sampling procedure, number of non-respondents and reasons for not taking part in the study are given elsewhere (22).

Throughout the study, the ethical rules for research described in the Helsinki Declaration (8) were followed. The 2013 survey was approved in 2012 by the Ethic Committee at the University of Linköping, Linköping, Sweden (Dnr 2012/191-31).

Clinical examination

The clinical examinations were carried out in dental offices with modern equipment and optimal light. Each clinical-radiographic examination required 60–90 minutes. Before the start of the study, the examiners were calibrated regarding the diagnostic criteria. A standardised computerized protocol designed for subsequent data processing was used.

Diagnostic criteria

Prevalence of edentulous individuals and number of existing teeth.
The number of edentulous individuals and the number of erupted incisors, canines, premolars, and molars were recorded. Third molars were excluded from the analysis. Only primary teeth were recorded and examined for the 3–5-year-olds while only permanent teeth were examined in subjects 10 years or older.

Caries.
All tooth surfaces that were possible to clinically evaluate were examined for caries according to the criteria stated by *Koch* 1967 (18). *Initial caries:* loss of mineral in the enamel giving a chalky appearance but without any clinical cavitation. *Manifest caries:* new carious lesions on surfaces not previously restored and of such extent that they could be verified as cavities by probing and that, on probing in fissures using light pressure, the probe became stuck. (See also the radiographic-diagnostic criteria for caries of approximal surfaces). *Secondary caries:* carious lesions according to the criteria of manifest caries but on restored surfaces.

Plaque.
The presence of visible plaque was recorded for all tooth surfaces after drying with air according to the criteria for Plaque Indices (PLI) 2 and 3 (16).

Gingival status.
The occurrence of gingival inflammation corresponding to Gingival Indices (GI) 2 and 3 was recorded for all tooth surfaces. Gingival inflammation was recorded if the gingivae bled on gentle probing (21).

Probing pocket depth:
In 1973, the presence of probing pocket depths in the permanent dentition equal to or exceeding 4 mm was recorded for all surfaces. In 1983, 1993, 2003, and 2013 the pocket depth was recorded in mm. No measurements were made in pockets of erupting teeth.

Supragingival calculus.
The presence of supragingival calculus was recorded for each tooth after drying with air.

Removable dentures.
The presence of removable partial or complete dentures in the upper and lower jaws were recorded.

Fissure sealings.
Fissure sealings were recorded.

Restorations.
Each tooth surface was recorded for the presence of amalgam, glassionomer cement or composite material, gold inlays, or metal or porcelain crowns and bridges. If two materials had been used for restoring the same surface, the material used most extensively was recorded. In addition, the presence of bridge pontics were recorded.

Dental implants.
The presence of implants and their location were recorded.

Radiographic examination
The radiographic examination was carried out using both extra- and intra-oral radiographs. Due to improved oral health and ethical considerations, the radiographic examination was changed compared to previous studies in this series (12).

In 2013, the radiographic examination of the 3- and 5-year-olds comprised two bite-wing radiographs when there was approximal contact in the molar regions. In the 10- and 15-year-olds four bite-wing radiographs were taken. In the 20-, 30-, 40-, and 50-year-olds, an orthopantomogram and six bite-wing radiographs – two each on the left and right sides and two in the frontal region – were taken. For the age groups 60 years and older, an orthopantomogram and a full-mouth, intra-oral radiographic examination including periapical and bite-wing radiographs was performed in dentate individuals. When teeth with deep carious lesions or root-filled teeth were recognized, an additional periapical radiographic examination was performed.

Edentulous individuals were radiographically examined by means of orthopantomograms.

Radiographic diagnostic criteria
Radiographically verifiable initial caries on proximal tooth surfaces:
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.

Radiographically verifiable manifest caries on proximal tooth surfaces:
The lesion extended into the dentine.

Classification according to the severity of the periodontal disease experience:
All dentate individuals were classified according to clinical and radiographic findings using *Hugoson & Jordan's* criteria (1982):
Group 1. Healthy or almost healthy gingival units and normal alveolar bone height; ≤12 bleeding gingival units in the molar–pre-molar regions.
Group 2. Gingivitis; >12 bleeding gingival units in the molar–pre-molar regions; normal alveolar one height.
Group 3. Alveolar bone loss around most teeth not exceeding 1/3 of the length of the roots.
Group 4. Alveolar bone loss around most teeth ranging between 1/3 and 2/3 of the length of the roots.
Group 5 Alveolar bone loss around most teeth exceeding 2/3 of the length of the roots; presence of angular bony defects and/or furcation defects.

Subgingival calculus:
The dentition was divided into sextants, delimited by the canines in each jaw. Subgingival calculus visible interproximally was recorded. A sextant was registered as having calculus when calculus was visible interproximally on at least one tooth surface.

Endodontic treatment and periapical status was recorded as follow:
1. Tooth not treated endodontically but with a periapical or juxtaradicular destruction.
2. Endodontically treated tooth (amputated or root canal filled).

Destruction was recorded when there was a locally widened periodontal membrane, a loss of lamina dura or destruction of bone adjacent to the root.

Other findings.
Findings on the radiographs which could not be categorised into any of the above mentioned diagnoses were noted. These findings were listed separately for dentate and edentulous individuals.

Additional variables
Occlusion, status of the oral mucosa, dental erosion, enamel disturbances, orthodontic treatment need (15–20-year-olds), salivary factors such as secretion rate, buffer capacity, endodontically treated teeth with periapical or juxtaradicular destruction, root surface caries, stomatognathic variables, function of complete or removable partial dentures, and prevalence and position of third molars were registered. The results of these examinations will not be presented in this review but will be published later.

Data processing
The questionnaires and clinical records were developed as a web survey in the software program EsMaker NX2 (Entergate AB, Halmstad, Sweden). Frequencies, mean values, and distributions were calculated. Data processing was performed with SPSS version 22 (IBM Corporation, Armonk, New York State, USA).

Results

Non-respondents

Depending on age group, 28–45% (mean 39%) of the 3–80-year-olds who were invited to participate in the study declined to take part for various reasons. The number of non-respondents was about 7% higher in 2013 compared with 2003 (22).

Prevalence of edentulous individuals and presence of complete or partial dentures

The number of edentulous individuals and the number of individuals with complete or partial dentures in one or both jaws over the 40 years from 1973 to 2013 are presented in Table 2. The frequency of edentulous individuals aged 40–70 years was 16, 12, 8, 1, and 0.3% in 1973, 1983, 1993, 2003, and 2013, respectively. No complete denture wearer younger than 80 years old was found in 2013. In total, 8 individuals were edentulous in 2013, of whom two 70 years old and one 80 years old, had implant supported prostheses (Table 3). The totally frequency of individuals, aged 40–70 years old, with removable dentures of any kind was 38, 28, 19, 18, and 4% in 1973, 1983, 1993, 2003, and 2013, respectively.

Number of existing teeth (excluding edentulous individuals)

The mean number of existing teeth is displayed in Figures 1 and 2. In these figures, edentulous individuals are excluded. During the 40-year period, the mean number of teeth in the age groups 30–80 years increased. In 2013, the 60-year-olds had nearly complete dentitions. The age-groups 70 and 80 had a mean number of teeth of 22.5 and 21.1, respectively (Fig. 1). The frequency distributions of teeth in different tooth type groups are presented in Figures 2. In 2013, most of the individuals had a complete set of incisors and canines. In 70-year-olds, the mean number of premolars increased from 2.4 in 1973 to 6.2 in 2013. The corresponding figures for molars were 1.0 and 5.3 respectively. The increase in mean number of teeth among the older age groups 60–80 years were due to an increase in premolars and molars.

Dental implants

In Table 3, the number of individuals and implants in edentulous and dentate individuals are presented. Implants were found in all age groups from 30 years of age. The total number of individuals with implants was 36 in 2013. This was higher than earlier surveys, 4 in 1993, and 18 in 2003.

◎ **Table 2.** Number of denture wearers in the age groups 40–80 years in 1973, 1983, 1993, 2003, and 2013.

Age group	Complete dentures (edentulous)										Complete denture (one jaw)									
	1973		1983		1993		2003		2013		1973		1983		1993		2003		2013	
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
40	1	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-		
50	3	2	3	1	-	-	-	-			3	7	2	2	1	1	-	-		1
60	12	8	9	5	5	4	3	1			2	6	3	5	-	6	5	1		
70	21	16	19	10	10	13	-	1			8	9	10	6	11	2	7	1	3	1
Total	63		47		32		5		0		37		30		21		14		5	
80	-	-	30	15	10	20	1	2	4	1	-	-	3	6	6	3	4	1	2	2

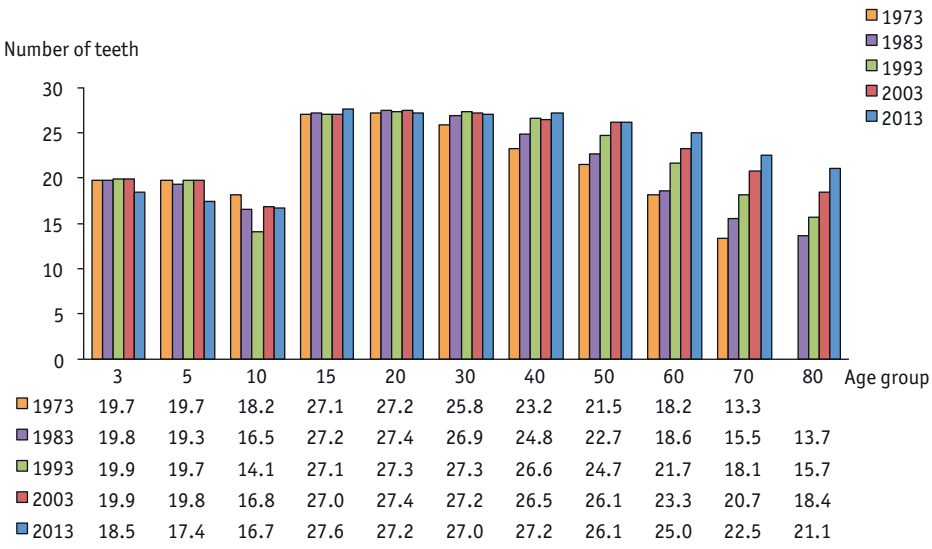
	Removable partial dentures									
	1973		1983		1993		2003		2013	
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
40	1	-	2	1	1	-	1	-		1
50	5	5	4	1	2	2	-	2		1
60	9	8	6	7	4	7	2	2	4	2
70	10	15	11	7	4	4	7	2	2	1
Total	53		39		22		16		11	
	-	-	7	6	8	3	6	2	1	2

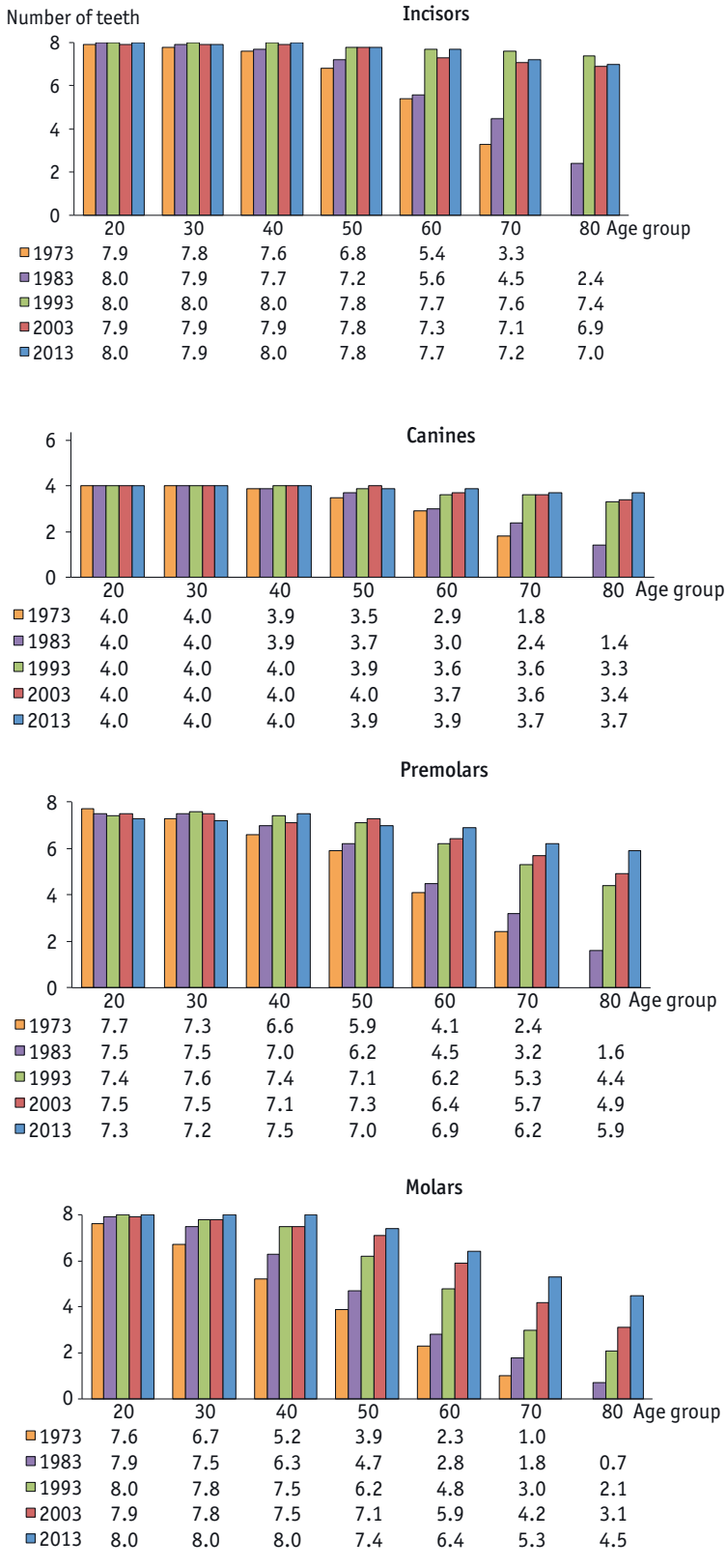
Table 3. Number of individuals with dental implants (number in brackets) in the age groups 20 to 80 years in 2003 and 2013.

Age group	Edentulous		Edentulous one jaw			
			Upper		Lower	
	2003	2013	2003	2013	2003	2013
20						
30						
40						
50						
60	**1** (11 implants)		**2** (5; 6 implants)	**2** (5; 6 implants)		
70		**2** (6; 11 implants)	**1** (6 implants)	**2** (5;6 implants)	**1** (6 implants)	**1** (5 implants)
80		**1** (11 implants)		**1** (6 implants)		

	Dentate individuals	
	2003	2013
20		
30	**1** (2 implants)	**2** (1; 4 implants)
40	**2** (1 implant)	**1** (2 implants)
50		**2** (1; 3 implants)
60	**1** (3 implants)	**5** (3x1; 2; 3 implants)
70	**4** (1; 2; 5; 6 impl.)	**10** (3x1; 5x2; 3; 6 implants)
80	**3** (1; 1; 5 implants)	**9** (1; 5x2; 3; 6; 7 implants

Fig. 1. Number of existing teeth (excluding edentulous individuals). Means in the different age groups in 1973, 1983, 1993, 2003, and 2013.





◎ **Fig. 2.** Number of incisors, canines, premolars, molars (excluding edentulous individuals). Means in the different age groups in 1973, 1983, 1993, 2003, and 2013.

Caries and restorations

Caries (decayed) data are presented as the sum of clinically and radiographically verifiable initial and manifest caries. The percentage of children and adults without caries or restorations increased during the 40-year period (Table 4). It was found that the percentage of caries-free 3- and 5-year-olds increased to 79% and 69%, respectively, of the individuals in 2013. In the age groups 10–20 years, the percentage of caries-free individuals increased between 2003 and 2013. In 2013, 43% of the 15-year-olds were completely free from caries and restorations compared to 20% in 2003.

In Table 5, the mean numbers of decayed and filled teeth (dft/DFT) are given for the various age groups. Up to the age of 60 years, the number of DFT declined in 2013 compared to 2003 while only a minor change was found for the age groups 70–80 years.

Figure 3 displays the total mean number of decayed and filled tooth surfaces (dfs/DFS), decayed tooth surfaces (ds/DS), and filled tooth surfaces (fs/FS). In all age groups from 5–60 years, DFS were lower in 2013 compared to the earlier examinations. Only minor changes were seen in the age group 3 years between 1993 and 2013. There was no major change in the number of DFS between 2003 and 2013 in the age groups 70 and 80 years. The most obvious change was the decrease in number of FS over the 40-year period of time. Among 15-year-olds, 17.8 FS were registered in 1973 compared to 0.9 in 2013. In the 40-year-olds, the corresponding figures are 50.8 and 13.1, respectively.

In Table 6, the mean numbers of DFS are given for the occlusal, proximal, buccal, and lingual surfaces. Generally, the number of occlusal and proximal DFS decreased in the age groups 10–60 years over time. Concerning the occlusal surfaces, a reduction of DFS in the age groups 10–50 years was seen in 2013 compared to the earlier examinations. In the15-year-olds the number of decayed or filled occlusal surfaces was 11.9 in 1973, compared to 0.9 in 2013. Regarding the buccal and lingual surfaces DFS decreased in the age groups 10–60 years.

The percentage of restorations with secondary caries in 2013 was between 0.1 and 2.7 (Table 7). Similar figures were recorded in 2003. In 1973, the percentage of restorations with secondary caries was higher compared to the other years.

Figure 4 shows the percentage of crowned teeth for various age groups in 1973, 1983, 1993, 2003, and 2013. The most obvious changes was the decrease in percentage of crowned teeth in the age groups 40–60 years. The percentage of crowned teeth was for the 50-year-olds, 24.5 in 1973 and 3.7 in 2013, expressed as percentage of existing teeth.

Plaque

The frequency of tooth surfaces exhibiting plaque in percentage of existing tooth surfaces is shown in Figure 5. In the age group 3 years no change in the total plaque score was seen between 1973 and 2013. In age group 5 years, there was a slight decrease in the total plaque score during 40 years. In age-groups 10–30 years a reduction in mean plaque score was seen between 1973 and 2003. Only a minor change in plaque score was seen the last decade in 10–30-year-olds. For the age-groups 40 years and older, a general decrease in the percentage of surfaces with plaque was observed between 2003 and 2013. In the 50-year-olds the percentage of tooth surfaces with plaque was 44.3 in 1973 and 15.1 in 2013.

Gingivitis

The frequency of sites exhibiting gingivitis in percentage of existing sites is shown in Figure 6. No change was seen in mean gingivitis score between 2003 and 2013, except for a slight increase in 20-year-olds. The frequency of sites with gingivitis was generally lower in 2013 compared with the other years, 1973–1993. In the 50-year-olds the percentage of tooth surfaces with gingivitis was 38.5 in 1973 and 15.3 in 2013.

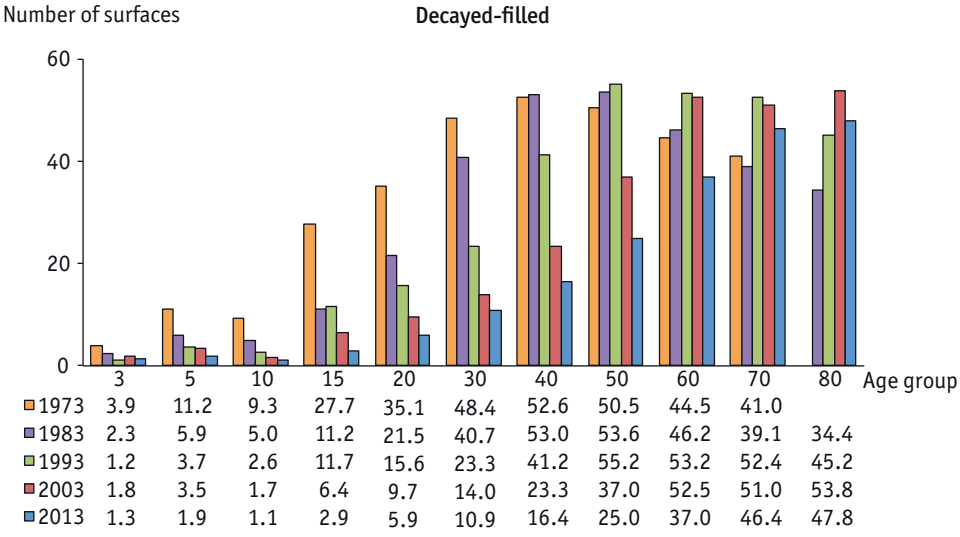
Probing pocket depth

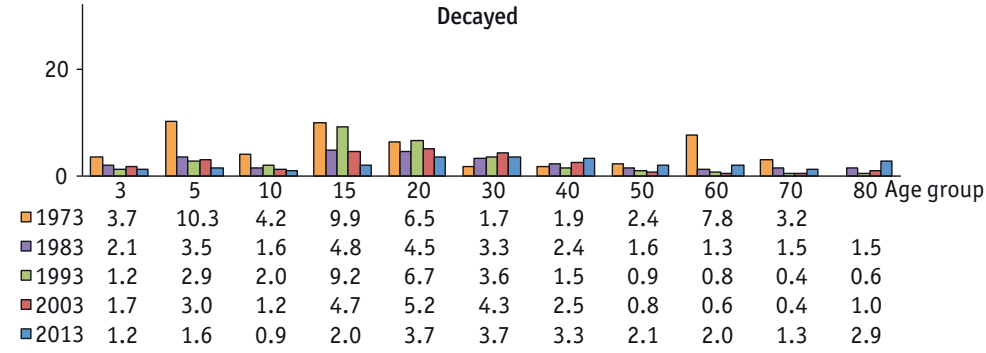
Table 8 show the percentage of individuals with one or more deepened periodontal pockets ≥4mm in 1973, 1983, 1993, 2003, and 2013. The percentage of individuals with probing pocket depths ≥4mm increased with age. Between 2003 and 2013 a clear reduction was seen in all age groups in frequency of individuals with probing pocket depth ≥4mm. About 80% of the 50-year-old individuals showed between 1973 and 2003 at least one pocket with probing pocket depth ≥4mm. The corresponding figure for 2013 was about 40% of the individuals.

Periodontal disease experience

In Figure 7, frequency distribution of periodontal disease experience is described. Over the 40-year period an increase was seen in the frequency of individuals with no marginal bone loss from 8% in 1973 to 44% in 2003 and 45% in 2013. The percentage of individuals with moderate severity of periodontal

◎ **Fig. 3.** Number of decayed (ds/DS) and filled (fs/FS) tooth surfaces Means in the different age groups in 1973, 1983, 1993, 2003, and 2013.





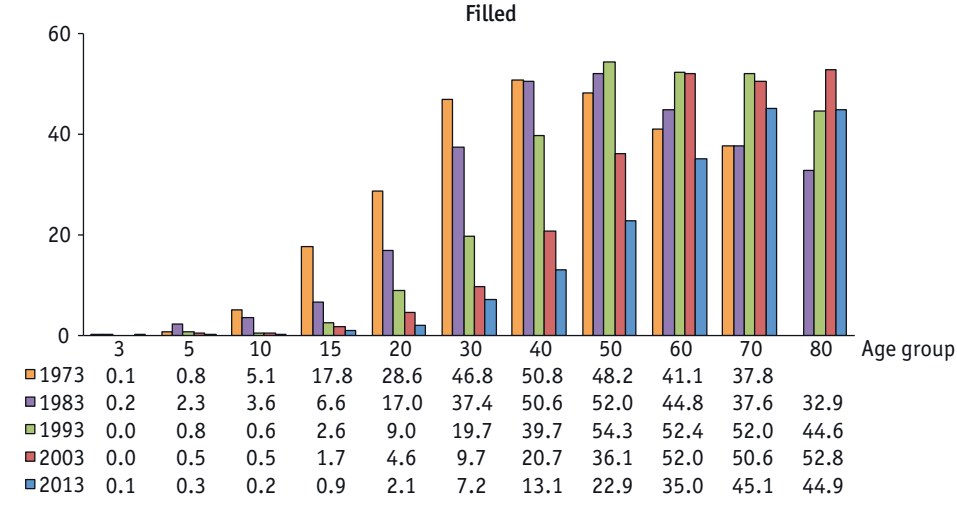


Table 4. Frequency (%) of individuals without caries and restorations in 1973, 1983, 1993, 2003, and 2013.

Agegroup	Caries-free individuals (%)				
	1973	1983	1993	2003	2013
3	35	70	72	69	79
5	9	29	48	46	69
10	1	17	37	52	61
15	0	6	14	20	43
20	0	2	3	12	19
30	0	0	1	8	8
40	0	0	1	0	3
50	0	0	0	0	0
60	0	0	1	2	0
70	0	0	1	0	0
80	0	0	1	2	8

Table 5. Mean number of decayed and filled teeth (dft/DFT) in various age groups in 1973, 1983, 1993, 2003, and 2013.

Agegroup	dft/DFT				
	1973	1983	1993	2003	2013
3	2.7	1.6	1.0	1.5	1.0
5	6.5	4.3	2.5	2.6	1.5
10	3.8	3.9	4.0	1.4	0.9
15	15.0	7.8	10.8	4.3	2.3
20	17.3	12.1	9.2	5.9	4.3
30	18.6	17.5	11.8	7.8	6.2
40	18.1	19.2	16.3	11.5	8.9
50	16.8	18.3	18.1	15.0	11.7
60	13.6	14.7	16.1	17.0	15.0
70	10.9	12.8	14.5	15.8	16.6
80		10.6	12.3	15.3	15.8

◎ **Table 6.** Mean number of decayed and filled occlusal, proximal, buccal, and lingual tooth surfaces (DFS) in various age groups in 1973, 1983, 1993, 2003, and 2013.

Age-group	dfs/DFS														
	Occlusal					Proximal					Buccal + lingual				
	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013
3	0.8	0.7	0.5	0.7	0.5	0.8	1.3	0.3	0.1	0.2	2.3	0.3	0.5	1.0	0.6
5	3.1	2.0	1.1	1.1	0.5	4.1	3.3	1.4	1.3	1.0	4.0	0.6	1.2	1.1	0.5
10	4.6	3.3	0.6	0.5	0.3	1.4	1.1	0.6	0.6	0.4	3.3	0.6	1.3	0.6	0.4
15	11.9	5.2	2.6	1.5	0.9	9.8	5.6	6.0	3.0	1.3	6.0	0.4	3.7	1.9	0.6
20	11.5	9.4	6.0	2.8	1.7	16.3	10.4	6.0	5.0	3.4	7.3	1.7	2.9	2.0	0.6
30	10.2	12.4	9.3	5.0	4.1	28.0	22.3	10.4	6.9	5.3	10.2	6.0	3.5	2.1	1.3
40	12.5	12.3	12.5	9.4	6.4	27.5	29.4	20.3	10.3	7.3	12.6	11.3	8.4	3.5	2.5
50	9.5	10.6	13.2	11.5	9.8	26.6	29.0	27.6	18.1	10.0	14.4	14.0	14.3	7.3	4.6
60	8.8	7.1	11.4	12.8	11.7	21.4	24.1	25.8	25.4	14.8	14.3	15.0	16.0	14.3	9.8
70	9.0	5.6	10.6	10.9	12.7	19.3	19.5	24.1	24.7	17.6	12.7	14.0	17.7	15.1	15.4
80		4.3	8.9	11.1	11.8		17.4	20.4	22.9	16.4		12.7	15.0	19.7	18.2

disease experience had decreased from 47% in 1973 to 22% in 2013.

Calculus

The frequency of tooth sections with subgingival calculus as percentage of existing dentate sextants are presented in Table 9. Generally, a lower percentage of subgingival calculus was seen in the surveys 2003 and 2013 compared to the previous examinations 1973–1993. In age group 20 years an increase in frequency of subgingival calculus was seen between 2003 and 2013.

Periapical status and endodontic treatment

Table 10 shows the frequency of teeth that have not been endodontically treated but exhibited periapical or juxtaradicular destructions. The frequency of endodontically treated teeth expressed as percentage of existing teeth is also given. The percentage of teeth not endodontically treated but exhibiting periapical or juxtaradicular destructions were few and of the same magnitude since 1983. The percentage of endodontically treated teeth decreased from 1973 to 2013 in all age groups. In the age groups 70 and 80 years, about 13–19% of all teeth had been endodontically treated in 2013.

◎ **Table 7.** Frequency (%) of restored tooth surfaces with secondary caries.

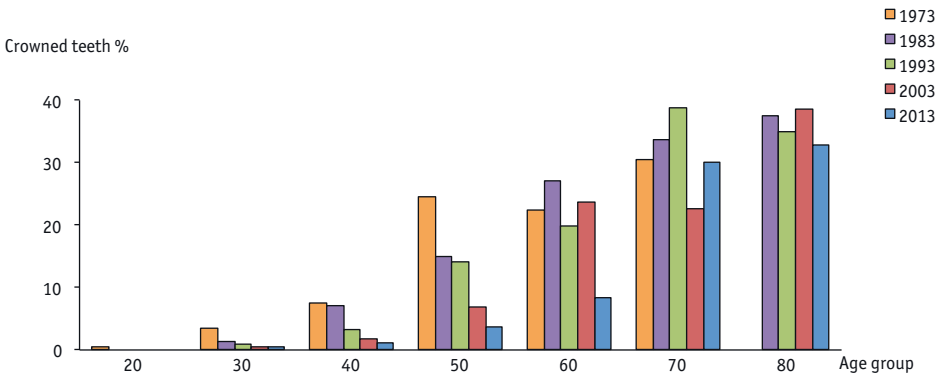
Age group	1973	1983	1993	2003	2013
10	13.9	2.8	7.6	0.0	0.0
15	7.5	1.8	5.7	0.0	0.0
20	8.6	1.9	0.3	0.2	0.1
30	4.8	2.5	3.2	0.3	0.2
40	6.8	2.9	2.0	0.7	0.2
50	8.6	3.5	2.8	0.8	0.7
60	8.9	2.8	2.4	0.8	1.0
70	12.6	3.7	4.3	0.8	1.2
80		8.3	5.8	2.0	2.7

Discussion

This paper is part two in a series of publications describing oral health in individuals aged 3–80 years in the city of Jönköping, Sweden during a period of 40 years. In paper one (22), there is a detailed presentation of the study population, non-respondents, findings on dental care habits, and knowledge of oral health. In the present paper, an overview of the clinical and radiographic findings from the same study population is given. To avoid repetition, parts of the discussion in the first paper can be applied to this discussion.

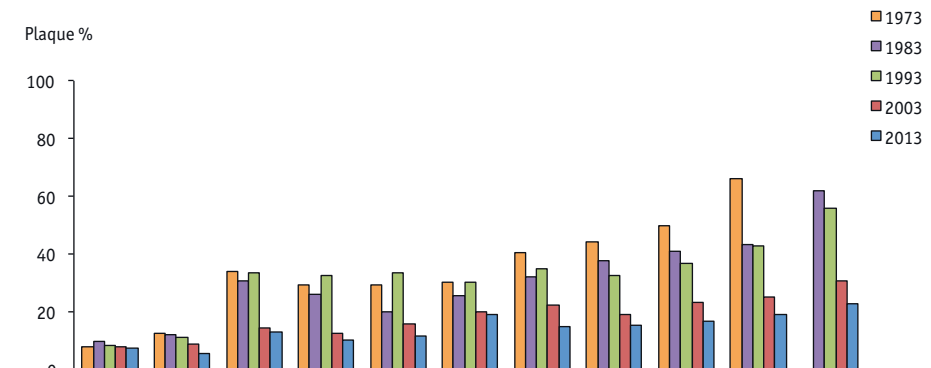
In 2013, the non-response rate was 28–45% in the various age groups. This is in line with or lower than in other recent studies (10, 20). In this study many of the selected individuals could not be reached by letter or telephone. There is a trend among people not answering telephone calls from unfamiliar numbers suspecting telephone sales companies. Various reasons were given for not wanting to come to the examination.None of them were likely to have had any major influence on the results (22).

Fig. 4. Frequency (%) of crowned teeth as a percentage of existing teeth. Means in the different age groups in 1973, 1983, 1993, 2003, and 2013.



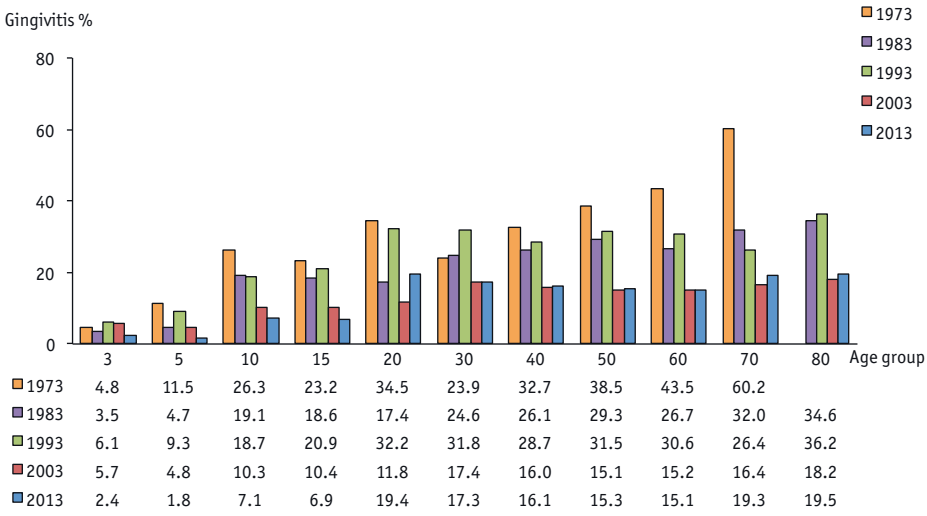
	20	30	40	50	60	70	80
1973	0.5	3.4	7.5	24.5	22.4	30.5	
1983	0.0	1.4	7.2	15.0	27.2	33.8	37.6
1993	0.0	1.0	3.2	14.2	19.9	38.8	34.9
2003	0.0	0.4	1.7	6.8	23.7	22.7	38.6
2013	0.0	0.4	1.1	3.7	8.3	30.0	32.8

Fig. 5. Frequency (%) of total number of tooth surfaces with plaque as a percentage of total number of existing surfaces. Means in the different age groups in 1973, 1983, 1993, 2003, and 2013.



	3	5	10	15	20	30	40	50	60	70	80
1973	7.8	12.3	33.9	29.4	29.1	30.3	40.4	44.3	49.7	66.2	
1983	9.8	11.9	30.6	26.0	19.9	25.3	31.8	37.5	41.1	43.1	62.1
1993	8.3	11.0	33.2	32.5	33.2	30.1	34.7	32.5	36.7	42.8	55.8
2003	7.9	8.8	14.4	12.6	15.6	19.7	22.3	18.9	23.3	25.1	30.7
2013	7.2	5.6	13.0	9.9	11.6	19.2	14.7	15.1	16.7	19.1	22.6

◎ **Fig. 6.** Frequency (%) of total number of sites with gingivitis as a percentage of total number of existing sites. Means in the different age groups in 1973, 1983, 1993, 2003, and 2013.



	3	5	10	15	20	30	40	50	60	70	80
1973	4.8	11.5	26.3	23.2	34.5	23.9	32.7	38.5	43.5	60.2	
1983	3.5	4.7	19.1	18.6	17.4	24.6	26.1	29.3	26.7	32.0	34.6
1993	6.1	9.3	18.7	20.9	32.2	31.8	28.7	31.5	30.6	26.4	36.2
2003	5.7	4.8	10.3	10.4	11.8	17.4	16.0	15.1	15.2	16.4	18.2
2013	2.4	1.8	7.1	6.9	19.4	17.3	16.1	15.3	15.1	19.3	19.5

◎ **Table 8.** Frequency (%) of individuals with probing pocket depth >4 mm in 1973, 1983, 1993, 2003, and 2013.

Agegroup	Percentage of individuals with probing depth ≥4 mm				
	1973	1983	1993	2003	2013
15	17	24	13		2
20	21	37	34	14	5
30	56	65	43	47	32
40	70	80	63	61	36
50	75	89	87	76	38
60	83	85	87	78	62
70	79	85	84	82	62
80		86	81	90	56

Owing to expected lower disease activity, and owing to ethical considerations, fewer intra-oral radiographs were taken in 2013. This limitation in the radiographic examination, however, does not preclude the use of the diagnostic criteria that were used in the earlier studies.

This study presents data on oral health covering a 40-year period 1973–2013. In the early 1970s an extensive preventive activity started up in the county of Jönköping with emphasis on diet, oral hygiene and fluoride (13). Such programmes were initiated also in other parts of Sweden during the same period due to a generally poor oral health. These programmes have during the years been modified according to new knowledge. When analyzing changes in in oral health during the 40-year period in the present study it has to be understood that a large group of the individuals up to 50-year-olds have taken part in preventive programmes during at least their first 20 years of life. Dental caries, if not controlled, is a progressing process that during life time steadily increases the need for restorations, endodontic treatment, crown and bridgework and finally edentulousness. If caries is controlled during childhood and adolescences a better oral health can be expected in the older ages by time, much depending on that primary carious lesions are not so commonly developing in adults as in younger ages. This is clearly shown in the present study.

The oral health situation of the examined population has improved extensively if it is judged by the prevalence of edentulousness and number of existing teeth. The prevalence of edentulous individuals with complete dentures in the age-groups 40–70 years, decreased from approximately every sixth individual in 1973 to none in 2013. There were still edentulous subjects among the age-groups but these individuals had received implant-supported prostheses in one or both jaws. The number of existing teeth kept increasing in the older age-groups 60–80 years, while only minor changes were recorded among the younger age-groups during the last dec-

Fig. 7. Distribution of all individuals 20–70 years regarding periodontal health and periodontal disease experience in Jönköping 1973–2013.

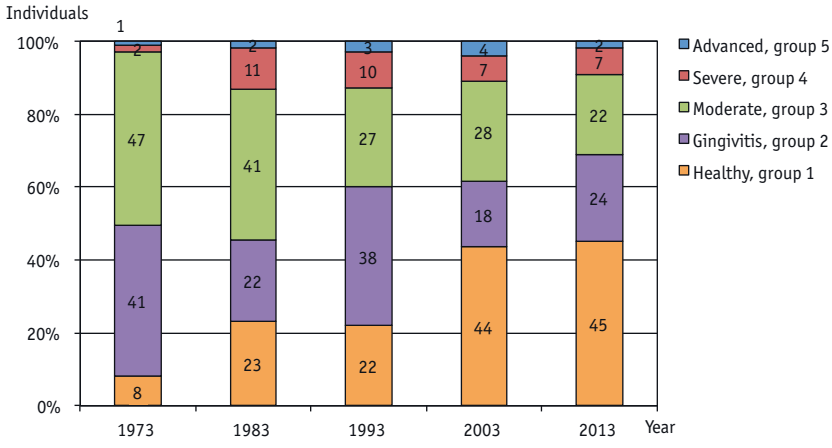


Table 9. Frequency (%) of tooth sections with subgingival calculus as a percentage of existing dentate sextants.

Agegroup	Subgingival calculus				
	1973	1983	1993	2003	2013
3					
5					
10	0.8	0.0	0.0	0.0	0.0
15	6.8	0.5	1.3	0.0	0.0
20	15.3	2.2	5.5	1.4	8.3
30	39.4	19.4	15.5	13.6	20.6
40	52.4	27.1	24.6	17.7	16.0
50	58.8	29.3	27.8	20.1	25.6
60	61.7	30.8	22.8	20.5	21.5
70	59.0	30.0	29.1	20.9	22.6
80		32.3	40.4	17.2	14.3

ade. Up to the age of 60 years, the individuals had almost complete dentitions. In the oldest age-group, 80 years, the mean existing number of teeth reached one of WHO goals, stipulating that more than 50% should be able to retain a minimum of 20 functional teeth (31). Consequently, the need for replacing missing teeth with prosthetic restorations is decreasing. Corresponding findings regarding prevalence of edentulousness, removable dentures and number of remaining teeth are in line with other studies (7, 10, 20, 23, 27).

The well-established technique of replacing missing teeth by means of osseointegrated implants has become a common method of rehabilitation. A two time increase in number of individuals with dental

Table 10. Periapical status and endodontic treatment.

Age-group	Percentage of teeth not endodontically treated exhibiting periapical or juxtaradicular destructions					Percentage of endodontically treated teeth				
	1973	1983	1993	2003	2013	1973	1983	1993	2003	2013
3	1.0	0	0	0	0	0	0	0	0	0
5	2.2	0	0	0	0	0	0	0	0	0
10	0.1	0	0	0	0	0	0	0.1	0.1	0
15	0.2	0.1	0	0.3	0	0	0.2	0.2	0	0
20	0.3	0.1	0	0	0	1.3	0.6	0.3	0.2	0.2
30	0.7	0.4	0	0	0.3	5.8	3.4	1.6	0.8	1.1
40	1.2	0.8	0.4	0.9	0.4	11.4	9.9	4.0	2.3	1.5
50	1.3	1.3	1.0	0.9	1.0	17.4	14.9	9.3	5.0	2.6
60	3.5	1.6	1.1	0.8	3.2	19.2	21.4	15.2	12.0	6.7
70	4.1	2.3	1.6	2.3	1.8	25.6	21.3	23.7	17.8	13.6
80		7.0	2.0	1.4	2.1	0	26.8	23.5	27.5	18.7

implants were found in 2013 compared to the previous study in 2003. During the same period the prevalence of removable dentures has decreased among dentate individuals. In Sweden, the dental care system includes in part economical financing of the treatment with implant supported prosthesis, which at least in part explains the increasing number of subjects with dental implants.

When caries data are analyzed in the present study it should be observed that the caries figures are the sums of initial and manifest caries. Compared to most other studies, where initial carious lesions are excluded, this means that the caries situation in the present study is no underestimation.

The oral health improvement seen over this 40-year period is clearly reflected in the decreasing number of carious lesions and restorations. This dramatic reduction in caries may be exemplified by the number of DFS in 15- and 20-year-olds who in 1973 had 28 and 35 DFS and in 2013 had 3 and 6 DFS, respectively. The trend is very clear. The number of DFS decreased decades after decades in all age-groups but for the 70- and 80-year-olds. The latter can be explained by the increasing number of existing teeth. The percentage of individuals without carious lesions and restorations is also increasing through the years and reached for the 15-year-olds 43% in 2013. The mean number of DF occlusal surfaces had also decreased. In the age group 20-year-olds these numbers had been reduced from 12 to 2 between 1973 and 2013. This remarkable reduction in caries and restorations in a caries prone tooth surface should be ascribed a general fissure sealing programme of all molars in close relation to eruption (30). This fissure sealing programme was a part of the above mentioned preventive activity. It is reasonable to believe that a constant decrease in carious lesions in the long run should have an effect on the number of crowned teeth and endodontically treated teeth. In the present study the percentage of crowned teeth was reduced from 25% in 1973 to 4% in 2013 in the 50-year-old group. The corresponding figures for endodontically treated teeth in the same age group was 17 and 3%, respectively. Thus the reduced caries prevalence clearly indicates that treatment need for more complicated procedures will decrease.

A problem over the next decade will be the increasing amount of treatment needed in the age-groups 70-80 years due to more remaining teeth and also a large number of restorations. However, in all other younger age-groups, a decreasing need for restorative treatment in the coming years can be seen. This is also reflected in the present study where a dramatic decrease in number of crowned and endodontically treated teeth was observed. This means that, although we still have a number of patients with extensive treatment needs, resources will gradually be released.

Only a minor decrease in plaque score was seen the last decade in 10–30-year-olds. For the age-groups 40 years and older, a general decrease in the percentage of surfaces with plaque was observed between 2003 and 2013. Visible plaque were recorded without using a disclosing solution or a periodontal probe. This method can underestimate the real plaque score. However, even taking a possible underestimation of the mean plaque values into account, the important finding is the positive trend of better oral hygiene over the 40-year period, shown in all age-groups except the youngest. A similar trend was seen in gingivitis scores. The frequency of sites with gingivitis was generally lower in 2003 and in 2013 compared with the other years, 1973–1993, in all age groups.

Over the 40-year period an increase in the number of individuals with no marginal bone loss and a decrease in the number of subjects with moderate alveolar bone loss were seen. This is an interesting finding due to the fact that more teeth are remaing even in the older age groups.

This study is a descriptive presentation of epidemiological data from a 40-year period and covering the age-groups 3–80 years in the city of Jönköping, Sweden. Major trends in oral health improvement were seen between 1973 and 2013, expressed as less edentulousness individuals, more remaining teeth, less carious lesions, less restorations, and better periodontal status. For better understanding of the changes over time in-depth analysis of the data is required and will be presented in subsequent papers.

An important question in epidemiological studies is whether the results can be regarded as representative for a population greater then the one studied. In the paper in this series published 2005 the possibility of generalizing data was discussed (15). The trends in oral health development described in the present paper are verified by several cross-sectional epidemiological studies performed in different parts in Sweden and at different times, which justify the assumption that data from this study can be used to draw general conclusions and to describe oral health trends representative for Sweden (10, 20, 28, 29, 33).

In conclusion, this epidemiologic study which

covers the last 40 years has shown a great and continuous improvement of dental health and a decrease of treatment need in age-groups 3–80 years. This has implications for most parts of the dental delivery system such as number of dental personel, the dental insurance system, the under- and postgraduate dental education, and for further research activities. This is a demanding and serious challenge for the dental profession.

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Diagnoses and treatment proposals in periodontal treatment. A comparison between dentists, dental hygienists and undergraduate students

LEIF LEISNERT , BJÖRN AXTELIUS, VERONICA JOHANSSON, ANN WENNERBERG.

Abstract

◎ The aim of this study is to find out how professionals in Swedish dental care perform diagnostic procedures in general. Is there a common ground between dentists and dental hygienists concerning sharing different job assignments in an effective way? Are the methods of treatment used in accordance with degree of severity of the disease and to what extent is proposed treatment in accordance with the National Guidelines?

A questionnaire consisting of three different patient cases with periodontal disease was sent to 804 private practitioners, 809 dentists in Dental Public Service, 802 dental hygienists and 40 dental students on their final semester at the Dental School in Malmö. The questionnaire was completed by 1,103 respondents (47%).

A majority of all practitioner groups (94%) found that a relatively healthy patient had disease, the risk for developing further disease was deemed none too low by 97%, but 91% wanted to give preventive care. A vast majority suggested more dental care to healthy patients as compared to patients with severe periodontal disease.

In Conclusion the two groups, *i.e.* dentists and dental hygienists, did not to a sufficiently high degree share views on diagnosis and treatment, in order to optimize the resources in dentistry. The delivery of dental care was not in line with the severity of disease and too much attention was paid to the needs of relatively healthy persons. To change this pattern, the incentives in and structure of the national assurance system could be adapted. Furthermore, the knowledge basis for periodontal diagnosis and treatment needs, with special reference to the National Guidelines, should to a higher degree be shared by all caregivers.

Key words

Periodontal treatment, undergraduate students, professional performers, evidence based treatment, National Guidelines.

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Diagnoser och behandlingsförslag vid parodontal sjukdom. En jämförelse mellan tandläkare, tandhygienister och tandläkarstudenter.

LEIF LEISNERT , BJÖRN AXTELIUS, VERONICA JOHANSSON, ANN WENNERBERG.

Sammanfattning

◎ Avsikten med denna studie var att beskriva hur professionella utövare i den svenska tandvården och studenter diagnosticerar och behandlar parodontal sjukdom. Finns det gemensamma värderingar mellan tandhygienister och tandläkare om en effektiv arbetsfördelning? Återspeglas sjukomens svårighetsgrad i föreslagen behandling och i vilken utsträckning är behandlingen i överrensstämmelse med Socialstyrelsens nationella riktlinjer?

En enkät med tre olika fall av parodontal sjukdom sändes ut till 804 privatpraktiker, 809 tandläkare i Folktandvården, 802 tandhygienister och 40 studenter på sista terminen på Tandvårdshögskolan i Malmö. Fallen beskrevs med olika grad av parodontal sjukdom inklusive röntgenbilder. Deltagarna ombads bedöma diagnos och vilken behandling som var indicerad.

En majoritet, 94 %, av alla som besvarade enkäten ansåg att en relativt frisk patient hade sjukdom och att risken för att utveckla fortsatt sjukdom var obefintlig till låg, 97 %. Trots detta ansåg man att patienten behövde förebyggande vård. En majoritet föreslog relativt sett mer tandvård till friska patienter jämfört med patienter med svår parodontal sjukdom.

De två grupperna, tandläkare och tandhygienister, hade olika uppfattningar om hur man optimerar resursanvändningen inom tandvården. Föreslagna insatser är inte i överenstämmelse med sjukdomens svårighetsgrad och för mycket uppmärksamhet riktas mot behoven hos relativt friska patienter. För att förändra detta kan strukturen i det nationella tandvårdsstödet förändras och de nationella riktlinjerna implementeras på ett effektivare sätt.

Introduction

The incidence of periodontal disease has, like other diseases in the mouth, decreased during the last thirty years. Accordingly, between 1973 and 2003 (8,10,11), in the Jönköping studies the number of edentulous individuals in the age groups 40-70 was reduced from 16% of the population 1973 to 1% in 2003. In an epidemiological study from the county of Skåne (18) the prevalence of partial or full removable dentures was 2.4%. In the Jönköping studies the mean number of remaining teeth had increased between 1973 and 2003 and up to 60 years of age individuals had more or less complete dentitions. In 1973, 50 year old individuals had a mean of 24.5% of their teeth crowned and in 2003 the value had decreased to 6.8%. The situation was mainly the same concerning number of caries lesions and endodontically treated teeth, which also had decreased during 1973-2003. In addition, the prevalence of periodontitis had changed during the same time, when the patients were divided into five groups (7) with different degrees of disease. In group 1, with individuals with no alveolar bone loss and no or low scores of gingivitis, i.e. periodontally healthy individuals, the percentage of individuals rose from 8% in 1973 to 44% in 2003. During this period there was a decrease of those with gingivitis and/or moderate alveolar bone loss, belonging to groups 2 and 3. However, those with advanced periodontal disease in groups 4-5 had not decreased over the years.

In a Consensus Report of the Sixth European Workshop on Periodontology (12), the conclusion was that data indicated a trend of a lower prevalence of periodontitis in recent years, but that the decrease had occurred primarily in the groups with gingivitis and mild/ moderate periodontitis. In the report it was also stated that estimates of trends over time are essential for the determination of treatment needs and subsequent cost-effectiveness analyses. These estimates are essential in order to appropriately allocate oral health care resources to achieve maximal benefit for the population. The "Oslo Study" (19) indicated that about 8% of 35 year old people had advanced periodontal destruction. In this study, they also highlighted the inconsistency in registration criteria, making comparisons between different publications difficult, although several consensus meetings have discussed the issue (1,2,4,14,17). This is also highlighted by *Baelum & Lopez* (3) who argued for a paradigm shift in defining and classifying periodontitis. They claimed that the past two decades have witnessed many proposals for the classification of periodontitis and that the concept "periodontitis" has no diagnostic truth, just as there is no natural basis for a sharp distinction between health and disease or between different forms of periodontitis.

In a previous report (15), it was concluded that within each category of clinicians – in this case dentists in the Public Dental Service, dental students and dental hygiene students – there were wide variations in how clinical findings were used to diagnose periodontitis, as well as between different categories of clinicians. This difference of treatment plans for the same condition raises an important question: if the occurrence of treatments for advanced periodontal destruction in the population is a result of priorities made by dentists and hygienists in their treatment plans, on what basis are these priorities made?

We know that dentists are eager to follow new developments in the dental profession (22), but there may be a gap in the understanding of scientific concepts that may impede the implementation of new information into common practice. Thus, the distribution of new knowledge throughout the dental health care sector may not be adequate. Only 12-21% of Swedish dentists have thoroughly read publications from the Swedish Council on Technology Assessment in Health Care (22), i.e. the dominating actor in Sweden in distributing knowledge in evidence based care.

The National Board of Health and Welfare has during 2011 established guidelines for evidence based treatment in both medicine and dentistry (20). In the present study, some of these Guidelines will be highlighted concerning periodontitis in order to find out whether actual treatment choices made today by dental personal are in accordance with the Guidelines. The different treatment options are in the Guidelines scored 1 to 10, where 1 is the best underpinned treatment and 10 is the least evidence based treatment choice.

In Sweden, the National Board of Health and Welfare forecasts a decrease of dentists from 7,000 in 2013 to 6,000 in 2023 and an increase in the number of dental hygienists during the same period from 4,000 to 4,500 (21). This, together with changes in both epidemiology and political priorities, calls for an effective and well-developed cooperation between dentists and dental hygienists in future dentistry.

Thus, it is important to not only discover how and why patients with periodontal disease are treated, but also how the different categories of clinicians interact to optimize the dental care with regard to

quality and economic aspects. In this aspect, the question of knowledge transfer both within and between different caregiver professions become of outmost importance. To answer these questions, a questionnaire was sent to dentists in the public dental service, private practitioners, dental hygienists in private and public dental care and to dental students in their final semester.

Thus, the aims of this study were to find out

1. Is there a common ground between dentists and dental hygienists concerning sharing different job assignments in an effective way?
2. How do professionals perform diagnostic procedures in general and are the methods of treatment used in accordance with the degree of severity of the disease?
3. To what extent was the proposed treatment in accordance with the National Guidelines?

Material and Method

The study was ethically approved by the Regional Ethical Board in Lund, Dnr 593/2010.

Respondents

From each professional organization of dentists in The Swedish Association for dentists of Public Dental Service, The Association for dentists in the Private Dental Care in Sweden and The Swedish Dental Hygienist Association, 809, 804 and 802 members, respectively, were randomly selected. Forty dental students in their final year at Malmö University were also invited to participate.

Of the respondents, 346 dentists were private practitioners (PP), 349 were dentists in the Public Dental Service (PDS), 369 were dental hygienists in the private and public sectors (DH), and 39 were dental students (DS).

A questionnaire was constructed consisting of three typical patient cases showing different degrees of periodontal disease. We used the grouping of disease classification made by *Hugoson & Jordan* (7) in the first Jönköping study. Some additional background information was added like gender, age and anamnestic information.

The questionnaires were distributed in the beginning of October 2011 and were followed by two reminders, four and seven weeks after the original distribution.

The completed questionnaires were scanned at the University of Linköping and transformed into a SPSS file. The scanned questionnaires were validated through a random sample (n=120) of all the questionnaires securing that a specific questionnaire with its number in the SPSS file had the right characteristic concerning age and gender. No misrepresented data was discovered.

Description of the clinical cases in the questionnaire

Case 1- healthy individual
Female, 45 years old, healthy and no medicines. Yearly checkups. Plaque index (PI) 28%, bleeding on probing (BOP) 22%. Small amount of calculus in the front of the lower jaw. No horizontal bone loss.

Case 2- localized mild periodontitis
Male, 55 years old, healthy and no medicines. No checkup for the last 3 years. Has the feeling that it is bleeding when he brushes his teeth. PI 40%, BOP 31%. Subgingival calculus and pus 17m, 16d and 26d. Deepened pocket >4 mm at 24 surfaces. Marginal bone loss ≤1/5 of the root. Vertical bone pockets 17md, 16d, 46d, 26d and 27m. Furcation involvement 17, 16 and 26.

Case 3- generalized advanced periodontitis
Male 45, years old. Medical treatment of high blood pressure. In other aspects healthy. Smokes 20 cigarettes/day. New patient, no checkup for the last 5 years. Has the feeling that it is bleeding when he brushes his teeth. PI 50%. BOP 41%. Subgingival calculus lingually in lower jaw. In general, deepened pockets >4mm. Generalized marginal bone loss 1/3-1/2 of the length of the root. Bone pockets 36m and 46m. Furcation involvement 16, 26, 37, 36, 46 and 47.

In the questionnaire to the clinicians, there were questions concerning gender, age, whether they worked in private or public dental health, whether they worked in big or small towns and where they were educated. In each case, there was a question if the patient was considered to have periodontal disease or not and whether treatment was suggested or not.

Also, there were questions about which clinical findings they used for the diagnostic classifications, what treatment was proposed, and which category of caregiver– dentist, dental hygienist or specialist – that was best suited to perform the treatment. There were choices from a list of alternative treatments possible to combine. All treatments were chosen from the National Guidelines as presented by The National Board of Health and Welfare (20).

Statistical methods

All data was inserted into the IBM SPSS Statistics version 20. An analysis of the missing answers, compared to those who answered, was made with a logistic regression analysis concerning age, gender and occupation as explanatory variables. There were no statistically significant differences between the groups concerning these factors.

A frequency analysis was made for all groups together for the different questions. Cross tabulation with Pearson Chi-square Test and Fischer´s Exact Test were used to analyze differences between the participating groups.

Results

In total, 2,455 questionnaires were sent out and the participation was voluntary and anonymous. After two reminders, the questionnaire was completed by 1,103 respondents (47%), while 1,235 did not return the questionnaire and 128 were returned by the Postal Service, i.e. it was not possible to deliver or the respondents mailed back and informed us that they for different reasons did not want to answer the questionnaire. The reasons for this were e.g. weakened health, no present activity in their profession or the questionnaire was too extensive and time consuming. The dental students answered the questionnaire in connection with one of their clinical sessions. Of the students, 40 received the questionnaire and 39 answered (98%).The students also participated voluntarily. They studied on their tenth and final semester of their five year dental education for becoming a dentist at the Faculty of Odontology, Malmö University.

In one question the participants were asked to describe their situation concerning number of patients waiting for dental care. PP had the lowest number of dentists with such patients (17%), while the same figure for PDS was 52%. Lack of patients was evident from 18% of the PP, 8% of the dentists in PDS and 8% of DH.

In Table 1, the results from the question whether the practitioners regarded the different patients to have a disease or not, are depicted. No significant differences were found between caregiver groups in case 1, 2 and 3. In case 1, almost 94% considered that the patient had disease, while 6% considered that the patient had no disease. For case 2 and 3, almost 100% had the opinion that patients had periodontal disease.

In Table 2, the clinicians were asked to describe what risks they forecasted for developing gingival or/and periodontal disease. For case 1, the different groups scored between 86 to 97%, with 86% saying the risk was low and 97% saying the risk was none or low.

Table 1. Percentages of care providers (PP, DH, PDS, DS) answering "yes" to the question. "Do you regard that this patient has disease or not?"

	Disease present	No disease	p-value
Case 1			
PP, n=346	93.9	6.1	
DH, n=369	92.7	7.3	
PDS, n=349	95.1	4.9	
DS, n=39	89.7	10.3	
			NS*
Case 2			
PP, n=346	100	0	
DH, n=369	100	0	
PDS, n=349	99.7	0.3	
DS, n=39	100	0	
			NS*
Case 3			
PP, n=346	100	0	
DH, n=369	100	0	
PDS, n=349	99.7	0.3	
DS, n=39	100	0	
			NS*

PP=Private practitioner
DH=Dental hygienist
PDS=Dentist in Public Dental Service
DS=Dental students
NS=Not Significant
* Fisher's exact test

No significant differences were found between the groups. The 2.6 percent of the students saying there was no risk of developing disease in any of the cases, represents one student.

In Table 3 is depicted whether the respondents regarded that the patients needed preventive care or not. In case 1, the students to a greater extent rejected that preventive dental care is needed, i.e. 17% in comparison to the other groups who scored about 8%. However, there were no significant differences between the caregiver groups. Still, about 91% of the professional performers wanted to give preventive care.

In Table 4 is depicted the opinion about what category of dental caregiver should examine the patient. In case 1, there were significant differences between the

◎ **Table 2.** Percentages of care providers (PP, DH, PDS, DS) answering the question "What risk do you see for developing gingival and/or periodontal disease?"

	No risk	Low risk	High risk	p-value
Case 1				
PP, n=346	11.8	86.1	2.1	
DH, n=369	7.6	90.1	2.3	
PDS, n=349	11.1	88.3	0.6	
DS, n=39	2.6	97.4	0	
				NS*
Case 2				
PP, n=324	0.3	8.3	91.4	
DH, n=359	0	8.6	91.4	
PDS, n=337	0	7.7	92.3	
DS, n=39	2.6	5.1	92.3	
				NS*
Case 3				
PP, n=334	0	0.3	99.7	
DH, n=361	0	0	100	
PDS, n=337	0	0	100	
DS, n=39	2.6	0	97.4	
				NS*

PP=Private practitioner
DH=Dental hygienist
PDS=Dentist in Public Dental Service
DS=Dental students
NS = Not significant

◎ **Table 3.** Percentages of care providers (PP, DH, PDS, DS) answering the question "Do you regard that this patient need preventive care?"

	Yes	No	p-value
Case 1			
PP, n=314	91.7	8.3	
DH, n=346	91.9	8.1	
PDS, n=318	91.2	8.8	
DS, n=34	82.4	17.6	
			NS*
Case 2			
PP, n=319	99.4	0.6	
DH, n=352	100	0	
PDS, n=328	99.1	0.9	
DS, n=35	100	0	
			NS*
Case 3			
PP, n=304	99.7	0.3	
DH, n=339	99.4	0.6	
PDS, n=319	98.1	1.9	
DS, n=34	100	0	
			NS*

PP=Private practitioner
DH=Dental hygienist
PDS=Dentist in Public Dental Service
DS=Dental students
NS = Not Significant
*Fisher's exact test

groups: 74% of the private practitioners, 49% of the dentists in the public dental services and 59% of the students wanted the dentist to examine the patients, while only 21% of the dental hygienists considered a dentist should examine the patient (p=0.000).

In case 2, the corresponding figures for caregiver groups were 88%, 80%, 72% and 67%, respectively. A significant majority of dental hygienists considered that they should examine the patients, while a majority of the dentists thought that a dentist should examine the patients (p=0.000).

In case 3, the corresponding figures for caregiver groups were 85%, 50%, 92% and 70%, respectively. In this case, a majority of all caregiver categories considered that the dentist should perform the examination, although 45% of the hygienists felt prepared to do so. In general, private practitioners to a significantly higher degree wanted to perform the examination of the patients (p=0.000).

In Table 5, it is depicted to what extent treatment was suggested and what category of dental caregiver should perform instruction for effective self-care. Relative agreement could be found between the groups that dental hygienist should perform this treatment. Dental students and private practitioners had lower scores, i.e. less support for leaving this to dental hygienists. The respondents had a possibility to choose more than one option. There were significant differences between categories of caregivers in all 3 cases, with the exception of specialists.

In Table 6, the respondents were asked to describe what findings they used for diagnoses with regard to presence of plaque and calculus.

Plaque

In case 1-3, significant differences were found between students and the other groups. Thus, the prevalence of plaque was in case 1 for the PP=77%, DH=88% and PDS=67 %, (p=0.000). In case 2, the corresponding figures were for the PP=77%, DH=88% and PDS=73 % (p=0.000). In case 3, the

Table 4. Percentages of care providers (PP, DH, PDS, DS) answering "yes" to the question "What category of dental caregiver should examine the patient?" More than one option possible.

	Dentist	Dental hygienist	Dental nurse	Specialist
Case 1				
PP, n=346	74.0	32.9	1.2	0
DH, n=369	21.4	82.9	2.2	0
PDS, n=349	49.3	56.2	0.6	0
DS, n=39	59.0	41.0	2.6	0
p-value	0.000*	0.000*	0.27*	n.a.
Case 2				
PP, n=346	88.4	26.9	0.3	6.9
DH, n=369	47.7	66.9	0.3	5.4
PDS, n=349	79.9	33.5	0.6	4.3
DS, n=39	71.8	20.5	0	0
p-value	0.000*	0.000*	0.65**	0.20*
Case 3				
PP, n=346	84.7	21.4	1.4	25.7
DH, n=369	50.1	45.3	0	32.0
PDS, n=349	74.8	20.9	0.3	29.0
DS, n=39	91.8	15.4	0	25.6
p-value	0.000*	0.000*	0.09**	0.30*

PP=Private practitioner
DH=Dental hygienist
PDS=Dentist in Public Dental Service
DS=Dental student
*Significance testing using the Pearson Chi squared method.
**Fisher's exact test
n.a. not applicable

Table 5. Percentages of care providers (PP, DH, PDS, DS) answering the question "Who should perform instruction for effective self-care?" More than one option possible.

	Dentist	Dental hygienist	Dental nurse	Specialist
Case 1				
PP, n=346	20.2	67.1	29.2	0
DH, n=369	0.8	90.0	14.1	0
PDS, n=349	13.8	81.1	18.1	0
DS, n=39	5.1	87.2	17.9	0
p-value	0.000*	0.000*	0.000*	n.a.
Case 2				
PP, n=346	16.2	89.0	9.0	0.9
DH, n=369	1.1	95.4	1.4	0.5
PDS, n=349	9.7	95.1	4.9	1.7
DS, n=39	2.6	84.6	5.1	0
p-value	0.000*	0.000*	0.000*	NS**
Case 3				
PP, n=346	19.4	85.3	6.4	7.2
DH, n=369	1.9	91.3	1.1	6.8
PDS, n=349	8.6	92.3	2.3	8.3
DS, n=39	12.8	87.2	2.6	7.7
p-value	0.000*	0.01*	0.000*	NS*

PP=Private practitioner
DH=Dental hygienist
PDS=Dentist in Public Dental Service
DS=Dental student
NS= Not significant
*Significance testing using the Pearson Chi squared method.
**Fisher's exact test
n.a. not applicable

figures were for PP=77%, DH=86% and PDS=73 % (p=0.000).

Calculus

In case 1-3, significant differences were found between students and the other groups. Thus, in case 1 the prevalence of calculus were for the PP=43%, DH=49% and PDS=42 % (p=0.000). In case 2, the corresponding figures were for the PP=79%, DH=88% and PDS=77 % (p=0.000). In case 3, the figures were for the PP=80%, DH=89% and PDS=76 % (p=0.000).

Who should perform professional cleaning? In Table 7, it is depicted what category of dental caregiver should perform professional cleaning of the teeth, according to the respondents. A significant difference appeared. In case 1, 15% of the PP wanted to give professional cleaning, while 0.3% of the DH wanted the dentist to perform this procedure. The corresponding figures for PDS were 7% and DS 0% (p=0.000). The PP was more inclined (25%) to let the dental nurse perform this treatment (p=0.000).

Discussion

Non-response

As mentioned earlier, an analysis of the non-respondents, compared to those who responded, was made with a logistic regression analysis concerning age, gender and occupation as explanatory variables. There were no statistically significant differences between the groups concerning these factors.

Diagnostic procedures in general

In a recent publication by *Leisnert et al.* (15), it was

◉ **Table 6.** Percentages of care providers (PP, DH, PDS, DS) answering the question "What findings do you use for making diagnosis?" More than one option possible.

	Plaque	Calculus
Case 1		
PP, n=346	76.9	43.4
DH, n=369	88.1	48.5
PDS, n=349	67.3	42.1
DS, n=39	28.2	10.3**
p-value	0.000*	0.000*
Case 2		
PP, n=346	77.2	78.9
DH, n=369	86.2	88.3
PDS, n=349	72.8	76.5
DS, n=39	25.6	28.2
p-value	0.000*	0.000*
Case 3		
PP, n=346	76.6	79.5
DH, n=369	88.3	88.6
PDS, n=349	72.5	75.6
DS, n=39	25.6	17.9
p-value	0.000*	0.000*

PP= Private practitioner
DH=Dental hygienist
PDS=Dentist in Public Dental Service
DS=Dental student
*Significance testing using the Pearson Chi squared method.
**Fisher's exact test

◉ **Table 7.** Percentages of care providers (PP, DH, PDS, DS) answering the question "What category of dental caregiver should perform professional cleaning of the teeth?" More than one option possible.

	Dentist	Dental hygienist	Dental nurse	Specialist
Case 1				
PP, n=346	15.0	60.4	25.1	0
DH, n=369	0.3	79.9	12.2	0
PDS, n=349	6.9	59.0	12.6	0
DS, n=39	0.0	51.3	17.9	0
p-value	0.000*	0.000*	0.000*	n.a.
Case 2				
PP, n=346	13.0	83.8	6.1	1.2
DH, n=369	0.5	91.1	1.1**	1.1
PDS, n=349	4.6	85.7	5.2	1.4
DS, n=39	2.6	76.9	12.8	0
p-value	0.000*	0.01*	0.000*	0.93**
Case 3				
PP, n=346	13.9	82.1	6.1	8.1
DH, n=369	0.8	86.2	1.9	8.9
PDS, n=349	3.7	85.1	3.2	7.7
DS, n=39	7.7	66.7	5.1	10.3
p-value	0.000*	0.01*	0.03*	0.91*

PP=Private practitioner
DH=Dental hygienist
PDS=Dentist in Public Dental Health
DS=Dental student
*Significance testing using the Pearson Chi squared method.
**Fisher's exact test
n.a. not applicable

concluded that beyond the traditional findings describing chronic periodontitis, i.e. soft tissue inflammation and loss of supporting tissue, all the participating dentists and students used irrelevant findings such as calculus and plaque as a basis for treatment planning. The dentists in the Public Dental Services and teachers at the dental school scored somewhat lower than the students, but also used irrelevant findings to diagnose periodontitis. With this in retrospect, we wanted to see if any change had occurred in this study. Thus, the participants were asked to describe the findings they used in relation to the study by *Leisnert et al.* (15) as the basis for the different diagnoses.

About 75% of respondents used plaque as a finding for diagnosing periodontal disease. It is interesting to see that students differed to a greater extent from the other groups, where the professional performers used this irrelevant finding three times more often than the students. It is difficult to explain, but the numbers for the students are in line with the results from the findings in *Leisnert et al.* (15). The situation in the present study is almost the same concerning calculus but on other levels, where the students to a lesser extent used irrelevant findings.

It is difficult to draw any conclusions on whether the use of irrelevant findings in any way influenced the quality of periodontal care. It could contribute to confusion that for example plaque is an indicator used for intervention. This, combined with the result published by *Baelum & Lopez* (3), could, in combination with the extensive use of irrelevant findings, influence the delivery of dental care not needed.

Is there a common ground between dentists and dental hygienists concerning sharing different job assignments in an effective way? This is an interesting question regarding a background of an increasing number of dental hygienists and decreasing number of dentists. In parallel to the discussions on the dimensionality of education for dentists and dental hygienists to meet epidemiological changes in the population, the discussion of the formal and informal competence of dental hygienists and in extension their role within dentistry, has been going on for decades. The debate has taken place in most European countries where dental hygienists have become a part of the oral health care system (5,6,13,16). Is there a consensus in Sweden for dental practitioners concerning different job assignments?

When we look at the examination procedure of the caregivers, the answer to this question is negative. In both case 1 and 2, a majority of the dentists thought that they should examine the patients and the dental hygienists had the opposite opinion. In case 3, there was a majority for dentists to examine the patient, but on the other hand, almost 50% of the hygienists felt prepared to examine the patients. Obviously, there is no agreement in this matter which may cause problems when the patients will show less disease in the future and more dental hygienists are expected to be in service. It is surprising that not even in case 1 the dentists were inclined to leave this examination procedure to the hygienists.

Also, with regard to less complicated treatment such as professional cleaning, only about 60% of PP and PDS thought this should be left to DH. The PP was also more inclined to use dental nurses for this treatment (25%).

Instruction for effective self-care being left to DH had a greater support, and this can depend on the fact that DH perhaps had a better education and interest for this procedure. In spite of this, the PP was the least inclined to leave this to DH. Perhaps the lack of patients – 18% in private sector and 5% in the Public Dental Service - could have had an influence on the willingness to leave the assignment to someone else in the team.

Are the methods of treatment proposed in accordance with the degree of severity of the disease?

Almost 94% of the respondents had the opinion that a 45 year old healthy woman with no bone loss and a bleeding index of 22% and a plaque index of 28%, had a periodontal disease. Is this condition a basis for reimbursement of care from the community? Where is the delineation towards the natural course of ageing?

When asked if they could see a risk for developing gingival and/or periodontal disease for case 1, 97% of performers judged this risk to none or low and this is in our opinion a correct judgment. Therefore, it is surprising that 91% of the caregivers said it was necessary to offer preventive care. In a national economic perspective, it seems like a waste of money and resources. When we look at case 2 and case 3, it seems relevant both to judge that they have disease and in need of dental care to a somewhat different extent. Case 3 belongs to the group where no improvement has occurred, i.e. number of patients with serious periodontal disease has not been reduced in the same way as in the other groups. To one more time come back to the opinion of Baelum & Lopez –that there is no natural base for a sharp distinction between health and disease or between different forms of periodontitis (3), could it be that it is easier to give treatment to healthy persons than to persons with severe illness? Could it be that there are no substantial financial incentives in the national assurance system to take care of the latter group?

We must also keep in mind that there may be a lot of traditions in dentistry concerning how often the patients are called for examinations and what kind of dental care is performed at these occasions. It seems to depend on expectations and demands from patients and to what extent there is a balance between demand and availability concerning dental care.

To sum up, the answer to the question in our aim – "Are the methods of treatment used in accordance with the degree of severity of the disease?" is in our view negative.

To what extent are treatment proposals in accordance with National Guidelines?

Professional cleaning of the teeth was proposed by 90 to 100% of the respondents, but we should be aware that the respondents had the possibility to choose more than one option concerning what caregiver category should perform the treatment. Thus, the numbers could be too high with regard to what extent they wanted to perform the treatment. We can conclude that the numbers, when we exclude the effect described above, were between 66-84%. This treatment option is described in The National Guidelines as the least recommended to perform (9), giving no effect at all on the patient's oral health and there is good evidence for this statement. We can

conclude that the dental care suggested to be performed to a limited degree is in line with the guidelines or with evidence based care. It is also important to underline that this treatment is not reimbursed in The Dental and Pharmaceutical Benefits Agency, TLV, who decide the reimbursement for different treatments in dentistry.

When we come to instruction for effective self-care, this was proposed from 84-89% of the performers and is also highly recommended in the National Guidelines. This treatment is also reimbursed by the Dental and Pharmaceutical Benefits Agency, TLV.

The question arises: Why use both one treatment with no effect and one treatment highly recommended from the National Board of Health and Welfare? The guidelines were presented in the beginning of 2011 but discussed and presented in a preliminary version 2010. Our questionnaire was presented and sent out around autumn 2011, so reasonably, the respondents should be aware of the content of the guidelines.

Thus, the knowledge of evidence and effect on the treatment options described above was low and treatment performed seems to be based a lot on treatment tradition within the traditional care professions. That professional performers to a great extent lean on tradition rather than on evidence based knowledge, has also been shown by others (22).

Conclusions

Regarding the first aim: the two groups, representing dentists and dental hygienist delivering basic periodontal care in Sweden, were to a significant degree not sharing the knowledge basis for diagnosis and treatment planning. This may result in a less than optimal utilization of resources in Swedish dentistry.

Regarding the second aim: the delivery of basic periodontal care was not in line with the severity of disease, and too much attention was paid to the needs of relatively healthy persons. When the clinicians were asked if they could see a risk for developing gingival and/or periodontal disease for case 1, 97% of performers judged this risk to none or low and this is in our opinion a correct judgment. Therefore, it is surprising that 91% of the caregivers said it was necessary to offer preventive care.

Regarding the third aim: we conclude that the dental care suggested to be performed, to a limited degree is in line with the guidelines or with evidence based care. To change this pattern we think that the incentives in and structure of the national assurance system have to be adapted in order to stimulate a better inter-collegial cooperation in basic periodontal care.

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We thank Per-Erik Isberg, lecturer at the Institution of Statistics, Lund University, for valuable help and advice. This paper is in memoriam of our colleague, late professor Björn Söderfeldt, who was actively part of the project until his death in the summer of 2013.

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What factors can be protective for both self-rated oral health and general health?

GUNNAR EKBÄCK[1, 2], CARINA PERSSON[3], MARGARETA LINDÉN-BOSTRÖM[3].

Abstract

◉ The aim of this study was to analyze if the same protective factors are significant for both self-rated health and oral health. It was hypothesized that these factors should be the same.

The material is based on a population sample of 17 113 women and men aged 18–84 years in one county in central Sweden. The response rate was 61%. The data were collected through a postal questionnaire "Life and Health" in 2008. The questionnaire comprised of 149 questions and was divided into a number of areas, e.g. socioeconomic conditions, quality of life, social relations, lifestyle, and health. To analyze the strength of the protective factors whilst taking into account the relationships between the various independent variables, multivariate analyses were conducted using binary multiple logistic regression.

The outcome measures with the strongest association to general health is belonging to the age group 18–34 years, positive faith in the future, good sleeping pattern and to be employed/self-employed/retired. The outcomes with the strongest association to oral health are good finances, belonging to the age group 18–34 years, to be born in Sweden and positive faith in the future.

Conclusions. This study shows that, in general, the same protective factors are significant for both self-rated health and self-rated oral health, making it possible to use the same approach to strengthen both general health and oral health. One important outcome, not often considered, is having positive faith in the future. It is a task for the health care system to strengthen people's faith in the future, partly through a very high quality care when needed, but also through active health promotion that increases the chances of a healthy life, both from a public health perspective as from an oral health perspective.

Key words

Promotion, Public health, Self-rated oral health.

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Finns det gemensamma skyddsfaktorer för självupplevd oral hälsa och självupplevd allmän hälsa?

GUNNAR EKBÄCK, CARINA PERSSON, MARGARETA LINDÉN-BOSTRÖM.

Sammanfattning

◎ Syftet med denna studie var att jämföra och undersöka om både allmän hälsa och oral hälsa har samma skyddsfaktorer. Hypotesen var att de skulle vara lika.

Resultatet baseras på ett urval av 17113 individer, 18 till 84 år, bosatta i Örebro län. Data samlades in från en enkätstudie ”Liv & Hälsa” 2008. Enkäten bestod av 149 frågor som var uppdelade i en rad områden som socioekonomiska förhållanden, livskvalité, sociala förhållanden och hälsa. Logistiska regressioner användes för att analysera sambandet mellan de skyddande faktorerna och såväl självupplevd allmän hälsa som oral hälsa, med hänsyn taget till ett antal oberoende faktorer.

Svarsfrekvensen var 61 %. Förutom ålder var positiv framtidstro, goda sömnvanor samt anställningsförhållanden viktigast för allmänhälsan. För oral hälsa var god ekonomi, ålder, födelseland Sverige, samt en tilltro till framtiden viktiga skyddande faktorer.

Sammanfattningsvis visar studien att flertalet av de viktigaste skyddsfaktorerna är gemensamma för både allmän hälsa och för oral hälsa vilket gör det möjligt att påverka båda dessa områden med samma hälsofrämjande insatser. En viktig faktor för såväl god allmän hälsa som god oral hälsa är tilltro till framtiden. Detta är en faktor som vare sig hälso- och sjukvården eller tandvården ensamt kan ge sina patienter. De kan dock bidra genom att patienten får både tillgång och tilltro till den vård han/hon behöver men även med att specifikt arbeta med att stärka individens framtidstro genom att delta i mer komplexa folkhälsoinsatser.

Introduction

Health is a concept that can be described in many ways. In the current usage, it implies a multifaceted concept, as a combination of assessment an individual's self-rated health and the medical evaluation of healthcare professionals [3]. It also overlaps with the broader concept "Health Related Quality of Life" (HRQoL) which addresses the question of whether health status leads to a life worth living [3]. Based on the same approach, the concept of oral health has been described in the same way without any strict definition of either oral health or "Oral Health Related Quality of Life" (OHRQoL) [2, 3].

The characteristic of these subjects is that they are dynamic, subjective and can change over time [5]. Both self-rated health and self-rated oral health can be measured either with a number of complex instruments or with some global questions [6, 9,17, 22].

There is evidence that oral health has a strong impact on general health and poor oral health has a profound effect on general health and quality of life [4]. The experience of pain, as well as trouble/inconvenience while eating, chewing, smiling or communicating due to discolored or damaged teeth, has a major impact on people's daily lives and well-being. The interrelationship between oral health and general health is particularly pronounced among older people [24-25]. Even if this problem is smaller in adolescents, especially females are affected with an impact on their daily lives and well-being [8]. WHO has listed the impact of oral health on the quality of life as an important element of the Global Oral Health Program and urged oral health care providers to integrate the OHRQoL concept into their daily practice to improve the outcome of their services [34]. They also encourage oral health planners and administrators to integrate interventions for oral health among older adults into general health programs to help people enjoy longer and greater quality of life [27].

In public health surveys, it is common to use poor health as an outcome variable, resulting in a risk perspective. Knowledge about protective factors is a useful tool in the choice of different methods of health promotion. As *Antonovsky* stated, "a salutogenetic orientation in and of itself would be a valuable foundation for those engaged in health promotion" [1]. In our earlier Swedish study we applied a promotive approach based on protective factors, which we have seen can contribute to valuable insights regarding good general health [15]. The results showed that there exists a positive correlation between the number of protective factors and both self-rated general health and mental health [15]. This results made us interested to study whether these relationships are applicable between protective factors, oral health and general health. Based on these gaps of knowledge, and knowing that correlations between these factors are complex, there is good reason to adapt a salutogenetic perspective and study protective factors for health and oral health, each measured with one global question. The aim of this study was to analyze if the same protective factors were significant for both self-rated health and self-rated oral health. It was hypothesized that these factors should be the same.

Materials and methods

Study population

The study was conducted in a population aged 18–84 in Örebro County in central Sweden. The response rate was 61%, 10 403 respondents. The sampling procedure used was an independent random sample stratified by sex, age group, and geographical area. The data was collected with a postal questionnaire "Life and Health" from Mars to May 2008 and ceased after three postal reminders.

Measures

The questionnaire comprised of 149 questions. The questions were divided into a number of areas, *e.g.* socioeconomic conditions, quality of life, social relations, lifestyle, and health. The outcome variable self-rated health was assessed using the question, "How do you rate your general health?" and self-rated oral health through, "How do you rate your oral health?". The options "Very good", "Good", "Neither good nor poor", "Poor" and "Very poor" were dichotomized. The first two alternatives were used to estimate good self-rated health and good self-rated oral health. All factors, except the factors age (four groups) and *education* (three groups) used in the analysis were dichotomized. The answers and study groups are given below and the reference group is marked (0). The questions for chosen analysis were based on earlier studies [12, 13, 15, 20].

Background factors

- *Sex:* Women (1) and men (0).
- *Age:* The age groups were 18–34 (1), 35–49 (2), 50–64 (3), and 65–84 (0).
- Country of birth: Born in Sweden (1), and born outside of Sweden (0).

Protective factors

• *Education:* Secondary education (10–12 years of education) (1), post-secondary education (more than 12 years of education) (2), and compulsory school or equivalent education for nine years or less (0).

• *Family structure:* This factor is constructed from a question about with whom the respondent is living and what connections they have (marriage, partnership, parenthood, etc.). People living with a partner (1), and those who are not (0).

• *Occupation:* This factor is constructed from a question where the respondent could give multiple answers. In the case of more than one answer, the answers have been ordered with working as an employee as priority one and thereafter in descending order of connection to the labour market: manages one's own or a partially owned business (self-employed), student, unemployed, retired (if older than 64 years), disability pensioner (if younger than 65 years), on parental leave, on leave, domestic worker, and other occupation. Persons that are employed, self-employed or retired (1), and those who are not (0).

• *Finances:* People with no trouble paying their current bills during the past twelve months (1), and those who had problems for at least one month (0).

• *Thriving in residential area:* Those who answered the question "How well are you thriving in the surroundings were you live?" with "Very good" or "Rather good" (1), and those who answered "Neither good nor poor", "Poor" or "Very poor" (0).

• *Safe in residential area:* Those who agreed with the statement "You can feel secure and safe that you won't be attacked or threatened in this neighborhood." (1), and those who did not agree (0).

• *Personal support:* The factor personal support is defined by a question whether the respondents believe that they have anyone who can help them in case of a personal problem or crisis in life. Those who answered "Quite sure" (1), and those who answered "Probably", "Probably not" or "No" (0).

• *Participation in associations:* Those who participate in activities or attend meetings in a group or organization (1), and those who do not (0).

• *Physical activity:* This factor was estimated with the question "How much do you exercise physically in your leisure time?" Those who are physically active at least 2 hours a week (1), and those who are not (0).

• *Body mass index (BMI):* From the respondents' self-reported weight and height, the body mass index (BMI=kg/m2) was calculated. BMI was categorized according to the WHO guidelines [31] i.e. those who are of normal weight (1) and those who are not (0).

• *Sleeping pattern:* This factor was estimated with the question "Have you had trouble sleeping during the past three months?". Those who "Did not experience any troubles" or "Have been troubled occasionally" (1), and those who have been troubled "Repeatedly" or "Nearly all the time" (0).

• *Eating habits:* This is an index composed of two questions about how often one consumes fruit and vegetables. Those who are defined as eating fruit and vegetables at least five times a day (1), and those who are not (0).

• *Faith in the future:* Those who answered the question "How do you look at the future for your own personal sake?" with "Very optimistic" or "Rather optimistic" (1), and those who answered "Neither optimistic nor pessimistic", "Rather pessimistic" or "Very pessimistic" (0).

Statistical methods

All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS, Release 21). Bivariate analyses were conducted by binary logistic regression. To analyze the strength of the protective factors whilst taking into account the relationships between the various independent variables, multivariate analyses were conducted using binary multiple logistic regression with categorical data. Multicollienarity was taken into consideration by studying bivariate correlation matrices and the standard errors for the beta coefficients in the multivariate analysis. A number of interactions between the independent variables were tested using multiple logistic regression as well as by performing separate analyses for men and women.

Ethical approval

The respondents agreed that official data records of sex, age, geographical area, education level, occupation, country of birth and year of immigration should be linked to the data in the questionnaire by providing informed consent. Statistics Sweden, the statistical administrative authority in Sweden, added registry data and returned unidentified files to the county. This was done under the jurisdiction of Swedish law of official statistics (2001:99 6§) and the law of secrecy (1980:100 9 kap. 4§), and the Declaration of Helsinki. The Ethical Review Act of Sweden (2003:460) did at the time of the data collection not require an approval of an ethics committee since the data are anonymous.

Fig. 1a. Associations between outcome measures (significant odds ratios in figure) and good self-rated health.

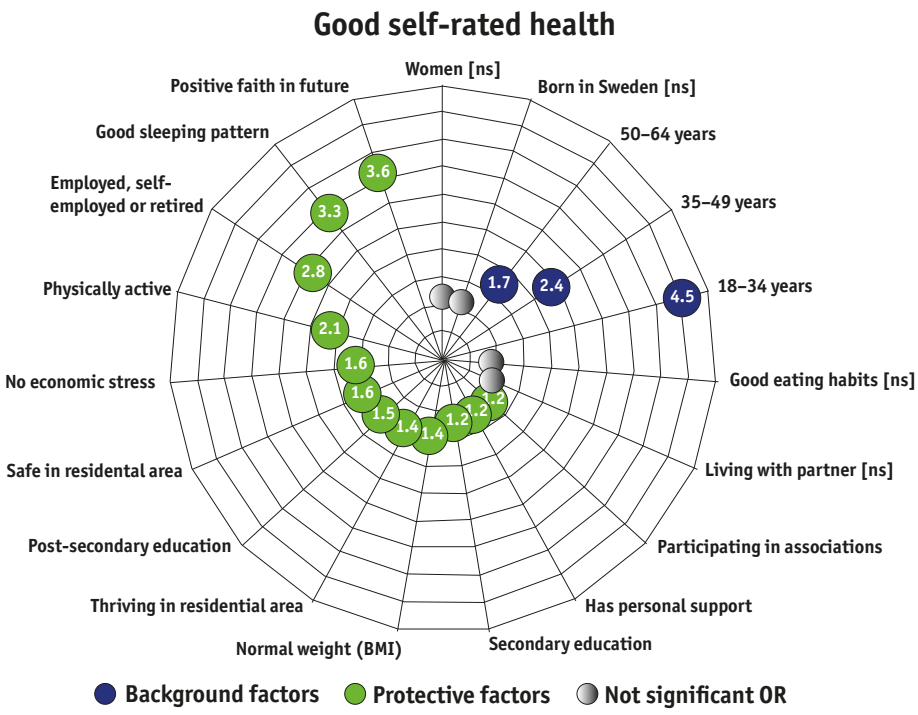
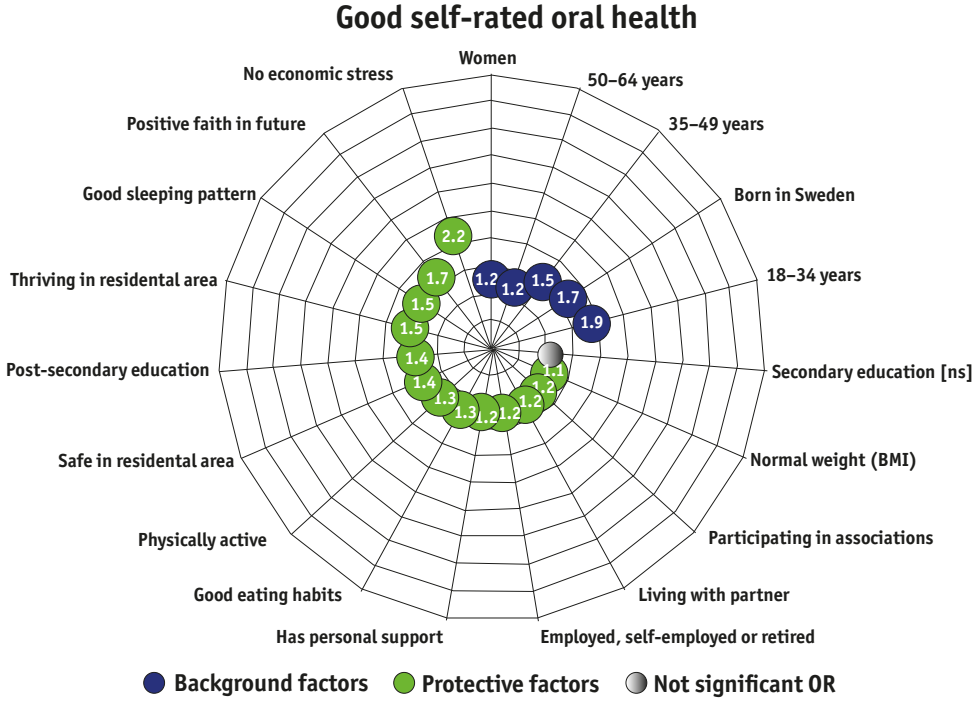


Fig. 1b. Associations between outcome measures (significant odds ratios in figure) and good self-rated oral health.



◎ **Table 1.** Multivariate logistic regression models for good self-rated health and good self-rated oral health. The distribution and number of responses per factor (N), odds ratio (OR) with 95% confidence intervals (95% CI) for the outcome measures.

	Good self-rated health						Good self-rated oral health					
	N	OR		95% CI			N	OR		95% CI		
Background factors												
Sex												
Men (ref)	3925						3935					
Women	4553	1.1	ns	0.98	–	1.24	4567	**1.2**	***	1.13	–	1.39
Age												
65–84 years (ref)	2735						2724					
18–34 years	1579	4.5	***	3.65	–	5.57	1591	1.9	***	1.57	–	2.24
35–49 years	1827	2.4	***	2.00	–	2.84	1834	1.5	***	1.32	–	1.80
50–64 years	2337	1.7	***	1.46	–	1,97	2353	1.2	**	1.06	–	1.39
Country of birth												
Not born in Sweden (ref)	836						833					
Born in Sweden	7642	1.1	ns	0,90	–	1.29	7669	1.7	***	1.42	–	1.94
Protective factors												
Education												
Compulsory schooling (ref)	2451						2434					
Secondary education	3872	1.2	**	1.05	–	1.37	3900	1.1	ns	0.97	–	1.24
Post-secondary education	2155	1.5	***	1.27	–	1,76	2168	1.4	***	1.23	–	1.66
Family structure												
Not living with partner (ref)	2446						2450					
Living with partner	6032	1.0	ns	0.88	–	1.13	6052	1.2	**	1.06	–	1.33
Occupation												
Not employed, self-employed or retired (ref)	1453						1465					
Employed, self-employed or retired	7025	2.8	***	2.38	–	3.30	7037	1.2	*	1.04	–	1.39
Finances												
Economic stress (ref)	1190						1205					
No economic stress	7288	1.6	***	1.34	–	1.86	7297	2.2	***	1.88	–	2.49
Thriving in residential area												
Not thriving in residential area (ref)	683						686					
Thrive in residential area	7795	1.4	***	1.18	–	1.78	7816	1.5	***	1.28	–	1.84
Safe in residential area												
Not safe in residential area (ref)	416						419					
Safe in residential area	8062	1.6	***	1.22	–	2.03	8083	1.4	**	1.11	–	1.73
Personal support												
Do not have personal support (ref)	2418						2430					
Access to personal support	6060	1.2	**	1.05	–	1.33	6072	1.2	***	1.09	–	1.36
Participation in associations												
Not participating in associations (ref)	4751						4764					
Participating in associations	3727	1.2	**	1.05	–	1.32	3738	1.2	**	1.06	–	1.31

(Table 1 continues on next page)

(Table 1, continued)

	Good self-rated health					Good self-rated oral health				
	N	OR		95% CI		N	OR		95% CI	
Physical activity										
Not physically active (ref)	5163					5167				
Physically active	3315	2.1	***	1.86	– 2.38	3335	1.3	***	1.20	– 1.49
Body Mass Index (BMI)										
Underweight/overweight/ obesity(ref)	4891					4906				
Normal weight (BMI 18.5–24.9)	3587	1.4	***	1.28	– 1.61	3596	1.1	*	1.02	– 1.26
Sleeping pattern										
Not good sleeping pattern (ref)	1875					1883				
Good sleeping pattern	6603	3.3	***	2.95	– 3.80	6619	1.5	***	1.37	– 1.74
Eating habits										
Not good eating habits(ref)	7784					7801				
Good eating habits	694	0,9	ns	0.73	– 1.12	701	1.3	*	1.04	– 1.56
Faith in the future										
Not faith in the future (ref)	2917					2920				
Faith in the future	5561	3.6	***	3.19	– 4.02	5582	1.7	***	1.48	– 1.84
Total	8502	Nagelkerke=35,9%			8478	Nagelkerke=14,3%				

*** p<0,001, **p<0,01, *p<0,05, ns=not significant

Results

Almost all the studied factors had a statistically significant association with self-rated general and oral health (Table 1). However, there was a difference in the span of strength regarding the outcome measures in relation to the two dependent variables, with significant OR ranging from 1.2 to 4.5 for general health and from 1.1 to 2.2 for oral health (Figure 1a, b). Nevertheless, the pattern is fairly similar and 13 of 18 background factors and protective factors were shared. The outcome measures with the strongest association to general health is *belonging to the age group 18–34 years, positive faith in the future, good sleeping pattern and to be employed/self-employed/ retired.* The outcomes with the strongest association to oral health are *good finances, belonging to the age group 18–34 years, to be born in Sweden and positive faith in the future. Eating habits* (good), *country of birth* (Sweden), *family structure* (living with partner), and sex (women) only had significant associations with oral health.

A bivariate correlation analysis rendered correlation coefficients from rs -0.195 to 0.365. The standard errors for the beta coefficients ranged from 0.053 to 0.201 (not in table) and did not indicate numerical problems such as multicollinearity among the independent variables, cells with a zero count for a dummy coded variable or complete separation. The separate analysis for women and men gave almost the same results as the main model and no sex-related interactions could be found. There was, however, a significant interaction between age and occupation (general health: OR=0.3 employed*aged 18–34; oral health: OR=0.7 employed*aged 18–34).

Discussion

Health services research aims to produce valid data on which to base appropriate, effective, cost-effective, efficient, and acceptable health services in the broadest sense [31]. In this study, we found that there are a number of protective factors that are strongly associated to both self-rated health and self-rated oral health. This makes it possible not only to draw conclusions about using the same promoting approach for both general health and oral health. It also allows for making conclusions about were the limitations is between how much can be done by health promotion in health care and what decisions that must be made by politicians [32].

Even if most protective factors were the same, the level of association differed between general health and oral health, with most factors showing a stronger association with general health. A comparison of background factors for health and oral health showed that age did not have as strong an association with oral health as with general health. To be employed, self-employed or retired also has a strong

positive association with general health when controlling for age, which is not the case for oral health, although the association is statistically significant. The oral health seems to be rather good among older Swedish people even though it is even better among the younger people. The differences in general self-rated health that can be seen between, for instance, employed and unemployed men and women is not as pronounced regarding the oral health. This gives an indication that the oral health is more equally distributed in Sweden, at least for the time being. However, eating habits, family structure, sex and country of birth were only statistically associated with oral health. The latter has been studied before and was reported as an important factor with a long-term effect on satisfaction with oral health, possibly explained by different oral health symptoms [7].

In health, faith in the future was one of the most important protective factor in this study, confirming earlier results [19, 28]. In this study it also turned out to be of significance for oral health and, to the best of our knowledge, has not previously been studied in this way. If this can be verified in further studies it will have a profound effect for many promotive approaches and perhaps leading to community development programs working toward the goal of increasing positive faith in the future [29-30].

For oral health, the absence of economic stress was the most important outcome measure. This is in line with the result of other studies and, among them; *Listl* stated that a "disproportionate concentration of access to treatment among the rich elderly populations" exists [16, 26]. This result supports the views expressed in an ongoing discussion in Sweden that not all people can afford dental treatment, and there is a trend for a growing gap in oral health. Some other protective factors for oral health were physical activity and good eating habits. Despite the fact that dietary habits are highlighted in the WHO report from 2003 [23], in this study, eating habits showed only a minor association with oral health and a non-significant association with general health.

Many studies have shown how sleep disorders negatively affect health. Our results show that good sleep is especially important in relation to general health, but is also essential for oral health [33].

Strengths and limitations

As far as the authors can find, this study is the first attempt to define and measure protective factors for oral health and to compare them with those of general health. The strength of this study is the use of a well-known Swedish study with many participants but, nevertheless, the non-response rate was 39%. However, a previously conducted non-response study showed that there was no difference in either good self-reported general or oral health between non-responders vis-à-vis others [13,14]. The global health measures, used in this study, have been found to be reliable and valid [18, 21]. However, all possible factors that are assumed to be associated with oral and general health could not be covered in this study, which means that the results must be interpreted with some caution. Finally, the study has some limitations caused by the cross sectional design and the reliance on self-reporting data. There is also a possibility that some answers might have been over- or under-reported due to subjects providing socially desirable responses [10].

Conclusion

This study shows that, for the most part, the same protective factors were significant for both self-rated health and self-rated oral health, suggesting that the same approach can be used to strengthen both general health and oral health. It also highlights an important profound factor in the promoting field of work i.e. positive faith in the future. A strong faith in the future is generally associated with good general and oral health. But is it possible, and even desirable, for the health care system to promote people's experience of their life? Yes, we believe it is. We are confident, both that it is a task and also possible, for the health care system to strengthen people's faith in the future. Partly through a very high quality care when needed, but also through active health promotion that increases the chances of a healthy life, both from a public health perspective as from an oral health perspective. Further studies along these lines are needed to make a more definite proposal as to the impact of different protective factors of oral health.

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Dental fear among children and adolescents in a multicultural population – a cross-sectional study

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Abstract

◎ The aim of this study was to explore dental fear in a multicultural population of child and adolescent dental patients, with background, gender, age, and socioeconomic status taken into account. A specific aim was to investigate whether the level of DF differed between patients with a non- Swedish background and patients with a Swedish background.

In conjunction with a routine visit to the dental clinic, 301 patients (8–19 years old) assessed their dental fear on the Children's Fear Survey Schedule – Dental Subscale, using self-ratings. Following an interview protocol, patients' and their parents' country of birth, and parents' education and occupation/employment were registered. An interpreter was present when needed.

Self-rated dental fear was almost equal among patients coming from a non-Swedish background and patients with a Swedish background. Girls scored higher than boys and younger children scored slightly higher compared to older children, but the pattern of dental fear variation was inconsistent. Socioeconomic status differed between the groups with a non- Swedish vs. a Swedish background, but no impact on dental fear was revealed. When children and adolescents with a non-Swedish vs. a Swedish background were modelled separately, female gender and younger age had an impact on dental fear only in the group with a Swedish background.

No differences in dental fear were found between children and adolescents from non-Swedish vs. Swedish backgrounds. Dental fear variations according to gender and age were more pronounced in the group with a Swedish background compared to the group with a non-Swedish background. No impact of socioeconomic status could be revealed.

Key words

Dental fear, questionnaires, cultural diversity

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Tandvårdsrädsla bland barn och ungdomar i en multikulturell population – en tvärsnittstudie

ANIDA FÄGERSTAD, JESPER LUNDGREN, KRISTINA ARNRUP

Sammanfattning

◎ Syftet med denna studie var att undersöka tandvårdsrädsla i en multikulturell population hos tandvårdspatienter där bakgrund, ålder, kön och socioekonomisk status beaktades. Ett specifikt syfte var att undersöka om graden av tandvårdsrädsla skiljde sig mellan patienter med icke-svensk resp. svensk bakgrund.

I samband med rutinmässigt besök på tandvårdskliniken, skattade 301 patienter (8–19 år) själva sin tandvårdsrädsla mätt med Children's Fear Survey Schedule – Dental Subscale. Uppgifter om födelseland samt föräldrars födelseland, utbildning och yrke/sysselsättning registrerades. Vid behov fanns auktoriserad tolk närvarande.

Självskattad tandvårdsrädsla var nästan lika mellan patienter med icke-svensk resp. svensk bakgrund. Flickor skattade högre än pojkar och yngre barn skattade lite högre än äldre barn, men mönstret var inte helt konsekvent. När barn och ungdomar med icke-svensk resp. svensk bakgrund analyserades separat, sågs köns- och åldersmönstret endast i den svenska gruppen. Socioekonomisk status skiljde sig mellan grupperna med icke-svensk resp. svensk bakgrund, men befanns inte ha någon inverkan på tandvårdsrädsla.

Inga skillnader i tandvårdsrädsla kunde påvisas mellan barn och ungdomar med icke-svensk resp. svensk bakgrund. Variationen i tandvårdrädsla mot bakgrund av kön och ålder var mer uttalad i gruppen med svensk bakgrund än i gruppen med icke-svensk bakgrund. Socioekonomisk status hade ingen inverkan på tandvårdsrädsla.

Introduction

One of the most common fears is dental fear (DF) (14), which can lead to avoidance of dental care (10, 14, 45) and may cause serious problems for the patient (7, 13, 14). The reported prevalence of DF in European child and adolescent populations varies from 6% to 20% (28). Several studies have reported that DF is more pronounced in girls (34, 40, 46, 49) and younger children (2, 39, 50), but others have failed to show any relationship between DF, gender (23, 44, 47), and age (3, 34, 36, 49).

Dental fear is likely to be of multifactorial origin (33) and several potential etiological factors have been proposed, including general fear (in younger children) (39, 47) and temperamental aspects (e.g., shyness, negative emotions) (27). Pain and negative experiences of dental treatment (13, 40), issues related to socioeconomic factors (20, 37), culture (34), family, and child rearing (e.g., in single-parent families) (28), and parental DF (39, 46) also affect children's DF. In adults, DF has commonly been reported to have developed in childhood in the context of negative dental experiences (1, 7).

Several different techniques have been used to measure DF among children and adolescents, such as projective techniques, physiological measures (e.g., heart rate, muscle tension), psychometric scales, and behavioural ratings (28, 38). A commonly used psychometric instrument to measure DF among children and adolescents is the CFSS–DS (11, 38). Population averages in the CFSS– DS among children in European countries are fairly similar (27, 49, 50), whereas higher averages have been reported from Asian and American countries (11, 16, 33, 44). This may, according to *Wogelius et al.* (50), be due to the way child dental care is organized, as well as to cultural differences and the population studied.

That cultural aspects have an impact on DF was supported by a study by *Hilton et al.* (19), which concludes that there are both similarities and differences in cultural beliefs between ethnic groups in American countries and, furthermore, that these beliefs together with parental DF can influence young children's access to dental care. *Nakai et al.* (34) investigated DF in children and adolescents (8–15 years) in Japan, measured using the CFSS–DS, and found that cultural and social behaviour may affect both the development and the expression of DF (34). *Mejare & Mjones* (32) found that DF was more common in Turkish children born in Sweden compared to both Swedish-born children and Turkish children born in Turkey (32). In the Netherlands, *ten Berge et al.* (49) revealed that a subgroup of children with a non-Western European background scored significantly higher on the CFSS–DS compared to Western European children (49). The effect of culture together with other factors (age, gender, socioeconomic) may be one of the reasons why DF varies from region to region (15).

Although there are growing proportions of people with non-Swedish background living in Sweden (43), the knowledge regarding DF among children and adolescents with non-Swedish background is limited. In some previous Swedish studies among children and adolescents referred for specialized dental care because of DF or dental behaviour management problems (4, 5, 17, 18), excluded those who couldn`t communicate in Swedish. Therefore, the aim of this study was to explore self-rated DF in a multicultural population of child and adolescent dental patients (8–19 years old), with gender, age, and socioeconomic status (SES) taken into account. A specific aim was to investigate whether the level of DF, as measured using the CFSS–DS, differed between patients with a non-Swedish background and patients with a Swedish background.

Materials and methods

The study was performed at a public dental clinic located in a multicultural area of Örebro, Sweden. Patients aged 8–19 years and called up for a regular dental examination at the clinic from June to October 2011 were consecutively enrolled. In total, 492 patients received written information about the study together with the recall letter. Of these, 315 patients (179 boys and 136 girls) were, in conjunction with their visit at the clinic, asked to participate and 304 patients agreed. Reasons why 177 patients (84 boys and 93 girls; 85 aged 8–12 yrs, 53 aged 13–16 yrs, 39 aged 17–19 yrs) were never asked to participate were delays of ≥20 minutes (91 patients), no-shows (21 patients), or, for 8–14-year-olds, attendance without their parents (required for agreement to study participation when aged below 15 yrs; 31 patients). Further, although interpreter service was routine, three patients were never asked for participation due to no understanding of Swedish and no interpreter present, and 31 patients had moved out of the area. Due to missing data, three patients of the 304 were excluded, leaving 301 for analysis (172 boys and 129 girls; 98 aged 8–12 yrs, 96 aged 13–16 yrs, and 107 aged 17–19 yrs). In accordance with the Swedish Ethical Review of Research Involving Humans (SFS 2003:460, §18) (9), patients, and if aged below 15 yrs

their parents, received information about the aims and procedures of the study (in writing and verbally), and that participation was voluntary. The study was approved by the Regional Ethical Review Board and was performed in accordance with the principles stated in the Declaration of Helsinki. Informed consent was obtained prior to inclusion.

Those patients who agreed to participate in the study were asked about their and their parents' country of birth and their parents' occupation and level of education. For assessment of DF, we used the Children's Fear Survey Schedule – Dental Subscale (CFSS–DS), with participants using self- ratings (11). Accompanying parents took no part in the CFSS–DS ratings. For those who required language assistance, a professional interpreter was present during the information session, explaining about the study and study procedure, as well as during the questionnaire completion phase. All data was collected before the patients were clinically examined.

Measures

The CFSS– DS is a frequently used tool for parental or self-ratings of children's dental fear (6). The CFSS– DS has been validated and used among different cultures and populations, including Turkey, Finland, Bosnia and Herzegovina, Sweden, China, Croatia and Japan (2, 3, 6, 17, 30, 31, 34). The CFSS–DS consists of 15 items. The response format ranges from 1 ("not afraid at all") to 5 ("terrified"), giving a sum score range of 15–75. A sum score of ≥38 on the CFSS–DS has been found to be indicative of DF (24), and is therefore commonly used as "standard" cut-off (11, 25, 50). An exception has been proposed by ten *Berge et al.* (49), who defined a borderline or risk range for DF from a sum score of 32 (49).

In this study, we report CFSS–DS sum score means and medians as well as frequency distributions of DF according to cut-off scores (≥38 = "standard," ≥32 = "risk"). We have used the individual mean to replace missing data on single items (maximum of three) on the CFSS–DS.

Data on parents' occupation and education level were combined into a measure of socioeconomic status (SES), using a Swedish translation of Hollingshead's four-factor index of social position (21), modified by *Broberg* (8). According to the Swedish version, an index was computed based on both parents' occupation and education. We used an extended version, which includes also parents with no regular occupation (12). In cases where information was available for only one parent, the index computed for that parent was used. *Hollingshead's* index range from 8 to 66 and was, in the analyses, classified into three categories ("low SES": 8–29.25; "average SES": 29.5–40.75; and "high SES": 41.0–66), according to the distribution in the *Dahlin–Wilhelmsson* sample where each category represents one-third of the total scores and may be considered Swedish norms (12).

Patients' and parents' country of birth was used to form the categories of non-Swedish (i.e., foreign-born with foreign-born parents or Swedish-born with foreign-born parents) and Swedish (i.e., Swedish-born with one foreign-born parent and with one Swedish-born parent or with both parents Swedish-born), according to a definition by Statistics Sweden (SCB) (42) (Table 1).

Statistical analysis

Prior to the data collection, a power analysis was performed to detect what was judged as clinically relevant differences in the CFSS–DS (four units, such as sum score 23 vs. 27; assumed standard deviation (SD) = 10) between two independent groups (non-Swedish background vs. Swedish background), with a power of 80% and significance level of 0.05. This required 100 participants in each group. Since the population was unevenly distributed, data collection was planned to continue until we had at least 100 individuals in each group (non-Swedish vs. Swedish background).

Medians (range and/or interquartile range (IQR)), means (SD), and frequency tables were use to describe data by groups (non-Swedish/ Swedish, gender, age). Group differences were analysed using non-parametric and parametric tests for two (chi square test, Fisher's exact test, Mann-Whitney U-test, Student's *t*-test) or more (Kruskal- Wallis test, analysis of variance (ANOVA)) groups. Multivariate comparisons were performed using logistic regression analyses (with ENTER method), with DF, according to the cut-off score of ≥32, as dependent variable. As independent variables (and possible "predictors"), we included group (non-Swedish vs. Swedish), gender, age (8–12 yrs, 13–16 yrs, and 17–19 yrs), and SES (low, average, high). All logistic regression analyses were initially performed on the total sample, as described, and thereafter repeated separately for non-Swedish vs. Swedish children and adolescents. Odds ratios (OR) with 95% confidence intervals (CI) are given. All statistics were performed using IBM SPSS statistics version 21.0 (SPSS Inc., Chicago, IL, US). The level of significance was set at $p<0.05$.

Table 1. Sample characteristics including gender, age and socio-economic status (SES) (Hollingshead Index) by groups and subgroups with non-Swedish and Swedish background.

	Gender	N	Age		Hollingshead Index	
			Mean	SD	Mean	SD
Non-Swedish background					**(valid n=183)**	
All	Boys	108	14.9	3.3	24.2	11.7
	Girls	79	13.8	3.6	23.6	11.1
	Total	**187**	**14.4**	**3.4**	**23.9**	**11.4**
Foreign born with foreign- born parents	Boys	62	15.4	3.0	22.3	11.7
	Girls	40	14.8	3.3	22.2	10.8
	Total	102	15.2	3.1	22.2	11.3
Swedish born with foreign- born parents	Boys	46	14.2	3.5	26.7	11.3
	Girls	39	12.8	3.6	25.1	11.3
	Total	85	13.5	3.6	26.0	11.3
	Gender	**N**	**Age**		**Hollingshead Index**	
			Mean	SD	Mean	SD
Swedish background					**(valid n=113)**	
All	Boys	64	13.9	3.8	33.5	11.7
	Girls	50	14.4	3.7	33.6	12.8
	Total	**114**	**14.1**	**3.7**	**33.6**	**12.1**
One foreign-born parent and one Swedish-born parent	Boys	6	13.3	3.9	28.1	18.4
	Girls	7	14.4	4.4	32.3	11.1
	Total	13	13.9	3.8	30.4	14.4
Swedish born parents	Boys	58	14.0	3.8	34.1	10.8
	Girls	43	14.4	3.6	33.9	13.1
	Total	101	14.2	3.7	34.0	11.8

Results

Sample characteristics

Altogether, there were 187 (62%) patients with a non-Swedish background and 114 (38%) patients with a Swedish background, according to the SCB definition (42). The non-Swedish background group included 102 foreign-born patients and 85 Swedish-born patients with foreign-born parents. The Swedish background group included 101 Swedish-born patients with Swedish-born parents and 13 Swedish born-patients with one foreign-born parent (Table 1). There were 172 boys (108 with a non-Swedish background and 64 with a Swedish background) and 129 girls (79 with a non-Swedish background and 50 with a Swedish background) who participated in the study, with mean ages 14.4 years (non-Swedish background) and 14.1 years (Swedish background).

In total, 42 countries were represented in this study in terms of participants' and their parents' country of birth (35 countries within the group from a non-Swedish background and seven countries within the Swedish background group). The origins among those with a non-Swedish background were Asian (85), followed by African (59), European (except the Nordic countries; 39), the Nordic countries (except for Sweden; 2), North America (1) and finally South America (1). In the group with a Swedish background and one foreign-born parent, the origins were European (except the Nordic countries; 5), the Nordic countries except Sweden (3), Africa (3) and Asia (2). Socioeconomic status scores were significantly lower in the group with a non-Swedish background compared to the group with a Swedish background (23.9 vs. 33.6; $p<0.001$; Table 1). Applying the SES categories, 64.5% (n=191) had "low SES," whereas 16.9% (n=50) had "average SES," and 18.6% (n=55) had "high SES." The distributions in SES categories differed significantly between the group with a non-Swedish background (76.5%, 13.1%, and 10.4%, respectively) and the group with a Swedish background (45.1%, 23.0%, and 31.9%, respectively; $p<0.001$), with the majority of participants reporting low SES belonging to the non-Swedish background group.

◎ **Table 2.** Dental fear shown in terms of sum score means and medians and frequency distributions, according to cut-off scores of ≥32 and ≥38 by background groups and subgroups including gender and age.

			FSS-DS Sum			Cut-offs %	
All		**n**	**Mean**	**SD**	**Median**	**≥32**	**≥38**
Non-Swedish background		187	23.9	6.9	23.0	14.4	5.9
Swedish background		114	23.7	8.4	21.0	14.9	8.8
Boys		172	22.5	7.0	21.0	12.2	5.8
Girls		129	25.5	7.7	24.0	17.8	8.5
8-12		98	24.8	7.1	24.0	18.4	5.1
13-16		106	24.3	8.5	22.0	18.8	10.4
17-19		107	22.5	6.7	21.0	7.5	5.6
All		301	23.8	7.5	22.0	14.6	7.0
Non-Swedish background							
Boys		108	22.9	6.8	21.5	13.9	5.6
Girls		79	25.2	6.6	24.0	15.2	6.3
8-12		58	25.3	6.1	24.0	20.7	3.4
13-16		74	23.6	7.1	22.0	14.1	6.3
17-19		65	23.0	7.1	22.0	9.2	7.7
Foreign born with	Boys	62	22.8	6.9	21.0	14.5	6.5
foreign-born parents	Girls	40	26.6	7.6	25.5	22.5	10.0
	8-12	23	25.7	6.9	24.0	30.4	4.3
	13-16	48	23.4	7.3	21.5	15.8	5.3
	17-19	41	24.4	7.7	23.0	12.2	12.2
	All	102	24.3	7.4	23.0	17.6	7.8
Swedish born with	Boys	46	22.9	6.8	22.0	13.0	4.3
foreign-born parents	Girls	39	23.9	5.3	24.0	7.7	2.6
	8-12	35	25.0	5.6	24.0	14.3	2.9
	13-16	26	23.7	6.7	22.5	11.5	7.7
	17-19	24	20.6	5.2	21.0	4.2	0.0
	All	85	23.4	6.2	23.0	10.6	3.5
Swedish background							
Boys		64	22.0	7.4	19.0	9.4	6.3
Girls		50	25.9	9.2	24.0	22.0	12.0
8-12		40	24.0	8.3	21.7	15.0	7.5
13-16		32	25.7	10.7	20.0	28.1	18.8
17-19		42	21.8	6.0	21.0	4.8	2.4
One foreign-born	Boys	6	26.3	11.1	22.5	16.7	16.7
parent and one	Girls	7	26.7	6.1	25.0	14.3	14.3
Swedish-born parent	8-12	4	22.6	6.1	22.5	0.0	0.0
	13-16	5	32.6	9.9	30.0	40.0	40.0
	17-19	4	22.8	3.6	21.5	0.0	0.0
	All	13	26.5	8.4	25.0	15.4	15.4
Swedish born parents	Boys	58	21.5	6.8	19.0	8.6	5.2
	Girls	43	25.7	9.7	23.1	23.3	11.6
	8-12	36	24.2	8.6	21.7	16.7	8.3
	13-16	27	24.4	10.5	19.0	25.9	14.8
	17-19	38	21.7	6.2	20.5	5.3	2.6
	All	101	23.3	8.4	20.0	14.9	7.9

Dental fear

The overall mean (SD) CFSS–DS score was 23.8 (7.5), median 22 (IQR 18–38, total range 15–53). The mean scores were equal between the two main groups of children and adolescents with a non-Swedish vs. Swedish background (23.9 vs. 23.7; Table 2); however, medians were 23 (IQR 7-32, total range 15–47) vs. 21 (IQR 8–38, total range 15–53). In the two subgroups coming from a non-Swedish background, means and medians were similar, while the subgroups with a Swedish background differed, although non-significantly, with higher values in the small group of 13 children/adolescents with one foreign-born parent (p=0.06; Table 2).

Girls had significantly higher CFSS–DS scores compared to boys in total (Table 2; p=0.001; Table 3). The gender differences were clear and statistically significant (p-values from 0.013 to 0.028) also when separated by groups (non-Swedish and Swedish).

There was a small, and non-significant, difference between age groups, with higher mean scores in the younger (24.8 and 24.3 for 8–12 and 13–16 yrs, respectively) compared to the older (22.5 for 17–19 yrs) age groups (p=0.072; Table 3). Medians ranged from 24 in the youngest group to 22 and 21 in the two older groups (p=0.036; Table 3). In the group with a non-Swedish background, the age pattern was consistent, with higher, although not significantly, DF values in the younger age group (8–12 yrs) compared to the older age groups (13–16 and 17–19 yrs; Table 2; p=0.07). In the group with a Swedish background, the highest DF values were found in the group of 13–16-year-olds (Table 2; p=0.68).

Applying cut-off scores for dental fear

Two different cut-off scores were applied: the standard cut-off score of ≥38 (11, 25) and the risk cut-off score of ≥32 (49). When the standard cut-off score of ≥38 was applied, 7% of all participants qualified for DF, 5.9% in the group with a non-Swedish background and 8.8% in the group with a Swedish background (Table 2; p=0.34; Table 3). In total, more girls than boys exceeded the cut-off of ≥38 although this was not significant (Table 2; p=0.36; Table 3).

Regarding age, the highest proportion exceeding the standard cut-off score was found among 13–16-year-olds (10.4%) as compared to 5.1% and 5.6% among 8–12 and 17–19-year-olds, respectively (p=0.27; Table 3). Significant difference in proportions exceeding the cut-off of ≥38 was found only in the group with a Swedish background explained by the high proportion of 13–16-year-olds exceeding the cut-off of ≥38 (p=0.041; Table 2).

Applying the risk cut-off score of ≥32, we found that equal proportions in the two main background groups (non-Swedish and Swedish) exceeded the cut-off (Table 2). The gender and age variations followed almost the same pattern as for the cut-off of ≥38, with the exception of age variations in the group with a non-Swedish background, where a uniform decrease was observed with increasing age (Table 2; p=0.20).

A summary of bivariate analyses is given in Table 3, illustrating that the only significant differences in DF with regard to background, gender, age, or SES concerned gender (means, medians) and age (medians, proportions above cut-off of ≥32).

Table 3. Summary of bivariate analyses using Children's Fear Survey Schedule – Dental Subscale (CFSS-DS) sum scores and cut-off scores of ≥32 and ≥38 by background, gender, age and socio-economic status (SES).

	Students t-test/ ANOVA		Mann Whitney U-test/ Kruskal-Wallis test		Chi^2-test Cut-off≥38	Chi^2-test Cut-off≥32
	t/F	*p*	U/Chi^2	*p*	*p*	*p*
Background						
Non-Swedish vs. Swedish	0.243	0.809	9741.5	0.210	0.340	0.910
Gender						
Boys vs. girls	3.443	0.001	8024.5	0.000	0.361	0.172
Age						
8-12 yrs vs. 13-16 yrs vs. 17-19 yrs	2.659	0.072	6.675	0.036	0.274	0.034
Socio-economic status						
Low vs. Average vs. High	1.163	0.314	1.858	0.395	0.192	0.210

◎ **Table 4.** Results of logistic regression analyses (using ENTER method) of dental fear (DF) with cut-off score ≥32 as dependent variable and possible predictors (background group, gender, age and socio-economic status (SES)) as independent variables. Significant odds ratios (OR) and confidence intervals (CI) are given in bold.

	Total sample				Non-Swedish background				Swedish background			
	OR	95% CI	*p*	Nagelkerke R^2	OR	95% CI	*p*	Nagelkerke R^2	OR	95% CI	*p*	Nagelkerke R^2
Model 1				0.00								
Background (Swedish = 0, Non-Swedish = 1)	0.96	0.50-1.86	0.91									
Model 2				0.01								
Background	0.97	0.50-1.88	0.93					0.00				0.05
Gender (Boys = 0, Girls = 1)	1.56	0.82-2.96	0.18		1.11	0.49-2.53	0.80		2.73	0.93-7.98	0.07	
Model 3				0.05								
Background	0.94	0.48-1.43	0.85					0.03				0.18
Gender	1.51	0.79-2.89	0.22		0.98	0.42-2.27	0.97		**3.00**	**0.99-9.18**	**0.05**	
Age*			0.05				0.21				0.04	
8-12 yrs = 1	**2.71**	**1.12-6.57**	**0.03**		2.58	0.89-7.48	0.08		4.07	0.75-22.07	0.10	
13-16 yrs = 1	**2.84**	**1.17-6.90**	**0.02**		1.61	0.54-4.83	0.40		**8.44**	**1.64-43.53**	**0.01**	
Model 4				0.08								
Background	0.71	0.35-1.46	0.35					0.05				0.21
Gender	1.60	0.82-3.10	0.17		1.04	0.44-2.50	0.93		3.31	1.06-10.35	0.04	
Age			0.06				0.28				0.07	
8-12 yrs = 1	**2.76**	**1.13-6.78**	**0.03**		2.36	0.80-6.96	0.12		5.08	0.90-28.66	0.07	
13-16 yrs = 1	**2.60**	**1.05-6.42**	**0.04**		1.48	0.48-4.57	0.50		**7.22**	**1.35-38.54**	**0.02**	
Socio-economic status**			0.17				0.61				0.36	
Low = 1	2.96	0.94-9.33	0.06		2.87	0.36-22.99	0.32		2.96	0.67-13.05	0.15	
Average = 1	2.11	0.54-8.19	0.28		2.50	0.24-26.47	0.45		2.01	0.34-12.00	0.44	

*Age, reference category = 17-19 yrs

**Socio-economic status, reference category = high

Logistic regression analyses

Logistic regression analyses in four steps were performed using a separate model per step. The first two models including background (Model 1) and the addition of gender (Model 2) revealed no impact on DF from those variables. In the third step, age was added, showing increased DF with younger age (Table 4). The fourth step included SES, and showed an association, although non-significant, between SES and higher DF. Socioeconomic status turned out to be the only variable causing a change in the OR estimate for background (decreased from 0.96 in Model 1 to 0.71 in Model 4), further strengthening the picture of no increased risk for DF in the group with a non-Swedish background. With both group (non- Swedish vs. Swedish) and background variables (gender, age, SES) taken into account, the only consistent "predictor" of DF was age. When children and adolescents with a non- Swedish and a Swedish background were modelled separately, gender and age patterns were found only in the Swedish group (Table 4).

Discussion

This cross-sectional study exploring self-rated DF in a multicultural population of child and adolescent dental patients (8–19 years) revealed almost equal DF scores among patients with a non-Swedish background and patients with a Swedish background. Girls scored higher than boys and younger children scored slightly higher than older children, but the pattern of DF variation was inconsistent. Socioeconomic status differed between the groups with a non- Swedish vs. a Swedish background, but no impact of SES on DF was revealed. When children and adolescents with a non-Swedish and a Swedish background were modelled separately, female gender and younger age affected DF only in the group with a Swedish background.

The highest DF scores were reported in the group of 13–16-year-olds with a Swedish background, which deserves further investigation.

In this study, the overall mean sum scores on the CFSS–DS are well in agreement with normal values in a Swedish population (26) and previous studies (28, 49, 50). Girls reported higher DF than boys which also is found in several previous studies (3, 46, 49). Other studies report no differences between genders (2, 36, 48) or else report boys scoring higher than girls (39). Some gender variations in CFSS–DS scores may be due to cultural differences. In other words, cultural expectations may not always allow boys to show their fears because the display of negative emotions is less acceptable for boys than for girls (35).

Higher CFSS-DS scores in younger children are in concordance with other studies (2, 11, 26, 39, 50). However, the pattern of DF decrease with increasing age was stable only in the group with a non-Swedish background. In the group with a Swedish background, higher DF scores were found in the age group of 13–16 years. One possible explanation may be that young adolescents in the Swedish group had limited dental experience (including injections, extractions, restorative care) while a clinical impression is that most non-Swedish children in the study area, already at 8–12 years of age, have experienced and are accustomed to invasive treatment of all kinds covered by the CFSS– DS questionnaire (32). However, even if the adolescents have lower CFSS–DS scores compared to younger children, this does not necessarily mean that they are not dentally anxious. Following a supposition that DF may have a more specific character among older children and adolescents, this may call for further differentiation in the use of the CFSS–DS, either as a multidimensional scale or with differing cut-off values for different ages (17). Previous studies have shown that the CFSS–DS, although seen as mainly one-dimensional, may cover subscales to allow fear of highly invasive procedures to be separated from other, more non-specific fears (3, 48, 49). Consequently, using only the sum score, i.e., using the CFSS–DS as a one-dimensional construct, may underestimate specific fears of injections, for example, or of other invasive treatment steps.

Low SES was common in the whole sample and particularly in the non-Swedish group, where >75% of patients were characterized by low SES. This relative homogeneity may be a limitation of this study. Evaluation of a possible impact of SES on DF should benefit from representation of a wider range of SES. Further research in larger groups of patients and possibly in different areas (low SES or no; urban and rural) is to be preferred when studying the correlation between DF and SES in different cultural groups in Sweden.

One strength of this study was the use of self-ratings instead of parental ratings on the CFSS– DS. A previous study by *Luoto et al.* (29) showed that parents had poor knowledge of, and could not evaluate, their children's DF. Parental ratings have also been questioned by *Gustafsson et al.* (17), who showed poor agreement between parental ratings and chil-

dren's self-ratings. Even though we presented the reasons why 177 of 492 individuals were not asked to participate, we consider that to be a study limitation. No data were available for these individuals, and a bias effect cannot be excluded. An obvious limitation is that we only used classifications of backgrounds in general (non-Swedish and Swedish) without any further specifications. Further investigations of DF in different subgroups of individuals with non-Swedish background are needed. Another obvious limitation is the use of ordinal outcome data that were not normally distributed. To maintain comparability with previous reports, combined with a restrictive approach to data, we report both means and medians and also we have used both parametric and non-parametric tests in the analyses.

In the present study, no differences in DF between patients with a non-Swedish background and patients with a Swedish background were found. Thus the clinical implications that DF was higher in a non-Swedish group could not be revealed when considering patients with non-Swedish background as one group. However, bigger sample sizes and more homogenous cultural groups would be preferable to allow separate group analyses of DF within the non-Swedish group. Furthermore, more research is needed regarding differences in DF related to gender and age, following an assumption of cultural differences in age and gender patterns. The validity of the CFSS–DS scale for children and adolescents in Sweden, but with different cultural backgrounds, should also be studied further. Furthermore, the validity and, consequently, the clinical relevance of questionnaire data (CFSS–DS) as a measure of DF can be questioned. Although previous studies have presented support for its validity (2, 3, 6, 17, 30, 31, 34), an additional measure of DF, such as direct clinical observation of children's behaviour in the dental context (22) or physiological measures (e.g., heart rate) (41), would have strengthened the results.

In conclusion, this study reports self-rated DF among children and adolescents in a multicultural suburban area of Örebro, Sweden. The results showed no differences in DF between children and adolescents from non-Swedish vs. Swedish background. Dental fear, as measured using the CFSS–DS, varies with gender and age. This was more pronounced in the group with a Swedish background compared to the group with a non-Swedish background. Socioeconomic status had no impact on DF, either in the group with a non-Swedish background or in the group with a Swedish background. Further research is needed to investigate DF among children and adolescents of different cultural background in Sweden.

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