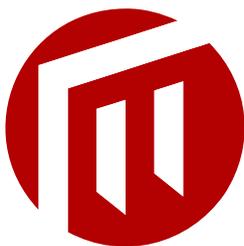


# **Oral B's Nordic Report on Oral Health**

Caries prevalence among children, adolescents and adults,  
and periodontal conditions among adults  
in Denmark, Finland, Norway and Sweden



**MALMÖ UNIVERSITY**

## Foreword

This report was commissioned and financed by Oral B. Oral B specified the limitations of national clinical data and conditions of interest, as stated in the introduction, but has not in any way participated in or influenced the production of the report.

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## Summary

The aim of this report was to compare the oral health in the Nordic countries of Denmark, Finland, Norway and Sweden, from existing national clinical data. The conditions of interest were caries prevalence and periodontal conditions. The groups of interest were children and adolescents up to the age of 19, and adults up to 60 years old. Further, socio-economic and ethnic differences, as well as differences in relation to living area were also of interest.

There are indications of similar trends in caries prevalence among children and adolescents in the Nordic countries, with a continuing decrease in caries prevalence during the past 20-30 years, and tendencies of a levelling out at the turn of the century. The WHO goal of a mean DMFT for 12-year-olds at 1.5 or below before the year 2020 (Petersen 2003), is already fulfilled in all four countries. However, it seems there is still work to do to attain the goal of at least 80% caries free 6-year-olds in 2020. The available data do not distinguish differences between urban and rural areas, nor ethnic and socio-economic differences.

The most important finding regarding both caries prevalence and periodontal conditions in adults is that there is a lack of national data from Norway and Sweden.

Although interpretations should be cautious, there are indications of slightly higher caries prevalence in Finland, compared to Denmark, among adult men. Data on educational level indicate similar patterns of associations between higher levels of education and lower figures of caries prevalence. There is a lack of data on ethnic differences in caries prevalence in adults. There is also a lack of data regarding differences between urban and rural living areas, which only were available for Denmark.

The results regarding periodontal conditions indicate that bleeding is widespread in both Denmark and Finland, while both shallow and deep pockets seem to be more common in Finland. Data on educational level indicate similar patterns of associations between higher levels of education and lower prevalence of shallow and deep pockets. There is a lack of data on ethnic differences in periodontal conditions in adults. There is also a lack of data regarding differences between urban and rural living areas, which only were available for Denmark.

From the available data, no interpretations regarding aggressive periodontitis, i.e. rapid deterioration of bone loss and periodontal ligaments, nor probability of developing it, can be made.

A recommendation for the future is to conduct more national clinical assessments of oral health in adults. National clinical research is needed in order to estimate what actions need to be taken to improve oral health. Without national assessments, political reforms cannot be evaluated and conclusions regarding their effectiveness cannot be drawn.

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## **Introduction**

The task from Oral B was to, in two months, produce a maximum of 20 pages report on the oral health in the Nordic countries of Denmark, Finland, Norway and Sweden, from existing national clinical data. The focus of the report was stated as:

- Caries prevalence for children, adolescents and adults, based on compilations of existing data and key numbers, with discussions of reported tendencies and differences between the countries
- Prevalence of gingivitis in the adult population, 30-60-years old, based on compilations of existing data and key numbers, with discussions of reported tendencies and differences between the countries
- Prevalence of periodontitis and aggressive periodontitis in the adult population, 30-60-years old, based on compilations of existing data and key numbers. Consequences of the disease based on the probability of developing aggressive periodontitis or losing teeth, and discussions of reported tendencies and differences between the countries
- Differences in caries, gingivitis and periodontitis between inhabitants living in urban and rural areas, with discussions of reported tendencies and differences between the countries
- Differences in caries, gingivitis and periodontitis between native inhabitants and ethnic minorities, with discussions of reported tendencies and differences between the countries

Gingivitis and periodontitis were collapsed under the heading “periodontal conditions”.

It was decided to also report on socio-economic indicators, such as education and occupation.

The overarching aim of this report was therefore to compare the oral health in the Nordic countries of Denmark, Finland, Norway and Sweden from existing national clinical data. The conditions of interest were caries prevalence and periodontal conditions. The groups of interest were children and adolescents up to the age of 19, and adults up to 60 years old.

## **Background - The dental care systems in the Nordic Countries**

The Nordic countries of Denmark, Finland, Norway and Sweden share similar characteristics in oral health care provision, and can be referred to as operating under a “Nordic model”. It is characterised by taxation financed public dental health service, governmental supervision and a national chief dental officer (CDO) (Widström & Eaton 2004). There are, however, differences in the provision of dental care. Short descriptions of the countries’ systems are appended in the back of the report.

## **Material and method**

Material was collected in several ways. Searches for articles published between 2000 and 2007 were conducted in the database PubMed, specifying national studies, country, and caries, gingivitis and periodontitis, respectively. The searches yielded 12 articles published between 2000 and 2007. Repeating the searches without the national studies specification yielded 368 articles published 2000 to 2007. The WHO database, available at Malmö University, was also scrutinized. Contacts were established with representatives from the different Nordic countries, who provided references and material. The provided information led to searches in the four countries’ statistical central databases, and of the homepages of the countries’ departments of health and welfare and national public health institutes. In total, 28 reports were found, as well as statistics on children and adolescents’ oral health from Denmark and Norway. The archives of the Danish and Norwegian Dental Journals were also

searched, which yielded 15 articles. Additional material was also found in references of provided material.

## **Children and adolescents**

### **Caries prevalence**

In this section, data concerning caries prevalence and experience in children and adolescents will be presented for all four Nordic countries. Data on oral health in children and adolescents are annually collected and reported in Denmark, Norway and Sweden, while data are collected and reported every third year in Finland.

#### *Denmark*

Poulsen and Malling Pedersen (2002) used cross-sectional national data on caries in children and adolescents from the Danish National Board of Health database, to study changes from 1988 to 2001. The age groups of interest were 5-, 7-, 12-, and 15-year olds. In table 1, mean number of decayed, missing and filled surfaces and teeth are presented for temporary (dmfs/dmft) and permanent teeth (DMFS/DMFT) for some of the years, as well as data from 2006, from Sundhedsstyrelsens Centrale Odontologiske Register (SCOR).

**Table 1.** Mean dmft/DMFT and mean dmfs/DMFS in 5-, 7-, 12-, and 15-year-olds in Denmark 1988 – 2006. Data from all years not presented. The scores are rounded to one decimal. Data from 1988 – 2001 from Poulsen & Malling Pedersen 2002. Data from 2006 from SCOR.

	1988	1990	1994	1997	2000	2001	2006
<i>5-year-olds</i>							
Nr. of children	32,760	34,798	52,995	60,584	63,061	60,709	48,069
dmft	1.5	1.4	1.3	1.0	1.0	1.0	0.8 <sup>1</sup>
dmfs	2.5	2.2	2.1	1.6	1.6	1.6	1.3 <sup>1</sup>
<i>7-year-olds</i>							
Nr. of children	52,630	43,145	50,853	58,908	62,197	64,568	50,227
DMFT	0.3	0.2	0.1	0.1	0.1	0.1	0.1
DMFS	0.4	0.2	0.2	0.1	0.1	0.2	0.1
<i>12-year-olds</i>							
Nr. of children	65,172	58,710	47,653	49,989	54,935	57,503	53,553
DMFT	2.2	1.4	1.3	1.1	1.0	0.9	0.8
DMFS	3.0	1.9	1.9	1.6	1.4	1.2	1.1
<i>15-year-olds</i>							
Nr. of children	66,655	66,141	51,884	47,667	49,242	50,478	47,895
DMFT	4.6	3.3	2.8	2.6	2.3	2.2	1.7
DMFS	6.7	4.6	4.1	3.9	3.3	3.2	2.5

<sup>1</sup> Here, defs/deft was reported for 5-year-olds (decayed, extracted, filled temporary surfaces or teeth).

The main result was a decline in caries prevalence from 1988 to 2001, in all four age groups. However, during later years the decrease tended to level out (Poulsen & Malling Pedersen 2002). The results from 2006 showed a new decrease in 5-, 12- and 15-year-olds, with 7-year-olds mean results remaining stable since 2001.

From SCOR, data were also available on percentages of caries free: children and adolescents with zero numbers of decayed, missing and filled surfaces (defs/DMFS). Of the 5-year-olds, 76% were caries free, while they were 94% among the 7-year-olds. In 12-year-olds, 65% were caries free, and 45% of the 15-year-olds (SCOR).

Data on distributions regarding different DMFS scores in 2006 were also available. Here, only data for 12-year-olds are presented. The distribution shows there still are children in high need of oral health care. In 2006, 65% of the 12-year-olds had no caries at all, while 21% had DMFS scores between 1 and 2. DMFS scores of 3-4 were found in 8%, and the remaining 7% had DMFS scores of 5 or more (SCOR).

### Finland

In Finland, Nordblad et al (2004a) reported on oral health in children and adolescents, from the late 1970's until 2000. Results regarding percentages of caries free and the mean number of decayed, missing and filled teeth are presented in table 2, as well as means of filled teeth (FT) from 1985.

**Table 2.** Caries prevalence in Finland, from 1975 to 2000. Mean ft/FT from 1985 to 2000. Data from Nordblad et al 2004a.

	1975	1976	1979	1982	1985	1988	1991 <sup>1</sup>	1994	1997	2000
<i>3-year-olds</i>										
Caries free (%)		64	75	75	77	79	87	86	86	84
dmft	1.5			0.7	0.6	0.4	0.3	0.3	0.2	0.3
ft					0.2	0.1		0.1	0.1	0.1
<i>5-year-olds</i>										
Caries free (%)		20	42	47	48	54	60	65	66	65
dmft	5			2.1	2.1	1.6	1.4	1.1	0.8	0.9
ft					0.9	0.8		0.6	0.4	0.5
<i>6-year-olds</i>										
Caries free (%)		10	30	38	40	45	52	58	56	58
DMFT	1.2			0.4	0.4	0.3	0.3	0.2	0.2	0.2
FT					1.1	0.9		0.7	0.5	0.6
<i>9-year-olds</i>										
Caries free (%)		2	5	16	20	24	31	36	37	40
DMFT	3.4			1.6	1.2	0.8	0.4	0.5	0.4	0.5
FT					1.2	1.1		0.9	0.7	0.7
<i>12-year-olds</i>										
Caries free (%)		1	2	7	15	21	30	35	35	38
DMFT	6.9			4	2.8	2	1.2	1.2	1.1	1.2
FT					0.9	0.6		0.6	0.5	0.5
<i>15-year-olds</i>										
Caries free (%)		1	1	2	6	13	23	26	26	24
DMFT	12.4			7.8	6.2	4.3	3.1	2.8	2.5	2.6
FT					1.4	0.9		0.9	0.7	0.8
<i>18-year-olds</i>										
Caries free (%)		-	0	1	2	5	11	14	15	16
DMFT	-			11.4	9.4	7.3	5.3	4.7	4.1	4
FT					1.3	1.1		1.1	1.0	1.0

<sup>1</sup> Estimation based on subsamples

The percentage of children and adolescents without caries activity had increased, in all ages. The average number of fillings had decreased in all ages, from 1985 to 2000 (Nordblad et al 2004a).

In 2003, 47% of children and adolescents under 18 had some caries (Widström & Suominen-Taipale 2006). The same year, the mean DMFT for 12-year-olds was 1.2 (STAKES, personal communication).

### Norway

Using aggregated national dental health data for 5- and 12-year old children in Norway, Haugejorden and Birkeland (2002) studied caries trends among children between 1997 and 2000. During this period, 82% to 89% of 60,526 to 61,086 5-year-olds were examined/treated in the public dental health service. The percentages among 12-year-olds were 80% to 88% of 52,747 to 60,708 subjects. Results regarding dmft, dt and ft for 5-year-olds are presented in table 3. The main result was that mean dmft had increased from 1997/98 to 2000. Decay was the main cause of the increase. There was also an increase in caries experience from 1997 to 2000, from 30% to 39%. Increased caries experience was found in 88% of the dental care

districts. There were variations among the counties regarding dmft, and mean number of decayed and filled teeth (Haugejorden and Birkeland 2002).

**Table 3.** Caries experience in 5-year-olds in Norway, in 1997 – 2000. Data from Haugejorden & Birkeland 2002.

	1997	1998	1999	2000
Nr. of children	33,481	34,622	34,669	34,020
Nr. of counties	12	13	14	14
dmft	1.1	1.1	1.2	1.5
Range of county dmft	0.7-1.8	0.8-1.6	0.9-1.9	1.1-2.3
dt	0.7	0.8	0.9	1.0
Range of county dt	0.4-1.6	0.5-1.2	0.6-1.5	0.7-1.9
ft	0.3	0.3	0.3	0.4
Range of county ft	0.2-0.4	0.2-0.4	0.2-0.4	0.3-0.6

Among the 12-year-olds, the caries prevalence decreased from 55% in 1997, to 52% in 2000. DMFT decreased from 3.4 in 1985, to 1.7 in 1997, and 1.5 in 1999/2000. During these three years, the D-component (decay) remained stable at 0.7. The missing teeth component was 0.1 or smaller (Haugejorden & Birkeland 2002).

Haugejorden and Birkeland later repeated the study of caries trends among 5-year-olds (2005). The percentages treated from 1997-2003 at national level were 77% to 89% of 59,667 to 62,202 children. The results regarding distribution of decay in dentine ( $d_3$ ) are presented in table 4. The main result was an increase in caries prevalence, from 1997/98 to 2001, which then had decreased in 2003. There were variations in the pattern and the variation was greater in district than county level. The mean  $d_3$ dmft per child increased from 1.1 in 1997 to 1.6 in 2001, and decreased to 1.4 in 2003 (Haugejorden & Birkeland 2005).

**Table 4.** National, aggregated, data regarding distribution (%) of caries prevalence ( $d_3$ ) in 5-year-olds in Norway, in 1997 – 2003. Data from Haugejorden & Birkeland 2005.

	1997	1998	1999	2000	2001	2002	2003
$d_3$	31	31	34	39	40	40	36

At Statistics Norway (2007), dental health status for 5-, 12-, and 18-year-olds is available from 1985 to 2006. In table 5, data from 1985, 1990, 1995, 2000 and 2006 are presented.

**Table 5.** Caries prevalence in 5-, 12-, and 18-year-olds in Norway, in 1985, 1990, 1995, 2000, and 2006. Data from Statistics Norway 2007.

	1985	1990	1995	2000	2006
<i>5-year-olds</i>					
Percent examined of the age group	85	89	85	79	74
Caries free (%)	50	61	65	61	73
Mean number of teeth with caries experience	0.0	0.0	0.0	0.0	1.0
<i>12-year-olds</i>					
Percent examined of the age group	89	93	87	78	74
Caries free (%)	19	32	40	48	44
Mean number of teeth with caries experience	3.4	2.4	1.9	1.5	1.6
<i>18-year-olds</i>					
Percent examined of the age group	72	80	78	70	73
Caries free (%)	1	7	11	16	16
Mean number of teeth with caries experience	10.3	7.4	6.5	5.1	4.9

The data show that the percentages of caries free individuals had increased, and that the mean numbers of teeth with caries experience had decreased since 1985. It also pointed to a levelling out in the mean number of teeth with caries experience. There are discrepancies in

the mean number of teeth with caries experience reported for 5-year-olds 1985-2000, compared to the reports of dmft from Haugejorden and Birkeland (2002, 2005). When looking on Statistics Norway's reports from the different counties, all counties report zero for all three variables for 5-year-olds in 1985-2000. This indicates that the mean caries experiences of zero are due to a lack of report in the database these years.

### Sweden

Since 1985, the Swedish National Board of Health and Welfare annually reports on oral health for children and adolescents (Socialstyrelsen 2006), using different indicators for different age groups. Results on caries trends for 3-, 6-, 12- and 19-year-olds, from 1985 to 2005 in 5-year-intervals are presented in table 6.

**Table 6.** Caries prevalence in 3-, 6-, 12-, and 19-year-olds in Sweden, in 1985, 1990, 1995, 2000, and 2005. Data from Socialstyrelsen 2006.

	1985	1990	1995	2000	2005
<i>3-year-olds</i>					
Caries free (%)	83	91	93	94	95
<i>6-year-olds</i>					
Caries free (%)	45	60	65	70	73
<i>12-year-olds</i>					
DFT <sup>1</sup>	3.1	2.0	1.4	1.0	1.0
Caries free (%) <sup>2</sup>	22	40	50	61	58
<i>19-year-olds</i>					
DFT <sup>3</sup>	8.5	6.3	5.1	3.6	3.1
Caries free, approximately (%) <sup>4</sup>	36	50	56	58	59
DFS-a <sup>5</sup>	3.3	2.0	1.6	1.4	1.3
DFS-a (caries free approximately excluded) <sup>5</sup>	5.3	3.9	3.2	3.4	3.2

<sup>1</sup> Nr of county councils that reported data: 1985: 15, 1990: 21, 1995: 22, 2000: 19, and 2005: 16

<sup>2</sup> Nr of county councils that reported data: 1985: 15, 1990: 22, 1995: 22, 2000: 19, and 2005: 16

<sup>3</sup> Nr of county councils that reported data: 1985: 23, 1990: 25, 1995: 25, 2000: 20, and 2005: 16

<sup>4</sup> Nr of county councils that reported data: 1985: 23, 1990: 25, 1995: 23, 2000: 20, and 2005: 16

<sup>5</sup> Nr of county councils that reported data: 1985: 23, 1990: 25, 1995: 26, 2000: 20, and 2005: 16

Since 2000, the increase in percent units in percentage of children free from caries was one for 3-year-olds, and three for 6-year-olds. The 2005 data encompassed 57% of all 3-year-olds in the country, and 58% of all 6-year-olds. There were only minor variations between the counties regarding percentage of caries free 3-year-olds (93-98%). The variations between counties regarding 6-year-olds were slightly larger (64-79%) (Socialstyrelsen 2006).

For 12-year-olds, there has been a three percent unit decrease in the percentage of caries free since 2000, when the percentage of caries free was 61%. There was no change in mean decayed and filled teeth (DFT) from 2000 to 2005. In 2005, there were slight variations in percentage of caries free (50-69%) and in mean DFT (0.6-1.3) between the counties. The study population was 59% of all 12-year-olds in the country (Socialstyrelsen 2006).

For 19-year-olds, 25% of the subjects were free from caries in 2005. The variation between counties was 18-33%. The decrease in mean DFT between 2000 and 2005 was 0.5, and the variation between counties in 2005 was 2.4 – 3.6. Turning to mean number of decayed and filled approximal surfaces (DFS-a) - surfaces that are next to another tooth - the increase was 0.7 percent units since 2000, and the variation between counties in 2005 was 54-68%. The decrease in the mean DFS-a from 2000 to 2005 was 0.1, and the variation between counties in 2005 was 0.8-1.7. The mean DFS-a excluding subjects without approximal caries had a decrease of 0.2 from 2000 to 2005. The study population was 64% of all 19-year-olds in the country (Socialstyrelsen 2006).

The Swedish National Board also reported on the distribution of 12-year-olds regarding different DFT scores. The distribution showed that though there had been a decline over the years, there were still children in high need of oral health care. In 2005, 58% of the 12-year-olds had no caries at all, while 28% had DFT scores between 1 and 2. DFT scores of 3-4 were found in 10%, and the remaining 4% had DFT scores of 5 or more (Socialstyrelsen 2006).

A similar pattern was found regarding approximal caries in 19-year-olds. In 2005, 59% were caries free, while 29% had DFS-a scores of 1-3. DFS-a scores of 4-6 were found in 7%, and the remaining 5% had DFS-a scores of 7 or more (Socialstyrelsen 2006).

## Discussion

Although interpretations should be cautious, there are indications of similar trends in caries prevalence in the Nordic countries. There has been a continuing decrease in caries prevalence during the past 20-30 years, with tendencies of a levelling out at the turn of the century. At the same time, the percentages of caries free children and adolescents in Finland and Sweden had increased. In Norway, an increase in caries prevalence was seen among 5-year-olds at the turn of the century, but the data from 2003 indicated a turn to decrease, which had continued 2006.

The WHO goal of a mean DMFT for 12-year-olds at 1.5 or below before the year 2020 (Petersen 2003), is already fulfilled in all four Nordic countries. However, from the data it seems there is still work to do to attain the goal of at least 80% caries free 6-year-olds in 2020.

The data from Denmark displayed differences in mean dmft/dmfs for 5-year-olds and DMFT/DMFS for 7-year-olds. Poulsen and Malling Pedersen noted: "caries in the primary dentition of 5 year old children seems to be under less control than caries in the permanent dentition of older children." (2002, p. 198). A similar pattern was displayed in the data from Finland: 5-year-olds had higher dmft-scores than 6-year-olds.

The available national data on children and adolescents only portray average tendencies, but information regarding distribution of different scores from Denmark (DMFS) and Sweden (DMFT) also depict that there still are children and adolescents in high need of dental care. So, even if the mean scores of the entire age groups are encouraging, there is still more work to be done for the individuals that need it most. In Sweden, the National Board of Health and Welfare monitors the high-risk groups with the Significant Caries Index (SiC) (Socialstyrelsen 2006). "SiC Index is calculated by taking the mean DMFT of the one-third of the individuals having the highest of DMFT values in a given population." (Nishi et al 2002, p. 296). In 2005, the SiC for 12-year-olds was 2.87, which means that the WHO goal of SiC below 3.0 DFT for this age group in the year 2015 (Socialstyrelsen 2006) was fulfilled.

The available data do not distinguish socio-economic patterns such as differences between urban and rural areas. There is some information on variations between counties, but without knowledge of, for example, number of inhabitants in the county or accessibility to dental care, the information does not provide indications on socio-economic patterns.

Regarding ethnic and socio-economic differences, Haugejorden & Birkeland addressed the issues (2002, 2005). However, the background data were not collected for the children of the study as they are based on aggregated data, which makes the analyses and findings questionable.

## **Adults**

### **Caries prevalence**

In this section, data concerning caries prevalence and experience in adults will be presented for Denmark and Finland. As to our knowledge, there are no recent national data from Norway or Sweden.

#### *Denmark*

In Denmark, a study on oral health studied a national sample of 762 adults 35-44-years of age (Krustrup & Petersen 2006, Krustrup 2004). Results regarding DMFS and DMFT are presented in table 7. Significant differences were found for missing surfaces/teeth: women had more missing surfaces and teeth than men did (Krustrup 2004).

**Table 7.** Average caries experience according to gender. P-values for gender differences. Data from Krustrup 2004.

	DS	MS	FS	DMFS	DT	MT	FT	DMFT
<i>35-44-year-olds</i>								
Men (n=343)	1.2	17.5	27.0	45.7	0.6	3.5	12.6	16.7
Women (n=419)	0.8	20.7***	25.8	47.3	0.4	4.1**	12.1	16.6
Total (n=762)	0.9	19.3	26.4	46.6	0.5	3.9	12.3	16.7

\*\* p<0.01; \*\*\* p<0.001

#### *Finland*

The Finnish Health 2000 Health Examination Survey reports on average number of sound, filled, decayed and chipped teeth in relation to gender and age group, from a national sample of 3,027 subjects (Vehkalahti, Varsio & Hausen 2004). The results are presented in table 8.

**Table 8.** Average number of sound, filled, decayed and chipped teeth in relation to gender and age group. Total n=3,027, but results for adults 65 years or over are not presented. Data from Vehkalahti, Varsio & Hausen 2004.

	Sound	Filled, no decay	Decay	Chipped, no	Nr. of teeth, total
<i>30-34-year-olds</i>					
Men	16.9	10.5	1.0	0.2	28.6
Women	16.9	10.8	0.3	0.1	28.1
<i>45-54-year-olds</i>					
Men	8.9	12.0	1.2	0.3	22.4
Women	7.5	14.6	0.5	0.3	22.9

In a baseline report from The Health 2000 Health Examination Survey, caries prevalence was examined in age groups (Nordblad et al 2004b). Here, caries prevalence distribution is only presented for 30-34 and 45-54-year olds. Among 30-34-year old men, 29% had caries activity. Among women the same age, caries activity was found in 17.3%. In the male 45-54-year-olds, 31% had caries, and 20% of the women. Collapsing all the age groups (30-64-years old) to study gender differences, a significant difference was found among men and women. Among men 30-64-years old, 30% had caries prevalence, compared to 20% of the women (p<0.001) (Nordblad et al 2004b). "Results were tabulated as means or prevalences using SUDAAN procedures that take into account the sampling design." (Aromaa et al 2004, p. 21).

#### *Norway*

As to our knowledge, there are no recent national clinical data on caries among adults in Norway. There are regional studies (e.g. Skudutyte-Rysstad & Eriksen 2007, Holst et al 2004), but since they are geographically limited, the results should not be generalized to depict the oral health of adults in the entire country. The lack of national clinical data on

adults has been pointed out in national reports about dental care in Norway (Sosial- og helsedirektoratet 2007, NOU 2005:11).

### Sweden

As to our knowledge, there are no recent national clinical data on caries among adults in Sweden. There are regional studies (e.g. Hugosson et al 2005, Wänman et al 2004, Uhrbom & Bjerner 2003), but since they are geographically limited, the results should not be generalized to depict the oral health of adults in the entire country. The lack of national clinical data has been pointed out in a recent national report about dental care in Sweden (SOU 2007:19).

## Socio-economic differences in relation to caries prevalence

### Annual income

#### Denmark

Caries experience was studied in relation to annual income (in Danish crowns; DKK), see table 9. Mean DMFS/DMFT, as well as decayed and missing surfaces and teeth, for adults with a personal annual income of less than 200,000 DKK was higher than for the other income groups (Krustrup 2004). In the other income groups, the variations were small and insignificant, according to analyses of variance (ANOVA).

**Table 9.** Average caries experience according to annual income. P-values for differences between annual income levels. Data from Krustrup 2004.

	DS	MS	FS	DMFS	DT	MT	FT	DMFT
<i>35-44-year-olds</i>								
< 200,000 (n=190)	1.9***	22.5***	26.2	50.6**	1.0***	4.6***	11.9	17.5*
200-299,999 (n=337)	0.7	18.9	26.4	46.0	0.4	3.8	12.6	16.9
300-399,999 (n=120)	0.6	18.2	26.2	45.0	0.3	3.7	12.0	16.0
≥ 400,000 (n=86)	0.4	15.6	25.1	41.1	0.4	3.1	12.0	15.5
Total (n=733)	1.0	19.3	26.2	46.5	0.5	3.9	12.3	16.7

\* p<0.05; \*\* p<0.01; \*\*\* p<0.001

### Education

#### Denmark

The different levels of education were defined as: low - 10 years or less, medium - 11-12 years, high - 13-14 years and very high education was 15 years or higher. The results regarding caries experience in relation to educational level and age group are presented in table 10.

**Table 10.** Average caries experience according to educational level. P-values for differences between education level. Data from Krustrup 2004.

	DS	MS	FS	DMFS	DT	MT	FT	DMFT
<i>35-44-year-olds</i>								
Low (n=62)	2.2***	27.2***	28.2***	57.5***	1.1***	5.6***	13.2**	19.9***
Medium (n=158)	1.5	20.6	27.3	49.4	0.8	4.2	12.3	17.3
High (n=299)	0.9	19.2	28.2***	48.3	0.5	3.9	12.9	17.3
Very high (n=193)	0.4	16.5	22.6	39.5	0.2	3.3	11.3	14.8
Total (n=712)	1.0	19.5	26.5	47.0	0.5	3.9	12.4	16.8

\*\* p<0.01; \*\*\* p<0.001

There were differences in mean DMFS and DMFT in relation to educational level. Individuals with low education had a significantly higher mean DMFS/DMFT. They also had significantly higher means of decayed, missing and filled surfaces and teeth (Krustrup 2004). However, those with high education had the same mean of filled surfaces as the low educated, which also was significantly different from the other educational levels.

### Finland

In Finland, the educational levels were defined as follows: “Persons who had no vocational training beyond a vocational course or on the job training and who had not taken the matriculation examination, were classified as having a basic education. Completion of vocational school was defined as secondary education regardless of basic education. Also those who had passed the matriculation examination but who had no vocational training beyond a vocational course or on the job training were also classified into this intermediate group. Higher education comprised degrees from higher vocational institutions, polytechnics and universities.” (Martelin et al 2004, p.27). Caries prevalence in Finland, in relation to education age group and gender are presented in table 11. No tests of significance were conducted, but high-educated subjects had less caries than secondary or basic educated subjects. The result was consistent for both men and women, and for all age groups (Vehkalahti, Varsio & Hausen 2004).

**Table 11.** Average number of sound, filled and decayed teeth in relation to education, gender and age group. Total n=3,027, but results for adults 65 years or over are not presented. Data from Vehkalahti, Varsio & Hausen 2004.

	Sound teeth			Filled teeth			Decayed teeth		
	Education			Education			Education		
	Basic	Secondary	High	Basic	Secondary	High	Basic	Seconda	High
<i>30-34-year-</i>									
Men	16.0	16.6	17.7	10.6	10.7	10.1	1.2	1.2	0.6
Women	15.0	16.5	17.4	11.5	11.0	10.6	1.2	0.4	0.2
<i>45-54-year-</i>									
Men	8.0	9.1	9.6	9.4	12.3	15.0	1.6	1.3	0.7
Women	6.7	7.3	8.4	12.4	14.3	16.7	0.6	0.6	0.5

### Occupation

#### Denmark

Results regarding average caries experience according to occupational level are presented in table 12. There was a difference in mean DMFS/DMFT according to occupation: unskilled workers had a significantly higher mean DMFS/DMFT than the other occupational groups. Looking at decayed, missing and filled surfaces and teeth, there were also differences. Skilled workers had a higher means of filled surfaces/teeth and pensioners had higher means of decayed and missing surfaces/teeth (Krustrup 2004).

**Table 12.** Average caries experience according to occupation. P-values for differences between occupation levels. Data from Krustrup 2004.

	DS	MS	FS	DMFS	DT	MT	FT	DMFT
<i>35-44-year-olds</i>								
Self-employed (n=61)	0.7	17.8	28.9	47.4	0.6	3.6	12.9	17.1
Staff members (n=457)	0.5	17.7	25.4	43.6	0.3	3.6	12.1	15.9
Skilled workers (n=57)	1.2	18.3	30.6*	50.1	0.7	3.7	14.1*	18.4
Unskilled workers (n=100)	1.5	24.3	28.4	54.2***	0.8	4.9	13.0	18.7***
Unemployed (n=21)	1.9	22.7	24.7	49.3	1.1	4.6	12.1	17.8
Pensioners (n=29)	3.8***	24.6***	25.0	53.4	1.7***	5.0***	11.5	18.2
Total (n=725)	0.9	19.1	26.5	46.5	0.5	3.9	12.4	16.8

\* p<0.05; \*\*\* p<0.001

## Caries prevalence and differences between living areas

### Denmark

Living areas were defined as: rural - less than 10 000 inhabitants, periurban - 10 000 to 30 000 inhabitants, and urban areas - more than 30 000 inhabitants (Krustrup 2004). Caries experience in relation to age groups and living area is presented in table 13.

**Table 13.** Average caries experience according to living area. P-values for differences between living areas. Data from Krustrup 2004.

	DS	MS	FS	DMFS	DT	MT	FT	DMFT
<i>35-44-year-olds</i>								
Rural (n=245)	1.1	20.1	27.5	48.7	0.6	4.1	12.8*	17.5**
Periurban (n=179)	0.8	19.5	26.1	46.4	0.5	4.0	12.5	16.9
Urban (n=338)	0.9	18.6	25.7	45.2	0.5	3.8	11.9	16.1
Totalt (n=762)	0.9	19.3	26.4	46.6	0.5	3.9	12.3	16.7

\* p<0.05; \*\* p<0.01

There were differences in mean DMFT in relation to living area: rural areas had a higher mean DMFT than urban and periurban areas. Rural areas also had a higher mean of filled teeth (Krustrup 2004).

## Discussion, caries prevalence

The data from Denmark showed that women had significantly more missing surfaces and teeth than men (Krustrup 2004). There were no significant differences in mean DMFS or DMFT. In Finland, caries was more prevalent among men than women (Nordblad et al 2004b).

Although comparisons and interpretations should be cautious, there seemed to be a different pattern in decayed teeth in Denmark, compared to Finland. While 35-44-year-old Danish men and women had similar mean DT: 0.6 for men and 0.4 for women, Finnish men had higher means of decayed teeth compared to the women in the same age groups. Among the Finnish 30-34-year-olds, men had a mean DT of 1.0, while women had a mean of 0.3, while men had a mean DT of 1.2, and women one of 0.5, among the 45-54-year-olds. Thus, the Finnish men had more than the double caries experience than Finnish women. The finding is interesting, but cannot be explained from the available clinical data. Overall, it seems that decay was similar among Danish and Finnish women, while there were differences between Danish and Finnish men.

Regarding filled teeth, there seemed to be similar patterns between men and women in Denmark, and between 30-34-year-old men and women in Finland. However, among the Finnish 45-54-year-olds, women had on average more than two more filled teeth than men.

Comparing the countries, the Danish 35-44-year-old men had higher means of filled teeth than the Finnish 30-34- and 45-54-year-old men. The Danish 35-44-year-old women, on the other hand, had a higher mean of FT than 30-34-year-old Finnish women, but a lower mean than the Finnish 45-54-year-old women. The differences between the Danish 35-44-year-olds and the Finnish 45-54-year-olds is interesting, but cannot be explained by the available clinical data. Further, interpretations about the differences between the countries regarding filled teeth should be cautious. Different age groups were studied in Denmark and Finland, and differences may reflect that prevalence in filled teeth is cumulative with age. The differences may also be an indication of different care utilization frequencies in the countries.

Regarding socio-economic differences, the only key indicator allowing for comparison was education. In Denmark, educational level was found to be significantly associated with caries experience: “relatively high caries index components as well as high means of DMF-S and DMF-T were found in participants with low education” (Krustrup 2004, p. 65). In

Finland, “untreated caries was more common in people with a lower level of education.” (Nordblad et al 2004b, p. 65). Although comparisons should be cautious, similar patterns were found in both countries. High-educated participants had lower means of decayed teeth than middle/secondary and low/basic educated. In Danish 35-44-year-olds and Finnish 30-34-year-olds, high-educated also had lower means of filled teeth. However, high-educated Finnish 45-54-year-olds had higher means of filled teeth than middle/secondary and low/basic educated. One should bear in mind that filled teeth rather mirrors history of care utilization than the actual caries situation. The findings are concordant with the general notion that there is a positive association between level of education and oral health.

Regarding the socio-economic indicators of annual income and occupational level, data were only available for Denmark. The findings regarding income were that “untreated decayed and missing surfaces/teeth as well as the total scores of DMF-S and DMF-T were high in the low income group.” (Krustrup 2004, p.65). Regarding occupation, “staff members had lower D-S/D-T and M-S/M-T-values whereas pensioners had significantly higher scores of D-S/D-T and M-S/M-T. Unskilled workers, unemployed persons and pensioners had high M-S and M-T components compared to the other occupation groups whereas the mean number of filled surfaces/teeth was significantly high among the skilled workers. The total DMF-S and total DMF-T were relatively low for staff members and significantly high in the unskilled workers group.” (Krustrup 2004, p.65)

There were no data on ethnic differences in caries prevalence in the material.

There was only material on differences between urban and rural living areas from Denmark, where participants from rural areas had significantly higher means of filled teeth and DMFT, than those from urban and periurban areas (Krustrup 2004).

A recommendation for the future is to conduct more national studies of caries prevalence in adults. Further, national clinical studies should also focus on socio-economic and ethnic differences, as well as differences in relation to living areas.

### **Periodontal conditions**

In this section, data concerning periodontal conditions in adults will be presented for Denmark and Finland. As to our knowledge, there are no recent national data from Norway or Sweden.

#### *Denmark*

From Denmark, there are several reports from the same study of adults’ oral health. Here, results will be presented from an article (Krustrup & Petersen 2006) and a thesis (Krustrup 2004). The Community Periodontal Index was used to assess periodontal conditions (gingival bleeding, calculus and gingival pockets) for all teeth present (Krustrup & Petersen 2006, Krustrup 2004). Krustrup and Petersen (2006) found that a higher percentage of women had healthy conditions (10.7 vs. 4.1,  $p < 0.001$ ) and a higher percentage of men had bleeding (91% vs. 81%,  $p < 0.001$ ). There were no gender differences regarding pockets. Pockets 4-5 mm were found in 36% of both the men and the women, and in both genders 6% had pockets 6 mm or deeper (Krustrup & Petersen 2006).

A gender difference was found for mean percentage of teeth with bleeding: men had a higher mean percentage of teeth with bleeding (30%) than women did (22%),  $p < 0.001$ . No significant gender differences were found in pockets, a mean of 6% of teeth with pockets 4-5 mm was found in the total group, and 1% with pockets  $\geq 6$  mm. Men had a mean of 7% teeth with shallow pockets (4-5 mm), and 1% with pockets 6 mm or deeper. Women had a mean of 5% teeth with shallow pockets and 1% teeth with deep pockets (Krustrup & Petersen 2006).

Krustrup (2004) also examined mean nr of sextants with certain CPI scores. In total, a mean of 2.4 sextants had healthy conditions, 3.6 had bleeding or higher, 1.6 had calculus or higher, 0.9 had shallow pockets or higher, and deep pockets were found in a mean of 0.1 sextants. Significantly more healthy sextants were found in women (2.7 vs. 2.0,  $p<0.001$ ), while more sextants with bleeding or higher (4.0 vs. 3.3,  $p<0.001$ ), as well as calculus or higher (1.7 vs. 1.4,  $p<0.01$ ), were found in men (Krustrup 2004).

Loss of attachment (LA), loss of bone and periodontal ligaments around the tooth's root was also studied (Krustrup & Petersen 2006, Krustrup 2004). No gender differences were found. A LA of 0-3 mm was found in 80% of the total group, 19% had LA 4-5mm, and 1% had a LA of 6-8 mm (Krustrup & Petersen 2006).

### *Finland*

In the Health 2000 Health Examination Survey, periodontal conditions were examined by measuring inflammation (bleeding on probing) in sextants and depth of gingival pockets. The results regarding prevalence of gingival bleeding according to age group and gender are presented in table 14.

**Table 14.** Prevalence of gingival bleeding in dentate adults. Total  $n=5,245$ , but results for adults 55-64, and 65 years or older are not presented. Data from Knuuttila 2004.

	Percentage of adults with bleeding in one or more sextants	Nr of sextants with bleeding	Percentage of adults with bleeding in both upper and lower jaw
<i>30-34-year-olds</i>			
Men	71	2.5	42
Women	64	1.9	32
Total	68	2.2	37
<i>35-44-year-olds</i>			
Men	76	2.7	46
Women	68	2.1	36
Total	72	2.4	41
<i>45-54-year-olds</i>			
Men	80	2.8	54
Women	71	2.2	42
Total	76	2.5	48
Total group, $n = 5\ 245$			
<i>30-65+</i>			
Men	77	2.7	51
Women	70	2.2	42

Of the total sample, 74% had one or more sextants with bleeding on probing, and bleeding in both upper and lower jaw was found in 46% of the subjects. The mean number of sextants with bleeding was 2.4. A lower percentage of women had one or more sextants with bleeding, as well as bleeding in both upper and lower jaw. Women also had a lower average number of sextants with bleeding (Knuuttila 2004).

Turning to depth of pockets, results regarding age group and gender are presented in table 15. Of the total sample, 64% of the adults had pockets  $\geq 4$  mm and 21% had pockets  $\geq 6$  mm. There was a consistent pattern between men and women in the age groups. A higher percentage of men had pockets  $\geq 4$  mm, as well as pockets  $\geq 6$  mm (Knuuttila 2004).

Turning to mean number of teeth with shallow and deep pockets, also presented in table 15, the average number of teeth with pockets  $\geq 4$  mm in the total sample was 4.2, and for pockets  $\geq 6$  mm it was 0.7. Men had a higher average number of teeth with pockets  $\geq 4$  mm than women did. However, women had a higher average number of teeth with pockets  $\geq 6$  mm (Knuuttila 2004).

**Table 15.** Percentage of adults, and average number of number of teeth with periodontal pockets 4 or 6 mm or deeper. Total n=5,255, but results for adults 55-64, and 65 years or older not presented. Data from Knuuttila 2004.

	Percentage of adults with periodontal pockets		Average number of teeth with periodontal pockets	
	Pockets $\geq$ 4 mm	Pockets $\geq$ 6 mm	Pockets $\geq$ 4 mm	Pockets $\geq$ 6 mm
<i>30-34-year-olds</i>				
Men	56	8	3.4	0.1
Women	40	4	2.0	0.2
Total	48	6	2.7	0.2
<i>35-44-year-olds</i>				
Men	69	19	4.9	0.2
Women	52	10	2.8	0.6
Total	61	14	3.9	0.4
<i>45-54-year-olds</i>				
Men	76	30	6.2	0.5
Women	62	17	3.6	1.1
Total	69	24	4.9	0.8
Total group, n= 5 255				
<i>30-65+</i>				
Men	72	26	5.3	0.4
Women	57	16	3.2	0.9

Turning to the distribution in Finnish men and women regarding number of teeth with periodontal pockets  $\geq$  4 mm, no teeth with periodontal pockets were found in 28% of the men and 43% of the women. Nineteen percent of the men had 1-2 teeth with pockets, and 20% of the women. Three to seven teeth with pockets were found in 25% of the men and 22% of the women, while eight or more teeth with pockets were found in 28% of the men and 15% of the women (Knuuttila 2004).

In the previous report from The Health 2000 Health Examination Survey, pockets  $\geq$  4 mm were examined in age groups (Nordblad et al 2004b). Here, distribution is only presented for 30-34, and 45-54-year olds. Among 30-34-year old men, 65% had pockets  $\geq$  4 mm. Among women the same age, pockets were found in 48%. In the 45-54-year olds, 76% pockets  $\geq$  4 mm, and 62% of the women. Collapsing all age groups to study gender differences, a significant difference was found among men and women. Among men 30-64-years old, 71% had pockets  $\geq$  4 mm, against 56% of the women ( $p < 0.001$ ). (Nordblad et al 2004b).

#### *Norway*

As to our knowledge, there are no recent national clinical data on periodontal conditions among adults in Norway. There are regional studies (e.g. Holst et al 2004), but since they are geographically limited, the results should not be generalized to depict the oral health of adults in the entire country. The lack of national clinical data on adults has been pointed out in national reports about dental care in Norway (Sosial- og helsedirektoratet 2007, NOU 2005:11).

#### *Sweden*

As to our knowledge, there are no recent clinical data on periodontal conditions among adults in Sweden. There are regional studies (e.g. Hugosson et al 2005, Wänman et al 2004, Uhrbom & Bjerner 2003), but since they are geographically limited, the results should not be generalized to depict the oral health of adults in the entire country. The lack of national clinical data has been pointed out in a recent national report about dental care in Sweden (SOU 2007:19).

## Socio-economic differences in relation to periodontal conditions

### Annual income

#### *Denmark*

There were no differences in mean percentage of teeth with periodontal conditions, according to income levels (Krustrup & Petersen 2006), see table 16.

**Table 16.** Mean percentage of teeth with periodontal conditions in relation to annual income. Data from Krustrup & Petersen 2006

	Bleeding	Pockets 4 – 5 mm	Pockets $\geq$ 6 mm
<i>35-44-year-olds</i>			
< 200,000 (n=190)	27.8	6.9	1.8
200-299,999 (n=337)	24.9	5.6	1.0
300-399,999 (n=120)	25.4	5.6	0.9
$\geq$ 400,000 (n=86)	21.5	3.6	3.1

There were neither any differences in percentage of adults with loss of attachment, according to income levels (Krustrup & Petersen 2006), see table 17.

**Table 17.** Percentage of adults with loss of attachment in relation to annual income. Data from Krustrup & Petersen 2006

	LA 0-3 mm	LA 4-5 mm	LA 6-8 mm	LA 9-11 mm
<i>35-44-year-olds</i>				
< 200,000 (n=190)	78.4	21.1	0.5	0.0
200-299,999 (n=337)	80.7	18.4	0.9	0.0
300-399,999 (n=120)	82.5	16.7	0.8	0.0
$\geq$ 400,000 (n=86)	79.1	20.9	0.0	0.0

### Education

#### *Denmark*

There were differences in mean percentage of teeth with periodontal conditions according to educational level, see table 18. Low educated adults had higher mean percentages of teeth with bleeding, pockets 4-5 mm and pockets 6 mm or deeper (Krustrup & Petersen 2006).

**Table 18.** Mean percentage of teeth with periodontal conditions in relation to education. P-values for differences between education levels. Data from Krustrup & Petersen 2006

	Bleeding	Pockets 4 – 5 mm	Pockets $\geq$ 6 mm
<i>35-44-year-olds</i>			
Low (n=62)	35.5*	10.7**	4.5***
Medium (n=158)	29.9	9.9	2.0
High (n=299)	23.6	4.4	0.6
Very high (n=193)	21.2	3.6	0.3

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$

There were no differences in percentage of adults with loss of attachment, according to education (Krustrup & Petersen 2006), see table 19.

**Table 19.** Percentage of adults with loss of attachment in relation to education. Data from Krustrup & Petersen 2006

	LA 0-3 mm	LA 4-5 mm	LA 6-8 mm	LA 9-11 mm
<i>35-44-year-olds</i>				
Low (n=62)	71.0	25.8	3.2	0.0
Medium (n=158)	82.3	17.7	0.0	0.0
High (n=299)	79.6	19.7	0.7	0.0
Very high (n=193)	81.3	18.1	0.5	0.0

### Finland

As to education, there were socio-economic differences in Finland regarding pockets  $\geq 4$  mm and  $\geq 6$  mm. Results for age groups 30-34, 35-44, and 45-54-year-olds, and for total group 30-65-years or older, are presented in tables 20 and 21. In all age groups, high-educated men and women had lower means of teeth with pockets  $\geq 4$  mm. The same pattern was found for pockets  $\geq 6$  mm, except for high-educated women 30-34-years old. They had a slightly higher mean of teeth with deep pockets (Knuutila 2004).

**Table 20.** Percentage of men and women with periodontal pockets 4 or 6 mm or deeper, according to education, gender and age group. Total n=5,255, but results for adults 55-64, and 65 years or older not presented. Data from Knuutila 2004.

	Total	Pockets $\geq 4$ mm Education			Total	Pockets $\geq 6$ mm Education		
		Basic	Secondary	High		Basic	Secondary	High
<i>30-34-year-olds</i>								
Men	56	-	59	48	8	-	11	3
Women	40	-	47	36	4	-	6	3
<i>35-44-year-olds</i>								
Men	69	72	72	61	19	29	22	8
Women	52	54	55	50	10	12	14	5
<i>45-54-year-olds</i>								
Men	76	75	78	75	30	37	32	20
Women	62	62	57	65	17	19	21	12
Total group, n = 5 255								
<i>30-65+</i>								
Men	71	73	73	68	26	33	26	19
Women	57	59	57	56	16	19	17	11

**Table 21.** Mean number of teeth with periodontal pockets 4 or 6 mm or deeper, according to education, gender and age group. Total n=5,255, but results for adults 55-64, and 65 years or older not presented. Data from Knuutila 2004.

	Total	Pockets $\geq 4$ mm Education			Total	Pockets $\geq 6$ mm Education		
		Basic	Secondary	High		Basic	Secondary	High
<i>30-34-year-olds</i>								
Men	3.4	-	3.9	2.2	0.2	-	0.2	0.1
Women	2.0	-	2.4	1.7	0.1	-	0.1	0.2
<i>35-44-year-olds</i>								
Men	4.9	6.6	5.4	3.0	0.6	1.0	0.8	0.2
Women	2.8	3.1	3.9	2.3	0.2	0.3	0.3	0.1
<i>45-54-year-olds</i>								
Men	6.2	6.9	6.0	5.5	1.1	1.2	1.2	0.7
Women	3.6	3.8	3.6	3.3	0.5	0.6	0.7	0.3
Total group, n = 5 255								
<i>30-65+</i>								
Men	5.3	5.7	5.5	4.4	0.9	1.1	0.9	0.7
Women	3.2	3.4	3.4	4.4	0.4	0.6	0.5	0.3

## Periodontal conditions and differences in living areas

### Denmark

There were no differences in mean percentage of teeth with periodontal conditions, according to living area (Krustrup & Petersen 2006), see table 22.

There were neither any differences in percentage of adults with loss of attachment, according to living area (Krustrup & Petersen 2006), see table 23.

**Table 22.** Mean percentage of teeth with periodontal conditions in relation to living area. Data from Krstrup & Petersen 2006

	Bleeding	Pockets 4 – 5 mm	Pockets $\geq$ 6 mm
<i>35-44-year-olds</i>			
Rural (n=245)	28.3	6.4	1.6
Periurban (n=179)	25.0	6.0	0.7
Urban (n=338)	23.7	5.3	0.1

**Table 23.** Percentage of adults with loss of attachment in relation to living area. Data from Krstrup & Petersen 2006

	LA 0-3 mm	LA 4-5 mm	LA 6-8 mm	LA 9-11 mm
<i>35-44-year-olds</i>				
Rural (n=245)	81.6	17.6	0.8	0.0
Periurban (n=179)	79.3	20.7	0.0	0.0
Urban (n=338)	79.3	19.8	0.9	0.0

### Discussion, periodontal conditions

In Denmark, bleeding was found in about one fourth of the teeth. One third of the 35-44-year-olds had at least one shallow pocket as the most severe sign of periodontal disease, while deep pockets were found in about 6% (Krstrup & Petersen 2006). In Finland, at least one pocket 4 mm or deeper were found in one out of two women, and two out of three men 30-44-years old (Nordblad et al 2004b).

The ways of presenting the results regarding bleeding were somewhat different in Denmark and Finland, which complicates comparisons between the countries. However, the results from the individual countries indicate similar patterns. The results from Denmark showed that bleeding was widespread in the population of 35-44-year-olds, and that it was significantly more common among men (91%) than women (81%). The results from Finland pointed to the same direction. Bleeding in one or more sextants was found in 76% of the male 35-44-year-olds, and in 68% of the women. It should be noted that bleeding, as an indicator of inflammation (gingivitis) is much debated as to whether it is a disease entity in itself, as well as having a role in the development of periodontitis (Sheiham & Netuveli 2002). It might instead represent a healthy defensive reaction against prevalence of bacteria.

Regarding pockets, there also seems to be similar patterns in Denmark and Finland, with deep pockets being less common than shallow ones. In Denmark, shallow pockets (4-5 mm) were found in 36% of the 35-44-year-old population, while pockets 6 mm or deeper were found in 6%. The distributions among men and women were similar. In Finland, pockets 4 mm or lower were found in 61% of the 35-44-year-olds. Deep pockets, 6 mm or deeper, were found in 14% of the 35-44-year-olds. The descriptive figures showed that both shallow and deep pockets were more common among men than women. Although interpretations should be cautious, it seems as both shallow and deep pockets are more common in Finland than in Denmark.

There was only material from Denmark on loss of attachment. Loss of attachment 3 mm or less was found in 80% of the 35-44-year-olds. There were no gender differences (Krstrup & Petersen 2006).

Due to different ways of measuring and presenting the results regarding periodontal conditions in relation to education, comparisons between the countries are complicated. However, there seems to be similar trends in both countries. In Denmark, “the mean percentages of teeth with gingival bleeding, shallow or deep pockets were high among participants in the low education group.” (Krstrup & Petersen 2006, p. 68). Further, the lowest mean percentages of teeth with bleeding, shallow and deep pockets were found among the high and very high educated. In Finland, lower percentages of high-educated men and

women had shallow and deep pockets. The mean numbers of teeth with pocket were generally also lower among the high educated than in those with lower educational levels.

There was only material on loss of attachment from Denmark. “High LA scores were indicated for lower educational groups among the younger adults, but this pattern was not statistically significant” (Krustrup & Petersen 2006).

Regarding the socio-economic indicators of annual income, data were only available for Denmark. No significant differences were found neither between different income levels and periodontal conditions, nor loss of attachment.

There was no data on ethnic differences in periodontal conditions in the material.

There was only material on differences between urban and rural living areas from Denmark. There were no significant differences, but higher mean percentages of teeth with bleeding, shallow and deep pockets were found among rural inhabitants. Regarding loss of attachment, similar distributions of 35-44-year-olds with loss of attachment 0-3, and 4-5 mm were found in all living areas. However, loss of attachment of 6-8 mm was not found at all in periurban areas, whilst rural and urban areas had similar distributions.

The findings are concordant with what Sheiham and Netuveli (2002) reported: “In Europe, whilst loss of bony support and loss of probing attachment is relatively common, low levels of advanced periodontal disease are reported in most of the representative populations studied” (2002, p. 107).

A recommendation for the future is clearly to conduct more national studies of periodontal conditions in adults. Further, national clinical studies should also focus on socio-economic and ethnic differences, as well as differences in relation to living areas.

### **General discussion and conclusions**

There are indications of similar trends among the four Nordic countries regarding caries prevalence in children and adolescents. There has been a decrease in prevalence during the past 20 years, but the decrease seems to be levelling out. There is a lack of data on socio-economic and ethnic differences in caries prevalence in children and adolescents.

The main finding regarding both caries prevalence and periodontal conditions in adults is that there is a lack of national data from Norway and Sweden.

Although interpretations should be cautious, there are indications of slightly higher prevalence of caries in Finland, compared to Denmark, among the men. Data on educational level indicates similar patterns of associations between higher levels of education and lower figures of caries prevalence. There is a lack of data on ethnic differences in caries prevalence in adults. There is also a lack of data regarding differences between urban and rural living areas, which only were available for Denmark.

The results regarding periodontal conditions indicate that bleeding is common in both countries, and that both shallow and deep pockets seem to be more common in Finland than in Denmark. Data on educational level indicate similar patterns of associations between higher levels of education and lower prevalence of pockets. There is a lack of data on ethnic differences in periodontal conditions in adults. There is also a lack of data regarding differences between urban and rural living areas, which only were available for Denmark.

From the available data, no interpretations regarding aggressive periodontitis, i.e. rapid deterioration of bone loss and periodontal ligaments, or probability of developing it can be made.

The most important finding from this report is that there is a need for more national epidemiological summative assessments on the oral health of adults. National clinical research is needed in order to estimate what actions need to be taken to improve oral health. Without national assessments, political reforms cannot be evaluated and conclusions regarding their effectiveness cannot be drawn.

The task from Oral B was to answer a series of questions about the oral health in the Nordic countries of Denmark, Finland, Norway and Sweden, from existing national clinical data. The conclusions from this report are:

- Caries prevalence for children, adolescents and adults:  
**There has been a decrease in caries prevalence in children and adolescents that seems to be levelling out. Caries prevalence for adults need more research attention. There were only national data from Denmark and Finland. Although interpretations should be cautious, there are indications of slightly higher caries prevalence in Finland, compared to Denmark.**
- Prevalence of gingivitis in the adult population:  
**This needs more research attention. There were only national data from Denmark and Finland. Differences in measuring and presenting results complicate intercountry comparison. However, there seems to be a similar trend with a high prevalence of bleeding in both countries.**
- Prevalence of periodontitis and aggressive periodontitis in the adult population:  
**This needs more research attention, especially for people at risk. There were only data on shallow and deep pockets from Denmark and Finland, and only from Denmark on loss of attachment. Differences in measuring and presenting results complicate intercountry comparison. However, there seems to be a similar trend with shallow pockets being rather common, while deep pockets seem to be rather uncommon in the populations. In Denmark, a loss of attachment 4 mm or deeper was found in one fifth of the population 35-44-years old. There were no national data on aggressive periodontitis.**
- Differences in caries, gingivitis and periodontitis between inhabitants living in urban and rural areas:  
**There were no national data on differences in caries prevalence between children and adolescents living in urban and rural areas. For adults, there were only national data from Denmark regarding caries prevalence and periodontal conditions. Differences in living areas were only found for caries prevalence: participants from rural areas had significantly higher means of DMFT and FT, than participants from periurban and urban living areas.**
- Differences in caries, gingivitis and periodontitis between native inhabitants and ethnic minorities:  
**There were no national data on differences in caries prevalence in neither children, adolescents nor adults, in relation to ethnicity.**

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## List of terms

**Aggressive periodontitis:** rapid deterioration of bone loss and periodontal ligaments

**Analysis of variance (ANOVA):** statistical method of estimating if three or more different groups values differ due to actual differences, or chance

**Approximal caries:** caries in the tooth's surface that are next to another tooth

**Bleeding:** bleeding when probing the gingival tissue around the tooth is an indication of inflammation. An indicator of periodontal status.

**Calculus:** hardened bacterial cover on the tooth. An indicator of periodontal status.

**Caries prevalence:** the total number of accumulated caries lesions, expressed as the mean for a population (DMFS or DMFT)

**Community Periodontal Index (CPI):** The WHO's recommended index for assessing periodontal conditions. Assessment of gingival bleeding, calculus and periodontal pockets

**d<sub>3</sub>:** decay in dentine

**dfs:** decayed, extracted, filled surfaces (temporary teeth)

**def:** decayed, extracted, filled teeth (temporary teeth)

**Dentine:** the bone of the tooth

**DFS-a:** decayed, filled approximal surfaces

**DFT:** decayed, filled teeth

**dmfs/DMFS:** decayed, missing, filled surfaces. Small letters used for temporary teeth (in children), capital letters used for permanent teeth

**dmft/DMFT:** decayed, missing, filled teeth. Small letters used for temporary teeth (in children), capital letters used for permanent teeth

**Chipped teeth:** teeth with a small piece missing

**Gingivitis:** inflammation in the gums

**Loss of attachment:** loss of bone around the root of the tooth

**p:** probability, tells us the statistical probability that a value differing from another is due to an actual difference, and not chance. For example:  $p \leq 0.05$  means that there was a 5% or less probability that the found difference was due to chance.

**Periodontitis:** inflammation in the attachment apparatus of the tooth, usually a destructive change leading to loss of bone and periodontal ligaments

**Pockets:** loss of periodontal ligament attached to the root of the tooth. Periodontal pockets are an indicator of periodontal status.

**Significance:** the statistical probability that a value differing from another is due to an actual difference, and not chance. Often reported as a probability, with a p-value, see above

**Sextant:** grouping of teeth in three segments in each jaw

**Sound teeth:** teeth without caries and fillings

## **The dental care systems in the Nordic Countries**

### *Denmark*

In Denmark, oral health care is provided free of charge to children and adolescents up to the age of 18 (Sundhedsstyrelsen, Widström et al 2005, Kravits & Treasure 2004, Widström & Eaton 2004), including orthodontic treatment (Widström et al 2005). The Public Dental Service (PDS) provides children and adolescents' oral health care, but private care can also be chosen (Widström et al 2005). However, private care for children and adolescents under the age of 16 may not be free of charge (Sundhedsstyrelsen, Sundhedsstyrelsen 2004). Between 95% and 100% of children and adolescents visit the PDS regularly (Widström et al 2005). The PDS also provide oral health care to elderly living at home but receive nursing care, or living in nursing homes (Widström et al 2005), and to mentally handicapped patients (Sundhedsstyrelsen, Widström & Eaton 2004). The PDS is organised by the municipal government (Kravits & Treasure 2004). For most adults, private practitioners provide oral health care, and there is a public subsidy reimbursing basic treatments, for example examinations, fillings, endodontic and periodontic treatments (Widström et al 2005, Kravits & Treasure 2004, Widström & Eaton 2004). Generally, the subsidy is higher for young adults, 18-25-years old (Kravits & Treasure 2004).

Since 1972, oral health data of children and adolescents are reported annually to the Danish National Board of Health's database. Since 1993, only data for 5-, 7-, 12-, and 15-year-olds are compulsory (Poulsen & Malling Pedersen 2002).

### *Finland*

In Finland, oral health care for children and adolescents up to the age of 17 is free of charge in the PDS, including orthodontic treatment (Widström et al 2005, Widström & Eaton 2004). Oral health care is provided through public health centres (Social- och Hälsovårdsministeriet, Widström & Eaton 2004). In 2000, the national attendance among 0-5-year-olds was 61%, and 81% among 6-8-year-olds (Nordblad et al 2004a). About 80% of patients entitled to free oral health care visit the PDS annually (Widström et al 2005). The PDS is run by the municipalities (Kravits & Treasure 2004, Widström & Eaton 2004). Since 2002, adults can choose between private practitioners and the PDS for their oral health care (Widström et al 2005, Widström & Eaton 2004). The National Health Insurance subsidises private dental care (Fpa, Widström et al 2005, Widström & Eaton 2004).

There are data on oral health care services at health centres, since the early 1970's (Nordblad et al 2004a).

### *Norway*

In Norway, oral health care for children and adolescents up to the age of 18 is free of charge in the PDS, not including orthodontic treatment (Widström et al 2005, Kravits & Treasure 2004, Widström & Eaton 2004). Orthodontic treatments are mainly provided by private practitioners, but subsidised by the state (Widström et al 2005). In 2001, around 93% of all children and adolescent utilized the public service (Widström et al 2005, Widström & Eaton 2004). Apart from children and adolescents, the PDS also provides oral health care for mentally handicapped, elderly living at home with nursing care or living in institutions, and young adults up to the age of 20. The PDS can also provide oral health care to other groups the municipality prioritises (Helse- og omsorgsdepartementet). The PDS is run by the counties (Helse- og omsorgsdepartementet, Kravits & Treasure 2004).

Most adult oral health care is provided by private practitioners (Kravits & Treasure 2004) to which there is no general subsidy (Widström et al 2005, Widström & Eaton 2004). However, specialist care is partly refunded (Widström et al 2005).

Data on caries prevalence in 5-, 12- and 18-year-olds are annually reported by Statistics Norway.

### *Sweden*

In Sweden, oral health care for children and adolescents up to the age of 19 is free of charge in the PDS, including orthodontic treatment (Widström et al 2005). Private dental care for children and adolescents can also be chosen (Widström et al 2005, Kravits & Treasure 2004), free of charge. The PDS is run by county councils, which are responsible for provision of oral health services (Kravits & Treasure 2004, Widström & Eaton 2004). About 80% of patients entitled to free oral health care visit the PDS annually (Widström et al 2005). Adults can choose freely between the PDS and private dental care (Kravits & Treasure 2004). There is a national insurance that subsidises oral treatments regardless of choice of caregiver (Widström et al 2005, Kravits & Treasure 2004), but the patient pays the predominant part of the costs.

Since 1994, annual data on caries prevalence is only reported for 3-, 6-, 12- and 19-year-olds (Socialstyrelsen 2006).