

Dental conditions in middle-aged and older people in Denmark and Sweden: a comparative study of the influence of socioeconomic and attitudinal factors

Sigvard Palmqvist, Björn Söderfeldt, Merete Vigild and Jakob Kihl

Departments of Prosthetic Dentistry and Community Dentistry, Dental School, Copenhagen University, Denmark; Department of Oral Public Health, Faculty of Odontology, Malmö University, Sweden; and National Institute for Working Life, Malmö, Sweden

Palmqvist S, Söderfeldt B, Vigild M, Kihl J. Dental conditions in middle-aged and older people in Denmark and Sweden: a comparative study of the influence of socioeconomic and attitudinal factors. *Acta Odontol Scand* 2000;58:113–118. Oslo. ISSN 0001-6357.

In 1998–99 two parallel questionnaire studies were performed in Denmark and Sweden. In Denmark the age group was 45–69 years and in Sweden 55–79 years. One aim was to study the influence of socioeconomic and attitudinal factors on dental status in the two countries. For the comparable age groups 55–69 years there was a striking difference in dental conditions between the countries. In Sweden, 72% had either all teeth remaining, missing teeth replaced by fixed prosthodontics, or only one or two single missing teeth not replaced. The corresponding figure for Denmark was 44%. Among Danes, 34% were wearing removable denture(s) or were edentulous in one jaw or both jaws, compared with 15% among Swedes. In logistic regression models, higher income and longer education were significantly associated with the best dental status categories in Denmark but not in Sweden. In the model with wearing removable denture(s) as the dependent variable, lower income and lower education level showed a significant influence for the Danes. In Sweden, lower income showed a significant influence but education level was insignificant. In both Denmark and Sweden, a positive attitude toward the importance of dental appearance was associated with an increased risk of wearing removable denture(s). □ *Attitudes; dental status; socioeconomic factors*

Sigvard Palmqvist, Department of Prosthetic Dentistry, Dental School, 20 Nørre Allé, DK-2200 Copenhagen N, Denmark. Tel. +45 35 32 67 45, fax. +45 35 32 66 02, e-mail. sigvard.palmqvist@odont.ku.dk

For a long period of time, strong associations between socioeconomic conditions and dental conditions have been demonstrated in the Scandinavian countries (1–18). However, the pattern has not been completely identical in all the countries. Regarding dental status, Sweden has been reported to have the lowest prevalence of total edentulousness; Denmark the highest. Comparing the various reports, a change over time is also visible. For example, gender differences seem to have decreased considerably.

Denmark and Sweden are two countries with a similar standard of living, but with different national policies toward dental care for adult citizens. In Sweden there has been an all-encompassing national dental insurance since 1974. Before that there were highly subsidized fees for all kinds of treatment in the Swedish Public Dental Health Service. The remuneration levels in dental insurance have changed over the years, but the leading principle has always been that of “high cost protection”. This means that patients have paid a lower percentage of fees for extensive treatment than for routine services.

In Denmark there is no comparable dental insurance. However, basic treatment items, such as tooth extractions and fillings, are included in the Danish general health insurance. More comprehensive treatment, prosthodontic services for example, must be paid entirely by the patients themselves or by their private insurance providers.

The aims of the present study were to describe the different dental conditions in middle-aged and older populations in Denmark and Sweden, and to analyze the patterns of socioeconomic and attitudinal factors associated with the dental conditions in the two countries.

Materials and methods

In 1998–99 two parallel questionnaire studies were carried out in Denmark and Sweden. The design of the studies was largely the same as in a previous study of the age group 45–69 years in Sweden and performed about 10 years earlier (5).

Random samples were taken from the national population registers in Denmark and Sweden; in Denmark, a sample of 1,175 subjects aged 45–69 years; in Sweden a sample of 1,001 subjects aged 55–79 years. Late in 1998, questionnaires were mailed to the sampled individuals with a request to return the questionnaire properly filled out. Those who did not respond within a few weeks were handled differently in Denmark and Sweden depending on the standard questionnaire study strategies in the two countries. In Denmark, after about 1 month a reminder together with a copy of the questionnaire was sent to each non-responder. In Sweden, those who had not responded within 3 weeks were sent a reminder and those who had

still not responded within another 3 weeks received a second reminder along with a copy of the questionnaire.

The Swedish questionnaire was a slight modification of a questionnaire used about 10 years earlier in a similar study (5). The Danish questionnaire was a translation of the Swedish text, but with a few revisions necessary due to different conditions in Denmark. For example, the information about treatment fees had to be altered because of different refunding systems. The Danish questionnaire was tested on a small group of dental patients before it was printed and mailed to the recipients.

In Denmark, 862 subjects out of 1,175 responded to the questionnaire, yielding a response rate of 73%. In Sweden, the corresponding figures were 667 subjects out of 1,001; a response rate of 67%.

For the Danish material, the responders and non-responders were compared with regard to gender, age, and residence. No statistically significant difference was found. A corresponding test was done for the Swedish material with regard to gender and age. No significant difference was found between the genders, but the non-responders were older ($P < 0.001$). However, in the age group 55–69 years, there was no significant difference between responders and non-responders related to age or gender. Non-response was concentrated to the oldest age group.

Further, an attempt was made to get in touch with the Swedish non-responders for an interview by telephone regarding their dental status. Only 68 persons could be reached. Twelve of them refused any participation. Of the other 56 individuals, 14 (25%) were totally edentulous compared with 7% among those having responded to the questionnaire ($P < 0.001$). It was emphasized in all contacts that response was wholly voluntary.

The following variables were used in the present study:

Dental conditions: Seven dental categories were used, the same as in the previous study (5):

1. All teeth remaining
2. All missing teeth replaced by fixed prosthodontics
3. One or two single teeth missing and not replaced
4. Several teeth missing and not replaced
5. Wearing removable partial denture(s)
6. Totally edentulous in one jaw
7. Totally edentulous in both jaws

Different dichotomies of this dental status variable were used as dependent variables in multivariate analyses using the following as independent (explanatory) variables:

Gender, male (reference category); female

Age, in years, used as a continuous variable

Marital status, married or cohabiting (ref. cat.); other status

Residence, in Denmark: Living in Copenhagen (+Fredriksberg), Århus, Ålborg or Odense with suburbs (ref. cat.); other residence, Sweden: Living in Stockholm, Göteborg, or Malmö with suburbs (ref. cat.); other residence

Income, <100,000; 101,000–150,000; 151,000–200,000; 201,000–250,000; 251,000–300,000; 301,000–350,000; 351,000–400,000; >400,000 per year in Danish or Swedish crowns, used as a continuous variable

Education, long = more than 9 years of schooling (ref. cat.); shorter education

Occupation and socioeconomic class, not working, including retirees (ref. cat.); blue-collar worker; white-collar worker; entrepreneur

Two attitudinal variables were constructed from answers on VAS scales, as in a previous study (7): dental appearance and dental function. The coding gave a possible value for each variable ranging from 2 to 28 (higher value = a more positive attitude). Each variable was used as a continuous one.

The chi-squared test was used for bivariate testing of differences between groups. Multivariately, logistic regression models were used. Cook distances were calculated for detection of influential outliers. Classification plots were inspected. Total chi-square was calculated for model significance.

Results

There was a certain resemblance between the Danish group and the 10 years older Swedish group with regard to edentulousness (Table 1). On the other hand, there were also great differences. The Danes had more removable dentures and the Swedes had more fixed partial dentures. For the comparable age groups 55–69 years, the difference between the countries was striking. Among Swedes, 72.4% had all teeth remaining, missing teeth replaced by fixed prosthodontics, or only one or two single missing teeth not replaced (categories 1–3). The corresponding figure for the Danes was only 44.3% ($P < 0.001$). Among Danes, 34% were wearing removable denture(s) (categories 5–7) compared with 14.8% of Swedes ($P < 0.001$).

In a logistic regression model with the best dental condition (categories 1–3) compared to the others as the dependent variable, the relative risks for NOT belonging to categories 1–3 was calculated for the independent variables (Table 2). The pattern was quite different for the two countries. Among Danes, income and education were statistically highly significant variables; among Swedes these were insignificant. In Sweden a positive attitude toward the importance of dental appearance was significantly associated with a higher risk for not belonging to the categories with the best dental status. In Denmark this variable was insignificant.

In the model with the poorest dental categories (5–7) compared to the others as the dependent variable, the pattern was more or less the same (Table 3). However, in the Swedish material, residence and income (but not education) now showed a weak significant association with the dependent variable, as did residence among the Danes.

Table 1. Dental conditions in Danes aged 45–69 years, in Swedes aged 55–79 years, and in the age group 55–69 years in Denmark and Sweden. Percentage figures in groups

	Age group 45–69 years in Denmark (<i>n</i> = 862)	Age group 55–79 years in Sweden (<i>n</i> = 667)	Age group 55–69 years	
			in Denmark (<i>n</i> = 455)	in Sweden (<i>n</i> = 457)
1. All teeth remaining	30.0	18.2	19.2	23.4
2. All missing teeth replaced by fixed prosthodontics	3.4	12.7	3.6	14.1
3. One or two single teeth missing and not replaced	23.9	34.0	21.5	34.9
4. Several teeth missing and not replaced	18.5	13.8	21.7	12.9
5. Wearing removable partial denture(s)	11.2	7.5	15.2	5.2
6. Totally edentulous in one jaw	6.4	6.8	9.4	4.8
7. Totally edentulous in both jaws	6.2	6.9	9.4	4.8

The attitudinal variable “dental appearance” in this model was significant in both Denmark and Sweden.

Discussion

Discussion of materials and methods

A percentage of non-responders, around 30–35%, is what must be accepted for questionnaire studies nowadays in Scandinavia (19, 20). The somewhat higher percentage of non-responders in the Swedish material can be attributed the fact that they were 10 years older than those in the Danish material.

In descriptive epidemiology, percentages of non-responders such as those in the present study mean that the results are often not inferentially representative of the total population concerning point estimates. Regarding dental conditions, it has been reported earlier from studies of older age groups that non-participants had poorer conditions compared to those participating in the studies

(21, 22). The non-participants in Sweden, interviewed by telephone, were more frequently edentulous than the participants.

The percentage figures for the different dental categories must therefore be considered as not exactly correct for the studied age groups in Denmark and Sweden. For example, the percentage of edentulous subjects is probably higher in the population compared to the group of participants. This could also be concluded from comparing the present Danish data with the results of a Danish general health study performed a few years ago (14). This study, which included some dental variables, used an expensive home interview technique and for that reason had a much lower percentage of non-participants. The different results indicate clearly that the percentage of edentulous subjects is a bit too low in the present study.

However, there is no indication that the groups of non-responders in Denmark and Sweden should differ significantly. Furthermore, the observed difference in dental status between Denmark and Sweden in the comparable age groups (Table 1) is so great that it cannot

Table 2. Logistic regression analyses of the Danish group aged 45–69 years and of the Swedish group aged 55–79 years with “all teeth remaining, all missing teeth replaced by fixed prosthodontics, or one or two single teeth missing and not replaced” (status categories 1–3) compared to the others as the dependent variable in each model. Odds ratios (OR) given for the relative risks for NOT belonging to the group with the best dental conditions (categories 1–3). *P*-values for the significant independent variables. N.S. = not significant

Independent variables	Danish group 45–69 years (<i>n</i> = 677)		Swedish group 55–79 years (<i>n</i> = 442)	
	OR	Sign.	OR	Sign.
Gender	0.81	N.S.	0.65	N.S.
Age	1.08	0.000	1.07	0.000
Marital status	1.29	N.S.	1.19	N.S.
Residence	1.00	N.S.	1.17	N.S.
Income	0.75	0.000	0.87	N.S.
Education	1.49	0.031	1.03	N.S.
Occupation and socioeconomic class (not working = ref. cat.)				
Blue-collar worker	1.27	N.S.	1.80	N.S.
White-collar worker	1.07	N.S.	1.08	N.S.
Entrepreneur	2.03	N.S.	2.12	0.045
Dental appearance	1.02	N.S.	1.05	0.009
Dental function	1.01	N.S.	1.01	N.S.
Model chi-squared = 115.6			Model chi-squared = 50.5	
df = 11		<i>P</i> = 0.000	df = 11	
			<i>P</i> = 0.000	

Table 3. Logistic regression analyses of the Danish group aged 45–69 years and of the Swedish group aged 55–79 years with wearing removable denture(s) or being totally edentulous in one jaw or both jaws (categories 5–7) compared to the others as the dependent variable in each model. Odds ratios (OR) given for the relative risks for wearing removable denture(s) or being totally edentulous in one or both jaws (categories 5–7). *P*-values for the significant independent variables. N.S. = not significant

Independent variables	Danish group 45–69 years (<i>n</i> = 677)		Swedish group 55–79 years (<i>n</i> = 442)	
	OR	Sign.	OR	Sign.
Gender	0.77	N.S.	0.70	N.S.
Age	1.07	0.001	1.09	0.000
Marital status	1.65	N.S.	1.65	N.S.
Residence	1.61	0.027	2.09	0.031
Income	0.80	0.005	0.75	0.027
Education	2.13	0.001	1.44	N.S.
Occupation and socioeconomic class (not working = ref. cat.)				
Blue-collar worker	0.89	N.S.	1.86	N.S.
White-collar worker	0.73	N.S.	1.34	N.S.
Entrepreneur	0.31	0.048	2.19	N.S.
Dental appearance	1.04	0.028	1.07	0.014
Dental function	1.01	N.S.	1.01	N.S.
Model chi-squared = 114.8			Model chi-squared = 59.9	
df = 11		<i>P</i> = 0.000	df = 11	
			<i>P</i> = 0.000	

be explained by differences between the groups of non-responders.

For analyses of the influence of background factors on the dental conditions, the percentage of responders is satisfactory. Among epidemiologists it is well known that a higher percentage of non-responders might even be beneficial. This is because the inclusion of persons with only minor interest in participation involves an increased risk of introducing less reliable data in the material. However, on the other hand, self-assessment of dental conditions among participants in questionnaire studies has previously been shown to provide valid data (23, 24).

Besides the high percentage of non-responders, there was also a fairly high internal non-response in both the Danish and the Swedish material. This gives lower *n*-values in the multivariate analyses. Still, the remaining number of subjects was sufficient for the analyses.

When interpreting the odds ratios in the multivariate models it should be noted that the value shows the influence for each step of the scale. For example, an odds ratio of 1.07 for age means a risk increased by 7% for each additional year. One should also keep in mind that an odds ratio below 1 can be as large as one above 1. For example, 0.5 is equal to 2—the only difference is the direction of the association.

Discussion of results

The better dental status in Sweden and the poorer status in Denmark can be attributed to several differences between the countries. In Denmark, there has been no real dental insurance; only a few basic treatment items have been included in the Danish general health insurance. In Sweden, a Public Dental Health Service was built up during the 1940s and 1950s with low fees for all kinds of treatment. The goal of the all-encompassing dental

insurance, introduced in 1974, was to make good dentistry available to all citizens. On this point the Swedish dental health policy has obviously been successful, since income and education levels were insignificant in the model with the best dental categories as the dependent variable (Table 2). In the model with wearing removable dentures as the dependent variable (Table 3) education was also insignificant, and income showed only a weak correlation. In the Danish material, the income and education variables were significantly associated with dental conditions in both models.

In this context it should be remembered, however, that income differences tend to be smaller in older age groups, and that the Swedish group was 10 years older than the Danish one. On the other hand, in the Swedish material education was an insignificant variable in both models. In the Danish material, education was highly significant with an OR of 2.13 in the model with the poorest dental conditions as the dependent variable.

In Denmark, unlike Sweden, there is no public dental health service for the ordinary adult citizen. Also unlike Sweden, denturists are authorized in Denmark to make removable dentures. This is probably a factor that has directed prosthodontic treatment in Denmark towards more removable dentures.

There are also obvious differences in social patterns between the two countries. In Table 2 there is an inverse social gradient in Sweden with a probability above 2 for entrepreneurs belonging to the poorest group. In Table 3 the relative risk for a Danish entrepreneur belonging to the poorest group is only one-third compared to those not working. When interpreting these results it should be remembered that income was controlled.

Hypothetically, the poorer dental conditions in Denmark could mean that Danes on average spend less money than Swedes on dental care. As there is no general dental

insurance in Denmark, it is difficult to get detailed information about the total cost of dentistry in Danish society. But according to available sources (25, 26), the total cost of dental care per adult citizen is about the same in both countries. Thus, the different dental care systems seem to give the Danish population poorer dental conditions than the Swedish population, although the average cost of treatment is about the same. It is well known that the fees for fixed prosthodontics are much higher in Denmark than in Sweden, making it possible only for wealthier people to demand such extensive treatment. Evidently, Danes pay much more money for dental care out of their own pockets than do Swedes.

In both countries, the attitudinal variable "dental appearance" was significantly associated with wearing a removable denture. This was also a finding in a previous study (7). It indicates that considering dental appearance important might have been a reason for the choice of a removable denture instead of preserving a dentition with many fillings.

Compared to the earlier Swedish study using the same questionnaire technique (5), the dental conditions in this new Swedish material, 10 years older than the previous one, were equal or even better. This finding calls for some explanation. First of all, different samples will always mean different values. For each value there is also a confidence interval, the size of which depends on the size of the sample. Longitudinally, only small changes in dental status have been noted for most groups in Swedish society during the last decade (27, 28). In the present material, compared to the group studied about 10 years earlier, there was also a higher percentage of non-participants with a presumably poorer dental status than among the participants. Another factor possibly explaining the better status than might have been expected is the well-known fact that subjects with poorer dental status have died earlier than those with better dental status. This was true at least in the past (29, 30).

The various prevalence figures can always be discussed. However, there is no doubt that there are real differences in dental conditions between Denmark and Sweden. There are also obvious differences in the patterns of socioeconomic factors associated with these differences.

Acknowledgements.—This study was supported by grants from the Swedish Council for Social Research (project no. 94-0068; 2B) and from the Danish Dental Association.

References

- Smedby B. Tandvårdsvanor och tandvårdskostnader. Bilaga 3 till Statens Offentliga Utredningar (SOU) 1965:4 Tandvårdförsäkring. Stockholm: Nordiska Bokhandeln; 1965.
- Statistiska Centralbyrån. Levnadsförhållanden 1975–1981. Tandhälsa och tandvård. Rapport nr 49. Stockholm; 1986.
- Palmqvist S, Österberg T, Mellström D. Oral health and socioeconomic factors in a Swedish county population aged 65 and over. *Gerodontology* 1986;2:138–42.
- Statistiska Centralbyrån. Levnadsförhållanden 1988–1989. Ohälsa och sjukvård. Rapport nr 68. Stockholm; 1991.
- Palmqvist S, Söderfeldt B, Arnbjerg D. Dental conditions in a Swedish population aged 45–69 years. A questionnaire study. *Acta Odontol Scand* 1991;49:377–84.
- Österberg T, Carlsson GE, Mellström D, Sundh W. Cohort comparison of dental status in the adult Swedish population between 1975 and 1981. *Community Dent Oral Epidemiol* 1991;19:195–200.
- Palmqvist S, Söderfeldt B, Arnbjerg D. Explanatory models for total edentulousness, presence of removable dentures, and complete dental arches in a Swedish population. *Acta Odontol Scand* 1992;50:133–9.
- Österberg T, Carlsson GE, Sundh W, Fyhrlund A. Prognosis and factors associated with dental status in the adult Swedish population, 1975–1989. *Community Dent Oral Epidemiol* 1995;23:232–6.
- Hugoson A, Koch G, Bergendal T, Hallonsten A-L, Slotte C, Thorstensson B, et al. Oral health of individuals aged 3–80 years in Jönköping, Sweden in 1973, 1983 and 1993. I: Review clinical and radiographic findings. *Swed Dent J* 1995;19:243–60.
- Nordström G, Sundberg H. Tandhälsa och tandläkarbesök i SCB:s Undersökningar av levnadsförhållanden (ULF). *Socialmed Tids* 1996;6:282–4.
- Petersen PE. Dental health behaviour, dental health status and dental treatment needs among workers and staff-members of a Danish shipyard. A socio-dental industrial investigation. Odense Universitetsforlag; 1981.
- Kirkegaard E, Sylling Borgnakke W, Grønbaek L. Oral health status, dental treatment need, and dental care habits in a representative sample of the adult Danish population. Survey of oral health of Danish adults. Århus, Odontologisk Boghandel; 1987.
- Schwarz E. Changes in demand for dental care among Danish adults, 1975–90. *Acta Odontol Scand* 1996;54:36–43.
- Bøge Christensen L, Kjoller M, Petersen P-E, Vigild M. Tandstatus og udnyttelsen af tandplejetilbuddet hos voksne i Danmark 1994. *Tandlægebladet* 1996;100:215–22.
- Ambjørnsen E. Remaining teeth, periodontal condition, oral hygiene and tooth cleaning habits in dentate old-age subjects. *J Clin Periodontol* 1986;2:138–42.
- Helöe LA, Holst D, Rise J. Development of dental status and treatment behavior among Norwegian adults 1973–1985. *Community Dent Oral Epidemiol* 1988;16:52–7.
- Holst D. Etterspørsel etter, konsum av tannbehandling og tannhelse i Norge. Tandvårdsforsikring i omvandling. Bilaga 7. Rapport Ds 1997; 16. Socialdepartementet, Stockholm; 1997.
- Suominen-Taipale A-L, Alanen P, Helenius H, Nordblad A, Uutela A. Edentulism among Finnish adults of working age 1978–1997. *Community Dent Oral Epidemiol* 1999;27:353–65.
- Japac L. Minska bortfallet. Statistics Sweden (SCB), Örebro; 1997.
- Nilsson P. Bortfallsbarometer. R + D report 1999:2. Statistics Sweden (SCB), Stockholm; 1999.
- Lysell L. Epidemiologisk-röntgendiagnostisk undersökning av tänder, käkar och käkleder hos 67-åringar i Dalby. Akademisk avhandling. Malmö; 1977.
- Palmqvist S. Oral health patterns in a Swedish county population aged 65 and above. *Swed Dent J Suppl* 32 1986.
- Palmqvist S, Söderfeldt B, Arnbjerg D. Self-assessment of dental conditions: validity of a questionnaire. *Community Dent Oral Epidemiol* 1991;19:249–51.
- Unell L, Söderfeldt B, Halling A, Paulander J, Birkhed D. Oral disease, impairment and illness: congruence between clinical and questionnaire findings. *Acta Odontol Scand* 1997;55:127–32.
- Socialstyrelsen (National Board of Health and Welfare) Efterfrågan på tandvård inom vuxentandvården under perioden 1990–1995. Rapport September 1996 (in Swedish). Stockholm; 1996.

26. European Union. Research and Technological Development Programme. Efficiency in oral health care. The evaluation of oral health systems in Europe. Biomed 1. Final report. January 1997.
27. Uhrbom E, Bjerner B. Epiwux 88. En epidemiologisk undersökning av tandhälsoläget i Kopparbergs län. En jämförande tvärsnittsstudie samt longitudinell studie 1983–1988. Kopparbergs läns landsting; 1988.
28. Norderyd O, Hugoson A. Tooth loss and periodontal bone level in individuals of Jönköping County. A comparison between two adult populations living in the city and in the surrounding area. *Swed Dent J* 1998;22:165–74.
29. Österberg T, Mellström D, Sundh V. Dental health and functional ageing. A study of 70-year-old people. *Community Dent Oral Epidemiol* 1990;18:313–18.
30. Palmqvist S. Tandlöshet—en socialmedicinsk riskindikator. *Socialmed Tids* 1991;68:255–8.

Received for publication 21 January 2000

Accepted 9 March 2000