RESEARCH REPORT

Children's use of dental services in the five Nordic countries

Jorma I Virtanen, Leeni T Berntsson, Eero Lahelma, Lennart Köhler, Heikki Murtomaa

J Epidemiol Community Health 2007;**61**:1080–1085. doi: 10.1136/jech.2006.052910

See end of article for authors' affiliations

Correspondence to: Dr Jorma I Virtanen, University of Helsinki, PO Box 41, FI-00014 Helsinki, Finland; jorma.virtanen@helsinki.fi

Accepted 19 February 2007

Background: An increase in the use of general practitioner services for children has taken place since the 1980s in the Nordic countries, but little is known about the use of dental services during this time.
Aim: To compare differences in children's use of dental services in the five Nordic countries and to analyse changes over time from the 1980s to the 1990s.
Methods: The participants were 20 500 children aged 2–17 years from Denmark, Finland, Iceland, Norway and Sweden. Cross-sectional population surveys using random samples comprising 3000 children in each country were conducted in 1984 and 1996. Changes over time in the use of dental services were studied in each country by age, sex, level of parental education and living area.
Results: The prevalence of children's utilisation of dental services varied between 60% and 34% in 1984, and between 42% and 30% in 1996. A clear change towards decreasing utilisation over time ($p<0.05$) was found in all countries except Finland, where utilisation increased statistically significantly ($p<0.05$). Odds ratios (1984 = 1.00) for the changes ranged between 0.66 (95% confidence interval 0.58 to 0.75) in Sweden and 0.71 (0.62 to 0.81) in Iceland, while the corresponding figure was 1.32 (1.16 to 1.48) in Finland. In 1996, children from families with the lowest education in Finland and Norway used dental services more frequently than children from families with higher education.
Conclusion: Children's use of dental services decreased significantly in four of the five Nordic countries between the mid-1980s and the mid-1990s.

Largely similar social welfare policies and systems in the Nordic countries justify references to the Nordic model of the welfare state.[1 2] In the Nordic welfare states, health services for adults as well as children are publicly arranged, widely available and most often free or subsidised for all.[3 4] In the primary health services as well as in dental health services, prevention has generally been given a high priority, especially regarding children and adolescents from birth until the completion of mandatory school education.[5]

A wide variety of systems have been developed for financing and organising health care and dental care in the EU, and Beveridgian, Bismarckian, Nordic and southern European systems have been identified.[6 7] The Nordic countries, having a fairly similar historical and cultural background and a common labour market, share strongly subsidised health care provision systems. Characteristics of the Nordic health care model are a high degree of government involvement, widespread availability and tax financing.[3 4]

Generally, there are few systematic studies concerning children's use of various health services in the Nordic countries. A recent study found that children's use of general practitioner services increased significantly in the Nordic countries between the 1980s and the end of the century.[8] Few studies of children's use of dental services have been reported in European countries, and the World Health Organization has strongly recommended that more research be devoted to public health and health systems.[9 10] Although dental caries has substantially declined over the last two decades in many European countries, recent reports suggest that the dental health of young school children is no longer improving and may even be declining.[11–14] The connection between these circumstances and the use of dental services in different countries is not well known.

The general purpose of this study was to compare children's use of dental services in the five Nordic countries, ie, Denmark, Finland, Island, Norway and Sweden. More specifically, we analysed changes over time from the 1980s to the 1990s in dental services and their sociodemographic and socioeconomic differences. Thus, this study also provides a basis for the systematic assessment of future trends.

METHODS

Sampling

Data from two cross-sectional population surveys in the five Nordic countries, i.e. Denmark, Finland, Iceland, Norway and Sweden, were included.[15] The surveys were first conducted in 1984 and then repeated in 1996.[8 16 17] In each of these surveys from the five countries, random samples of about 3000 children aged 2–17 years were drawn from the population registers of the national statistical authorities. In conformity with basic statistical rules, these samples were constructed based on the need to work with subgroups of a certain size, ie, 20% of the samples should consist of no fewer than 600 individuals.[15] In addition, children born on the fourth of every month in 1984 and on the fifth in 1996 were chosen. Children living in institutions were excluded.

The parent who was most familiar with the child's situation was instructed to fill in a postal questionnaire, together with the child, if possible.[15] Two reminders were sent. There were 10 219 completed questionnaires in spring 1984 and 10 317 in spring 1996. The response rates varied between countries, and the mean response rate was 67% in 1984 and 70% in 1996. Comprehensive non-response analyses performed by the statistical authorities in each country revealed no differences between respondents and non-respondents with regard to age and sex, but families with parents with a low level of education and families from a working-class background or with only one parent were over-represented among the non-respondents in both years.[18] Otherwise the representativeness of the samples was high.[15 18]

Questionnaire

In general, identical questions were used in both questionnaires but some new items were added in the 1996 survey.[15] The questionnaires, which have been described elsewhere in

detail,[8 15] included background information about the child and the family, the health of the child, contacts with health care and the child's own activities and activities together with the parents, socioeconomic data and the parents' health and well-being.

Ethical issues

The national ethics committees approved the study. The parents and children were informed about the study aims in a letter accompanying the questionnaire. They were told that anonymity in data processing and presentation was followed and that they had the right to refuse to participate in the study. They were asked to contact the researchers for further information if needed.

Data cleaning procedure

The returned questionnaires were coded and anonymised, and the data were scanned into SPSS and SAS data files.[8 15]

Variables

The dependent variable was dental service utilisation. In all five countries dental service utilisation was measured by asking whether the parents had consulted a dentist or a dental nurse during the previous 3 months. In Denmark, information on the use of services in 1996 was limited to that provided by a dentist.

Independent variables were study year (1984 and 1996), country, living area, the child's age and gender, and the family's highest level of education. The sample was classified into three age groups: 2–6 years, 7–12 years and 13–17 years. Living area was subdivided into three groups according to the degree of urbanisation, ie, number of inhabitants: (1) city (> 100 000 inhabitants), (2) town (3000–100 000 inhabitants) and (3) rural area (< 3000 inhabitants). The family's education was defined as the highest education level of either parent. Four levels were distinguished: (1) university/college level (> 12 years of education), (2) upper secondary school (12 years), (3) lower secondary school (10–11 years) and (4) primary school (< 10 years).[8]

Statistical analyses

First, we calculated the prevalence (%) of dental service utilisation during the previous 3 months among children in 1984 and 1996 by age, sex, the parents' level of education and the living area. Differences were tested by chi-square test.

Second, logistic regression analysis was used to calculate unadjusted and mutually adjusted odds ratios (ORs) and their 95% confidence intervals (CIs) for the independent variables for each country separately. Third, unadjusted and mutually adjusted ORs for age, sex, living area and the parents' level of education were calculated for children's use of dental services in each Nordic country using the year 1984 as a reference (OR = 1.00).

RESULTS

The prevalence of children's utilisation of dental services in 1984 varied from 60% in Denmark to 34% in Finland (table 1). The corresponding figures in 1996 were 42% in Iceland and 30% in Denmark. A clear change over time towards decreasing utilisation of dental services ($p<0.05$) was found in all countries except Finland, where the use of dental services by children increased significantly ($p<0.05$) between 1984 and 1996.

In addition to age of the child, living area and parents' education had some effects on utilisation of dental services in the five countries (tables 2–6). Unadjusted models in 1996 showed that children in families with the lowest education in Finland (OR = 1.41; 95% CI 1.02 to 1.95) and Norway (OR = 1.44; 1.02 to 2.06) used dental services more frequently than those in families with higher education. Mutual adjustment simultaneously for all independent variables did not have any major effects on the results. In a couple of cases categories of variables lost their statistical significance compared with the reference, but the direction of the associations remained.

Table 1 Utilisation of dental services (%) among children in the Nordic countries in 1984 and 1996 by age, sex, living area and family's highest level of education

	Sweden		Iceland		Norway		Finland		Denmark	
	1984	1996	1984	1996	1984	1996	1984	1996	1984	1996†
Age (years)										
2–6	36*	27	41	41	35	30	25	29	49*	22
7–12	53*	42	61*	44	58*	44	41*	50	67*	36
13–17	55*	45	50*	40	55*	44	35	37	63*	33
	**	**	**		**	**	**	**	**	**
Sex										
Boys	47*	40	49*	41	49	39	32*	41	59*	30
Girls	50*	36	52*	43	50	41	35	39	61*	30
Living area										
City	50*	38	49*	42	50*	38	34	37	59*	31
Town	45*	37	53*	42	48*	40	33*	43	55*	31
Rural area	50*	39	48	42	51*	41	33*	38	66*	29
									**	
Education										
University/ college	43*	37	48	43	47*	39	33	37	58*	28
Upper secondary	53*	39	52*	40	48*	37	32*	39	55*	32
Lower secondary	51*	37	50*	41	50	43	33*	41	56*	32
Primary school	49*	39	50	41	53	48	35*	45	66*	35
	*								**	
Total	48*	38	50*	42	50*	40	34*	40	60*	30
N	1759	2124	1409	1995	1647	1722	2690	1872	2007	2050

Note: Statistically significant differences in each category, *$p<0.05$, **$p<0.001$ between 1984 and 1996, and between variable categories.
†Use of dentist services only was available.

Table 2 Utilisation of dental services among children in Sweden in 1984 and 1996 by age, sex, living area and family's highest level of education. Logistic regression analysis. Unadjusted and mutually adjusted odds ratios (ORs) for the other variables and their 95% confidence intervals (CIs)

	1984, OR (95% CI)		1996, OR (95% CI)	
Variable	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Age (years)				
2–6	1.00	1.00	1.00	1.00
7–12	2.02 (1.61 to 2.54)	2.03 (1.61 to 2.56)	1.99 (1.60 to 2.47)	2.04 (1.63 to 2.56)
13–17	2.18 (1.71 to 2.78)	2.14 (1.67 to 2.74)	2.25 (1.79 to 2.83)	2.32 (1.82 to 2.97)
Sex				
Boys	1.00	1.00	1.00	1.00
Girls	1.15 (0.95 to 1.38)	1.17 (0.97 to 1.42)	0.85 (0.71 to 1.01)	0.82 (0.68 to 0.98)
Living area				
City	1.00	1.00	1.00	1.00
Town	0.82 (0.65 to 1.04)	0.80 (0.63 to 1.01)	0.95 (0.77 to 1.18)	0.89 (0.71 to 1.12)
Rural area	1.00 (0.79 to 1.28)	0.99 (0.78 to 1.27)	1.02 (0.82 to 1.28)	0.95 (0.74 to 1.21)
Education				
University/college	1.00	1.00	1.00	1.00
Upper secondary	1.49 (1.00 to 2.02)	1.54 (1.13 to 2.10)	1.11 (0.86 to 1.42)	1.11 (0.86 to 1.43)
Lower secondary	1.40 (1.10 to 1.78)	1.44 (1.12 to 1.84)	1.00 (0.79 to 1.25)	1.00 (0.79 to 1.27)
Primary school	1.32 (1.03 to 1.70)	1.20 (0.92 to 1.56)	1.09 (0.81 to 1.48)	0.99 (0.73 to 1.34)

Table 3 Utilisation of dental services among children in Iceland in 1984 and 1996 by age, sex, living area, and family's highest level of education. Logistic regression analysis. Unadjusted and mutually adjusted odds ratios (ORs) for the other variables and their 95% confidence intervals (CIs)

	1984, OR (95% CI)		1996, OR (95% CI)	
Variable	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Age (years)				
2–6	1.00	1.00	1.00	1.00
7–12	2.24 (1.76 to 2.84)	2.18 (1.71 to 2.77)	1.13 (0.91 to 1.39)	1.11 (0.89 to 1.38)
13–17 years	1.47 (1.11 to 1.94)	1.48 (1.11 to 1.97)	0.94 (0.75 to 1.18)	0.90 (0.71 to 1.15)
Sex				
Boys	1.00	1.00	1.00	1.00
Girls	1.11 (0.90 to 1.37)	1.10 (0.89 to 1.36)	1.08 (0.91 to 1.30)	1.07 (0.89 to 1.29)
Living area				
City	1.00	1.00	1.00	1.00
Town	1.14 (0.90 to 1.44)	1.13 (0.89 to 1.44)	1.00 (0.77 to 1.29)	1.02 (0.78 to 1.33)
Rural area	0.95 (0.71 to 1.27)	0.97 (0.72 to 1.31)	1.00 (0.81 to 1.23)	1.02 (0.81 to 1.29)
Education				
University/college	1.00	1.00	1.00	1.00
Upper secondary	1.17 (0.88 to 1.55)	1.08 (0.81 to 1.44)	0.89 (0.71 to 1.11)	0.89 (0.71 to 1.12)
Lower secondary	1.09 (0.82 to 1.45)	1.02 (0.76 to 1.37)	0.94 (0.72 to 1.24)	0.95 (0.71 to 1.26)
Primary school	1.10 (0.74 to 1.63)	0.98 (0.64 to 1.48)	0.92 (0.66 to 1.28)	0.91 (0.65 to 1.29)

Table 4 Utilisation of dental services among children in Norway in 1984 and 1996 by age, sex, living area, and family's highest level of education. Logistic regression analysis. Unadjusted and mutually adjusted odds ratios (OR) for the other variables and their 95% confidence intervals (CI)

	1984, OR (95% CI)		1996, OR (95% CI)	
Variable	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Age (years)				
2–6	1.00	1.00	1.00	1.00
7–12	2.49 (1.96 to 3.16)	2.49 (1.96 to 3.16)	1.86 (1.45 to 2.38)	1.84 (1.42 to 2.39)
13–17	2.28 (1.77 to 2.93)	2.26 (1.75 to 2.92)	1.86 (1.44 to 2.41)	1.93 (1.47 to 2.55)
Sex				
Boys	1.00	1.00	1.00	1.00
Girls	1.02 (0.84 to 1.23)	1.01 (0.83 to 1.24)	1.06 (0.87 to 1.28)	0.92 (0.74 to 1.14)
Living area				
City	1.00	1.00	1.00	1.00
Town	0.93 (0.72 to 1.21)	0.90 (0.69 to 1.18)	1.11 (0.86 to 1.41)	1.07 (0.82 to 1.40)
Rural area	1.08 (0.84 to 1.39)	1.07 (0.82 to 1.40)	1.16 (0.89 to 1.51)	1.07 (0.79 to 1.44)
Education				
University/college	1.00	1.00	1.00	1.00
Upper secondary	1.02 (0.74 to 1.40)	1.05 (0.76 to 1.46)	0.91 (0.71 to 1.17)	0.98 (0.74 to 1.29)
Lower secondary	1.11 (0.85 to 1.44)	1.01 (0.77 to 1.32)	1.16 (0.88 to 1.52)	1.10 (0.82 to 1.48)
Primary school	1.24 (0.95 to 1.61)	1.10 (0.84 to 1.45)	1.44 (1.02 to 2.06)	1.45 (0.99 to 2.13)

Table 5 Utilisation of dental services among children in Finland in 1984 and 1996 by age, sex, living area, and family's highest level of education. Logistic regression analysis. Unadjusted and mutually adjusted odds ratios (ORs) for the other variables and their 95% confidence intervals (CIs)

	1984, OR (95% CI)		1996, OR (95% CI)	
Variable	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Age (years)				
2–6	1.00	1.00	1.00	1.00
7–12	2.05 (1.69 to 2.50)	2.09 (1.71 to 2.55)	2.50 (1.98 to 3.17)	2.66 (2.08 to 3.41)
13–17	1.57 (1.28 to 1.92)	1.58 (1.28 to 1.95)	1.49 (1.16 to 1.91)	1.48 (1.12 to 1.94)
Sex				
Boys	1.00	1.00	1.00	1.00
Girls	1.12 (0.95 to 1.31)	1.10 (0.94 to 1.30)	0.91 (0.76 to 1.10)	0.90 (0.74 to 1.10)
Living area				
City	1.00	1.00	1.00	1.00
Town	0.96 (0.79 to 1.17)	0.94 (0.77 to 1.15)	1.27 (1.00 to 1.60)	1.22 (0.95 to 1.57)
Rural area	0.92 (0.76 to 1.12)	0.92 (0.75 to 1.11)	1.05 (0.82 to 1.36)	0.99 (0.75 to 1.30)
Education				
University/college	1.00	1.00	1.00	1.00
Upper secondary	0.96 (0.74 to 1.25)	0.96 (0.73 to 1.25)	1.10 (0.84 to 1.44)	1.11 (0.84 to 1.46)
Lower secondary	1.00 (0.76 to 1.32)	0.99 (0.75 to 1.30)	1.20 (0.89 to 1.62)	1.16 (0.84 to 1.59)
Primary school	1.06 (0.82 to 1.37)	0.99 (0.76 to 1.29)	1.41 (1.02 to 1.95)	1.33 (0.95 to 1.87)

Table 6 Utilisation of dental services† among children in Denmark in 1984 and 1996† by age, sex, living area, and family's highest level of education. Logistic regression analysis. Unadjusted and mutually adjusted odds ratios (ORs) for the other variables and their 95% confidence intervals (CIs)

	1984, OR (95% CI)		1996, OR (95% CI)	
Variable	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Age (years)				
2–6	1.00	1.00	1.00	1.00
7–12	2.11 (1.70 to 2.61)	2.06 (1.67 to 2.56)	1.99 (1.57 to 2.51)	1.86 (1.43 to 2.37)
13–17	1.75 (1.39 to 2.20)	1.74 (1.37 to 2.20)	1.74 (1.36 to 2.23)	1.63 (1.25 to 2.20)
Sex				
Boys	1.00	1.00	1.00	1.00
Girls	1.07 (0.89 to 1.27)	1.05 (0.88 to 1.26)	1.00 (0.83 to 1.21)	1.03 (0.85 to 1.26)
Living area				
City	1.00	1.00	1.00	1.00
Town	0.85 (0.68 to 1.06)	0.83 (0.66 to 1.04)	1.01 (0.79 to 1.30)	0.95 (0.73 to 1.24)
Rural area	1.35 (1.09 to 1.68)	1.33 (1.07 to 1.67)	0.92 (0.72 to 1.19)	0.92 (0.70 to 1.20)
Education				
University/college	1.00	1.00	1.00	1.00
Upper secondary	0.88 (0.59 to 1.29)	0.87 (0.59 to 1.29)	1.23 (0.95 to 1.57)	1.21 (0.94 to 1.56)
Lower secondary	0.94 (0.72 to 1.24)	0.92 (0.70 to 1.21)	1.23 (0.95 to 1.59)	1.20 (0.92 to 1.55)
Primary school	1.42 (1.07 to 1.89)	1.24 (0.93 to 1.67)	1.40 (0.89 to 2.22)	1.33 (0.83 to 2.13)

†Use of dentist services only was analysed.

Table 7 Differences in utilisation of dental services among children in 1984 and 1996 by country. Logistic regression analysis. Odds ratios (ORs) and their 95% confidence intervals (CIs) unadjusted and adjusted for age, sex, living area and family's highest level of education. The year 1984 was used as a reference (=1.00)

	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Sweden 1984	1.00	1.00
Sweden 1996	0.66 (0.58 to 0.75)	0.67 (0.58 to 0.76)
Iceland 1984	1.00	1.00
Iceland 1996	0.71 (0.62 to 0.81)	0.69 (0.59 to 0.79)
Norway 1984	1.00	1.00
Norway 1996	0.68 (0.59 to 0.78)	0.69 (0.59 to 0.81)
Finland 1984	1.00	1.00
Finland 1996	1.32 (1.16 to 1.48)	1.34 (1.18 to 1.53)
Denmark 1984	1.00	1.00
Denmark 1996†	0.29 (0.26 to 0.33)	0.31 (0.27 to 0.37)

†Use of dentist services only was available.

Unadjusted odds ratios for changes over time (1984 = 1.00) varied from 0.71 (0.62 to 0.81) in Iceland to 0.29 (0.26 to 0.33) in Denmark (table 7). The corresponding figure in Finland was 1.32 (1.16 to 1.48). Adjusting mutually for the independent variables did not have any major effects on the results.

DISCUSSION

The main finding of our study was a marked decrease in the use of dental services by children between 1984 and 1996 in all Nordic countries except Finland. This finding is in contrast to a recent report of increased use of general practitioner services in the Nordic countries during the same time period.[8] As very few comparative studies have been reported previously, further research is needed to confirm these findings. This study contributes to the existing literature on dental services usage in at least three respects. It uses comprehensive international data that are highly representative of children aged 2–17 years in the populations of the five relatively homogeneous Nordic welfare states. In addition, it offers a unique opportunity to

examine changes over time in children's use of dental services from the mid-1980s to the mid-1990s in these countries. Finally, it sets a statistically sound benchmark for determining and assessing future trends.

Although wide variation in oral health care provision systems between the EU member states has been found, the existence of a Nordic model has been widely recognised.[7] Typical features of this Nordic model are a significant level of public funding, a large number of dentists working for the public health service, free dental care for children and widespread use of dental auxiliaries.[9] In Denmark, Finland, Norway and Sweden the community-based Public Dental Service employs 23–56% of all dentists and provides free dental care for all children under the age of 19 years.[19] Iceland lacks such a service. Recently, the availability of community-based and publicly subsidised oral health care has been extended to cover wider groups of the total population in Finland and Sweden, and to a lesser extent in Denmark.[19]

Overall, the dentist to population ratio is very high in the Nordic countries. In particular, regarding dental care of those under 19 years, the systems in these countries are very similar. Between 80% and 95% of children are seen by a dentist or a dental hygienist every year.[7] The results of this study are based on service utilisation data obtained during the 3-month period prior to the survey. Although they are not directly comparable to the national figures, which are based on annual utilisation figures, they nevertheless confirm the high utilisation rates. For decades, all the Nordic countries have placed great emphasis on national programmes and their focus has been on preventative work, especially for children and adolescents.[20] A wide variety of preventative measures, e.g. dietary counselling, oral hygiene programmes and various forms of fluorides and sealants have been applied extensively.[21]

However, lifestyles, dietary habits and dental health behaviours are affected by cultural and social factors.[10] Socioeconomic status, family income and parents' education, for instance, have been shown to be associated with the dental health of children and adolescents.[22–25] In this study, children from families with the lowest education level in Finland and Norway used dental services more frequently in the 1990s than did children from families with a higher level of education.

Tooth brushing is the main preventative method and universally the recommended frequency is twice a day. The Nordic countries have relatively high numbers of oral hygienists and clinical auxiliaries.[9] Their roles vary, but their contribution to preventative dental care has been well recognised. This might have played a significant role in facilitation of good oral hygiene habits in the Nordic countries, as tooth brushing frequencies have been found to be high in Denmark, Norway and Sweden.[26] On the other hand, tooth brushing frequencies in Finland have been reported to be among the lowest in Europe. However, during the time period studied here, there seemed to be no relationship between poor oral hygiene habits and caries status in Finland.[27]

The utilisation of dental services in 1996 was lowest in Denmark, partly because services by dental nurses were not available that year, thus lowering the figure somewhat. However, the change in Denmark was otherwise similar to that observed in the other Scandinavian countries.

The most likely explanation for the decrease in the use of dental services in four of the five Nordic countries is the clear reduction in the prevalence of dental caries over the period, as reported by the national officials, particularly in the young age groups.[27–31] Because of this decrease, which is attributable mainly to extensive preventative programmes, but also economic reasons, the intervals between check-ups have been extended. Although recall has been shown to be an important factor influencing care seeking among adults in the Nordic countries, there is little scientific evidence to help determine appropriate individual check-up intervals.[32–34] However, the National Institute for Clinical Effectiveness in the UK recommends that the shortest check-up interval for all patients should be 3 months and the longest interval should be 12 months for those under 18 years and 24 months for older patients.[34] Public subvention alone has not been found to strongly affect dental service utilisation and thus the implementation of appropriate check-up intervals will be crucial for the quality of dental health care, especially among young people, in the future. This practice however, was adopted later in Finland than in many other countries, which might partly explain the different trend observed in Finland.[35]

The severe economic recession in the early 1990s in Finland might have had an effect on the use of dental services by the adult population, but this should not have affected the use of preventative dental services by young people, as these were still being provided free of charge. Additionally, health policy changes in dental care, decentralisation, state subsidy reforms, termination of fluoridation programmes and a focus on individual preventative care at the dental surgeries took place at this time.

In contrast to children's increased use of general practitioner services, their use of dental services significantly decreased in four of the five Nordic countries between the 1980s and the 1990s.[8] The marked decrease in dental caries and an economic recession, together with increased use of individual recall intervals, probably contributed to this change. More comparative studies on dental health services in the future are recommended along the lines of the WHO goals and recommendations for year 2020 for oral health care services.[25] The findings of this study form the basis of a follow-up study of the trends in this aspect of dentistry.

What this paper adds

Although children are frequent users of health services, systematic evidence on their use of these services is sparse. In particular, there is a dearth of studies examining changes in children's health care utilisation over time. An increase in the use of general practitioner services for children has taken place since the 1980s in the Nordic countries, but little is known about the use of dental services during this time.

In contrast to children's increased use of general practitioner services, a clear change over time towards decreasing utilisation of dental services was found in all Nordic countries except Finland. Marked decreases in the prevalence of dental caries and an economic recession, together with increased use of individual recall intervals, probably contributed to this trend. Research in dental health services use in the future is recommended along the lines of the WHO goals and recommendations for year 2020.

Authors' affiliations

Jorma I Virtanen, Heikki Murtomaa, Institute of Dentistry, University of Helsinki, Helsinki, Finland
Jorma I Virtanen, Lennart Köhler, Nordic School of Public Health, Gothenburg, Sweden
Leeni T Berntsson, Institute of Health and Care Sciences, University of Gothenburg, Gothenburg, Sweden
Eero Lahelma, Department of Public Health, University of Helsinki, Helsinki, Finland

Competing interests: None.

Ethics approval: The national ethics committees approved the study in each country. The parents and children were informed of the aims of the study in a letter accompanying the questionnaire. They were informed of their right to refuse to participate in the study and that the data processing and presentation would be anonymous.

REFERENCES

1 **Kautto M**, Heikkilä M, Hvinden B, *et al*, eds. *Nordic social policy*. London: Routledge, 1999.
2 **Kautto M**, Fritzell J, Hvinden B, *et al*, eds. *Nordic welfare states in the European context*. London: Routledge, 2001.
3 **Kristiansen IS**, Pedersen KM. Health care systems in the Nordic countries – more similarities than differences? *Tidskr Nor Laegeforen* 2000;**120**:2023–9.
4 **Rostgaard T**, Lehto J. Health and social care systems: how different is the Nordic model? In: Kautto M, Fritzell J, Hvinden B, *et al*, eds. *Nordic welfare states in the European context*. London: Routledge, 2001:137–67.
5 **Wendt LK**. Dental health – a dramatic improvement. In: Norvenius G, Köhler L, Johansson J, *et al*, eds. *Protection, prevention, promotion.Development and future of child health services*. Gothenburg: Nordic School of Public Health, 2001:201–8.
6 **Anderson R**, Treasure ET, Whitehouse NH. Oral health systems in Europe. Part I: Finance and entitlement to care. *Community Dent Health* 1998;**15**:145–9.
7 **Widström E**, Eaton KA. Oral heath care systems in the extended European Union. *Oral Health Prev Dent* 2004;**2**:155–94.
8 **Virtanen JI**, Berntsson LT, Lahelma E, *et al*. Children's use of GP services in the five Nordic countries. *J Epidemiol Community Health* 2006;**60**:162–7.
9 **Widstöm E**, Eaton KA. *Systems for the provision of oral health care, workforce and costs in the EU and EEA*, A Council of European Chief Dental Officers' Survey. Saarijärvi: STAKES, 1999.
10 **Petersen PE**. Priorities for research for oral health in the 21st Century – the approach of the WHO Global Oral Health Programme. *Community Dent Health* 2005;**22**:71–4.
11 **Marthaler TM**, O'Mullane DM, Vrbic V. The prevalence of dental caries in Europe 1990–1995. *Caries Res* 1996;**30**:237–55.
12 **Virtanen JI**. Changes and trends in attack distributions and progression of dental caries in three age cohorts in Finland. *J Epidemiol Biostat* 2001;**6**:325–9.
13 **Poulsen S**, Scheutz F. Dental caries in Danish children and adolescents 1988–1997. *Community Dent Health* 1999;**16**:166–70.
14 **Haugejorden O**, Birkeland JM. Evidence for reversal of the caries decline among Norwegian children. *Int J Paed Dent* 2002;**12**:306–15.
15 **Berntsson L**. *Health and well-being of children in the five Nordic countries in 1984 and 1996* [dissertation]. Gothenburg: The Nordic School of Public Health, 2000.
16 **Halldórsson M**, Kunst AE, Köhler L, *et al*. Socioeconomic differences in children's use of physician services in the Nordic countries. *J Epidemiol Community Health* 2002;**56**:200–4.
17 **Köhler L**. Children with and without disabilities in the Nordic countries. A Nordic project. *Scand J Soc Med* 1993;**3**:146–9.
18 **Reinhardt Pedersen C**. *Parents' labour market participation and children's health and well-being – in the five Nordic countries in 1996 and the changes from 1984 to 1996* [dissertation]. Copenhagen: National Institute of Public Health, 2004.
19 **Widström E**, Ekman A, Aandahl LS, *et al*. Developments in oral health policy in the Nordic countries since 1990. *Oral Health Prev Dent* 2005;**3**:225–35.
20 **Wang NJ**, Källestål C, Petersen PE, *et al*. Caries preventive services for children and adolescents in Denmark, Iceland, Norway and Sweden: strategies and resource allocation. *Community Dent Oral Epidemiol* 1998;**26**:263–71.
21 **Källestål C**, Wang NJ, Petersen PE, *et al*. Caries-preventive methods used for children and adolescents in Denmark, Iceland, Norway and Sweden. *Community Dent Oral Epidemiol* 1999;**27**:144–51.
22 **Bolin AK**. Children's dental health in Europe. An epidemiological investigation of 5- and 12-year-old children from eight EU countries. *Swed Dent J* 1997;**122**(Suppl.):1–88.
23 **Åstrøm AN**, Samdal O. Time trends in oral health behaviors among Norwegian adolescents: 1985–97. *Acta Odontol Scand* 2001;**59**:193–200.
24 **Lalloo R**, Myburgh NG, Hobdell MH. Dental caries, socio-economic development and national oral health policies. *Int Dent J* 1999;**49**:196–202.
25 **World Health Organization**. *The world oral health report 2003*. Geneva: World Health Organization, 2003.
26 **Kuusela S**, Honkala E, Kannas L, *et al*. Oral hygiene habits of 11-year-old schoolchildren in 22 European countries and Canada in 1993/1994. *J Dent Res* 1997;**76**:1–9.
27 **Nordblad A**, Suominen-Taipale L, Rasilainen J, *et al*. *Oral health care at health centres from the 1970s to the year 2000*, Report 278. Helsinki: Stakes, 2004.
28 **Socialstyrelsen**. *Public health report 2001*. Stockholm: Socialstyrelsen, 2001.
29 **Helsedirektoratet/Statens helsetilsyn**. *Tandhelsetjenesten i Norge. Årsmelding 1985–2000*. Oslo: Helsedirektoratet/Statens helsetilsyn, 1986–2000.
30 **Sundhedsstyrelsen**. *Report on dental health of children and adolescents*. Copenhagen: Sundhedsstyrelsen, 1999.
31 **Einarsdottir KG**, Bratthall D. Restoring oral health. On the rise and fall of dental caries in Iceland. *Eur J Oral Sci* 1996;**104**:459–69.
32 **Nguyen L**, Häkkinen U, Rosenqvist G. Determinants of dental service utilization among adults – the case of Finland. *Health Care Management Science* 2005;**8**:335–45.
33 **Davenport C**, Elley K, Salas C, *et al*. The clinical effectiveness and cost-effectiveness of routine dental checks: a systematic review and economic evaluation. *Health Technol Assess* 2003;**7**:1–127.
34 **National Institute of Clinical Effectiveness (NICE)**. *Dental recall: recall interval between routine dental examinations. Evidence, methods & guidance*, www.nice.org.uk.
35 **Lahti SM**, Hausen HW, Widström E, *et al*. Intervals for oral health examinations among Finnish children and adolescents: recommendations for the future. *Int Dent J* 2001;**51**:57–61.