Heavy use of dental services among Finnish children and adolescents

A. NIHTILÄ, E. WIDSTRÖM*

**Abstract.** Aim Our aim was to identify the heavy use of dental services among children and adolescents in the Public Dental Service (PDS) of one of the biggest cities in Finland, and compare oral health and treatments provided for heavy and low users. Methods All patients under 18 years of age having had 6 or more dental visits (n=2,285) in 2004 and a comparison group of those having had 3 or fewer visits (n=27,957) were selected from the patient register of the PDS of the city of Espoo. A sample of 245 patients was randomly selected from each group and information on age, sex, dental status, number and types of visits and treatments provided was collected from their treatment records. Results Seven percent of the children and adolescents who had visited the PDS in 2004 were heavy users according to the definition used. Their visits accounted for 26.3% of all dental visits of children and adolescents. The heavy users were classified as basic care heavy users and orthodontic heavy users. The mean treatment time for the basic care heavy users was 3 hours and 50 minutes, and for orthodontic heavy users 3 hours and 23 minutes; it was 40 minutes for the low users. Heavy users were on average 1.8 years older than low users. The basic care heavy users had more treated and untreated caries (mean DMFT/dmft=4.0 and D/d=2.4) than the low users (DMFT/dmft=0.95 and D/d=0.4). Of the low users, 43.6% had a healthy periodontium (CP=0) compared with 27.4% of the basic care heavy users and with 30.8% of the orthodontic heavy users. The most frequently provided treatments for heavy users were orthodontic care and fillings by dentists and for low users preventive measures and examinations. Most of the heavy users (66.4%) received less complicated orthodontic treatment given by a dentist compared with only 7.9% of the low users. Despite the low users’ significantly better oral status compared with basic care heavy users there were only minor differences in the type of preventive measures provided for the two groups. The orthodontic heavy users received fewer preventive measures than low users. Conclusion Our study revealed two main reasons for heavy use of dental services: high numbers of orthodontic treatments provided by dentists and high numbers of decayed teeth in a small number of children. To increase productivity, orthodontic care should be provided more efficiently and preventive care needs to be targeted more carefully.

Key words: Heavy consumption of oral health services; Children; Adolescents; Prevention; Orthodontic treatment.

**Introduction**

In the Nordic countries (Denmark, Finland, Norway and Sweden) a Public Dental Service (PDS) run by local municipalities or counties and financed by tax revenues provides oral health care for children and adolescents [Widström and Eaton, 2004]. In Finland, all children and adolescents under 18 years of age are offered regular dental examinations, preventive and necessary restorative and orthodontic treatment free of charge. Among schoolchildren, participation in these services is very high and few children (about 1%) use private services.

In 2001-2002 the dental care provision system was reformed and earlier age limits restricting adults’ use of the PDS were abolished [Niiranen et al., 2008]. All adults became eligible to use the PDS. The increased demand and need for care by the increasingly dentate adult and elderly population generated pressures to review the treatment routines for young people in the PDS, especially in bigger cities where previously little care had been offered for adults [Widström, 2006].

Espoo, close to Helsinki and with 227,500 inhabitants in 2004, is the second largest city in Finland. Of the population, 24.3% was under 18 years of age; of these 61.2% had visited the PDS in 2004. The dental workforce in the PDS of Espoo consisted of 82 dentists, 13 specialists, 36 dental hygienists, and 139 dental assistants giving a dentist to population ratio of 1:2363, somewhat higher than the national average (1:2539). Despite the relatively high workforce numbers and good supply of private services for adults in the capital region, the PDS of Espoo was not able to respond to the increased demand of oral health care by the adult population after the dental care reform. Thus, there was a great need to allocate the PDS’ resources more efficiently and according to population treatment needs.
Our aim was to identify heavy users among children and adolescents in the city of Espoo and to compare their oral health status and treatments with that of the low users in order to rationalise care provision in the PDS.

Oral health services in the city of Espoo follow a locally designed oral health programme for children and adolescents. Teamwork provided by dentists, dental hygienists and dental assistants is a central component of the programme. Parents are recommended to make a first appointment with a PDS dental hygienist when their child is one year old to receive oral health information. Later the children are screened by dental hygienists when they are 3 and 5-years old. At these visits parents are given further information on prevention of oral diseases. In case the hygienists notice oral disease or marked deviation in occlusion, the child is referred to a dentist. The oral health programme requires that all 8, 12 and 15-year olds living in Espoo are to be examined by a dentist. In between these examinations, those children with high risk of oral diseases are to see a dental hygienist. Approximately 70% of the 8 and 12-year-olds and 55% of the 15-year olds were examined by dentists in 2004.

An initial screening for orthodontic treatment is done by a dentist but final diagnosis and a decision to offer the child free orthodontic care in the PDS is made by a specialist in orthodontics. As there are few orthodontists in the PDS of Espoo (1 orthodontist/11000 children aged 0-17-years) general practitioners treat lateral and anterior crossbites, single tooth scissor-bites and open bites caused by sucking habits in primary and early mixed dentition. The orthodontists treat the more complex cases.

Material and methods

Those children and adolescents who had received 6 or more dental visits in 2004 were defined as heavy consumers of dental services. Low consumers were those who had received 3 or fewer visits during that year. In the first stage, all patients under 18 years of age having had 6 or more dental visits (n=2,285) and a comparison group of those having had 3 or fewer visits (n=27,957) were identified in the patient register of the Espoo PDS. A sample of 245 patients was randomly drawn from each group. Research permission was granted by the city administration, the legal owner of the patient register. In the next step information on age, sex, dental status, numbers and types of visits and treatments provided to these patients in 2004 was collected from the records. All visits to dentists and hygienists were included but visits to specialists (orthodontics) were omitted. Information on the duration of each visit and whether or not the treatment course had been completed was also recorded. The necessary information was available for 240 heavy users and 226 low users. All heavy users having had orthodontic treatment were classified as orthodontic heavy users (n=120) and the other heavy users as basic care heavy users (n=80).

The d, D, dmft and DMFT -indexes were used to describe the caries experience, and the Community Periodontal Index (CPI) [Ainamo et al., 1982] to describe the periodontal status. A child/adolescent was defined to be caries-free when the deciduous/permanent teeth had no active caries (dt/DT = 0). A tooth was defined as decayed (d/D) when in presence of caries needing restorative care. The Significant Caries Index (SiC) was used to illustrate the high caries experience group [Bratthall, 2000]. The periodontal status of children and adolescents was assessed by the CPI index codes:
- 0 healthy gingivae,
- 1 gingival bleeding,
- 2 gingival bleeding and calculus,
- 3 shallow periodontal pocket (4-5mm),
- 4 deep periodontal pocket (≥6 mm).

The sextant with the highest CPI score was noted. Statistical significance of differences between groups was evaluated by means of the $\chi^2$ and the t-tests.

Results

Use of dental services

Seven percent of the subject under 18 years (n = 2,285) who had visited the PDS in 2004 were heavy users, according to our definition. Their visits accounted for 26.3% of all dental visits by children and adolescents (specialist visits excluded). Heavy users were on average 1.8 years older than low users and most of them fell between 9 and 14-years old. Their number of visits and treatment time was 5 times higher compared to the low users. Orthodontic treatment accounted for the majority of the heavy users’ visits to a dentist. The highest number of visits in the heavy users group was 22. Most low users (63.6%) had made only one visit. There was no significant difference in the mean duration of the dental visits between the basic care heavy users and low users, but the total treatment time for all heavy users was considerably higher than for the low users (Table 1). Basic care heavy users had more visits to the dental hygienist than low users. Of the low users, 26.4% were between 1 and 5 years of age and 74.5% of these children had been screened by dental hygienists. Only 3.8% of the heavy users were under 5 years of age. Treatment courses had been completed by 68.5% of the heavy users and by 83.5 % of the low users (p< 0.001).

Oral health status

Most of the orthodontic heavy users and low users had no caries requiring restoration. However, only 36% of the basic care heavy users were caries free (Table 2). Almost 19% of the basic care heavy users had a high number of cavities (DT/dt=5 or more). The basic care heavy users had more caries experience (mean...
than the orthodontic heavy users (mean DMFT/dmft=0.98 and mean D/d=0.4) or low users (mean DMFT/dmft=0.95 and mean D/d=0.4). The SiC index for the basic care heavy users was 9.2 compared with 2.8 for the orthodontic heavy users and 3.1 for the low users. The periodontal status was recorded in 80.4% of heavy users and in 65.9% of low users. A significantly higher percentage of low users had healthy periodontium compared with orthodontic heavy users or basic care heavy users (p<0.05) (Fig. 1). Both heavy users groups had significantly more gingivitis than the low users (p=0.001).

Treatments provided
In the heavy users group the most frequently provided treatments were orthodontics (45.0%), fillings (18.6%), preventive measures (15.8%) and examinations (7.4%). In the low users group, the most frequent treatments were prevention (36.6%), examinations (24.3%), orthodontics (12.2%) and fillings (10.9%) (Fig. 2). Most heavy users (66.4%) received orthodontic treatment from a dentist compared with only 7.9% of the low users (p<0.001). Removable orthodontic appliances were worn by 21.7% of the heavy users, 20.9% had fixed appliances and 19.2% were treated with both, 4.6% mainly underwent control visits and had no appliances. Only 1 low user had fixed appliances, 3.9% had removable appliances and the rest (3.8%) had just control visits.

The heavy users received fillings for an average of 1.3 carious lesions per visit and the low users 1.1.

### Table 1 - Comparison of the basic care heavy users, the orthodontic heavy users and the low users of dental services among the 1-17 year olds in the PDS of Espoo with regard to sex, age, number of dental visits, treatment time, visits to a dental hygienist and proper examination provided in 2004.

<table>
<thead>
<tr>
<th></th>
<th>Heavy users n=240</th>
<th>Low users n=226</th>
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<tbody>
<tr>
<td>Sex: Girls %</td>
<td>42.0 NS</td>
<td>51.7</td>
</tr>
<tr>
<td></td>
<td>58.0 NS</td>
<td>48.3</td>
</tr>
<tr>
<td>Sex: Boys %</td>
<td></td>
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<tr>
<td>Mean age (years)</td>
<td>11.6 (SD 3.4)***</td>
<td>9.1 (SD 4.7)</td>
</tr>
<tr>
<td></td>
<td>10.6 (SD 3.0)***</td>
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<tr>
<td></td>
<td>8.9 (SD 2.6)**</td>
<td>1.5 (SD 0.8)</td>
</tr>
<tr>
<td></td>
<td>31.1 (18-68)</td>
<td>25.4 (5-60)</td>
</tr>
<tr>
<td></td>
<td>23.0 (13-54)*</td>
<td></td>
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<tr>
<td>Mean total treatment time (minutes)</td>
<td>230.0 (90-563)**</td>
<td>39.6 (5-120)</td>
</tr>
<tr>
<td></td>
<td>203.5 (90-500)**</td>
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<tr>
<td>Mean number of visits to dentist</td>
<td>6.0 (SD 2.3)**</td>
<td>1.2 (SD 0.9)</td>
</tr>
<tr>
<td>Mean number of visits to dental hygienist</td>
<td>1.2 (SD 1.9)**</td>
<td>0.3 (SD 0.7) NS</td>
</tr>
<tr>
<td>Mean number of orthodontic visits to general dentist</td>
<td>0***</td>
<td>6.9 (SD 2.7)** NS</td>
</tr>
<tr>
<td>Proportion of subjects examined (complete oral health status) % by a dentist or dental hygienist</td>
<td>92.6***</td>
<td>70.6 NS</td>
</tr>
<tr>
<td>Proportion of subjects having visited a dental hygienist %</td>
<td>39.5*</td>
<td>17.5 NS</td>
</tr>
</tbody>
</table>

### Table 2 - Distribution (%) of the heavy (n=197) and low users (n=164) of dental services among the 1-17 year olds in the PDS of Espoo (who had a complete dental status recorded in 2004) according to the number of decayed teeth.

<table>
<thead>
<tr>
<th>Number of dt+DT</th>
<th>Heavy users %</th>
<th>Low users %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basic care heavy users n=75</td>
<td>Orthodontic heavy users n =122</td>
</tr>
<tr>
<td>0</td>
<td>36.0***</td>
<td>73.8 NS</td>
</tr>
<tr>
<td>1</td>
<td>18.7 NS</td>
<td>16.4 NS</td>
</tr>
<tr>
<td>2</td>
<td>10.7 NS</td>
<td>6.6 NS</td>
</tr>
<tr>
<td>3-4</td>
<td>16.0***</td>
<td>1.6 NS</td>
</tr>
<tr>
<td>5-11</td>
<td>18.6***</td>
<td>1.6 NS</td>
</tr>
<tr>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

***P<0.001; *P<0.05; NS=P≥0.05
Among the heavy users, 24.2% of those with gingivitis (CPI=1) and 27.7% with gingival bleeding and calculus (CPI=2) had visited a dental hygienist, and among the low users 7.5% and 6.8% respectively. Oral hygiene instruction (brushing twice a day with fluoride toothpaste and use of dental floss) was the most common preventive measure for all groups followed by topical fluoride application (Fig. 3). Orthodontic heavy users received significantly less oral hygiene instruction, nutritional advice and other preventive treatment measures than basic care heavy users or low users (p<0.001). Of the basic care heavy users, 5.1% had received a topical fluoride application more than once during 2004. Fissure sealants were seldom applied, however more basic care heavy users received fissure sealants than low users (p<0.05). Motivation and home care instruction, nutritional advice and other preventive treatment measures (mainly chlorhexidine gel applications) were given more often to basic care heavy users than low users, but the differences were not statistically significant.

Discussion

The mean number of dental visits (specialist visits excluded) at the PDS of Espoo in 2004 for all patients less than 18 years of age was 2.14. We set the criterion for heavy consumption to 6 visits or more during a year to be sure to include only patients who had benefitted of substantial PDS resources. In the literature there is no consensus definition of heavy use of dental services. A study conducted in Finland in the '80s [Milen et al., 1988] used criteria for heavy consumption by different age groups ranging from 3 to 6 visits per year.

Due to the random sampling method used, our material can be considered to be representative of heavy and low users of dental services in Espoo.

The study showed that the oral health status of most children was relatively good. Espoo is one of the wealthiest cities in Finland where the average taxable income was EUR 29,900 compared with the national mean of EUR 21,020 [City of Espoo, Pocket Statistics, 2008]. By educational level, the population of Espoo is nation’s elite and these factors probably explain much of the good oral health of the children. The mean DMFT of 12 year olds was 1.1, less than the national average of 1.3, and 53% of the subjects of this age group had intact dentitions (DMFT=0).

It is clear from our study that the reason for high use of dental services was no longer the treatment of traditional dental disease but orthodontic treatment.
This data is in accordance with a previous study that reports the treatment provided in 9 Finnish PDS units in different parts of the country [Läärä et al., 2000] showing that orthodontics (32%), examinations (25%) and prevention (21%) accounted for the most frequently provided dental care type for 0-18 year olds.

It is obvious that a large amount of dentists’ treatment time was devoted to orthodontic procedures. There is a general consensus on the fact that free orthodontic treatment to all those in need of treatment should be provided by the PDS. The selection criteria for offering orthodontic treatment used in the PDS [Salmi and Heikinheimo, 1984] are intended to eliminate disparities in access to orthodontic care [Ministry of Social Affaires and Health, 2005]. Priority should be given to the most severe malocclusions and those with poor prognosis when left untreated. In Espoo, only the most difficult malocclusions have been treated in the PDS and only 9.9% of the children aged 6-17 years received active orthodontic treatment at the time this study was carried out. This figure is lower than the national average of 15.1% [Järvinen and Widström, 2007].

Children with minor malocclusions can easily get orthodontic treatment in the private sector of the capital region. In the '70s and '80s, when there were fewer orthodontists and when systematic and comprehensive oral health care of the children and adolescents was being developed, dentists treated children with less severe malocclusions under the supervision of an orthodontist. In the city of Espoo, 54% of all orthodontic treatment measures are still provided by dentists. Dental hygienists have shown to be effective in carrying out orthodontic auxiliary procedures [Mandall and Read, 1999] and they should be used more for this purpose in Finland, too; it is known that hygienists wish to participate more in orthodontic care in order to make use of their professional skills [Niiranen and Widström, 2005]. Orthodontic care provision could be made the responsibility of teams of orthodontists and dental hygienists, allowing dentists in the PDS to treat more adults and elderly.

In our study, the majority of children and adolescents in the low users group and in the orthodontic heavy users group were caries free. A small number of children in the basic care heavy users group had a lot of caries. Both basic care heavy users and orthodontic care heavy users had significantly more gingivitis than low users. Unexpectedly, the orthodontic heavy users received a lesser amount of oral hygiene instruction than the other groups, and low users and basic care heavy users were shown to receive rather similar preventive treatment measures, mostly topical fluoride applications and oral hygiene instructions, with little regard to the patients’ health status. Fissure sealants were seldom used and dietary advices were not frequently provided.

In the heavy users group, 40.8% of those who had fixed orthodontic appliances probably needed more individual oral hygiene instruction and preventive care, as fixed orthodontic appliances are a known risk factor for enamel demineralisation [Lovrov et al., 2007]. Earlier studies have shown [Varsio and Vehkalahdi, 1996; Varsio et al., 1999] that dentists do not consider the patient’s individual oral health when providing preventive interventions. It seems that preventive care remains inflexible and not in accordance with patients’ individual needs and risks of oral disease. This is alarming, and further researches on the efficiency of preventive measures has been done by Finnish researchers [Hausen, 2005; Hausen et al., 2007] and also in Sweden; the national technology assessment unit (SBU) has published reports on evidence-based preventive methods showing little evidence of the
usefulness of single topical fluoride applications on healthy individuals [SBU, 2002]. The preventive treatment practices currently used in Espoo need to be re-examined.

Most of the dentist’s time was used on relatively healthy children. The mean total treatment time for heavy users was almost 4 hours, but a number of children and adolescents had spent more than 9 hours in the dental chair in 2004. The mean treatment time for low users only was also high, 39.6 minutes. This was the same as the average time including orthodontics in children’s dental care in the PDS is Denmark [Thylstrup et al., 1997]. The relatively liberal use of treatment time probably dates from the days when the PDS was primarily responsible for children and wealthy cities had no lack of staff. Better planning and longer appointments for the heavy users would result in lower numbers of visits for individual patients. As the parents often accompany their children to dental clinics, elevated numbers of visits for the children entail more absence from work for the parents.

A dental hygienist’s contribution to care provision was mainly limited to screenings of the preschool children and some preventive treatment for older children. Only one youngster out of four with gingivitis or calculus among the heavy users had seen a dental hygienist. At a national level, hygienists’ treatments have become more common in the PDS (dental hygienists in Finland have a 3.5 years long bachelor-level education). In 1998, dental hygienists provided 20% of all treatments in children and adolescents, and in 2003 the percentage raise up to 26% [Suominen-Taipale and Widström, 2006]. Espoo lies below the national average in this respect and our study indicates a need for better task sharing between personnel categories to improve efficiency, especially as the cost of a dentist and a dental assistant working team is more than three times the cost of a dental hygienist. There is evidence from other countries [Riordan, 1997] that hygienists and appropriately trained dental therapists can be the primary dental care providers for children and adolescents.

Conclusion

As the Public Dental Service since 2002 is responsible for the dental care for the whole population, organising the service to use all staff’s competencies is of major importance. Our study showed that children’s and youngster’s treatments in Espoo could be organised more efficiently, thus reducing their heavy consumption of dental services.

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The amine fluoride of the elmex® formula promotes the superficial formation of a well-adhering calcium fluoride precipitate which protects the tooth enamel against acid attack. Thanks to this protective layer, levels of fluoride are provided to the surroundings, thus promoting the natural mechanism of remineralisation of initial caries lesions in the deciduous dentition.

Toothpastes with different fluoride concentrations (0, 250, 500 ppm fluoride) were tested in a four week, cross-over, in situ trial on 6 volunteers carrying appliances with demineralised enamel specimens from extracted milk teeth. The 500 ppm fluoride toothpaste (elmex® kids) exhibits the higher remineralisation effect of initial caries lesions in milk teeth.