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HEAVY USE OF ORAL HEALTH SERVICES

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ACADEMIC DISSERTATION

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LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following publications:

I **Nihtilä A**, Widström E. Heavy use of dental services among Finnish children and adolescents. *European Journal of Paediatric Dentistry* 2009; 10(1): 7-12.

II **Nihtilä A**, Widström E, Elonheimo O. Heavy consumption of dental services among Finnish adults. *Community Dental Health* 2010; 27: 227-232.

III **Nihtilä A**, Widström E, Elonheimo O. Heavy consumption of dental services; a longitudinal cohort study among Finnish adults. *BMC Oral Health* 2013, 13: 18.

IV **Nihtilä A**, Widström E, Elonheimo O. Finnish adult frequent and low users of dental services: treatment provided. Submitted.

The publications are referred to in the text by their roman numerals. Original publications are reprinted with the permission of their copyright holders. In addition, unpublished material is presented.

ABSTRACT

A reform to Dental Care legislation in 2002 abolished age limits restricting adults' use of public dental services in Finland. This Dental Reform aimed to increase equity by improving adults' access to care and reducing cost barriers. The adult population's increased demand for dental care put pressure on the Public Dental Service (PDS). The aim of this study was to compare heavy and low use of dental services in the PDS of Espoo in order to identify reasons for heavy use and to suggest improvements to care provision.

This study is based on register data. All patients who had visited the PDS of Espoo in 2004 were identified (n=63 850) from the patient register. These patients were divided into two groups: children and adolescents (1-17-years) and adults (≥ 18 years). Within each group, all patients who had made six or more dental visits to the PDS in 2004 were defined as heavy users of oral health services and all the patients who had had three or fewer visits as low users. A sample of 320 patients was randomly drawn from each adult group and a sample of 245 patients was randomly drawn from the children and adolescent groups. All adult heavy and low consumers of dental services identified in 2004, who had visited the PDS in Espoo during 2005-2009, were followed for five years. Information on age, sex, number and types of visits, oral health status and treatment provided was collected from treatment records. Seven per cent of the children and adolescents in 2004 could be classified as heavy users and the main reasons of heavy use were high numbers of orthodontic treatment occasions provided by dentists and high numbers of decayed teeth in a small number of children. For adults, 10% were heavy users. A need for complicated treatment, dentists' and dental hygienists' lack of experience of adult dental care and lack of specialist resulted in high numbers of visits for these patients. The adult heavy users were older and had lower social status than low users. Of these "baseline" adult heavy users 11% persisted as chronic frequent users during 2005-2009.

Typical for adult heavy use in the baseline and the follow-up study was a lack of proper examinations, poor quality of periodontal diagnosis, lack of preventive care,

and a cycle of repetitive repair or replacement of restorations, often as emergency treatment. Fixed prosthetic treatment was seldom used in the PDS of Espoo.

The PDS should seek to early identify possible heavy users and they should be offered a comprehensive approach to treatment and a responsible team of a dentist and dental hygienist. In order to manage adult dental health effectively, the PDS should encourage regular examinations, treatment plans and recall visits based on patients' oral health and risk factors.

ABBREVIATIONS

CI	Confidence Interval
CPI	Community Periodontal Index
DMFT	Number of Decayed, Missing, and Filled permanent Teeth
dmft	Number of decayed, missing, and filled teeth in primary dentition
DT	Decayed teeth
dt	Decayed teeth in primary dentition
ED	Emergency department
GP	General Practice
GPs	General Practitioners
KELA	The Social Insurance Institution of Finland
OR	Odds Ratio
PDS	Public Dental Service
SES	Socioeconomic status
SiC	Significant Caries Index
SPSS	Statistical Package for Social Sciences
WHO	World Health Organisation

1 INTRODUCTION

Health and oral health care provision systems are complex organizations constantly undergoing change and development. Modern health and oral health care systems reflect the values and priorities of the societies in which they are developed. Despite the differences in oral health care systems, all the industrialized countries face the same challenges (Widström and Eaton 2004). These include changing patterns of diseases, the socio-demographic change of the aging population and consumers' increasing demand and expectations for health and oral health care.

Even in industrialised countries, oral diseases, though highly preventable, represent a major public health problem marked by social inequality. By definition, a health system is equitable if the utilisation of health services is based on need, regardless of individual or social differences (Andersen and Newman 1973). In Finland, equity is highly valued and the Finnish law gives the same rights for all citizens, including access to health care services. Yet according to recent reports (Nguyen et al. 2005, Hosseinpoor et al. 2012, OECD 2012) inequality in health and oral healthcare coverage favouring the rich is apparent in Finland. In 2002, the Finnish Oral Health Care Reform legislation aimed to reduce inequity and increase balance in the care provision system. The underlying principle for this reform was that oral health care should be distributed primarily according to treatment needs and no longer by age group or having been a "former" patient.

Although frequent use of health services has been the subject for numerous studies, research on frequent use of oral health services and related factors is more limited. Yet the frequent use of oral health services consumes significant personnel resources and is costly both for the individual and the society. Frequent attenders consume a large portion of the available services when others may have to wait, especially in a publicly funded care provision system with limited resources. Further, heavy users run the risk of unnecessary or inadequately planned procedures leading to complications, excessive costs and lots of time spent in dental chair.

This thesis provides new insight into the quantity and reasons of heavy use of oral health services in the Finnish Public Dental service (PDS).

The primary research questions were (the) following:

- What are the demographic characteristics of heavy users of oral health services in the PDS?
- Why do these users make frequent visits?
- Do the frequent attenders benefit from their visits?

Heavy consumption of oral health services can be studied from the perspective of the individual patients, the care providers or the oral health care provision systems. This study is a register study and the main focus is organisational.

This study represents health services research. According to the American Agency for Healthcare Research and Quality (2002), health services research examines how people get access to health care, how much care costs, and what happens to patients as a result of this care. The main goals of health services research are to identify the most effective ways to organise, manage, finance, and deliver high quality care, reduce medical errors and improve patient safety.

A better understanding of the patterns of heavy use of oral health services can be used to evaluate performance of the oral health care provision system and to improve the oral health care provision system, thus facilitating and encouraging appropriate utilisation.

2 REVIEW OF THE LITERATURE

This literature review is divided into two sections: frequent use of health services and factors that affect the utilisation of oral health care services. As the literature on heavy use of oral health services is very limited, the phenomenon is generally explored through the literature on frequent use of health services.

2.1 Frequent use of health services

2.1.1 Definition and prevalence of frequent attenders in primary health care

There is no generally accepted definition for frequent use of health services. Vedsted and Christensen (2005) conducted a comprehensive literature review including 61 peer-reviewed articles. According to their review, when frequent attendance is defined as a proportion, the 10% of patients making the most visits have most often been defined as frequent attenders. These top 10% of visitors accounted for 30-50% of all contacts with doctors and up to 40% of frequent visitors were still frequent visitors the following year.

Several researchers have used the number of contacts to define heavy use and the threshold has ranged from two to 24 contacts during a period from 2 to 48 months. The most commonly used time period has been 12 months (Vedsted and Christensen 2005).

Two Finnish studies of frequent attenders in general practice have classified frequent users as persons who have made eight or more visits in a year (Larivaara 1987, Jyväskylä et al. 1998). In the first study in Kolari, northern Finland, the frequent attender patients represented 7.5% of the total population and accounted for 31.8% of all general practitioners' visits at the public health centre (Larivaara 1987). The second study was carried out in Oulainen, another rural town in northern Finland (Jyväskylä et al. 1998). The heavy attenders accounted for 4.7% of the population

aged 15 years or older and they made up 23.5% of all visits to general practitioners (GPs).

Only a small number of patients who made frequent GP consultations persist in doing so (Carney et al. 2001, Smits et al. 2009 a&b). A Dutch study looked at heavy users whose attendance was in the top 10% during a year (1-year frequent attenders) or during three years (the persistent frequent attenders). Among the 1-year frequent attenders, 15.4% became persistent frequent attenders, equating to 1.6% of all patients. These persistent heavy attenders were responsible for 8 % of all consultations (Smits et al. 2009a). In a UK study defining heavy users as having more than 12 consultations in one calendar year, approximately 1 in 3 new frequent users remained so the following year (Gill et al. 1998). According to a Swedish study, 14% of the frequent attenders (defined as having had at least 5 GP consultations during one year) were still in this category after five years (Andersson et al. 2004). Carney et al. (2001) looked at 58 frequent users with a matched control group in a retrospective 20-year follow-up study. The inclusion criterion for these frequent attenders was more than 12 visits in 1975. These patients were cross-matched with 58 patients of the same age and sex who had consulted for the same diagnosis three times or less. Of the 14 patients who attended on average over 12 times during a year throughout the follow-up period, 10 were originally frequent attenders and four low attenders. In Finland, Koskela studied long-term frequent attendance in his thesis (Koskela 2008). He followed 85 primary health care patients from Tampere City Health Centre for four years. A person who had made at least eight visits a year for at least three out of the four follow-up years was considered a long-term frequent consumer.

2.1.2 Morbidity and social and demographic conditions of frequent attenders in primary health care

There is some controversy about the morbidity of frequent users compared with controls. In one study, morbidity levels within different age groups in frequent visitors were reported to be similar to those of controls, but there was a higher consulting frequency and a significantly higher consumption of antibiotics (Bergh

and Marklund 2003). In most studies, the frequent attenders had a significantly larger burden of physical, mental and social impairments (Jyväsjarvi et al. 1998, Sun et al. 2003, Vedsted et al. 2004, Smits et al. 2009a) than controls. Vedsted and Christensen (2005) supported these findings and stated in their literature review that more than 50% of frequent attenders had a physical disease and more than 50% of frequent attenders suffered from psychological distress. Social factors, multiple problems, increasing age and female sex have been associated with frequent attendance (Vedsted and Christensen 2005). The results from the retrospective 20-year follow-up study of frequent users who initially attended more than 12 times in 1975 confirmed that frequent attenders were more likely to be elderly and female (Carney et al. 2001).

Among Finnish frequent users, somatic symptoms were predominant, and psychiatric and social factors played a distinctive role (Jyväsjarvi et al. 1998). These Finnish frequent attenders had also difficulties in forming a good patient-doctor relationship.

According to a thesis by Koskela, the most important risk factors for long term heavy users were being female, body mass index over 30, former frequent attendance, fear of death, abstinence, low patient satisfaction and irritable bowel syndrome (Koskela 2008). The associations of high BMI, abstinence from alcohol and irritable bowel syndrome with long-term frequent attendance were new findings in his study. He used the Bayesian method to model the frequent attenders in his study and argued that it could be used for identifying the frequent users but needs to be validated with different patient groups.

2.1.3 Frequent emergency department attenders

In a systematic review of the literature on frequent emergency department (ED) users, the definitions of frequent ED users varied from only two visits per year to as many as 12 visits per year (LaCalle and Rabin 2010). The threshold most commonly used to define frequent ED use has been four or more visits per year. When defined as four or more ED visits per year, frequent users accounted for 4.5% to 8.0% of all emergency department patients but contributed 21% to 28% of all ED visits. This

systematic review included studies from the United States from 1990 to 2010. The results were compared with studies from Canada, New Zealand, Taiwan, Sweden, Ireland and France.

According to LaCalle and Rabin (2010), the majority of the frequent emergency department users in the United States were white with bimodal age distribution. Patients aged 25 to 44 years and those older than 65 years had an increased risk of using ED (LaCalle and Rabin 2010). Frequent ED users were often sick patients with chronic illness and also reported subjectively poorer physical health than occasional users. It is therefore not surprising that frequent emergency department attenders often used also the other parts of the health care provision system (Hansagi et al. 2001, Byrne et al. 2003).

Attrition seems to be associated with frequent use of the emergency department; a frequent emergency department user who makes four or more visits in a given year has a probability of just 28% to 38% of being a frequent user the next year (Mandelberg et al. 2000). However there probably exists a smaller group of persistent ED frequent users.

Due to the complexity of the health problems of many emergency department frequent users, the goal should be to address the unique needs of these patients by a multidisciplinary approach (Ovens and Chan 2001, Sun et al. 2003). One important way of reducing ED utilisation would be to improve the coordination between the emergency department and the primary care service. Information sharing between ED and primary care was tested and found to be beneficial, although in a small subgroup of patients it did not decrease the overall use of health services (Hansagi et al. 2008).

2.1.4 Summary of the literature review on frequent use of health services

Although the diversity of definitions makes comparison between the studies on frequent attenders difficult, it is clear that much of general practitioners' work and emergency department work relates to transient and persistent frequent consumers. This is a major drain on health care resources. Transient frequent attendance is usually readily explicable but persistent frequent consumption may be difficult to explain and may often be related to medically unexplained physical symptoms (Smits et al. 2008).

Persistent heavy users increase GPs' workload and reduce their work satisfaction. Previous studies have used different synonyms for frequent user such as "heart sink patients" (O'Dowd 1988), "doctor shopper" (Demers 1995) and "problem patient" (Larivaara 1987), reflecting the frustration of general practitioners treating patients who never seem to be cured in spite of all the care.

There is general agreement that a comprehensive approach to treatment and a "management plan" are needed for frequent consumers. This plan should take into account biomedical, social and psychological elements of the patient, his/her life, and the family (Larivaara 1987). For a general practitioner getting to know the patient and family better seem to make them less "heart sink" (O'Dowd 1988). Also the information transfer between emergency departments and primary health care should be efficient.

Smits et al. (2008) see the persistent frequent consumption as the main problem. This research group from the Netherlands suggested that it would be logical in further research to focus mainly on social and psychiatric problems and medically unexplained physical symptoms of persistent frequent users, in order to try to improve their quality of life and to prevent the continuation of persistent frequent consulting behaviour (Smits et al. 2008).

2.2 Factors affecting the utilisation of oral health services

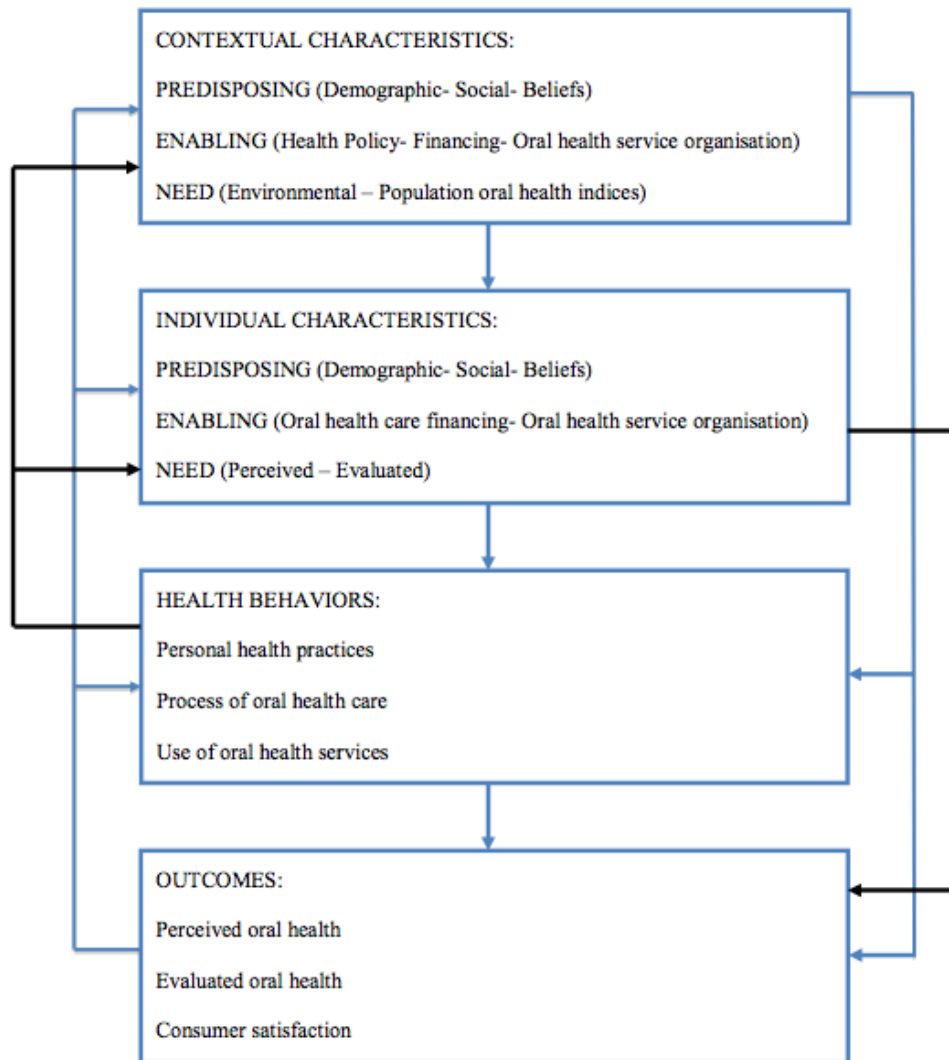
A number of factors affect the three steps during which individuals first become aware that they have a need for oral health care, secondly, whether or not they seek care and, finally, whether or not they receive such care. Most factors influencing first two stages relate to the individuals, but, at step three, the influence of dental professionals and legislators is considerable (Eaton 2004).

Although the literature on frequent use of oral health services is scarce, literature on the overall utilisation of oral health services is quite extensive. The Andersen's Behavioural Model has been one of the most widely used models to demonstrate the factors that lead to the use of health services (Babitsch et al. 2012) and therefore was chosen as a framework by which to classify and assess previous literature affecting the utilisation of oral health services.

The Model has evolved over time (Andersen and Newman 1973, Andersen and Newman 2005, Andersen 2008) and, in the most recent version, both contextual and individual characteristics are divided into three major components: predisposing factors, enabling factors and need factors (Figure 1).

The model has been used previously to classify and illustrate the individual determinants of utilisation of oral health services (Suominen-Taipale 2000, Eaton 2004, Baker 2009, Arcury et al. 2012). A modified version of the model was developed and used in the WHO Second International Collaborative Study of Oral Health Outcomes (ICSII) (Chen et al. 1997).

Figure 1. Factors affecting the use of oral health services (modified from Andersen 2008)



2.2.1 Predisposing factors

Contextual predisposing factors include the socio-demographic factors of the society, societal cultural norms and political perspectives (Andersen and Newman 2005).

Individual predisposing factors exist prior to a disease and predispose a person to use a service; they include demographic characteristics, social factors and mental factors in terms of health beliefs (Andersen and Newman 2005).

The following individual predisposing socio-demographic factors have been related to the demand for oral health care: age, sex, marital status, ethnicity, educational level, occupation and social class.

Although a substantial decline in dental caries has occurred among children in most industrialised countries over a relatively short period, not all children have benefited equally. Even in Nordic countries, where children and adolescents have had access to oral health care by Public Dental Services free of charge, a higher risk for dental caries has been reported for children and adolescents from working class homes and from outside Western Europe (Källestål and Fjelddahl 2007), in families with low income and a high number of children, and with low mothers' educational level (Christensen et al. 2010). In the US, the disparities of poor oral health and lack of dental care was found to be most evident among children in low-income families and among racial and ethnic minorities (Edelstein and Chinn 2009). The racially and income-based disparities in both oral health and oral health service utilisation were reported to continue into adolescence and young adulthood. Parallel results were reported in an Australian study (Crocombe et al. 2011); individuals who grew up experiencing low childhood socioeconomic (SES) status were less likely to adopt a routine oral health service visiting pattern in adulthood than those with a high childhood SES.

The dental health status of adults has improved in recent years in many European countries but oral diseases still remain major public health problems. Socio-economic inequalities persist in adults' dental health status (Haugejorden et al. 2008,

Somkotra 2011) and in oral healthcare coverage (Christensen et al. 2007, Kaikkonen 2008, Hosseinpoor et al. 2012). In Finland, 25% of adults with lower education had six or more missing teeth, while fewer than 10% of those with higher education had lost the same number of teeth (Kaikkonen 2008). A recent study on socio-economic inequalities in Europe (Listl 2012) studied regular dental attendance throughout the life-course on a retrospective sample on more than 26 000 Europeans aged 50 years or more. The study findings suggested that a considerable proportion of inequalities in oral health service use is already established at childhood and persists throughout life. In Finland, a study on income-related inequalities in dentist utilization among Finnish adults stated that the two main factors of inequity were income and dentist's recall practices (Nguyen and Häkkinen 2004). Low income has also been shown to be associated with higher problem-oriented utilisation of oral health services (Thomson et al. 2010, Geyer and Micheelis 2012).

Many studies have shown that women and young and middle-aged persons are more likely to attend oral health care regularly than men and elderly persons (Suominen-Taipale and Widström 1998, Christensen et al. 2007, Suominen-Taipale 2008, Widström et al. 2013).

Demographic and social structure factors are also linked to attitudes or beliefs about medical and dental care, physicians and dentists and disease. Individual thinking does influence health and illness behaviour. Attitudinal-belief factors can be divided into values concerning health and disease, attitudes towards health services and knowledge about diseases (Andersen and Newman 2005).

Positive factors influencing the oral health behaviour and dental attendance include valuing healthy lifestyle, valuing oral health care and awareness of the positive effect of good oral hygiene. Although most adolescents in Sweden had a positive dental attitude and also perceived their own oral health to be good, sex differences existed (Östberg et al. 1999). Girls showed more interest in oral health and scored more favourably on behavioural measures, use of dental floss and fluorides. Another study of 19-year-old individuals did not find differences in oral health habits and dental care priorities in different socio-economic groups (Östberg et al. 2010). Three factors dominated when regular future dental visits were not planned: tooth brushing less

than twice a day, smoking and being male. In an Australian adult sample, dental behaviour in terms of brushing and visiting was associated with social gradients in oral health for decayed teeth across income groups, with less favourable dental behaviour having a stronger negative association with oral health among lower income groups (Brennan et al. 2011).

Negative factors influencing oral health behaviour and dental attendance included fear, lack of perception of need, laziness and frustration with past care. Dental fear has been reported to be associated with irregular dental attendance and avoidance of oral health care (Pohjola et al. 2007, Crocombe et al. 2011). A comprehensive literature review from the US suggests that, during a 50-year period, dental anxiety has remained stable (Smith and Heaton 2003). However, a Norwegian study (Åstrom et al. 2011) reported reduced dental anxiety among 25-year-olds from 1997 to 2007.

2.2.2 Enabling factors

According to Andersen and Nyman (2005), it is likely that the enabling component that has the greatest effect on health service utilisation relates to how medical and oral health care is financed.

At the contextual level financing includes the resources available within the society such as community income, methods of compensating providers, and health care expenditure. Organisation at this level refers to the amount and distribution of health services facilities and personnel. Health policies also fall into this category.

Different payment methods can affect provider behaviour. In oral health services, different payment methods are used such as: fee-for-service payments, per capita payments, and a fixed monthly salary, with an additional payment based on treatment measure codes as used in the PDS in Finland.

According to a review article by Grytten (2005), per capita payments secure effectiveness, but fee-for-item payments gain quality. With per capita payments, there is a potential for patient-selection and under-treatment, while limitation of costs

is a problem with fee-for-item payments. The fee-for-service based systems have been criticised because, when providers make more money by providing more care, supply may induce its own demand. In the US, by some estimates 50% of health care consumed seems to be driven by physician and hospital supply, not patient need or patient demand (Brownlee 2007). In a recent Finnish study (Tuominen et al. 2012), private practitioners who have a contract with the public oral health service systematically classified the treatment procedures they provided as more demanding, and therefore more economically rewarding, than their public sector counterparts. Christensen et al. (2009) proposed a different approach of charging an annual fee to patients. Then the providers would profit from patients' wellness, rather than their sickness (Christensen et al. 2009). In Sweden, an innovative dental care insurance scheme "Frisk tandvård" that offers regular dental care at fixed price has been developed (Frisk tandvård 2012). The dental contract is tailored to dental care needs and is based on a personal oral health care plan made by a dentist or a dental hygienist. The cost depends on individual risk assessment and includes self-care, preventive care and treatment (orthodontic and aesthetic dental care are not included). The term of the contract is three years.

In a national health care system, resources and organisation are important dimensions. Resources are the labour and capital allocated to health care and they include health care personnel, structures in which health care and education are provided, the equipment and materials used. In most EU countries, the overall size of the dental workforce is expanding quite slowly but big variations in oral health care provision systems exist between the countries (Widström and Eaton 2004). The dental workforce consists of dentists, dental hygienists, dental nurses and dental technicians. The dentists are the main providers of care. Many EU countries educate dental hygienists and their numbers have risen more than the dentist numbers during the last 10 years. Nevertheless there exist only a few countries where the dental hygienist numbers are sufficient to make a significant difference to oral health care delivery (Widström et al. 2010).

Organisation describes what the system does with its resources and the components of organisation are access and structure. Access refers to the means through which the patient enters the medical/oral care system and continues the treatment process.

Structure of the system determines what happens to the patient following access to the system.

After a major Oral Health Care Reform in Finland that opened access to the PDS for all age groups and expanded the partial reimbursements of private practitioners' fees, demand for oral health care in both sectors increased. The PDS in many big cities was not able to respond to the adult population's demand and access to care was restricted by long waiting lists (Niiranen et al. 2008). The Finnish oral health care system is described in detail under Subjects and Methods.

Individual financing factors involve the income and wealth of an individual to enable payment for oral health services. Enabling conditions can be measured by family resources (such as income), having a health insurance, type of regular source of care and access to the regular source of care.

A number of studies (Nguyen and Häkkinen 2004, Kiyak and Reichmuth 2005, Guiney et al. 2011, Arcury et al. 2012) have shown that income is a significant predictor of utilisation of oral health care among adults and older adults. In a study of income related inequalities in dental service utilisation by Europeans aged 50+ years, a disproportionate concentration of access to treatment among rich and elderly population sectors was reported in all 14 countries included in the study (Listl 2011). The author concluded that there was considerable income-related inequality in dental service utilization by several elderly populations residing in Europe. A questionnaire study of older Japanese showed also a significant relationship between income inequality and poor self-rated health and poor dental status (Aida et al. 2011). Among young adults, affordability together with need factors has been shown to be more significant than general health behavioural factors in influencing the use of oral health services (Roberts-Thomson et al. 2011). A recent Finnish register study stated that a considerably proportion of young adults (18-29 years) had not used dental services (Kallio et al. 2013). Compared with other age groups, 25% of the Finnish metropolitan young adults had not used oral health services and 41% had not had an examination during the years 2005-2009. The most important factor for non-use of oral health services was low income (Kallio et al. 2013).

When dental insurance is available and the costs are paid by a third party, the demand seems to be higher and those insured visit dentists more frequently (Kiyak and Reichmuth 2005).

Dentists recalling their patients regularly can encourage the use of dental services. The recall system is widely used in private practice and in better off populations but it is disadvantaged population groups, supported by publicly funded programs, that would really benefit from more frequent recall in order to maintain their oral health (Nguyen and Häkkinen 2006, Durham et al. 2009). This is also the case in Finland where big differences exist in adults' attendance patterns between the private and public sectors (Widström et al. 2013). In private practise, most adults attend regularly but in the PDS they attend on a much more irregular basis. The PDS in Finland only recalls, in practice, patients younger than 18 years, even though individual recall intervals are advised for all examined PDS patients. Patients in private practices in Finland have higher income and educational level compared with PDS and regular recalls are widely used in private practise and are also considered as important marketing tool (Widström et al. 2011).

Certain enabling characteristics of the society can affect the use of services. Examples are the number of health facilities and personnel, the price of health services, the region of the country and its urban or rural character. In the US, rural older adults have worse oral health than those living in urban areas, and Arcury et al. (2012) reported that regular and recent dental care was infrequent among rural older adults.

2.2.3 Need factors

At the contextual level, the need factors are composed of environmental need characteristics and population health indices. Population health indices are measures of community health status including epidemiological indicators (Andersen and Newman 2005).

At the individual level, need factors describe the characteristics of a person's illness that require the use of services and they represent the most immediate cause of health service use. Illness level or need for treatment can be evaluated by the patient by "subjective evaluation" or by professionals by "objective evaluation".

Caries and periodontal diseases are the most prevalent oral diseases. In Finland according to the Health 2011 survey of persons aged 30 and over, 28.2% of men and 14.1% of women had active caries needing care and 70.0% of men and 55.6% of women had periodontal disease (Koskinen et al. 2012). The immediate causes of these major oral diseases are oral biofilms (poor oral hygiene), diet and smoking. These risk factors are common with many chronic diseases (Petersen and Yamamoto 2005). The biofilm-associated oral diseases cause ailments in the oral cavity but may influence general health by spreading infections to adjacent tissues and spaces, possible hematogenous dissemination of oral biofilm bacteria, or through inflammatory mechanisms (Beikler and Flemmig 2011). Strong evidence supports the oral-systemic link between periodontitis and cardiovascular diseases, cerebrovascular diseases and diabetes mellitus, all these diseases have an inflammatory etiology (Beikler and Flemmig 2011, Borgnakke et al. 2013, Taylor et al. 2013, Tonetti et al. 2013). Oral diseases are "silent" diseases and do not become visible or cause pain until they are in more advanced stages. These diseases are highly preventable by healthy dietary and oral health habits. Therefore regular use of oral health services should be promoted to detect early signs of oral diseases and to focus on prevention. Traditional treatment of oral diseases is extremely costly (Beikler and Flemmig 2011, Petersen et al. 2005).

The oral health illness level of children and adolescents has mainly been defined by measures of dental caries. An indicator of dental caries severity, the mean DMFT, has decreased substantially in industrialised countries (Oral health database 2013). The World Health Organization has set a target for Europe of no more than 1.5 DMFT by the year 2020 for 12-year olds (WHO 1999) and all the Nordic countries except Iceland have already reached the target. For example, in Denmark the recent (2010) mean national score for 12-year olds was as low as 0.6 (Ekornrud and Wilberg 2013). The decline in mean DMFT and dmft values has been accompanied by increased number of caries free (dmft=0, DMFT=0) children and adolescents. The

proportion of caries free children and adolescents is commonly used to assess overall levels of oral health over time among populations of children and adolescents. Among the Nordic countries the growing proportion of caries free children and adolescents has been most notable in Denmark, where proportion of caries free 12-year-old children was 17% in 1985 and 70% in 2010 (Ekornrud and Wilberg 2013).

After the decrease in dental caries, children and adolescents are no longer visiting the oral health care services annually in most Nordic countries. Nevertheless, the proportion of children and adolescents under 18/19/20 years old who visited the oral health services within a year in the Nordic countries was reasonably high. It varied from 59% in Iceland (2010) to 77% in Finland (2007) and Denmark (2005) (Ekornrud and Wilberg 2013).

As the oral health status of children and adolescents has improved, orthodontic visits as a proportion of all dental visits of children and adolescents has somewhat risen in many countries (Pietilä et al. 2009). There is general consensus in the Nordic countries that necessary orthodontic treatment is an important part of oral health care for children and adolescents and it is financed, remunerated or supported by society in these countries. In Denmark, Finland and Sweden, the PDS plays a major role in children's orthodontic care. In Norway, public funding remunerates orthodontic treatments, but a majority of orthodontists work in the private sector (Widström et al. 2005). In Finland, general dentists may provide quite a lot of orthodontic treatment and in all Nordic countries the delegation of orthodontic tasks to dental auxiliaries is an acceptable practice (Pietilä et al. 2009). In Finland, about one in ten children and adolescents aged 6-17-years had made an orthodontic visit (Widström et al. 2011). In Finland the orthodontic treatment in PDS is limited to the most severe cases and a priority is given to functionally disturbing malocclusions. A 10-grade scale ranking the indications for treatment according to the severity of the deviation emphasising the functionally disturbing occlusal deviations (Heikinheimo 1989) is used by more than half of the health centres in Finland (Pietilä et al. 2004).

A Finnish study analysing the consumption of oral health services among 4-16-yr-old children stated that public oral health services were used very unevenly (Milen et al. 1988). The frequent consumers (3-6 visits per year for different age groups), about

one-fifth of the total, used half of all the services provided. Among preschool children, the frequent consumers were mainly from lower socioeconomic groups but no obvious predictive factors for heavy consumption were found among the schoolchildren. Frequent consumers had more both treated and untreated caries than did the other children. The treatment of frequent users was mainly restorative; at least half of them did not receive adequate preventive care (Milen et al. 1988).

It has been agreed that the recent decline in dental caries partly resulted from the widespread use of fluoride in toothpastes, but also the changes in broad socioeconomic factors resulting in general health improvement are seen as an important cause of the decline. According to Nadanovsky and Sheiham (1995) the role of oral health care services in explaining the decline has been relatively unimportant, explaining only 3% of the variation in changes of caries experience among 12-year-olds between 1970 and 1980 in industrialised countries.

Despite the decline in dental caries in children, there is a continuous increase in caries with age and most dental caries occurs in adults. As sugars are one of the causes of dental caries, fluoridating the mouth is not enough and policies to reduce sugar consumption are needed in order to decrease caries rates and need for treatment also among adults and elderly (Sheiham 2013).

Number of teeth is one of the major factors influencing demand in adults (Suominen-Taipale 2008, Takehara and Shimoyama 2009). Number of teeth is also strongly connected with perceived oral health (Haugejorden et al. 2008). Edentulousness has been considered an important indicator of oral health care utilisation. Being edentulous was related to lower income and lower level of education in the comprehensive national study in Finland, Health 2000 (Suominen-Taipale 2008). With the decline in edentulousness, quite dramatic changes in attendance patterns among elderly adults have been reported. In Finland, the greatest increase in regular dental check-ups was observed for those aged 55 or over when comparing national data from 2000 with 1980 (Suominen-Taipale 2008). The same trend could be observed from the United Kingdom Adult Dental Health Surveys; in 1978 a self-reported attendance rate in those over 55 years of age was 32%, the lowest for any

age group (Nuttall et al. 2001). By 1998, the self-reported attendance rate for this age group was 66%, the highest for any age group.

It is not only oral diseases that influence need for oral health care. As growing number of adults retain their teeth and have high numbers of treated teeth, they need continuing maintenance and replacement of restorations because of fractures and failures of fillings. A Finnish study reported that 65% of the adult restorative treatment was replacement of previous restorations and this is a heavy burden to oral health services (Forss and Widström 2004).

Dentists' "objective evaluation" affects the use of oral health services, as it is known that treatment decision-making among dentists shows wide variation (da Silva et al. 2012). Changing a dentist can increase the use of oral health services, and visiting a new dentist has been reported to result in more restorative treatment (Korhonen et al. 2009).

2.2.4 Summary of the literature review on factors affecting the use of oral health services

The Andersen's Behavioural Model suggests that there are individuals who are more likely to use oral health services and this can be explained by predisposing, enabling and need factors (Andersen and Newman 2005). The interrelationship between these three categories determines the implementation of personal oral health practices and the use of oral health services. In turn, these affect oral health outcomes including patients' satisfaction with care. This emphasises that a number of factors other than merely illness level affect the use of oral health services.

Independent relationships between patterns of oral health care utilisation and many individual characteristics, such as socio-demographic factors, attitudinal-belief factors, affordability of care, oral health problems, perceived quality of oral health care and their relationships with oral health status have been comprehensively studied (Pohjola et al. 2007, Kaikkonen 2008, Suominen-Taipale 2008, Edelstein and Chinn 2009, Christensen et al. 2010, Östberg et al. 2010, Arcury 2012, Listl 2012). Considering the research reviewed, many of the studies have focused on the

individual components while fewer studies can be found on the societal determinants and oral health service delivery systems and the role of different personnel categories in care provision.

Although the literature on factors affecting the use of oral health services is quite comprehensive, research on reasons and patterns of frequent use of oral health services is limited. Neither studies investigating the frequent use of oral health services by adults, nor studies assessing the persistent frequent use of oral health services were found in the literature.

3 AIMS OF THE STUDY

The aim of the study was to analyse heavy use of oral health services and associated factors in the Public Dental Service (PDS) in Espoo, Finland after a major Dental Care Reform in 2001-2002 that abolished age limits restricting adults' use of public dental services in Finland. As a result of this reform, the proportion of adults rose from 36% in 2000 to 57% in 2009 in the PDS of Espoo. Despite the increase in workforce after the Dental Care Reform, the PDS of Espoo had problems responding to the increased demand for oral health care by the adult population.

The general objective of this study was to describe the care provision system after the Reform and to suggest improvements to processes of care in order to allocate the resources more efficiently and according to population treatment needs.

The specific objectives were:

To identify the heavy users of oral health services among children and adolescents in PDS in Espoo and to analyse their oral health status and treatment provided compared with low users. (PAPER I)

To identify the heavy users of oral health services among adults in PDS in Espoo and to analyse their oral health status and treatment provided compared with low users. (PAPER II)

To follow the adult heavy and low users of oral health services in the PDS of Espoo in order to analyse persistent heavy use during a five-year follow-up period. (PAPER III)

To analyse whether the treatment provided differed between baseline heavy and low users of oral health services during a five-year follow-up period. (PAPER IV)

4 SUBJECTS AND METHODS

4.1 Oral health care provision system in Finland

The Finnish system of organising healthcare is largely decentralised and has a mixed basis of funding. Two paths provide public funding: municipal health expenditure and the National Health Insurance scheme provided by KELA, The Social Insurance Institution of Finland. The municipal financing is based on municipal taxation, state subsidies and patient fees. KELA is financed by national taxation and employer contributions.

The municipalities are responsible for organising oral health services including oral health promotion and preventive care. Oral health services are provided both by the public and private sectors. In 2010 there were 3955 licensed dentists, of whom more than 50% worked at the Public Dental Services (PDS). The number of inhabitants per dentists was 1358 in 2010, the highest ratio in the Nordic countries. In addition, there are about 1980 dental hygienists and about 300 clinical dental technicians (Nihtilä 2010, Ekornrud and Wilberg 2013).

Private and public dentists are obliged to use standardised dental records and treatment measure codes defined by the Social Insurance Institution of Finland (KELA). Private dentists charge their patients on a fee for service basis. The PDS dentists receive a fixed monthly salary and an additional productivity payment.

A major oral health care reform was carried out in 2001-2002 in order to increase equity by improving adults' access to oral health care and decreasing cost barriers (Niiranen et al. 2008). After the reform (since December 2002), public oral health services are accessible to the entire population and all users are entitled to reimbursements by the Social Insurance Institution of Finland. All children under the age of 18 years are entitled to care free of charge in the PDS, including necessary orthodontics. Almost all (99%) children and adolescents have been using the PDS (Nordblad 2004). Patients at 18 years of age or older have to pay fixed fees of the oral health care services at the PDS. If patients use private dental services, the Social

Insurance Institution of Finland (KELA) will cover part of the treatment costs (about 30%), but prosthetics and orthodontics are not covered. Private dentists' fees are not regulated and KELA reimburses according to its own fee scale. Even after KELA reimbursement, the fees at the private services are at least twice as high as PDS fees.

The number of oral health care visits increased somewhat during 2002–2004; in particular, those age groups that were not previously entitled to use the PDS or not covered by private services at reduced prices accounted for this change. The number of visits increased, especially among people whose last dental visit was more than two years previously (Nihtilä 2010). Especially in the PDS, great demand for care has led to modification of the allocation of tasks between professional groups in oral health care.

In March 2005, new legislation took effect in Finland stating that non-urgent treatment and examinations at PDS units and hospitals must be provided within clear time frames (Ministry of Social Affairs and Health, Finland 2004). Oral health care was included in this reform. According to the law, patients must be able to contact their PDS unit immediately by phone during office hours. Usually a dental nurse assesses the need for treatment during this initial contact. Emergency services should be given immediately or within three days and non-urgent care within six months at the latest. Access to oral health care has been hindered by lack of dentists due to the closure of two dental schools in the 1990s. The schools have been reopened (in Turku 2004 and in Kuopio 2010) and the number of new dental graduates is increasing in Finland. Numbers of dental hygienists in the PDS increased greatly after the Dental Reform.

Health promotion is founded on the Health Care Act and is part of public health work (Ministry of Social Affairs and Health, Finland 2010). Preventive care for children and adolescent is defined in more detail in a regulation (380/2009) (Ministry of Social Affairs and Health, Finland 2009). Access to preventive oral health care is included in the uniform criteria for access to non-emergency treatment.

4.1.1 Oral health care in Espoo

Espoo, close to Helsinki, is the second largest city in Finland with a steadily growing population, 227,500 inhabitants in 2004 and 248,000 in 2011. Of the population, 75.7% were over 18 years of age in 2011. The educational level in Espoo is the second highest in Finland and mean personal income (subject to state taxation) was €37,440, compared with the national average of €26,555 in 2011 (City of Espoo 2013).

The PDS of Espoo operates 27 dental clinics. In 2004, the workforce in the PDS of Espoo consisted of 82 general dentists, 13 specialised dentists, 36 dental hygienists, and 139 dental assistants. By 2011, the numbers had somewhat decreased and the workforce consisted of 68 dentists, 9 specialists, 31 dental hygienists and 113 dental assistants. Since 2005, the PDS of Espoo has contracted out some specific treatments for PDS patients, mainly extractions and endodontic treatment following emergency visits from the private sector. In 2009, cities in the Helsinki Metropolitan Area and the municipality of Kirkkonummi founded jointly a unit for specialist dental care. This unit handles those basic health care patients who require specialist dental care and whose treatment does not require hospital facilities; it also serves as a training location for specialising dentists. Three specialists moved to this unit from the PDS of Espoo in 2009. In 2009, the same cities founded a joint dental health emergency department, which handles urgent and sudden dental emergencies in the evenings, at weekends and on public holidays. Each municipality is responsible for providing its own daytime emergency services.

The total number of visits to Espoo PDS increased from 168 208 in 2004 to 187 323 in 2011. In 2004, 59.9% of the population aged 0-17-years had visited the PDS and in 2011 the proportion had decreased slightly (57.0%). Of the adults living in Espoo, 17.5% had visited the PDS in 2004 and the figure was somewhat higher 22.9% in 2011. The proportion of adults among patients in the PDS has progressively increased; 36.2% in 2000, 47.6 % in 2004 and 56.7% in 2011.

4.2 Study subjects

The method of selection of study participants from the patient register in the PDS of Espoo is presented in Figures 2 and 3.

All patients who had visited the PDS in 2004 were identified (n=63 850) from the patient register (Figure 2). The patients were divided into two groups: children and adolescents (1-17-years) and adults (≥ 18 years). Then, within each group, all patients who had made six or more dental visits to the PDS in 2004 were defined as heavy users of oral health services and all the patients who had had three or fewer visits as low users. A ten per cent sample was then randomly drawn from each adult group (320 patients) and from the children and adolescent group (245 patients). The same number of adult low users and children and adolescent low users were included, representing 1.4% and 0.9% of the total populations in these groups. A systematic random sampling method was used. Starting point was randomized and then for heavy users every 10th patient was selected and for adult low users every 71th patient and for children and adolescent low users every 114th patient was selected. For adults, satisfactory information was available for 300 heavy and 314 low users out of the two samples of 320. For children and adolescents, satisfactory information was available for 240 heavy users and 226 low users out of the two samples of 245 persons.

In the follow-up study, all adult heavy and low consumers of dental services identified in 2004, who had visited the PDS in Espoo during 2005-2009, were included (Figure 3). Of the heavy users who had made no visits during the follow-up period (n=42), 42.3% had moved, 4.8% had died and the rest had either visited the private sector or made no dental visits. Of the low users with no visits (n=69), 42.0% had moved and 7.2% had died. The difference in the mean age in 2004 was not statistically significant between the heavy (36.9 years) users and low users (39.2 years) with no visits. No significant differences in demographic characteristics were noted between the baseline heavy users and the follow-up heavy users or the baseline low user and the follow-up low users.

Figure 2. Selection of the study participants from the patient register in the PDS of Espoo (Studies I and II).

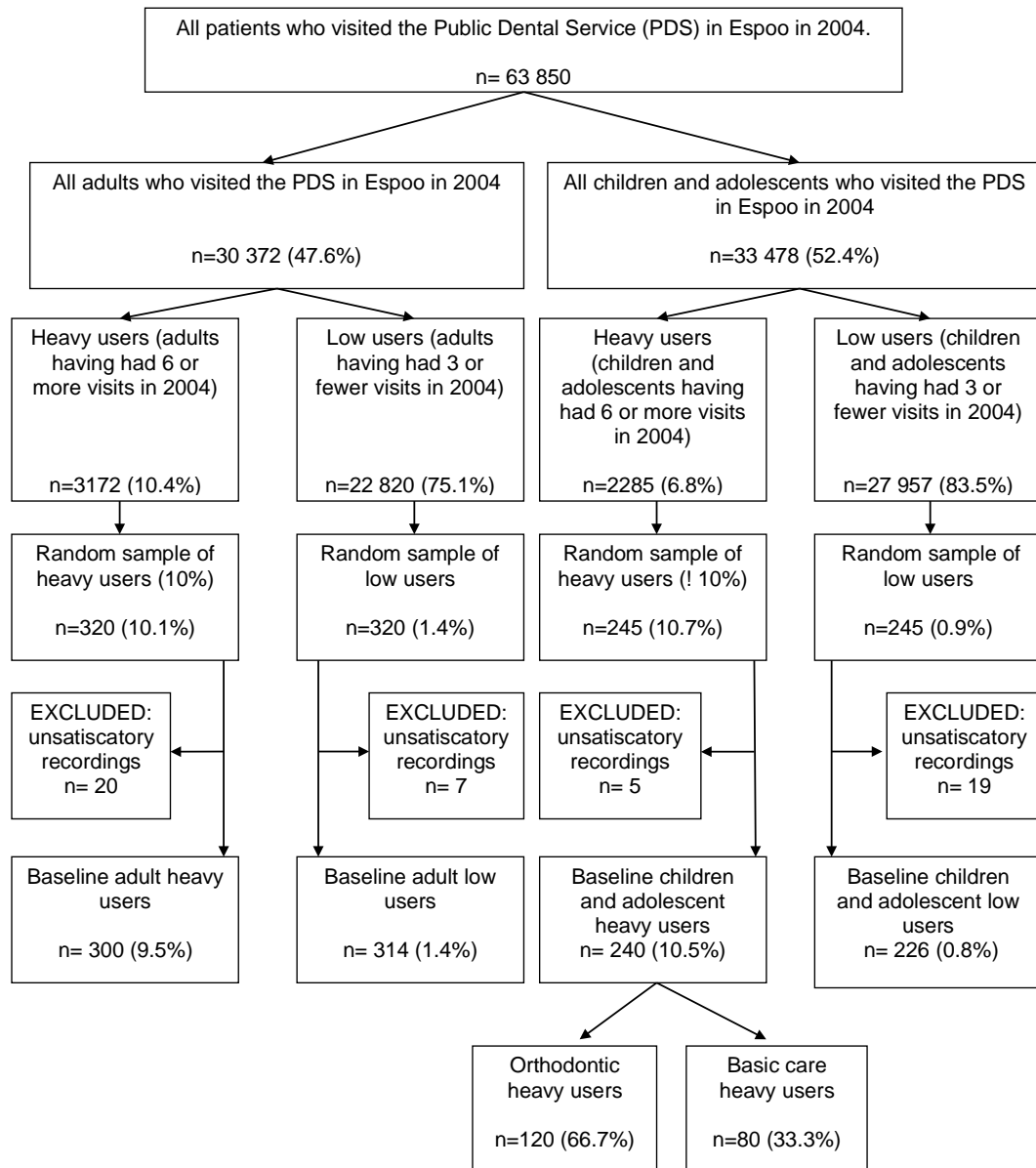
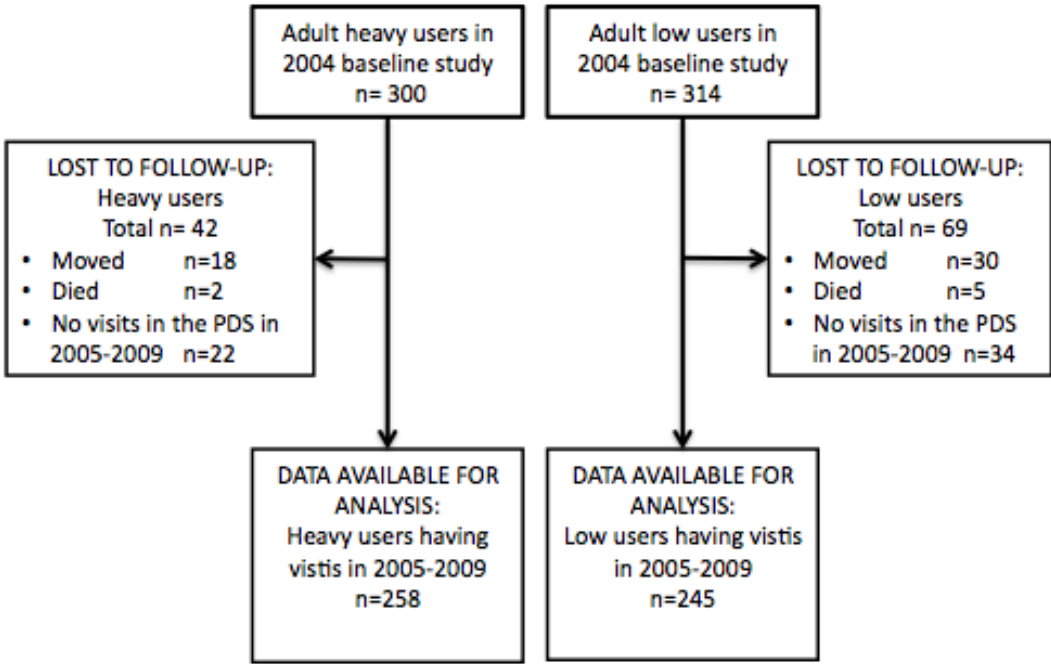


Figure 3. Selection of the follow-up study participants from the baseline study (studies III and IV).



4.3 Methods

4.3.1 Baseline study in 2004 (Papers I and II)

For adults, information on age, sex, occupation and self-reported general health status was collected from the patient records. From the treatment records, information on the number of visits (dentist or dental hygienist), their duration, the number of treating dentists, fees paid and all treatment measures provided were noted. The PDS dentists use the classification of the Finnish Social Insurance Institution (KELA) to record the treatment measures provided and these codes were used. Information on the duration of each visit and whether or not the treatment course had been completed was recorded. Data on dental status were noted mainly from the 2004 records but also from the 2003 records when dental status had not been recorded in 2004. We used the classification of occupations recommended by Statistics Finland (2001) and categorized occupational status into six classes: upper-level white-collar workers, lower-level white-collar workers, blue-collar workers, students, pensioners and others. The DMFT index and its D component (WHO 1997) were used to describe the caries status and the Community Periodontal Index (CPI) (Ainamo et al. 1982) to describe periodontal conditions. The sextant with the highest CPI score was recorded. The numbers of teeth and prosthetic constructions (crowns, bridges, implants and removable dentures) present were also registered.

For children and adolescents, information on age, sex, dental status, numbers and types of visits and treatments provided on these patients in 2004 was also collected from the records. All visits to dentists and hygienists were included but visits to specialists (orthodontics) were excluded. Information on the duration of each visit and whether or not the treatment course had been completed was also noted. The d, D, dmft and DMFT -indices (WHO 1997) were used to describe caries experience and the Community Periodontal Index (CPI) (Ainamo et al. 1982) described periodontal conditions. The sextant with the highest CPI score was noted. A child/adolescent was caries-free when the deciduous or permanent teeth were without active caries (dt or DT = 0). A tooth was defined as decayed (d/D) when there was caries lesion needing restorative care. The Significant Caries Index (SiC) was used to identify the high caries experience group (Bratthall 2000). All heavy users who had

received orthodontic treatment were classified as orthodontic heavy users (n=120) and the other heavy users as basic care heavy users (n=80).

4.3.2 Follow-up study 2005-2009 (Papers III and IV)

In the five-year follow-up study, numbers and types of visits, treatments provided, the sequence of periodontal and restorative treatment and dental status (D, DMFT, highest CPI score, periodontal status and the number of teeth) when accessible were collected for each year as well as the number of treating dentists.

4.4 Statistical methods

In the baseline studies, the data were analysed by SPSS version 17.0 (Statistical Package for the Social Sciences). Statistical significance of differences between the heavy and low user groups both for children and adolescents and adults was evaluated by the chi-square test and the *t*-test.

In the follow-up study, data were analysed by SPSS version 18.0. Differences between the heavy and low consumers of dental services were evaluated by chi-square and the Mann-Whitney test. Differences between the baseline and follow-up groups were evaluated by chi-square and Wilcoxon test. Predictors for persistent heavy consumption and determinants of emergency visits and preventive visits were analysed by logistic regression analyses.

4.5 Ethical aspects

This study is a register-based study. In Finland, in order to obtain register data for research purposes, an authorisation from the register controller is needed. This study was limited to the register information and no data were collected directly from the study subjects and group-level data was used in the analysis. Espoo city administration, the legal owner of the patient register, gave research permission in June 2005.

5 RESULTS

Detailed results are given in the original publications and only the main results are presented in this section.

5.1 Baseline study results in 2004 (Papers I, II)

5.1.1 Demographic and service utilisation characteristics of heavy and low users

Children and adolescents (I)

Seven per cent of the children and adolescents (n=2 285) who had visited the PDS of Espoo in 2004 were heavy users and 83.5% were low users (n=27 957). Low users were younger than the basic care heavy users and orthodontic heavy users (Table 1), most of the heavy users were between nine and 14 years old. The visits of heavy users explained 26.3% of all dental visits by children and adolescents in 2004. The number of visits of heavy users was five times higher compared with the low users. Mean total treatment time was 230 minutes for basic care heavy users, 203.5 minutes for orthodontic heavy users compared with 39.6 minutes for low users ($p<0.001$). The highest number of visits in the heavy users group was 22; on the other hand most low users (63.6 %) had made only one visit. Of the basic care heavy users 92.6% had had examination compared with 70.6% of the orthodontic heavy users and 71.7% of the low users ($p<0.001$). Almost 40% of the basic care heavy users had visited a dental hygienist but only 17.5% of the orthodontic heavy users and 24.2% of the low users had such visits ($p<0.05$).

Table 1. Demographic and oral health service utilisation characteristics of the basic care heavy users, orthodontic heavy users and low users of the PDS among the 1-17 year olds in 2004.

		Basic care heavy users n= 80	Orthodontic heavy users n=160	Low users n=226
Gender:	Girls %	42.0	51.3	51.7
	Boys %	58.0	48.8	48.3
Mean age in years (SD)		11.6 (3.4)***	10.6 (3.0)***	9.1 (4.7)
Mean number of visits (SD)		7.2 (1.4)***	8.9 (2.6)***	1.5 (0.8)
Mean number of visits to a dentist (SD)		6.0 (2.3)***	8.6 (2.6)***	1.2 (0.9)
Mean number of visits to a dental hygienist (SD)		1.2 (1.9)***	0.3 (0.7)	0.3 (0.5)
Mean number of orthodontic visits to a general dentist (SD)		0***	6.9 (2.7)***	0.4 (0.9)

***P<0.001; *P<0.05

Adults (II)

Heavy user adults made up 10.4% (n= 3 173) of those who had visited the PDS in 2004 and 75.1% (n=22 820) were low users. Treatment of heavy users explained 31.6% of all adult dental visits and the treatment of low users 46.1% in 2004. Heavy users had had more than five times the number of visits than had the low users. Two heavy users had 22 visits in 2004 as half of the low users (51.6%) had made only one visit. The mean number of treating dentists was 2.2 for heavy users and 1.1 for low users (p<0.001); 44% of the heavy users had visited a dental hygienist compared with 23.8 % of the low users (p<0.001).

Heavy users were more often pensioners (20.3%) and blue-collar workers (27.7%) than the low users (10.5% and 16.9% respectively) and they were on average 6.5 years older than the low users (Table 2).

Significantly more heavy users reported having ill health (36%) compared to low users (19.8%; $p < 0.001$).

Table 2. Demographic and oral health service utilisation characteristics of the adult heavy and low users of PDS of Espoo in 2004.

	Heavy users (n=300)	Low users (n=314)	p- value
Gender (%)			
Women	55.0	65.0	
Men	45.0	35.0	0.012
Mean age in years (SD)	47.9 (18.9)	41.4 (16.5)	0.000
Age groups (%)			
18–29	19.7	23.6	0.241
30–44	28.0	45.5	<0.001
45–64	31.7	19.8	0.001
65+	20.6	11.1	0.001
Occupational level			
Upper-level white-collar workers	9.4 %	18.6 %	<0.001
Lower-level white-collar workers	25.7 %	33.2 %	0.046
Blue-collar workers	27.7 %	16.9 %	0.001
Students	9.3 %	12.8 %	0.179
Pensioners	20.3 %	10.5 %	<0.001
Others	7.7 %	8.0 %	0.892
Mean number of all visits (SD)	8.2 (2.9)	1.6 (0.8)	<0.001
Average time of one visit in minutes (SD)	39.4 (8.4)	34.0 (8.5)	<0.001
Mean total treatment time in minutes	328.2	58.3	<0.001
Mean number of visits to a dentist (SD)	7.3 (2.9)	1.3 (0.7)	<0.001
Mean number of visits to a dental hygienist (SD)	0.9 (1.2)	0.3 (0.5)	<0.001

5.1.2 Oral health status

Children and adolescents (I)

Of the basic care heavy users, 92.6% had had a proper full mouth examination compared with 70.6 % of the orthodontic heavy users and 71.7% of the low users. Most of the orthodontic heavy users (73.8%) and low users (73.2%) had no caries that needed restorative intervention (Table 3). On the other hand, only 36% of the

basic care heavy users had no obvious decay experience. Almost one fifth of the basic care heavy users had a high number of decay (DT/dt=5 or more). The basic care heavy users had also more caries experience (mean DMFT/dmft=4.0 and mean D/d=2.4) than the orthodontic heavy users (mean DMFT/dmft=1.0 and mean D/d=0.4) or low users (mean DMFT/dmft=1.0 and mean D/d=0.4). The SiC index for the basic care heavy users was much higher (9.2) compared with 2.8 for the orthodontic heavy users and 3.1 for the low users.

Information on periodontal status was available for 80.4% of heavy users and in 65.9% of low users. Of the low users 43.6% had healthy periodontium compared with orthodontic heavy users (30.8%) or basic care heavy users (27.4%) (p<0.05; Table 3). Gingivitis was significantly more common in basic and orthodontic heavy user groups than the low users (p=0.001).

Table 3. Distribution (%) of basic care and orthodontic heavy users and low users of oral health services among the 1-17 year olds in the PDS of Espoo according to the number of carious teeth (dt + DT) and maximum CPI scores.

Indicator	Children and adolescent heavy users %		Children and adolescent low users %
	Basic care heavy users (n=75)	Orthodontic heavy users (n =122)	(n=164)
dt+DT =0	36.0***	73.8	73.2
dt+DT= 1	18.7	16.4	16.5
dt+DT= 2	10.7	6.6	6.1
dt+DT =3-4	16.0***	1.6	2.4
dt+DT =5-11	18.6***	1.6	1.8
Healthy periodontal conditions (CPI=0)	27.4*	30.8*	43.6
Gingival bleeding (CPI=1)	47.9***	46.7***	26.8
Calculus (CPI=2)	23.4	22.5	29.6
Shallow periodontal pockets (CPI=3)	1.4	0	0

***P<0.001; *P<0.05

Adults (II)

A full mouth examination was provided to about 63% of the patients in each group; the other patients had mainly had emergency visits and partial examinations. Both groups had almost the same number of teeth (mean 25.3 for heavy users, 26.9 for low users, $p < 0.05$) and the number of teeth did not differ significantly in either group according to sex. Edentulousness was rare; there were only three edentulous persons in the low users group and two in the heavy users group. Of patients over 65-years of age, 35.0% in both groups had fewer than 20 functional teeth.

One fifth (20.7%) in the heavy users group and half (52.8%) in the low users group had no obvious decay experience ($p < 0.001$) (Table 4). The DMFT and D values were significantly higher in the heavy user group (mean D=2.9, mean DMFT=20.1) than in the low user group (mean D=1.2, mean DMFT=14.4) ($p \leq 0.001$). Almost half of the heavy users (46.8%) had high number of cavities ($DT \geq 3$) needing restorations compared with 13.3% of low users ($p \leq 0.001$). There were no significant differences in the numbers of decayed teeth between the sexes.

Only 7.2% of the heavy users and 8.6% of the low users had healthy periodontal conditions ($p = ns$) but heavy users had significantly more periodontal disease than the low users ($p < 0.001$).

A greater proportion of heavy users had removable dentures (11.2%), bridges (4.3%) and crowns (7.3 %) than low users (3.4%, 1.3%, 4.3% respectively; $p < 0.05$). Only 1% in both groups had one or more implants.

Table 4. Distribution (%) of the heavy and low adult users of oral health services in the PDS of according to number of carious teeth (DT), maximum CPI scores and number of functional teeth, in 2004.

Indicator	Heavy users	Low users
	(n=188) %	(n=195) %
DT=0***	20.7	52.8
DT=1-2	32.5	33.9
DT=3-5***	31.9	10.3
DT=6-14***	14.9	3.0
Healthy periodontal conditions (CPI=0)	7.2	8.6
Gingival bleeding (CPI=1)*	9.3	17.3
Calculus (CPI=2) *	52.6	63.5
Shallow periodontal pockets(CPI=3)***	21.1	9.1
Deep periodontal pockets (CPI=4) ***	9.8	1.5
More than 20 functional teeth	89.8	94.8

***P<0.001; *P<0.05

5.1.3 Treatment provided

Children and adolescents (I)

Heavy users received most frequently orthodontics (45.0%), fillings (18.6%), preventive treatment measures (15.8%) and examinations (7.4%) and the low users prevention (36.6%), examinations (24.3%), orthodontics (12.2%) and fillings (10.9%). The difference was notable in orthodontic treatments, as most heavy users (66.4%) received orthodontic treatment from a dentist compared with only 7.9% of the low users (p<0.001; Figure 4).

Basic care heavy users had more visits to the dental hygienist than low users. Oral hygiene instruction was the most common preventive measure for all groups succeeded by topical fluoride application. Orthodontic heavy users received significantly fewer preventive measures than basic care heavy users or low users (p<0.001).

Children and adolescent heavy users

Children and adolescent low users

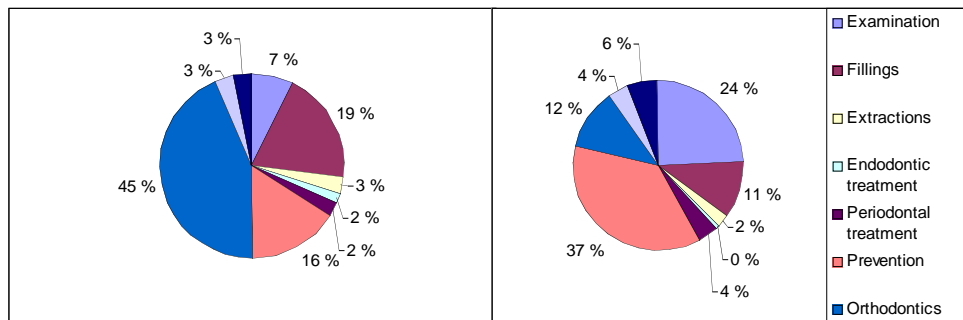


Figure 4. Distribution (%) of treatment measures provided for the heavy and low users of oral health services among 1-17 year olds in the PDS of Espoo in 2004.

Adults (II)

Adults received most frequently emergency care, restorative treatment and endodontic treatment. Emergency visits were common for heavy and low users. Almost 70% (67.9%) of the heavy users and half of the low users had made emergency visits in 2004. Proper examination was provided to 63.3% of heavy users and to 62.7% of low users.

Restorative treatment was common; of the heavy users, 87.0% and of the low users, 49.7% had received fillings. Most of the heavy users (76.3%) who did not have caries (D=0) had had restorative treatment; this suggests replacement of existing dental restorations for reasons other than caries. Endodontic treatment was provided to 44.5% of heavy users compared with 6.6% of low users ($p < 0.001$).

Extractions were more common for heavy users, a third of the heavy users (33.6%) had had at least one tooth extracted compared with 7.9% of the low users. At least one prosthetic treatment measure was provided to 15.0% of the heavy users. These prosthetic treatment measures were mainly removable dentures (47.4%) and denture repairs (36.4%). Fixed prosthetics (in 18.2% of cases) for heavy users were usually fibre-reinforced composite bridges and only one porcelain crown was made. For low users, all prosthetic treatment measures were repairs to existing dentures.

Most heavy users (88.1%) who had had an examination and had periodontal pockets (CPI \geq 3) received periodontal treatment and compared with only 45.0% of low users with periodontal pockets (CPI \geq 3).

Oral hygiene education was the most common preventive measure provided in 2004. Counselling on tooth brushing was provided for 45.8% and 27.4% of the heavy and low users respectively. Oral hygiene education was provided for 71.7% of the heavy users and for 25.0% of the low users with periodontal pockets. Of the heavy users 43.2% and 22.6% of the low users had received fluoride varnish and dietary advice was only given to 4.3% of heavy users and 0.6% of low users.

The distribution of different treatments provided in 2004 to adult heavy and low users is presented in Figure 5.

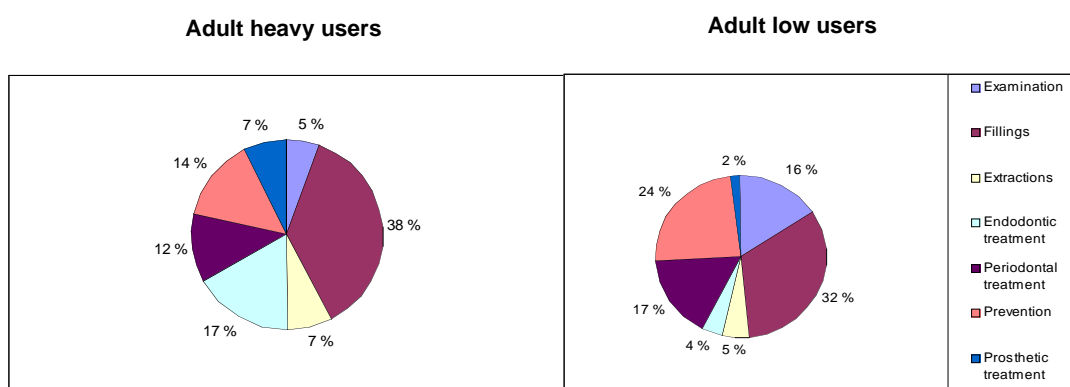


Figure 5. Distribution (%) of treatment measures provided for the heavy and low users of oral health services among adults in the PDS of Espoo in 2004.

5.2 Follow-up study results (Papers III, IV)

5.2.1 Demographic and service utilisation characteristics (III, IV)

Of the initial heavy users 86.0% revisited the PDS of Espoo during 2005–2009 compared with 78.0% of the initial low users ($p < 0.05$). Among the heavy users, 11.2% became persistent attenders and had 30 or more visits during 2005–2009.

Heavy users were older, to greater extent men and pensioners, and had lower social status than the low users. The persistent heavy users were even older, more than 80% of them were 45 years or older.

The mean number of all dental visits per year (3.0) during the follow-up period decreased for heavy users and was significantly lower than initially in 2004 (8.2; Table 5). Nevertheless, the mean number of visits remained higher compared with the low users. In the low user group, no significant differences could be seen. The use of dental hygienist services had increased somewhat; 53.5% of the heavy users and 49.0% of the low users (p=ns) had visited a dental hygienist during the follow-up period.

The mean number of dentists seen by the patients during the study period 2004–2009 was 5.7 for heavy users and 3.8 for low users (p<0.001). For persistent heavy users, the mean number of dentists seen was 9.4.

Table 5. Service utilisation characteristics of the adult heavy and low users of PDS of Espoo in baseline year 2004 and during the follow-up period 2005-2009.

	Heavy users		Low users	
	Baseline n=300	Follow-up n=258	Baseline n=314	Follow-up n=245
Mean annual number of all dental visits	8.2	3.0***	1.7	1.6
Mean annual number of visits to a dentist	7.3	2.6***	1.3	1.3
Mean annual number of visits to a dental hygienist	0.9	0.4***	0.3	0.3
Mean annual number of emergency visits	1.3	0.6***	0.6	0.06***
Proportion who made emergency visits %	67.9	74.8	50.0	21.6***
Proportion examined % (complete oral health status recorded)	63.3	67.0	62.7	66.9
Proportion who visited a dental hygienist %	44.0	53.5*	23.8	49.0***

*** p<0.001, * p<0.05

5.2.2 Treatments provided and changes in oral health status (III, IV)

The decrease of total number of treatment measures for heavy users (73.2% after follow-up) and low user (31.7% after follow-up) is presented in Figure 6. During the follow-up period, heavy users had a significantly higher number of treatment measures except for examinations and treatment planning, compared with the low users. At least one examination was provided to 67.0% heavy users and to 66.9 % of low users and at least two examinations were provided to 46.1 % of heavy users and 46.5% of low users ($p=ns$) during 2004-2005.

During the follow-up period, most heavy users (74.8%) had emergency visits compared with 21.6% of the low users ($p<0.001$). Oral health status was not a significant predictor for emergency visits.

Restorative treatment was provided to 88.8% of the heavy and 79.6% of the low users during the follow-up period. Endodontic treatment remained more usual for heavy users, 44.2% of the heavy users had had at least one endodontic treatment measure compared with 24.1% of the low users ($p<0.001$). Of the heavy users, 26.0% had received at least one prosthetic treatment measure compared with 14.3% of the low users ($p=0.001$). Fixed prosthetic treatments were rare.

Periodontal treatment was provided to 63.6% of the heavy users and 64.5% of the low users ($p=ns$). Dental hygienists usually provided the periodontal treatment as well as most preventive treatments. For low users, most of the periodontal treatment measures given by dentist (63.3%) were carried out together with other treatment measures, mainly restorative treatment during the same visit. For heavy users, dentists performed 38.8% of the periodontal treatment measures during visits for other treatment measures and 31.0% of the periodontal treatment measures during separate visits between the other treatment visits. Dentists seldom started the treatment program with periodontal treatment measures, only 4.9% of the periodontal treatment measures were performed prior to restorative treatment for low users and 10.8% for heavy users. Dental hygienists also carried out most of the treatment measures either between the other visits or after the restorative treatment program, for 72.2% of the low users and for 85.4% of the heavy users.

As about 46% of patients had had a comprehensive examination initially and during the follow-up period and changes in dental status could be studied for these patients. Despite the high number of restorative treatment measures the mean changes in DMFT and DT were minor and not statistically significant. The patients had more periodontal diseases during the follow-up measured by the CPI-index, but also these changes were not statistically significant.

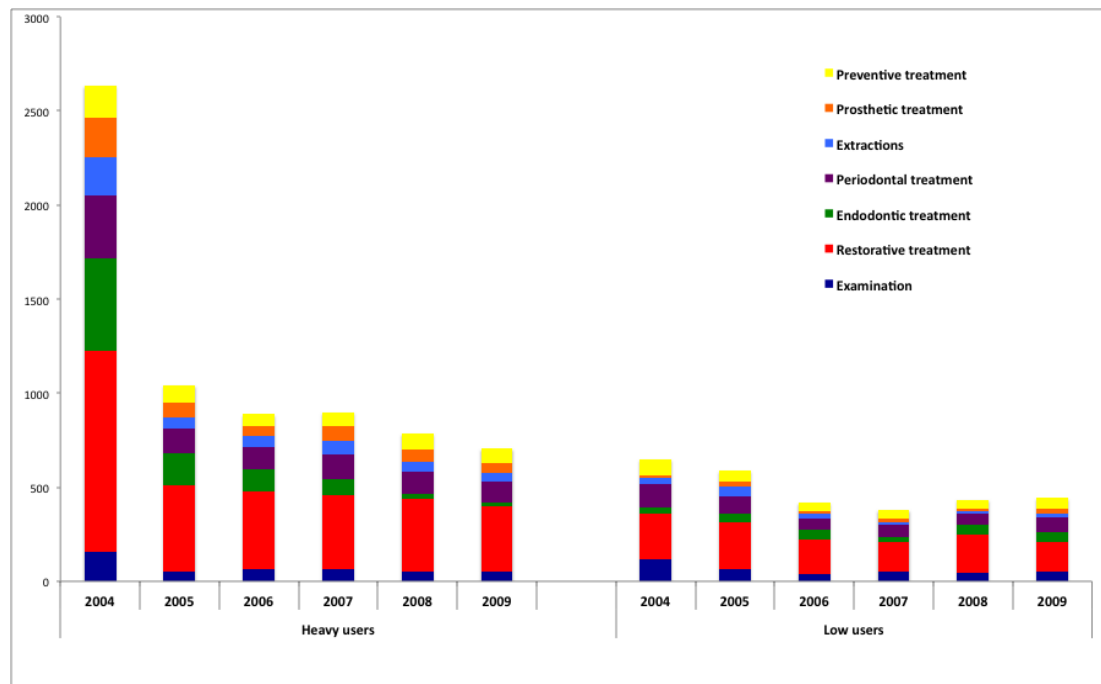


Figure 6. Total numbers of treatment procedures for heavy and low oral health service during 2004-2009.

5.2.3 Persistent heavy use of oral health services (III)

The determinants of persistent heavy use of oral health services were explored with logistic regression analysis (Table 6). The persistent heavy users ($n = 29$) had higher odds of being 65 years or older and being a pensioner (compared with the persistent low users ($n = 223$)). When adjusted for sex and age, having three or more decayed teeth and having had five or more different treating dentists remained significant risk variables. The persistent heavy users had higher risk for all different treatment measures compared with persistent low users when adjusted for sex and age. The highest risk was for emergency visits ($OR=7.9$, $p < 0.001$) when compared with persistent low users.

Table 6. Predictors (OR, 95% CI) of persistent heavy use of oral health services. Persistent heavy users (n=29) are compared with persistent low users (n=223).

Independent variables	OR (95% CI)	p-value
n=252		
Sex		
Male	Reference	
Female	1.0 (0.4, 2.1)	0.917
Age group (years)		
18-29	Reference	
30-44	0.4 (0.1, 2.2)	0.307
45-64	4.4 (1.2, 16.6)	0.027
65+	6.7 (1.7, 26.6)	0.007
Occupational status		
Students	Reference	
White-collar workers	1.6 (0.2, 12.9)	0.685
Blue-collar workers	3.7 (0.4, 31.8)	0.230
Pensioners	10.0 (1.2, 85.6)	0.036
General health status		
No chronic illnesses	Reference	
Self-reported chronic illnesses	1.6 (0.7, 3.9)	0.276
Oral health status in 2004		
0-19 teeth	Reference	
3 or more D teeth	7.4 (2.1, 26.5)	0.002
0-2 D teeth	Reference	
Periodontal pockets (CPI 3 or 4)	2.6 (0.7, 10.4)	0.162
No periodontal pockets	Reference	
Functional dentition, more than 20 teeth	0.3 (0.0, 2.7)	0.266
Number of treating dentists		
1-4	Reference	
5 or more	14.4 (5.5, 38.0)	<0.001
Type of treatment measures		
No such treatment measures in question	Reference	
Emergency	7.9 (3.0, 20.7)	<0.001
Examination	2.6 (1.7, 4.2)	<0.001
Radiographs	3.2 (2.2, 4.8)	<0.001
Restorative	1.4 (1.3, 1.6)	<0.001
Endodontic	1.7 (1.4, 2.1)	<0.001
Extractions	1.5 (1.2, 1.9)	<0.001
Prosthetic	1.4 (1.3, 2.0)	<0.001
Periodontal	1.3 (1.2, 1.5)	<0.001
Preventive	1.6 (1.3, 2.0)	<0.001

6 DISCUSSION

6.1 Methodological aspects

There is no consensus for the definition of heavy consumption of oral health services. The definition of frequent attenders in our study was an absolute numerical definition of six or more visits during a calendar year 2004. The criterion was chosen to include only patients who had benefited of substantial PDS resources. The mean number of adult visits was 2.7 and children and adolescent visits 2.1 in the Espoo PDS in 2004. Adult heavy users accounted for the top 10.4% of all adults, and, for children and adolescents, the frequent users accounted for 7.0 % of all children and adolescents. In primary medical care, the 10% of patients making the highest number of visits have most often been defined as frequent users (Vedsted and Christensen 2005) but in “real-life” clinical settings it might be more sensible to define and identify heavy users by number of visits. An interesting approach would be to use the total count of different treatment measures or estimate the strain of different treatment measures (Elonheimo 1999).

Due to the random sampling method used, our material can be considered representative of heavy and low users of oral health services in the city of Espoo. Routine register data was used in all studies. PDS dentists’ remuneration is partly based on standardised treatment item codes, defined by the Finnish Social Insurance Institution (KELA) and collected in the PDS register. As this encourages careful recording of the dental visits and treatment items, information on service utilisation and treatment provided to heavy and low users can be considered reliable. Because preventive treatment items do not contribute to extra compensation for PDS dentists, they might have been underestimated in this study. Nevertheless, the PDS dental hygienists do not get additional productivity bonus fees and they had carefully recorded the preventive treatment measures provided to heavy and low users.

The sample size was 10% of the heavy users and a comparison group had an equal number of the low users. The information concerning the number of visits was not accurate for all the patients. Patients were excluded when the number of visits was

incorrect. For heavy users, the problem was mainly that the patients did not show up for their appointments and these were unintentionally registered as visits or telephone contacts were registered as visits. For low users the problem was the opposite, unintentionally not all the actual visits were registered.

Methodological limitation

One limitation of our study is the lack of information concerning the possible dental visits to the private sector. It is probable that some of the heavy or low users had used both private and public sectors. A recent questionnaire study of middle aged Finnish adults from the metropolitan region showed that 9.2% of the respondents had used both the private and the public sector (Widström and Seppälä 2012).

Another limitation is the use of the *t*-test in the first two articles instead of a Mann–Whitney U-test although the Mann-Whitney test has greater efficiency than the *t*-test on non-normal distributions. However, the choice of the test did not change the statistical significances presented in the results.

6.2 Results of the study

For this study, three primary research questions were addressed. These were:

1) What are the demographic characteristics of heavy users of oral health services in the PDS in Espoo?

For both children and adolescents, and adults the heavy users of oral health services were significantly older than the low users. The adult heavy users had lower social status and more self-reported general health problems. In the follow-up study, the mean age in the group of persistent heavy users with complex oral health problems was even higher and this group had more retired persons than the other heavy users. This is of concern, as in the future we anticipate a greater number of older people with more retained teeth and this seems to lead to more complicated work for the oral health care personnel (Joshi et al. 1996) and more dental visits, unless regular dental care including timely and effective preventive care is organised for the elderly.

2) Why do these users make frequent visits?

For children and adolescents two main reasons for the frequent visits were: high numbers of orthodontic treatment occasions provided by dentists and high numbers of decayed teeth in a small number of children. The results showed clearly that the heavy use of oral health services was linked to orthodontic treatment. If the orthodontic treatments were carried out to a greater extent by a team of orthodontists and dental hygienists instead of non-specialised PDS dentists, the latter could allocate more time to treating adults and elderly.

Both the heavy and low users of PDS in Espoo had retained high numbers of teeth (mean number of teeth for both groups was over 25) and less than 1% of heavy low users were edentulous. It is well documented that number of teeth is one of the major factors influencing demand of oral care in adults (Suominen-Taipale 2008; Takehara and Shimoyama 2009). Edentulousness has declined rapidly in Finland; in 1980, 37% of women and 22% of men were edentulous; in 2000, the figures were 17% for women and 12% for men and by the year 2011, the figures had decreased to 10% of women and 9% of men (Suominen-Taipale 2008; Koskinen et al. 2012). The difference between the age groups was substantial; among those younger than 55-years of age, fewer than 1% were edentulous, but, among those 75 years or older, 46.7% of women and 28.7% of men were still edentulous in 2011 (Koskinen et al. 2012). Clinical Dental Technicians catered mainly for edentulous patients. In 2011 the mean number of teeth present was 22.7 for those aged 30 years or older in this regional study (Koskinen et al. 2012). The figure was still lower than in our study in 2004 for heavy or low users of PDS in Espoo. Espoo residents, in terms of education and personal income, are of high socio-economic status, consistent with having better oral health and a higher number of teeth in other populations (Haugejorden et al. 2008, Somkotra 2011).

The heavy users had more caries in need of restoration and more periodontal disease (shallow and deep periodontal pockets) than low users. Restorative treatment dominated in both groups at both the baseline year and during the follow-up. In 2004, 40% of all treatment measures were fillings for heavy users and 37% for low

users. In 2009, the figure was even higher for heavy users, as almost half of all treatment measures were restorative treatments and for low user the figure remained quite stable. Restorative treatment was common also for heavy users without active caries, confirming that they needed continuing maintenance and replacement of old restorations. A recent study of dentists' perceptions confirms that fractures and failures of fillings predominated as the reasons for which dentists reported performing replacements (Palotie and Vehkalahti 2012). It is known from other studies in Finland (Palotie and Vehkalahti 2002; Burke 2004, Forss and Widström 2004) that, after the recommendations in 1994 to avoid the use of amalgam for environmental reasons, composite fillings have been provided on broad indications, even in load bearing molars and in cases where prosthetic replacements would have been more suitable but the cost would have been too high for the patient. Studies indicate that the survival times for composite fillings are not very long (Van Nieuwenhuysen et al. 2003; Forss and Widström 2004). There is a need for critical analysis of indications and quality of restorative treatment procedures in the PDS. One solution would be for the PDS to offer longer lasting fixed prosthetic treatment to adults, in order to limit service consumption. The problem of PDS dentists avoiding prosthetic treatments could be solved by appropriate continuing education. The necessary prosthetic treatments for adults should also be subsidised so that the choice of treatment would not be influenced by the cost for the patient.

3) Did the frequent attenders benefit from their visits?

The follow-up study showed that, after the baseline year 2004, the mean number of visits made by the adult heavy users declined considerably and was only slightly higher than the mean number of visits made by adults in general in PDS in Espoo. The great majority of the frequent users were "transient" heavy users who seemed to have profited from their dental visits. A number of these initial frequent users were likely to have been new PDS patients in 2004 who had qualified for access to the PDS after the Dental Care Reform in 2002 and had accumulated treatment need. Nevertheless, 11.2% of the heavy users remained persistent and they had very high numbers of treatment measures. In particular, the high numbers of fillings required in

this group was alarming; 62.1% had more than 20 fillings during 2004-2009 and one persistent heavy user received 71 fillings during the six-year period.

Dental status could be analysed only for those patients who were examined at least twice. Only small and insignificant changes could be noted even for the heavy users who had made a high numbers of visits. It was not possible to draw conclusions on the benefit of care to the patient based on the dental status information; the status recording routines were too imprecise. Concerning the periodontal diagnosis and treatment, there seemed to be a notable gap between science and practise in the PDS. From the Finnish national studies, we know that the prevalence of edentulousness and dental caries has significantly decreased over the past 30 years (Suominen-Taipale 2008; Koskinen et al. 2012). This positive trend has not been observed for periodontal disease, which remains a major oral health problem in Finland. In our study, the quality of periodontal diagnosis was poor; the CPI index was the prevalent mode of recording periodontal status. There was no summary information on bleeding on probing or on the numbers of shallow and deep pockets and no notes on patients' oral hygiene levels so it was not possible to estimate periodontal treatment needs or the success of treatment for heavy or low users. In the baseline and the six-year follow-up examinations, periodontal charts were provided to only 4.3% of heavy users and 1.6% of low users. The recent Finnish current care guidelines on chronic periodontitis (2010) state that periodontal treatment measures should in general be carried out before other treatment measures. This was not current practice in Espoo as dentists rarely started the treatment program with periodontal treatment measures and also the periodontal treatment measures by dental hygienist were mainly performed between the other visits or after the restorative treatment program. The PDS in Espoo should improve the quality of the periodontal diagnostic practices and documentation and give priority to early detection and treatment of periodontal diseases. Preventive and periodontal treatment measures should systematically begin the treatment program and consequently the improvement in periodontal status could be evaluated during the following visits. The quality of restorative treatment measures improves when periodontal problems have been treated first.

Many emergency patients and those with other oral diseases than periodontal diseases missed the benefits of prevention. Both for children and adolescents and

adults, preventive care seems to be sporadic and not in accordance with patients' individual needs and risks of disease. For adults, our study showed that only about 50% of the heavy and low users had received any preventive treatment, including oral hygiene instruction, but almost 90% of the heavy users and 80% of the low users had received restorative treatment. Furthermore, preventive treatment was almost always offered only to patients who had periodontal treatment measures provided by dental hygienists. It seems that dentists do not value preventive care enough to make it an important part of their daily work. Almost a hundred years ago, in 1923, dental surgeon and researcher H. P. Pickerill wrote in his book "The Prevention of Dental Caries and Oral Sepsis": "If during the past one hundred years, half as much time, money and brain power had been spent on the prevention of dental caries as had been spent on the perfecting of ways and means of replacing artificially tissue lost by disease, there can be no doubt that the present condition of affairs would not have come about". It is worrying that, still today, oral care mainly focuses on treating the consequences of diseases and not the causes, which certainly leads to unnecessary procedures.

Limitations of the results

The PDS of Espoo was chosen to this study because the researcher was working there as a dentist and later as a specialist during the study period. It was recognised from the beginning that Espoo is a wealthy area and employment rate, income and education levels are above national average. Therefore as our results are limited to only the PDS of Espoo all the results cannot be extrapolated to all the PDS units in Finland or to private practice. However, it is reasonable to presume that work of dentists rather parallel in different PDS units in Finland.

6.3 General aspects and recommendations

The early recognition of the patients at risk of becoming heavy consumers of oral health services, especially persistent heavy users, is important for the patient, the dental team and the oral health care provision system. It seems that many heavy consumers of the PDS use the services without a proper examination and treatment plan and their needs remain unidentified. When the dentist's and the dental hygienists' knowledge of the patient is poor and the patient is seen mainly on emergency visits, the heavy use of services may continue unrecognised for a long period of time, causing a drain of resources for all three parties: the patient, the dental team and the PDS.

It is generally agreed in primary health care that the frequent users need a comprehensive approach to treatment and a multi-disciplinary team responsible for the treatment (Larivaara 1987; Jyväsjarvi et al. 1998, Koskela 2008). This team should have regular meetings to deal with the frequent attenders. As the treatment of heavy users and especially persistent heavy users is demanding, the same approach should be adopted in oral health services. All patients and especially the persistent heavy users should be offered a responsible team of a dentist and a dental hygienist who could consult dental specialists and medical doctors when needed. This is especially important as the frequent changes of treating dentist can lead to an elevated number of restorative treatments (Korhonen et al. 2009).

The heavy users and especially the persistent heavy users in this study made high numbers of emergency visits. It has been documented that problem-oriented users have poorer oral health and tend to have more emergency visits than regular attenders (Kay 1999; Crocombe et al. 2012). The PDS advises individualised recall intervals based in theory on patient needs and they often exceed one year. Unfortunately, after the Dental Care Reform, most PDS units in Finland were overwhelmed and were unable to recall any adult patients (Widström et al. 2010). A recent Finnish study (Widström et al. 2013) showed that there is a great difference in adults' attendance patterns between the private and public sectors. In private practice, most adults attended regularly but, in the PDS, this is much more irregular. The PDS should encourage regular utilization of oral health services by actively offering recall

intervals based on patients' oral health status and risk factors. Reducing heavy use of dental services would free resources and these resources could be used to better manage the adult dental health effectively.

The number of patient visits (for example, the number of patients seen per hour) has been used to measure the effectiveness of oral health care provision system (Whelton 2003), but the numbers of visits tell little about the quality of care or patient satisfaction. The numbers of treatment items provided to patients have also been used to measure effectiveness.

Paying productivity fees to PDS dentists certainly increases the productivity measured by the quantity of different treatment items performed. Are the dentists being paid for the proper performance? Pay-for performance incentive systems that have been gaining acceptance in medicine have also been considered for implementation in dentistry (Voinea-Griffin et al. 2010). These programs attempt to link provider reimbursement to improvements in healthcare quality. Unfortunately, some of the key elements in these systems, such as clear objectives, definable units of assessment, valid performance and quality indicators, analysis and interpretation of performance data, performance standards and financial rewards have not been sufficiently developed hitherto in oral health care.

As each financing system seems to have possible adverse side effects, focus should be placed on the individual care provider in relation to ethics, norms and quality of care (Grytten 2005). In order to provide ethical and good quality care to patients, the care providers should receive the necessary resources. This should include necessary continuing education for the care providers and clinical treatment routines need to be adjusted accordingly.

After the 2002 Dental Care Reform, the PDS had an important role in improving equity in the use of dental services in Finland, by offering care to adults who did not have the financial means or the wish to use the private sector. The changing needs and demands of adult and elderly populations will further put pressure on the PDS, therefore aiming for good quality care and avoiding unnecessary procedures is important.

There are many interesting and important implications for future research as this research area have been little investigated. For future research, an interesting question is to what extent are the heavy users of dental services also frequent attenders in primary health care. Another important question is how to reduce the attendance rates of heavy consumers and especially the persistent heavy users. According to our study, heavy consumption seems to be predominantly a temporary phenomenon, therefore greater attention should be placed on persistent frequent users. The next step would be to plan intervention studies in order to reduce the heavy consumption of oral health services.

7 CONCLUSIONS

The heavy users (7% of children and adolescents and 10.4% of adults), defined in this study as those who made six or more visits during a calendar year, consume substantial PDS resources.

Adult heavy users were older, had lower social status and more oral diseases (dental caries and periodontal diseases) and needed more complicated treatments than adult low users.

Only a small proportion of adult heavy users (11.2%) remained persistent heavy users during a 5-year follow-up period. The persistent heavy users visited several dentists and made high numbers of emergency visits.

The PDS should seek to identify early patients at risk of becoming persistent heavy users, and each such patient should be allocated to a dental team (dentist and/or dental hygienist), which will be responsible for that person's care.

Dental clinical recordings were imprecise and it was not possible to detect changes in oral health status. Recordings should be improved to monitor better oral health status of adult patients in PDS.

In order to reduce heavy consumption of oral health care, the quality of care in the PDS needs to be improved. All patients should be offered proper examinations and treatment plans, including individualised preventive measures and regular care with individual recall intervals.

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Annamari Nihtilä

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