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**EERO RAITTIO**

**USE OF ORAL HEALTH CARE SERVICES AND  
PERCEIVED ORAL HEALTH AFTER THE ORAL HEALTH  
CARE REFORM INTRODUCED DURING 2001–2002**

*The More Comprehensive Public Coverage of Oral Health Care,  
the Lower Socioeconomic Inequalities?*



*Use of Oral Health Care Services and  
Perceived Oral Health after the Oral Health  
Care Reform Introduced during 2001–2002*



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Use of Oral Health Services and Perceived Oral Health after the Oral Health Care Reform Introduced during 2001–2002. The More Comprehensive Public Coverage of Oral Health Care, the Lower Socioeconomic Inequalities?

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## ABSTRACT

Between 2001 and 2002, major legislative changes were made in Finland; public coverage of oral health care extended to cover the whole population. Effects of the reform on the distribution of oral health and use of oral health care services by socioeconomic strata have not been examined in enough detail, despite the fact that the major aim of the reform was to decrease age-related, regional and socioeconomic differences in the use of oral health care services and thus also in oral health. This study, investigated how these legislative changes have affected the socioeconomic differences in the use of oral health care, the perceived oral health and oral health-related quality of life (OHRQoL) among adult Finns.

Three identical and nationally representative postal surveys, focusing on the use of oral health care and oral health, were conducted before the reform in 2001 and two times after the reform in 2004 and 2007. Study population concerned adult Finns born in 1970 or earlier. Data were analyzed using logistic regression analyses, concentration index and its decomposition, slope and relative index of inequality.

The use of oral health care services increased in the study population from 2001 to 2007. The increased use stemmed from clearly increased use of Public Dental Services. Socioeconomic inequity in the use decreased slightly from 2001 to 2007. Income and regular dental visiting explained most of the inequity.

OHRQoL improved in the study population from 2001 to 2007. Socioeconomic inequality in it remained on the same level throughout the study years. Income, perceived general health and the number of missing teeth and inequality in these factors explained most of the inequality in OHRQoL.

No changes in levels of self-rated poor oral health or reported toothache occurred from 2001 to 2007. Instead, perceived need for oral health care clearly decreased in the study population. Socioeconomic inequality in self-rated oral health remained, while socioeconomic inequalities in reporting toothache and need for care increased clearly from 2001 to 2007. Most of the inequalities were related to income and perceived general health.

The use of services and satisfaction with last treatment period and inequalities in them explained relatively small part (10-20%) of the inequalities in OHRQoL already in 2001, but seemed to have a clearly greater role in explaining the inequality in self-rated oral health and perceived need for care. All these contributions diminished (approximately 35-85%) from 2001 to 2007, probably at least partly due to the major reform.

Despite the increased use of services and slightly decreased socioeconomic inequity in the use after the reform, inequalities in OHRQoL and perceived oral health seemed to remain or even increase among +30 years old adult Finns.



Raittio, Eero

Suun terveydenhuoltopalvelujen käyttö ja koettu suunterveys vuosina 2001–2002 toteutetun hammashoitouudistuksen jälkeen. Kattavampi julkinen tuki suun terveydenhuoltopalveluille, pienemmät sosioekonomiset erot?

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## TIIVISTELMÄ

Koko Suomen väestö tuli julkisesti tuettujen suun terveydenhuoltopalvelujen piiriin vuosien 2001 ja 2002 aikana toimeenpantujen lakimuutosten myötä. Uudistuksen keskeisenä tavoitteena oli vähentää hoitoon hakeutumista estäviä, ikään, asuinpaikkaan ja toimeentuloon, liittyviä tekijöitä. Tässä tutkimuksessa selvitettiin, kuinka uudistus vaikutti suun terveydenhuoltopalvelujen käytön, koetun suunterveyden ja suunterveyteen liittyvän elämänlaadun sosioekonomisiin eroihin ja niitä selittäviin tekijöihin suomalaisessa aikuisväestössä.

Vuonna 1970 tai sitä ennen syntyneiden suomalaisten suunterveyttä ja suun terveydenhuoltopalvelujen käyttöä selvitettiin vuosina 2001, 2004 ja 2007 toteutetuilla kansallisesti edustavilla postikyselyillä. Aineisto analysoitiin käyttämällä logistista regressioanalyysiä ja eriarvoisuusmittareita (konsentraatioindeksi, slope and relative index of inequality).

Suun terveydenhuoltopalvelujen, erityisesti terveystieteiden palvelujen, käyttö yleistyi tutkimusväestössä uudistuksen jälkeen. Paremmassa sosioekonomisessa asemassa olleet käyttivät arvioituun hoidon tarpeeseensa nähden yleisemmin palveluja kuin heikommassa asemassa olleet, tämä ero pieneni hieman vuodesta 2001 vuoteen 2007. Eroa selittivät kotitalouden tulot ja hammashoidossa käytetty raha.

Tutkimusväestön suunterveyteen liittyvä elämänlaatu parani vuodesta 2001 vuoteen 2007. Sen jakautumisessa sosioekonomisen aseman mukaan ei tapahtunut merkittäviä muutoksia tutkimusvuosina; mitä korkeampi sosioekonominen asema, sitä parempi elämänlaatu. Tätä selittivät kotitalouden tulot, koettu terveys ja puuttuvien hampaiden määrä.

Koetussa suunterveydessä tai hammassäryn yleisyydessä ei tapahtunut muutoksia tutkimusvuosina. Koettu hammashoidon tarve puolestaan väheni. Sosioekonomiset erot hammassäryn ja koetun hammashoidon tarpeen yleisyydessä kasvoivat merkittävästi uudistuksen jälkeen. Koetun suunterveyden sosioekonomiset erot olivat samalla tasolla kaikkina tutkimusvuosina. Merkittävimmät sosioekonomisten erojen selittäjät olivat kotitalouden tulot ja koettu terveys.

Palvelujen käyttö ja tyytyväisyys saatuun hoitoon sekä niissä olevat sosioekonomiset erot selittivät osan havaitusta sosioekonomisista eroista elämänlaadussa (10–20%) ja koetussa suunterveydessä (35–85%). Selitysosuudet pienenevät vuodesta 2001 vuoteen 2007, todennäköisesti ainakin osin uudistuksen vaikutuksesta.

Näyttää siltä, että huolimatta suun terveydenhuoltopalvelujen käytön lisääntymisestä ja palvelujen käytön sosioekonomisten erojen kaventumisesta uudistuksen jälkeen, koetun suunterveyden ja suunterveyteen liittyvän elämänlaadun sosioekonomiset erot eivät kaventuneet yli 30-vuotiaiden suomalaisten keskuudessa.

Luokitus: WA 30, WA540 GF5, WU 29, WU 30, WU 32.1, WU 80

Yleinen Suomalainen asiasanasto: suun terveys, sosioekonomiset tekijät, suun terveydenhuolto, terveystieteiden politiikka, hammashoito



# List of the original publications

This dissertation is based on the following original publications:

- I Raittio E, Kiiskinen U, Helminen S, Aromaa A and Suominen AL. Dental attendance among adult Finns after a major oral health care reform. *Community Dentistry and Oral Epidemiology* 42: 591-602, 2014.
- II Raittio E, Kiiskinen U, Helminen S, Aromaa A and Suominen AL. Income-related inequality and inequity in the use of dental services in Finland after a major subsidization reform. *Community Dentistry and Oral Epidemiology* 43: 240-54, 2015.
- III Raittio E, Lahti S, Kiiskinen U, Helminen S, Aromaa A and Suominen AL. Inequality in oral health-related quality of life before and after a major subsidization reform. *European Journal of Oral Sciences* 123: 267-75, 2015.
- IV Raittio E, Aromaa A, Kiiskinen U, Helminen S and Suominen AL. Income-related inequality in perceived oral health among adult Finns before and after a major dental subsidization reform. *Acta Odontologica Scandinavica*, 2016. (Published online ahead of print)

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# Abbreviations

CI	Concentration index
FOVO	Fairly often, very often
NHI	National Health Insurance
OECD	Organization for Economic Cooperation and Development
OFOVO	Occasionally, fairly often, very often
OHCR	Oral Health Care Reform
OHIP	Oral Health Impact Profile
OHRQoL	Oral health-related quality of life
PDS	Public dental services
RII	Relative index of inequality
SII	Slope index of inequality



# 1 Introduction

Health care services are generally seen as a public good. Diseases, accidents and ill-health are notable problems within the human life; hence health of the population is socially and economically important. Therefore, the health of the population and factors affecting it are of great interest to public authorities and policy makers. In practice, all developed countries have organized health systems to prevent health risks and to treat maladies. In many countries public authorities involve directly in arranging health care services. [1]

Health care system characteristics and development reflect major political traditions (liberal, conservative, social democratic) as well as economic and social organization of a society [2]. However, the picture is not straightforward. For instance, the rather quick development of public health care systems occurred in social democratic Denmark, Sweden and Norway, but also in the liberal United Kingdom after the World War II. Whereas, many conservative European countries, for example, Germany, France, Hungary and Belgium, adopted comprehensive national health care systems based on social health insurance, origins dating back to Otto von Bismarck's reforms in Germany in the 1890s. [3]

Health care systems are labor and capital intensive, and typically complicated [4]. They have been developed and reformed in stages [4]. Unsurprisingly, development of health care systems has been time-consuming [4]. For example, the National Health Service in the United Kingdom has been under development work since its foundation [5]. In contrast to the era of building up more and more comprehensive health care systems in many Western countries in the mid-20<sup>th</sup> century [3], "changes [made in health care systems in high-income countries during the last 25 years] have been remarkably consistent in different countries and under successive governments, regardless of their political affiliation. The emphasis has unswervingly been on promoting choice, competition, and the role of markets in health care, ostensibly to drive up quality, stimulate innovation, and promote greater equity" [6]. Another important reason behind the recent health care system reforms in the Western countries has been cost containment during last decades.

In the first half of the 20<sup>th</sup> century Finland was a poor agricultural country. Industrialization, urbanization and build-up of Nordic welfare system occurred relatively fast in Finland during the 1960s and 1970s, clearly later than in other Nordic countries. Sweden was a main source of influence in many areas of welfare state development, including health care system development [7]. However, scarcity of resources, in comparison with other Nordic countries, had limited the development in Finland before the 2000s [7,8]. In addition, social expenditure, in relation to gross domestic product, had also been lower in Finland than in Denmark and Sweden before the 2010s [9]. Understandably, Finland is occasionally described as a "poor man's Nordic welfare state" [10]. During the last 50 years, Finland has developed a unique, comprehensive, complex, extremely decentralized and multisource-financed health care system [3]. Coverage of health care expanded in Finland still in the 2000s, when public coverage of oral health care services expanded substantially. These kind of reforms were already made in Sweden and Denmark during the 1970s [11,12].

Oral health care systems have also been greatly improved since the early twentieth century. In some countries, oral health care has primarily been seen as a sub-specialty of medicine, while in others oral health care, and other health care have been seen (and therefore developed) as separate systems [13]. This of course has affected the development of oral health care systems in different countries [13].

Information about health, wellbeing, ability function and factors affecting them (e.g. health care use) are necessary for a rational health policy. National health studies are valuable in providing the information. In Finland, the Social Insurance Institution conducted the first extensive national health interview studies in 1964 [14] and further studies in 1967, 1976, 1987

and 1995/6. The Mini-Finland study [15] was the first national (clinical) health examination and interview study, and it was conducted by Social Insurance Institution in 1977-80. Further (and partly follow-up) studies were conducted by the Social Insurance Institution and the National Institute for Health and Welfare (formerly the National Public Health Institute) in 2000 and 2011. All these studies also included, at least some information about oral health and oral health care service use.

In the early 2000s major legislative changes extending public coverage of oral health care, were made in Finland. Effects of the reform on the distribution of oral health and use of oral health care services by socioeconomic strata have not been examined in enough detail, despite the fact that the major aim of the reform was to decrease age-related, regional and socioeconomic differences in the use of oral health care services and thus in oral health. In this doctoral thesis, it was investigated how these legislative changes have affected the socioeconomic differences in the (perceived) oral health and the use of oral health care among adult Finns.

## 2 *Review of Literature*

In this next section, firstly, some essential characters of health care systems and development of Finnish oral health care system are briefly reviewed. Then, these considerations are discussed in the light of socioeconomic differences in health and the use of health care services including oral health and oral health care. Finally, literature on socioeconomic differences in oral health and the use of oral health care services in Finland are reviewed.

### 2.1 HEALTH CARE SYSTEMS

According to the Finnish Health Care Act: "Health care services shall encompass health and welfare promotion, primary health care, and specialized medical care." In this thesis, health care system refers to the entirety of an organization; delivery, funding, goals, policymaking and governance of health care services. The oral health care system is a part of the health care system which involves care and prevention of oral diseases. This care and prevention is given by oral health care professionals (i.e. dentists, dental hygienists, dental nurses).

#### 2.1.1 Health care

"Without strong policies and leadership, health systems do not spontaneously provide balanced responses to these challenges, nor do they make the most efficient use of their resources." National health policies have typically noble aims and commitments, e.g. commitment to advance health equity and to ensure equal access to care. [16]

Equal access to health care services is defined as a fundamental right in almost all developed countries [1]. Universal health coverage can be seen as an inherent embodiment of this endeavor. The World Health Organization [17] defines universal health coverage as a "situation where the whole population of a country has access to good quality services according to needs and preferences, regardless of income level, social status, or residency." And where same scope of benefits are extended to the whole population but the range of benefits can vary between contexts; and it incorporates the policy objectives of equity in payments, financial protection and equity of access or use [17,18]. However, this is just an optimum situation, and e.g. the OECD (Organization for Economic Cooperation and Development) sees universal health coverage as a situation where the whole population is entitled to receive "a core set of health care goods and services under public programmes and through private insurance" [19], i.e. actual access to care is not considered. In practice, it is possible that, universal health coverage defined by the World Health Organization is not present anywhere.

Since the mid-1900s, three main ways of funding health care services and sharing the (financial and social) risks of health hazards collectively and providing services have occurred in the Western countries:

- general taxation (Beveridge model)
  - Public authorities organize the funding by taxation or fees under public law
  - Typically services are provided by public sector
  - Nordic countries, the UK, Southern and Eastern European countries
- social insurance (Bismarck model)
  - Funds for compulsory health insurance are usually collected with insurance premiums levied on the employee and employer.
  - Typically mix of public and private health service providers
  - Germany, France, Belgium, the Netherlands, Switzerland

- private insurance
  - Community, not-for-profit private or for-profit commercial health insurance
  - Public or private management
  - Voluntary or mandatory
  - Financed typically through employer, employee, individual or family contributions which are either risk- or income-related.
  - Health services are typically provided primarily by a private sector
  - the USA

It must also be noted that in many systems at least a part of the funding comes from out-of-pocket payments. Moreover, it should be noted that this is just a broad division. For example, typically, there is a combination of social and private insurance schemes, whereas the extreme types are not very common. Finland is another kind of extreme example; there are both comprehensive general taxation and social insurance based systems. There is also great variation in practices within the categories, for example, generosity and comprehensiveness of health care systems and the organization responsible for health care services vary greatly from country to country despite rather similar general taxation funding and publicly provided services. [1,3,20,21]

Public authorities generally steer and organize nationwide actions and strategies ensuring that appropriate health care services are provided at right place and at right time. General division to primary and secondary health care and hospital districts, in addition to standards, norms and guidelines concerning, for instance, patient safety, access to care and quality of care are examples of such actions. [16]

Funding and organizing authorities also control and govern health service providers through keeping cash flow under control. Personnel costs are remarkable in health care, and so the payment model is crucial. On the other hand, it seems likely that the payment model affects the decisions of operators (doctors, dentists and so on). The three main payment models are:

- Fixed salary system; salaried employees. Typical in general taxation-based models.
- Capitation system; pay is a fixed sum based on, for example, the amount of population assigned to them and population characteristics (e.g. age, sex, health status). Typical in both general taxation and insurance based models.
- Fee-for-service; pay is based on identified prices of services. Typical in insurance based models.

Again, these are just extreme types. For example, payment for Finnish public dental service dentists is based both on a fixed salary and fee-for-service models. [1,22]

“The health workforce is central to achieving health. A well performing workforce is one that is responsive to the needs and expectations of people, is fair and efficient to achieve the best outcomes possible given available resources and circumstances.” [16] Therefore, it is common that public authorities steer e.g. education of health professionals, job related norms, deployment of support systems and also enable cooperation of all stakeholders (e.g. donor coordination groups, professional associations, communities). [16]

### **2.1.2 The Nordic model**

It is commonly perceived that the collective history of the Nordic countries (i.e. Sweden, Norway, Denmark, Finland and Iceland) has led to rather similar welfare states. The Nordic or Scandinavian or social democratic welfare model is characterized by the great role of the state in welfare arrangements (stateness), universal social rights (universalism) and equality. [23,24]

There are also broad similarities in goals and basic commonalities in the structure of health care systems in these countries. The possibility to influence the health care system (e.g. through elections and public hearings) and equity in health and access to health care services (with focus on geographical and social equity) are elevated aspirations of Nordic health care systems. Nordic health care systems are predominantly funded by general taxation. In

addition, health care delivery structure is mainly publicly owned or controlled. Decentralized public governance of the health care system is also typical in Nordic countries. In addition, children are typically the ones who enjoy most comprehensive and generous welfare benefits in these countries. [24]

### 2.1.3 Oral health care

The above mentioned basic principles of health care systems holds good also in oral health care systems. However, there are some typical differences. As it was already mentioned, grade of integration between oral health care and health care varies from country to country. This reflects the organization, financing, delivery, education, personnel and course of action in the current oral health care systems in these countries. Evidently, the systems also reflect on other institutional, as well as historical and political context. For example, Finnish oral health care system has been developed separately from other health care since Emperor's declaration in 1869. [3,13,22]

As public resources are finite in all countries, it can be seen justified to arrange publicly (or subsidize) "core services" only, for example essential drugs and to cover the vulnerable groups in particular [1]. Thus, as they are not seen as a fundamental part of the health care systems, for example eye and oral health care services are commonly lower subsidized than the core services or they are completely excluded from public schemes [13,20,22,25]. Role of the citizens as direct funders of these services is greater and out-of-pocket payments are higher than in other health care [19]. Nordic countries are not exception. In fact, out-of-pocket expenditure of total expenditure on oral health care is higher in Nordic countries than OECD average (26 countries) [19].

The private sector has traditionally been a greater operator in oral health care, particularly in adults' oral health care. For example, in Finland, private entrepreneurship was common among dentists in mid-20<sup>th</sup> century, and group practices and corporations have become more and more notable operators in private oral health care over the past three decades. Overall, it is not a surprise that private sector has also been seen as a natural part of the oral health care system, and the boundary between public and private oral health care is not deemed as pronounced as in other health care, and for example, in Finland, co-operation between the sectors has long and generally been emphasized as being fruitful. [3,26,27]

Oral health care systems and subsidization of oral health care, in particular have traditionally focused on children (and healthy mobile young adults) in many countries over the years [13]. On the one hand, this has been a result of the idea that establishing a solid foundation of oral health and oral health-related behaviors through regular examinations and prevention results in better oral health in adulthood [13]. On the other hand, it can be seen that the focus of subsidized oral health care on children is about cost containment in public health care [1]. In addition, effective early treatment and prevention of dental diseases among children could contain costs, if it leads to sustainable good oral health in adulthood (and less need for care). Furthermore, it is clear that leaving the adult population without public coverage regardless of their oral health status is a low-priced solution. Overall, during the last decades, higher and higher priority has been given to adult oral health care e.g. in Finland and Sweden [28].

Contrary to typical problem-driven care-seeking in other health care, the role of regular use of oral health care services in maintaining oral health has long been emphasized [29]. Regular dental check-ups, early treatment and preventive orientation in oral health care are generally seen important and effective. At least during the last three decades, the personalized check-up intervals have been used instead of annual check-ups for all [29]. In practice, it is viewed that everyone needs these regular check-ups [30], and problem-oriented oral health care seeking is not recommended for anyone.

#### **2.1.4 Finnish oral health care system**

Table 1 shows how the Finnish oral health care system has been gradually developed since 1957 when municipalities were instructed to organize free oral health care for children in primary schools. In 1972, The Primary Health Care Act was implemented. Since then, public oral health care has been considered as a part of other primary health care governed by the state but operated by local communities. Guaranteeing public oral health care for the children (0-18 year olds) and equal regional availability of oral health care have been given heavy weight since then. During the 1980s, discussion about more comprehensive oral health care systems and equity in oral health care delivery intensified. For example, in the Finnish Health for All by the Year 2000 program [31], it was stated that the whole adult population is under subsidized oral health care by the year 2000 and that it is unacceptable that the use of oral health care services depends clearly on residential location, income or wealth. Concrete changes were made in the late 1980s, when young adults (born in 1958 or later) were gradually given entitlement to receive subsidized care at both private and public sector.



*Table 1. Summary of gradual development of Finnish oral health care system 1957-2015 [3,32,33].*

<b>Public Dental Services</b>	<b>Year</b>	<b>Subsidized private oral health care services</b>
Free oral health care for children (7-14 year olds) in all schools.	1957	
Primary Health Care Act. Free oral health care for under 17-year-olds in Public dental services (PDS). If municipality had sufficient resources, PDS had possibility to provide care (subject to a fixed, well subsidized, charge) for the older too.	1972	
Municipalities had to provide PDS for those younger adults born in 1961 or later.	1986	National Health Insurance (NHI) partly reimbursed private dentist's care costs for those younger adults born in 1961 or later.
Coverage of PDS gradually extended to include those adults born in 1956 or later.	1988-1990	Coverage of NHI reimbursements gradually extended to include those adults born in 1956 or later.
Costs of health care were no longer tax deductible. Central steering was reduced; freedom of municipalities to arrange public health care increased.	1991-1993	Costs of health care were no longer tax deductible.
	1997	Adults born in 1955 or earlier were entitled to one subsidized dental check-up or preventive care given by private dentist to the year 2000.
All age restrictions on accessing to PDS were gradually abolished (Oral Health Care Reform). The whole population was entitled to use PDS.	2001-2002	All age restrictions on NHI coverage were gradually abolished (Oral Health Care Reform). The whole population was covered.
Reform that aimed to guarantee access to public health care in a reasonable period of time (less than half a year) was implemented.	2005	
	2008	Level of reimbursements from NHI increased.
	2010	NHI coverage extended to include care provided by dental hygienists.
	2015	Level of reimbursements from NHI decreased.

In 1983, Committee on Dental Care [26] saw it necessary to use both public and private oral health care delivery to provide subsidies equally in the whole of Finland. The use of private dentist's care became subsidized in 1986, and since then there has been two parallel systems providing subsidized oral health care in Finland: the private sector and the Public Dental Services (PDS). The costs of care (excluding orthodontic and prosthetic care) given by a private dentist is partly subsidized by social insurance system maintained by the Social Insurance Institution. The prices are freely set by private practitioners, however, reimbursements from the National Health Insurance (NHI) is fixed according to treatment. Reimbursement level has not followed actual prices at private oral health care; year by year difference between reimbursement and actual price has increased (Figure 1). Fee-for-service payment model is typical in the private sector. Private services are concentrated on the bigger (university) cities. PDS are provided by municipalities (452 in 2000, 313 in 2016), either by themselves or as cooperative efforts between several municipalities. PDS are funded partly by municipal and state taxes (two-thirds) and partly by client fees (one-third). PDS dentists are salaried but a part of their payment is based on fee-for-service basis. PDS are provided in every municipality. Despite the original idea that the costs of the use of private and public oral health care should be rather equal [26], out-of-pocket payments in the private sector are (in the present) approximately at least twice higher than those in the PDS, despite the reimbursements from the NHI. Sectors are quite equal-sized in terms of dental personnel. Overall, it can be said that the Finnish oral health care system is a complex combination of numerous private and public care organizers and providers, and its funding is based on direct out-of-pocket payments and on both tax-funded and social insurance systems (Figure 2).

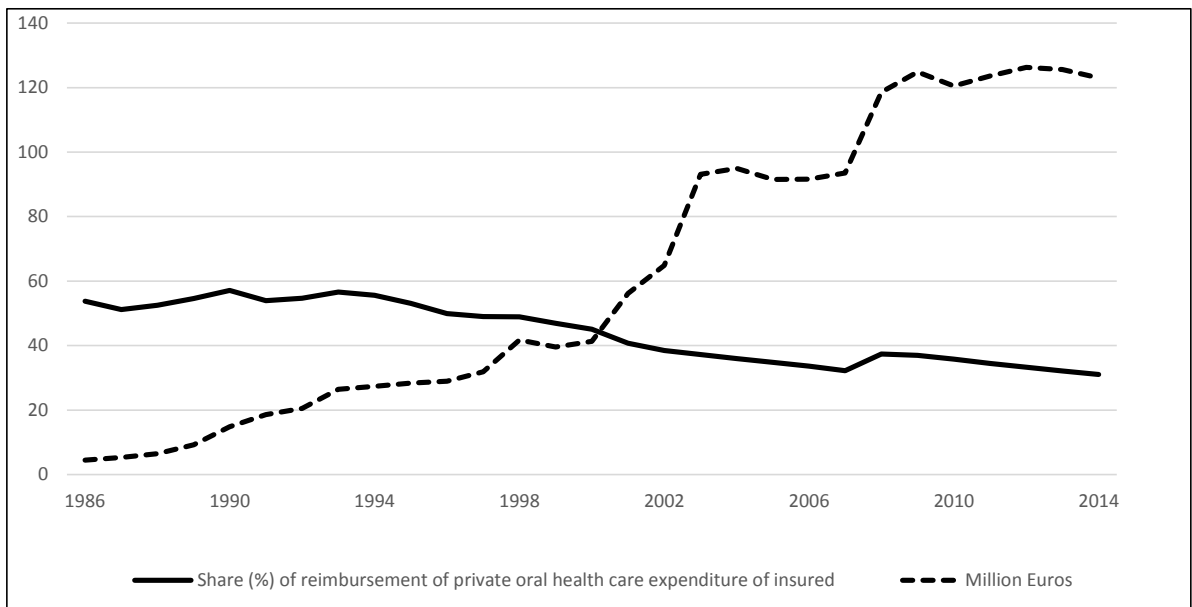


Figure 1. Level and total costs of the National Health Insurance reimbursements for using private oral health care (data from [kela.fi/tilastot](http://kela.fi/tilastot)).

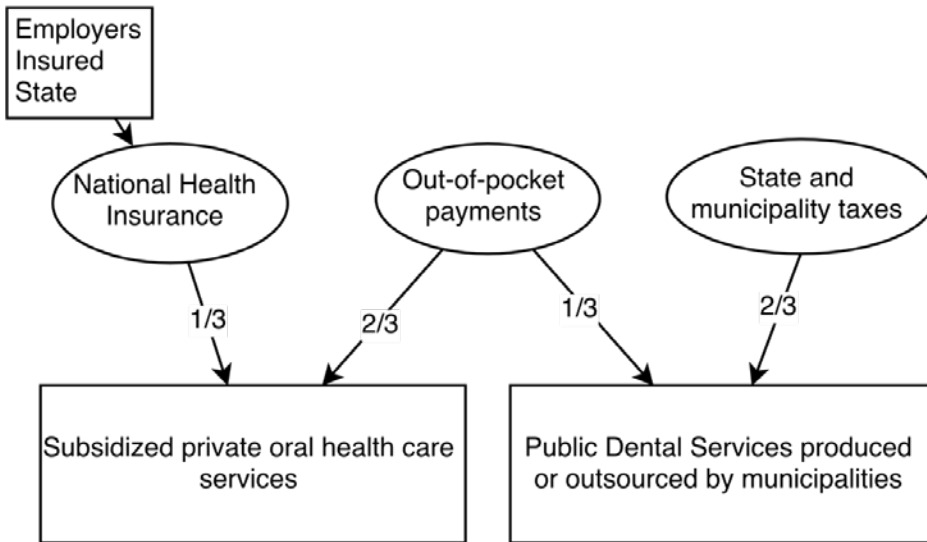


Figure 2. Summary of the current Finnish oral health care system and its funding.

The government slowed down the planned expansion of oral health care coverage due to the recession in the early 1990s, and only minor changes were made during the 1990s. In the late 1990s, adults who were born in 1955 or earlier were not entitled to subsidized oral health care in Finland. They did not have access to PDS and were not entitled to receive reimbursement for private oral health care costs from the NHI. They were thus required to pay the full costs of their oral health care. However, it was estimated that one-third of the adult population lived in municipalities that were able, temporarily and voluntarily, to provide PDS for their inhabitants born in 1955 or earlier. These municipalities were typically smaller ones. In contrast, some municipalities were not able to supply services even to those entitled to receive them. It was estimated that in these, typically bigger, municipalities lived one-third of the Finnish population in the 1990s. Overall, there were clear regional- and age-related and also socioeconomic differences in access to oral health care in the late 1990s. [34]

All age restrictions were gradually abolished following the introduction of the major Oral Health Care Reform (OHCR) between 2001 and 2002. In the first phase of the OHCR, in spring 2001, entitlements to use PDS and to receive reimbursements from the NHI were extended to cover those born between 1946 and 1955. In the second phase, in December 2002, all age restrictions were abolished. Since then, the entire Finnish population has been entitled to use PDS and to receive reimbursements from the NHI for their private oral health care costs.

The aim of the reform was to improve oral health in the whole population and to improve access to oral health care services, promote greater equity in the use of services, as well as reduce the financial barrier on care-seeking and receiving treatment. Another aim was to harmonize oral health care with other health care: the provided care should be based on need for care, not on e.g. the age of individual. The use of oral health services was expected to increase, no dramatic move from using private to public sector was expected to be seen [35,36].

In many municipalities, PDS has been congested since the OHCR; in addition to longer treatment queues, treatment periods have prolonged and there has been problems in treating high-need patients [37-40]. Meanwhile, in the private sector there is a clear overcapacity in bigger municipalities; however, vast majority of private dentists feel that the demand for their care is reasonable [41].

Over the past decade, limited access to medical care was the main concern in public health care in Finland, including PDS. Legislative reforms aiming to guarantee access to care in a

reasonable period of time (less than half a year) and to standardize medical (dental) assessment on the need for care were introduced in 2005. The government also encouraged the health care sector to make the system more effective, for example by developing distribution of work. [42]

In addition to legislative changes (normative steering), public authorities have regulated supply of oral health professionals (and thereafter also supply of oral health care services) by regulating student intake. The manpower in oral health care services increased steadily during the latter half of 20th century. In the first decade of 21st century, the number of dentist decreased while the number of dental hygienists increased both due to the changes made in student intake in the 1990s and 2000s. The number of dentists will again start to increase in coming years. Despite major changes in public coverage of oral health care, distribution of workforce between private and public sector has been rather stable since the 1990s [43,44].

## **2.2 HEALTH CARE SYSTEMS AND RELATED SOCIOECONOMIC INEQUITY AND INEQUALITY**

Since The Black Report [45], social differences in health have been given more and more attention [46]. It is a widely accepted view that health, including oral health, is not distributed evenly between social/population groups, categorized by, for example, occupation, income, education or ethnic background. Those with a higher education, income and wealth tend to have better health, oral health and a longer life span than those who are in disadvantage in sense of socioeconomic factors [46,47]. It seems that these social differences in health and life-expectancy have been widening since the early 20<sup>th</sup>, century regardless of building up and cut backs in health and welfare systems done during the same time period [48]. However, it should be noted that circumstances where the build-up and the cut-backs were made were clearly very different from each other, and overall it is difficult to determine the actual role of changes in health and welfare systems in these widening inequalities.

Health inequality concept refers to differences in health between social groups, especially between socioeconomic groups, whereas health inequity refers to a view that these differences are unacceptable, avoidable and unfair, as they “arise because of the circumstances in which people grow, live, work, and age, and the systems put in place to deal with illness. The conditions in which people live and die are, in turn, shaped by political, social, and economic forces.” These conditions also strongly determine behavior and, in turn, determine health. For example care-seeking, smoking and eating habits are examples of such. In other words, health equity is a matter of social justice. These kind of conditions/circumstances are frequently called ‘social determinants of health’. [17,18]

In the Health for All by year 2000 [49] program that was launched in the early 1980s, the World Health Organization encouraged countries worldwide to improve the level of health and to control its distribution in a certain population but also internationally through effective (health) policies [31,49]. As health is not distributed evenly within (or between) countries, the latter aim can be understood as a goal of decreasing health differences between population groups. For example, Finland directly adopted these objectives, and it has been presented in programmes, such as the Health 2015 public health programme. [50]

According to Teperi and Keskimäki [50], the minimal requirement for a fair health care system is that it would not increase or cause health inequities [50]. In order to reach said goal, the health care services should be allocated to those individuals in need of such services [50]. Based on Aristotelian philosophy, horizontal and vertical equity in health care delivery can be discussed. Horizontal equity refers to ‘equal treatment of equals’ that is, those with equal need for care should be treated similarly [50]. In addition, vertical equity means ‘unequal treatment of unequals’. In other words, those with severe curable disease should be treated more intensively than those with a mild spontaneously healing disease [50]. Inequity refers to a situation where the allocation of health care is affected by factors that are considered to

be unfair [50,51]. Generally, for example income, education, area of residence and ethnic background are considered as 'unfair factors' if they influence on receiving the care needed [51]. For example, horizontal income-related inequities in the use of oral health care and specialist/secondary care are common in western countries [52,53]. It is also common to find that the advantaged benefit more from the care than the disadvantaged [54,55].

Plenty of explanations for these systematic inequities in health care have been suggested. It seems likely that the disadvantaged seek for care differently than the advantaged, and that the care provider treats them differently. The advantaged likely have more knowledge on health and the health care system and they can manage through the complexities in the care-seeking and treatment procedures. Access to and availability of care also differs according to socioeconomic status, for example, due to out-of-pocket payments, treatment queues or physical barriers. As Hart [56] has put it, "the availability of good medical care tends to vary inversely with the need for it in the population served". This is called an 'inverse care law' [56]. Overall, inequity is related to the side of factors of demand (patient) and supply (health care), their interplay and, of course, to wider political, social, and economic factors (e.g. poverty). [18,50,54,57]

In social epidemiology, it is generally viewed that modern-day comprehensive health care services and systems do not play a crucial role in tackling health inequities in most of the high-income countries, as health care does not affect causes of ill-health to a large extent [55]. However, not all diseases are out of reach of health care – some diseases are clearly preventable, for example by vaccination, and in addition, common oral diseases (caries and periodontitis) are to a large extent preventable by rigorous and frequent plaque control that can be promoted in oral health care services. Evidently, if there is inequity in vaccination coverage, it is likely that it also causes inequity in falling ill. However, as vaccination systems or any other health systems do not exist in a vacuum, it seems plausible to assume that factors, causes of the causes (of diseases prevented by the vaccination), which clearly have social, political and economic nature (e.g. income inequality), are the key [18,55].

Overall, lack of access to care needed, is seen as an important determinant of health inequities [17,18,58]. Considerable inequity in access to and use of primary and secondary/special health care are typical in low- and middle-income countries, while there is typically a notable inequity in access to and use of e.g. specialist/secondary care, dental care, surgery and ophthalmologic care in many high-income countries [18,52,53,59]. These could be seen as sources of health inequities [18,50]. For example, limited access to oral health care services seems to contribute to inequality in oral health [60-63] and there is a clear socioeconomic inequality in mortality amenable to health care services [58,64].

Modern-day social epidemiology [47,48,65-68] emphasizes the roles of social, economic and cultural factors behind the health inequalities. Etiological explanations for health inequalities can be divided into four segments:

- behavioral and cultural explanations
  - emphasis on the role of health-related behaviors (e.g. alcohol or tobacco use, eating habits, self-care)
- psychosocial explanations
  - emphasis on social networks, relationships, capital and community level social structures and practices
- materialistic explanations
  - emphasis on wealth, class, income, income inequality, poverty, physical aspects of environment and health care
- life course approach
  - emphasis on critical periods, sensitive developmental stages and socioeconomic conditions on both temporal and social perspectives.

All of these explanation are supported by scientific evidence and none of these seem to be the determining or exhaustive one. They are also strongly related to each other. Overall, there

is extensive literature on health inequalities and its determinants, whereas literature on how health policies reduce/affect health inequalities is scarce. [57,69]

### **2.2.1 Health care system reforms – health and health care inequity**

Health and health care (in)equity aspects have been in an important role in health system reforms during the last decades, for example in Finland [35,36], Chile [70] and Israel [71]. What should be the key objectives of the health care reforms aiming to alleviate health inequalities and health care inequities based on the literature?

- To create publicly funded universal primary health care,
- to improve access to care by enhancing
  - affordability,
  - availability,
  - and acceptability of health care services,
- to improve quality of care,
- and to enforce fair (redistributive) financing of health care [6,17,18,72].

It is important to note that recent reviews [6,72] and the World Health Organization [17,18] suggest that private insurance, marketization, out-of-pocket payments and privatization of health services have a negative impact on health and health care equity. However, the evidence concerning the health care reforms is preliminary and not in high-quality [72,73]. Furthermore, there is much more supporting evidence based on studies, for example, about out-of-pocket payments, which are not directly related to health care system reforms [17,18]. Overall, as advancing equity in health and health care delivery are important goals and tasks of health care systems, evaluating the effects of health care reforms in them is crucial from economic, political, societal and international perspectives.

### **2.2.2 Oral health care system - socioeconomic inequity in the use of oral health care services**

In addition to many individual and contextual level factors (which e.g. Nihtilä [74] reviewed in her thesis in 2014), it is evident that the oral health system and reforms related to it affect the use of oral health care services. But how is the oral health system related to the socioeconomic inequity in the use of services in light of the literature?

Presumably, it is evident that universalness and extent of public coverage of oral health care affect the use of services and socioeconomic inequity in it. By comparing 11 European countries, Palencia et al [75] showed that in those countries with a higher public oral health care coverage showed lower socioeconomic inequities in the use of oral health care services. Using data from 52 countries, Hosseinpoor et al [76] showed that socioeconomic inequity in the use was higher in low income countries and clear inverse association between the universalness of public coverage of oral health care and socioeconomic inequity in the use was found. However, it should be noted that inequity still also exists in most of the universal systems [76]. And moreover, in Norway there is no income-related inequity in the use despite minimal public coverage [77], for example, in comparison with other Nordic countries [28]. Overall, it seems that the universal public coverage plays a notable role in equity in the use of oral health care services. However, it may not be necessary and factors outside of oral health care system seem to be also very important.

As it was already mentioned, client fees are common in oral health care services [19]. These fees form financial barriers to care-seeking. It is evident that these financial barriers are more pronounced among those with a lower socioeconomic status [60,61,78-80]; out-of-pocket payments/dental insurance affect care-seeking, more among the poor than the rich [81,82]. It seems plausible to assume that lowering out-of-pocket payments could narrow socioeconomic inequity in the use of oral health care services.

Correspondence of demand for and supply of oral health care services can also affect the socioeconomic inequity in the use, in particular, in systems where there are several options available in care-seeking. "The less accessible services in relation to the demand for those

services, the greater sacrifices are needed in order to use those services...scarcity of services limits the use of them." [83] In addition, a multi-tiered system in which individuals (distributed in socioeconomic groups) are able to use different parts of the system (public/private) seems to be related to socioeconomic inequity in the use. [13] "Such systems may not only be available differentially to these [socioeconomic] groups, the policies and styles of practice, and types and quality of personnel may vary and affect care." [13] For example, in Finland where the public (oral) health care sector is congested, the private sector provides excellent fast line for the use of, however lower, subsidized services for the solvent individuals.

In many high income countries, the use of oral health care services is, at least to some extent, driven by regular visits for a check-up. In some countries, regular visiting is clearly encouraged e.g. by incentives or using an organized recall system [26,29]. Visiting a dentist for a check-up is frequently seen as and adopted 'habit' or 'behavior' driven by awareness, attitudes, motivation and education [84-87]. However, despite seeking for check-ups is to some extent affected by these kind of individual factors it is also clearly driven by the oral health care system itself. In Finland, both private and public sector explicitly regulate demand for care by using and not using recall systems, respectively [88]. In addition, you cannot visit for a check-up if your ongoing treatment period never ends [89] or simply if you cannot access the services whatever reason. Nguyen and Häkkinen [90] have shown that recall is clearly associated with income-related inequity in the use of oral health care services in Finland. It is evident that the oral health care system can, to some extent, maintain the socioeconomic inequity in the use through practices related to recall systems.

Oral health care systems, place of residence and socioeconomic inequity in the use are clearly connected. In rural areas the socioeconomic situation, accessibility of oral health care services and (so) the use of oral health care services are, on average, lower than in urban areas [13,26,83,85,86]. In many countries subsidized oral health care services are organized, or at least attempted to be organized, so that access to care does not intolerably depend on the place of residence [26]. As the private sector is a big operator in oral health care, word 'organize' in practice means that the distribution of subsidized private services is regulated, for example, by licenses/concessions, like in Sweden [26]. It seems unlikely that unregulated distribution of health services could be equal [17,18].

"Health is not a tradable commodity. It is a matter of rights and a public sector duty." [18] Based on a literature review [17], the World Health Organization [18] has concluded that commercialism in health care is unbeneficial from health and health care equity perspectives. It is likely that this holds true in oral health care too, however, no studies were found. In the end, it is a question of political decisions, though, affected by many interest groups (also within oral health care system) with different agendas. [17,18]

The oral health system is also, at least potentially, related to socioeconomic inequity in the use through many other factors formed in complex interaction between the system and the individual within certain social context, for example:

- health literacy
- bureaucracy in care seeking and treatment process
- acceptability (beliefs, social and cultural distance between patient and health professionals)
- attitudes, awareness and motivation
- symptoms and perceived need for care
- dental anxiety

Overall, the use of services emerges from the meeting of the system and the individual, and evidently this process also affects the socioeconomic differences, and inequity, in the use.

There are some studies concerning the effects of reforms on the socioeconomic inequity in the use of oral health care services. However, diversity of countries, studies, systems and reforms is huge, making adequate comparisons between studies and reforms very difficult.

Overall, there are some successful reforms that narrowed the inequity [91,92], and reforms that did not affect the inequity [93], but also reforms that widened the inequity [94,95].

### **2.2.3 Oral health care system - socioeconomic inequality in perceived oral health**

Major dental diseases, caries and periodontitis, have a relatively simple nature and they are easily avoidable. Their impacts are also rather simply treated or restored with slight adverse effects. Rigorous oral health-related behavior is essential in preventing these diseases. Oral health care services are essential to treat and restore teeth and occlusion of the individual plagued by these diseases, but also they are important in supporting and advocating oral health-related behavior in both individual and community level. In both of these levels, socioeconomic inequality in oral health and the oral health system are likely connected. As the oral health care services seem to be in a key role in the connection between individuals (distributed in socioeconomic groups) and the oral health care system, it can be assumed that inequity in the use of services is connected with inequality in oral health measured with e.g. number of teeth and decayed teeth. Some studies also support this [61,62].

However, in the case of perceived oral health, the picture is not that clear. Firstly, there is a great difference between perceived and clinically determined need for oral health care. In other words, people perceive a lower need for care than that is clinically determined [96]. Secondly, it is not well known how individuals determine their oral health status, i.e. what does perceived oral health represent and what is its basis [97]. Moreover, perceived oral health and oral health care services intertwine closely and form an ambiguous process [98]. Nobelist Amartya Sen [99] provides one interesting and descriptive example: perceived health in rural Indian village decreased significantly after health care services were founded in the village. Although it seems that perceived oral health is formed by many physical (e.g. function), psychological (e.g. awareness) and social (e.g. reference group) factors [97], it must be noted that subjective feelings matter regardless of the objective status.

Overall, the evidence of an association between socioeconomic inequality in perceived oral health and socioeconomic inequity in the use of oral health is rather scarce. Swedish studies have shown that socioeconomic inequity in the access to oral health care services explains a considerable part of the socioeconomic inequality in perceived oral health [60,61]. By contrast, Sabbah et al. [100] found that oral health behaviors (including oral health care visiting) did not significantly explain socioeconomic inequality in perceived oral health [100]. An Australian study found that socioeconomic inequality in Oral Health-Related Quality of Life (OHRQoL) was partly explained by oral health care visiting [101].

### **2.2.4 The use of oral health care services and related socioeconomic inequality in Finland**

The proportion of the population that has visited a dentist or oral health care services during the past 12 months has been widely used to measure of the use of oral health care. According to national surveys, the proportion of adult Finns who have visited oral health care services during the past 12 months has steadily increased from approximately 40% to approximately 65% between 1971 and 2014 [83,85,86,92,102-108]. Traditionally, most of the adults have used private oral health care services. Since the late 1980s, the number of adults treated in PDS has steadily increased and so the difference in proportion of adult visitors to public and private has clearly declined. [83,85,86,104]

According to Poutanen and Widström [103], who have reviewed literature on social differences in the use of oral health care services in Finland between 1950s and the late 1990s, socioeconomic differences were clear in the whole time period, but narrower in the last decade. First comprehensive national surveys on the issue were conducted in the mid-1960s [14,109], however, inequity in the use was not measured, as these studies did not take into account the need for care. However, it can be said that the socioeconomic differences in the use and oral health (i.e. need for care) were so clear, that the existence of significant socioeconomic inequity in the use of oral health care services was also obvious: during 1977-1980, there was 3-4-fold difference in the use during the past 12 months between the lowest



and highest income and education groups, despite the fact that those in the less advantaged groups had two or three times more decayed teeth [86]. Overall, the studies show that the use of PDS has been more common among the less well-off (at least) since the 1970s, while the use of private oral health care has been more common among the well-off [83]. As the use of private oral health care services has been more common and more disproportionately distributed by socioeconomic strata than the use of PDS, the total use has been higher among the advantaged groups [110].

More recent studies have used regression analyses and concentration index. They also tried to take into account the need for oral health care services. These studies show that socioeconomic inequity in the use of oral health care services among adults, seems to have narrowed from 1976 to 2009. Nyman [83] showed that educational and income-related differences in the use of oral health care services narrowed from 1976 to 1987, in particular among the younger adults, who received entitlement to subsidized services in 1986. Suominen-Taipale et al. [92] showed that the educational level was statistically significantly associated with the use of oral health care services during the past 12 months only in 1978, not in 1988 or in 1997. Using concentration index and income as a measure of socioeconomic status, Manderbacka et al. [110] showed that socioeconomic inequity in number of visits to oral health care decreased clearly among the (+18 years old) adult population from 1987 to 2004. Most of this decrease occurred during 1987-96 and was particularly related to decreased inequity in the number of visits to a private dentist. According to the OECD report [52], income-related inequity in the probability of a dentist visit during the past 12 months decreased clearly in Finland from 2000 to 2009, however, the study populations were different in 2000 (+15 year olds) and in 2009 (15-64 year olds) and so the comparison may not be very meaningful [52,53]. Cross-sectional studies have shown the presence of socioeconomic inequity in the use of oral health care services [90,111,112]. However, it has been rather consistent in finding that the socioeconomic inequity is narrower or not even present in population groups entitled to subsidized care. [83,85,86,90]

The expansion of coverage of subsidized oral health care, improved availability of services and increased wellbeing have been seen important factors behind the increased use and narrowed socioeconomic inequity in it. Presumably, the removal of tax deduction possibility in the early 1990s also somewhat narrowed the socioeconomic inequity in the use. Whereas, regional and municipal-related differences in availability and affordability of services, age-restrictions on the subsidization coverage, relatively high out-of-pocket payments, recall systems and differences in care-seeking caused by socioeconomic status itself (motivation and knowledge through education, resources through income and so on) have been seen as key factors behind the socioeconomic inequity in the use of oral health care services. [83,85,86,90,92,110,111]

### **2.2.5 Oral health and related socioeconomic inequality in Finland**

Population based clinical oral health examination surveys have shown that oral health has improved among adult Finns continuously at least during the past 40 years. The number of teeth per individual has increased and the number of edentulous people has decreased continuously. Teeth are also periodontally and cariologically healthier at the present. [85,86,113]

About two thirds of the adult Finnish population sees their oral health as good or very good [85]. The proportion increased 12 %-points during the past decade [113]. The proportion of +15 year old adults who reported having had toothache or other oral discomfort during the past 5 months increased from 1987 to 1995/6; 19%, 19% and 26% in 1976, in 1987 and in 1995/6 respectively [83,114]. Using a 12 month reference period in Health 2000 survey, the corresponding figure was 32% [85]. Approximately half of the adult population view that they are in need of oral health care services at the moment [85]. 82% and 86% reported being capable to bite hard food in 1987 and 2000, respectively [83,85].

It seems that there has been a socioeconomic inequality in oral health among adult Finns as long as scientific studies have been conducted [103]. In terms of edentulism and number of teeth, it seems that education-related inequality decreased between 1977/80 and 2000 [85,86,115]. Socioeconomic inequality in self-reported number of teeth also decreased from 1976 to 1995/6 [83,114]. In terms of the number of decayed teeth, education-related inequality widened between 1977/80 and 2000 [85,86]. In 2000, there was education-related inequality in the number of teeth, decayed teeth and teeth with deepened periodontal pockets [116].

Long term follow-up data concerning socioeconomic inequality in perceived oral health is scarcer. However, it seems that in 1976, 1987 or 1995/6, there was no education- or income-related inequality in reporting toothache among the +15 year old adult population [83,114]. In 2000, education-related inequality in perceived oral health was clear [116].

In recent decades, more and more emphasis on OHRQoL has been given. OHRQoL-measures (e.g. Oral Health Impact Profile [117]) take typically into account the social, functional, physical and psychological aspects of oral health. Studies conducted in Finland have shown that discomforts in these aspects of oral health are rather common among adults in 2000 [85]. Socioeconomic inequality in OHRQoL is also clear: those with lower education or income reported clearly more and also severer oral health impacts than ones with higher education or income [118,119].

The use of and access to oral health care services is seen to have been a key mediator between socioeconomic status and oral health in Finland [85,86]. As dental diseases are preventable to a large extent, oral health-related behaviors are generally also seen important for the socioeconomic inequalities in oral health [85,86,100]. Education is seen as an important factor in adopting these healthy habits [86] and it was recently shown that oral health-related behavior explains most of the education-related inequality in caries increment among Finnish adults in a 4-year follow-up [87]. Bernabe et al. [116] showed that life-course models somewhat explain the education-related inequalities in oral health in Finland. This connects inequalities in oral health to wider social determinants of health discussed earlier. Overall, it can be said that socioeconomic inequalities in perceived oral health, OHRQoL and factors explaining them have not been studied in enough detail (Table 2).

Table 2. Summary of findings of Finnish national health surveys concerning the use of oral health care services and self-reported measures of oral health [83,85,86,90,105,109,110,113,114,116].

	<b>Follow-up time</b>	<b>Change in level</b>	<b>Socioeconomic difference</b>	<b>Change in socioeconomic difference</b>	<b>Factors explaining the difference</b>
The use of oral health care services	1964-	Increased clearly, 1964-	Clear in population not entitled to subsidized care, 1960-	Narrowed	Recall, income, public coverage
Self-rated oral health	1980-	Improved, 2000-2011	Clear in 2000	Not reported	Life-course model, no other factors studied
Perceived need for care	1968, 2000-	Reported only in 2000	Not reported	Not reported	Not studied
Toothache or oral discomfort	1964-	Somewhat more common nowadays	Equally distributed by socioeconomic status	No change	Not studied
Oral Health Related Quality of Life	2000-	Reported only in 2000	Clear in 2000	Not reported	Not studied

### 2.3 MEASURING SOCIOECONOMIC INEQUALITY AND INEQUITY IN HEALTH AND HEALTH SERVICE USE

Many socioeconomic measures, such as educational level and income, have natural ordering. Socioeconomic inequalities are measured comparing health status or health service use across socioeconomic strata. Traditionally, it is done by comparing average health status or health service use of certain groups (e.g. primary/secondary/tertiary educated or income quintiles) by using e.g. regression analysis or simple tabulations [92,116,120]. However, this raises clear disadvantages:

- whole range of socioeconomic status is not taken into account,
- population sizes in socioeconomic groups are not taken into account,
- comparisons (over time or between studies) are difficult to make, and
- absolute or relative inequalities are not considered.

Therefore, it is nowadays widely recommended to use summary measures of inequalities, such as concentration index, relative index of inequality and slope index of inequality. These measures overcome all the problems stated above, and produce one easily comparable figure about magnitude of inequality. However, problem with the summary measures is that they may be harder to interpret and calculate. [121,122]

During the past 30 years, use of the summary measures of inequalities has been steadily increasing in epidemiological literature [123-126]. However, only some studies have used summary measures of inequalities in dental setting [90,123,127-129].

Inequity refers to avoidable and unfair difference in health or health service use between socioeconomic groups. But, what is avoidable and what is unfair? [48]

In the case of health services use, it is generally considered that (horizontal) inequity is present when the use of services is not distributed according to need for care, i.e. health

service use is affected by factors that are considered to be unfair (e.g. low income). Measuring inequity in health service use is rather straightforward: when health care need is taken into account (i.e. need standardization is made), unexplained variation in health service use between socioeconomic groups represents the magnitude of socioeconomic inequity in the use. Typically, age, sex and factors representing health status (e.g. diseases and perceived health status) are considered as health care need factors. [51,123,130]

Health inequity is not that simple. It is not obvious that all health inequalities are unfair. In addition, it is hard to say, for instance, to what extent differences in health between lower and higher educated are acceptable and fair? Evaluation should focus on the causes of health inequalities and their distributive justice: i.e. could they be distributed more equitably? Therefore, in order to measure health inequity, it is essential to detect factors causing the health inequalities, and evaluate their fairness. [48,131]

### *3 Aims of the Study*

The aim of this thesis was to investigate among adult Finns the impact of a major oral health care reform on

- the use of health care services
- the socioeconomic inequity in the use of oral health care services
- the socioeconomic inequality in perceived oral health and OHRQoL and
- the factors associated with them and
- how they have changed from just before the reform to a few years after the reform (between 2001 and 2007).

## 4 Population and Methods

### 4.1 POPULATION

#### 4.1.1 Surveys

Data gathered with three identical, nationally representative, cross-sectional postal surveys conducted by the Social Insurance Institution of Finland and The National Institute for Health and Welfare (formerly the National Public Health Institute) was used. Surveys were conducted before the OHCR in February 2001 and after the OHCR in February 2004 and in February 2007. Surveys concerned the use of oral health care services and perceived oral health, and were carried out in order to investigate effects of OHCR on them. Surveys used stratified cluster sampling framework of the Health 2000 Survey [132]. Study population concerned individuals born in 1970 or earlier and living in Mainland Finland in 2001. In addition, those born in 1971-1973 and 1971-1975 were included in 2004 and 2007, respectively.

Sample sizes were 4029 in 2001, 3963 in 2004 and 4250 in 2007. The response rates were 70% (n=2838), 64% (n=2551) and 60% (n=2565) in 2001, 2004 and 2007, respectively. Those born later than 1970 were excluded from the analysis and only respondents, who had answered to all questions used, were included. Therefore, the effective final sample sizes varied in papers I-IV.

When the first two rounds of this postal survey were carried out no ethical approval was needed for such questionnaire studies. However, the requirements were becoming stricter and for the survey conducted in 2007, ethical approval was conferred by the ethical committees of the National Public Health Institute and the Social Insurance.

#### 4.1.2 Variables

Questions in these surveys and (so) variables selected for the analyses were mainly based on the earlier Finnish studies [133]. The questionnaire (in Finnish) is available online [133]. In addition to information on sex, year of birth and place of residence, following information gathered with the surveys was used:

*The use of oral health care services.* Respondents were asked whether they had visited any oral health care services during the past 12 months. Options were yes or no.

*Number of visits to oral health care services.* Those, who had visited oral health care services during the past 12 months, were asked to report the number of visits to a *private dentist, public dentist and other oral health care*.

*Time since last visit to a dentist.* Those, who had not visited a dentist during the past 12 months were asked how long time ago they had visited a dentist. Options were 1-2 years, 3-5, >5 years ago and never.

*Regular dental visiting.* Dentate respondents were asked "Do you usually go to a dentist..." with options: "regularly for check-up", "only when you have toothache or some other trouble" and "never".

*Recall.* Those who "had certain dentist whom they contact when they need dental treatment" were asked if the dentist had recalled them during the past 12 months. Options were yes or no.

*Self-rated oral health.* Respondents were asked "Is the condition of your teeth and the health of your mouth at present: good, rather good, moderate, rather poor or poor?"

*Perceived need for care.* Respondents were asked "Do you think you need dental treatment now?" with yes/no options.

*Toothache or oral discomfort during the past 12 months.* Respondents were asked: "Have you during the past 12 months had toothache or other trouble related to your teeth or dentures?" with yes/no options.

*Number of missing teeth* (including wisdom teeth) was queried with options: no missing teeth, 1-5 missing teeth, 6-10 missing teeth, >10 missing teeth but not all and all teeth missing.

*Denture wearing.* Respondents were asked whether they wear removable dentures and whether they were complete or partial ones.

*Oral health impact profile-14 (OHIP).* OHIP includes 14 questions concerning frequency of oral adverse impacts in seven dimensions: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. 1 month reference period was used. The response format was: 'very often' (=4), 'fairly often' (=3), 'occasionally' (=2), 'hardly ever' (=1), 'never' (=0) and 'I don't know' [117].

*Tooth brushing frequency.* Frequency of using manual tooth brush and electronic tooth brush was elicited with options: daily, weekly, more seldom and never.

*Perceived general health.* Respondents were asked: "Is your present state of health: good, rather good, moderate, rather poor or poor?"

*Education.* Highest basic and vocational educational level were queried.

*Household income.* Respondents were asked their monthly household gross income, including all income transfers, with 13 answering options which were identical in all the study years. The options grouped household income from < 420 to > 8400 Euros.

*Main type of activity* was elicited with options: full-time job, part-time job, student, retired, unemployed or temporarily laid-off, caring for close relatives and conscript.

*Marital status.* Options were married, cohabiting, divorced or living apart, widowed and single.

*Dental anxiety, perceived availability of PDS, perceived availability of private dental services and satisfaction with last dental treatment period* were elicited with statements: "I'm scared to visit a dentist", "There is good availability of PDS in the municipality where I live", "There is good availability of private dental services in the municipality where I live" and "I am satisfied with the last dental treatment period", respectively. Options were 'agree', 'agree to some extent', 'I don't know', 'disagree to some extent' and 'disagree' to all these statements.

#### 4.1.3 Variable modifications for analyses

Based on year of birth respondents were divided into three groups based on the execution phases of the OHCR; people born between 1956 and 1970, people born between 1946 and 1955 (first phase of the OHCR) and people born before 1946 (<1946, second phase of the OHCR).

Three educational groups were formed by a similar method used in earlier Finnish studies [134]: low (no formal vocational training or senior secondary education), medium (completed vocational training or matriculation examination) and high (degree or diploma from higher vocational institution, polytechnic or university).

Based on household income and number of adults and children in household, household income OECD was used; i.e. household income was divided by the weighted sum of household members where the first adult was given the weight of 1.0, other adults 0.7 and under 18 year olds 0.5 [135]. The change in the value of money was taken into account by change coefficients that were based on consumer price index which inflated income to common price of 2011 [136]. Moreover, natural logarithm transformation and quintile division were used. Hereafter, *income* refers to household income per consumption unit.

OHIP was used as an indicator of OHRQoL. Five measures based on OHIP were used: *severity* measure and two *prevalence* and *extent* measures of oral health impacts on quality of life (17, 18). Severity was calculated by summing the values of the 14 answers giving severity range between 56 (the poorest oral health) and 0 (the most healthy). Two different threshold levels *OFOVO* ('occasionally' or 'fairly often' or 'very often') and *FOVO* ('fairly often' or 'very often') for the prevalence and extent measures were used. The prevalence measure was 1 if the respondent had reported one impact or more occurring on a specified threshold (*OFOVO* or *FOVO*) and 0 otherwise. The extent measure was calculated by summing the number of items in which the respondent reported one impact or more on a specified threshold (*OFOVO*

or FOVO), so the value for the extent measure ranges from 14 (the poorest oral health) to 0 (the most healthy) [119,137]. If the respondent had one or two missing or 'I don't know' answers, these answers were replaced with the sample mean, while respondents who had more than two missing or 'I don't know' answers were excluded from the analyses.

As there are more and more dental hygienists in Finland and distribution of work between a dentist and a dental hygienist has been emphasized, in public sector particularly, during the last decades and as a majority of them work in public sector [44], those who reported that they had visited a public dentist or other oral health care was assumed to have visited PDS.

Based on the place of residence, respondents were divided into those *living in one of the 15 biggest municipalities* and those who were not. Information was based on the sampling framework [132].

Otherwise, variables were used as 'natural' or some answer options were combined due to practical reasons and also to avoid multicollinearity in regression analyses. For example, self-rated oral health was categorized to three groups in paper I: good or rather good/moderate/rather poor or poor, while in papers II-IV dichotomization to good or rather good/moderate or rather poor or poor was used.

## **4.2. METHODS**

All used statistical methods that took account the stratified cluster sampling and sample weights generated were based on gender, age, region and language. SAS survey procedures (paper I) and R *survey* package (papers I-IV) were used.

### **4.2.1 The use of oral health care services and associated factors (I)**

Table 3 shows variables used and their roles in analyses and modelling strategy in logistic regression analyses. In addition, basic tabulation with the dependent and some explanatory variables over study years were performed. Anova and Rao-Scott Chi-Square test was used.



Table 3. Variables used and modelling strategy for logistic regression analyses in paper I.

	<b>Model 1a</b>	<b>Model 1b</b>	<b>Model 2a</b>	<b>Model 2b</b>	<b>Model 3</b>	<b>Model 4</b>
<b>Dependent variables</b>						
Regular dental visiting			x	x		
The use of any oral health care services	x	x				
The use of PDS					x	
The use of private dentist's care						x
Number of visits to any oral health care services						
Number of visits to PDS						
Number of visits to private dentist care						
<b>Explanatory variables</b>						
Year of birth	x	x	x	x	x	x
Sex	x	x	x	x	x	x
Income quintiles	x	x	x	x	x	x
Education	x	x	x	x	x	x
Perceived need for care	x	x	x	x	x	x
Toothache or oral discomfort	x	x	x	x	x	x
Self-rated oral health	x	x	x	x	x	x
Number of missing teeth	x	x	x	x	x	x
Perceived availability of public dental services	x	x	x	x	x	x
Perceived availability of private dental services	x	x	x	x	x	x
Dental anxiety	x	x	x	x	x	x
Recall				x		
Regular dental visiting		x				

#### 4.2.2 Concentration index and its decomposition

Concentration index is based on a concentration curve that is constructed from the cumulative sum of the variable of interest (for example health or use of services) in the population, ranked by a variable describing socioeconomic status of an individual in a society that was income in this study [51,138]. If the variable of interest is distributed uniformly with respect to the ranking variable, the concentration curve will be a 45-degree line – 'line of equality'. CI is twice the area between a concentration curve and a line of equality. The values of CI range from -1 to 1; negative value indicates that the event of interest is more prevalent in those with lower income than in those with higher income. Conversely, positive values indicate that there is a disproportionately high concentration of the events of interest in subjects with a high income. While zero represents the equal distribution of events by income, the higher or lower the value of CI, the more unequal is the distribution by income. The so-called 'extended KWD (Kakwani, Wagstaff, van Doorslaer)' approach was used to estimate the CI and its variance [138,139]. CI measures relative inequality. To measure absolute inequality in dependent variables and to overcome problems related to CI for binary variable, CI was calculated using a method introduced by Erreygers [140]: CI was multiplied with 4 and mean of the variable of interest. Its interpretation is similar to the CI [141]. Wagstaff has also proposed correction for CI for binary variable [142]. It is formed by dividing CI by 1 minus the mean of variable of interest [142].

The major advantage of CI is that it produces a well comparable summary measure of magnitude of inequality [143]. In addition, it takes into account the whole distribution of socioeconomic ranking variable and health/use variable. However, interpretation is complicated; for example, is inequality of -0.2 considerable? Koolman and van Doorslaer

[127] provide one interpretation tool: multiplying the CI by 75 produces the percentage of the variable of interest that should be moved from the richer(poorer) to the poorer(richer) half of the population in order to achieve equality (i.e. CI=0).

CI decomposition analysis was used to investigate factors related to income-related inequality in the use of oral health care services, perceived oral health and OHRQoL. The method has been presented comprehensively and understandably in many freely accessible scientific papers, reports and guides [51]. In other words, the decomposition of CI is based on the means of explanatory variables ( $\bar{x}_k$ ), CIs for explanatory variables ( $C_k$ ), the mean of the dependent variable ( $\mu$ ) and marginal effects ( $\beta_k$ ) from probit regression (when binary dependent variable) or beta coefficients ( $\beta_k$ ) from linear regression (when continuous dependent variable) according to the following equation:

$$CI = \sum_k (\beta_k \bar{x}_k / \mu) C_k + GC_\varepsilon / \mu \quad (1)$$

And so, the contribution of explanatory variable (k) to CI is product of the association of explanatory variable with the dependent variable ( $\beta_k \bar{x}_k / \mu$ ) and the income-related inequality in the explanatory variable ( $C_k$ ). CI for the dependent variable is the sum of these contributions. The last term ( $GC_\varepsilon / \mu$ ) is part of CI not explained by the explanatory variables (i.e. residual term) [51]. Similarly, the 'corrected' CI was decomposed using its own decomposition equation [140].

To decompose changes in the CI from 2001 to 2007, the Oaxaca-type decomposition method was used. It makes possible to distinguish which changes in income-related inequality were attributable to changing inequality in the explanatory variables ( $C_k$ ) and which are due to changing association of explanatory variable with the dependent variable ( $\beta_k \bar{x}_k / \mu$ ). [144]

#### 4.2.3 Income-related inequity in the use of oral health care services (II)

CI and corrected CI and their decompositions were used separately for the study years. Table 4 shows the variables and their roles in the analyses. As the question concerning regular dental visiting was asked only if the respondent had own teeth, edentate were excluded from the analyses. To measure inequity, the contributions of variables representing need for care were subtracted from the total CI for the use of oral health care services [51]. Oaxaca-type decomposition was used to distinguish factors related to change in CI from 2001 to 2007. In addition, basic tabulations with the dependent and explanatory variables over study years were performed, and Rao-Scott Chi-Square test and Anova were used.

Table 4. Variables used and their roles in concentration index decomposition analyses in paper II.

	Main	Additional	
<b>Dependent variables</b>			
The use of any oral health care services	x		x
The use of public dental services	x		x
The use of private dentist's care	x		x
The use of other oral health care services		x	
The use of any dentist's care		x	
<b>Socioeconomic ranking variable</b>			
Income	x	x	x
<b>"Proxy for need" variables</b>			
Year of birth	x	x	x
Sex	x	x	x
Number of missing teeth	x	x	x
Perceived general health	x	x	x
Self-rated oral health	x	x	x
Toothache or oral discomfort	x	x	x
Perceived need for care	x	x	x
<b>Other variables</b>			
Dental anxiety	x	x	x
Tooth brushing frequency	x	x	x
Education	x	x	x
Living in one of the 15 biggest municipalities	x	x	x
Income	x	x	x
Regular dental visiting	x	x	

#### 4.2.4 Income-related inequality in the OHRQoL and perceived oral health (III, IV)

CI and corrected CI and their decompositions were used separately for the study years. Table 5 shows the variables and their roles in the analyses. In addition, Rao-Scott Chi-Square test and ANOVA were used to test differences in the dependent variables across study years.

Table 5. Variables used and their roles in concentration index decomposition analyses in papers III and IV.

	<b>Paper III</b>	<b>Paper IV</b>
Dependent variables		
OHIP <sup>1</sup> - Prevalence - OFOVO <sup>2</sup> threshold	x	
OHIP <sup>1</sup> - Prevalence - FOVO <sup>3</sup> threshold	x	
OHIP <sup>1</sup> - Severity	x	
OHIP <sup>1</sup> - Extent - OFOVO <sup>2</sup> threshold	x	
OHIP <sup>1</sup> - Extent - FOVO <sup>3</sup> threshold	x	
Toothache or oral discomfort		x
Perceived need for care		x
Self-rated oral health		x
Socioeconomic ranking variable		
Income	x	x
Explanatory variables		
Year of birth	x	x
Sex	x	x
Living in one of the 15 biggest municipalities	x	x
Marital status	x	
Number of missing teeth	x	x
Denture wearing	x	
Tooth brushing frequency	x	x
Perceived general health	x	x
Education	x	x
Income	x	x
Main type of activity	x	x
Time since last visit to a dentist	x	x
Satisfaction with last dental treatment period	x	x
Dental anxiety	x	x
1 = Oral Health Impact Profile		
2 = "occasionally, fairly often, very often" threshold		
3 = "fairly often, very often" threshold		

#### 4.2.5 Relative index of inequality (RII) and slope index of inequality (SII)

To produce more easily interpretable measures of income-related inequality and to also study the education-related inequality in the use of oral health care services during the past 12 months, OHIP- and perceived oral health-measures, age- and sex-standardized RII and SII were calculated [143]. They are regression-based summary measures of inequality. Calculator developed by Public Health England was used [145]; more about calculation elsewhere [143,146-148].

SII represents the absolute difference in the dependent variable between hypothetically the least and most advantaged individual. Whereas, RII represents decline in the dependent variable in proportion to the mean, when moved from the hypothetically least advantaged to the most advantaged individual [146-148]. As RII and SII were compared over time, it should be considered that SII is sensitive to changes in the mean of dependent variable, while RII is not [143,148]

## 5 Results

Table 1 in paper I shows distributions of main background variables in 2001, 2004, and 2007. The number of respondents with low educational level or who were edentulous decreased from 2001 to 2007. Otherwise, no clear differences between study years was seen.

### 5.1 THE USE OF ORAL HEALTH CARE SERVICES AND ASSOCIATED FACTORS (I)

Proportions of those who visited any oral health care services during the past 12 months or reported visiting the dentist regularly for check-up increased from 57% and 59% to 63% and 64% between 2001 and 2007, respectively. The use of any oral health care services increased from 2001 to 2007 particularly among those with middle-income, low or medium level education, own teeth and who were born later than 1946 (Table 2 in paper I, Table 6).

Particularly, the proportion of those who visited PDS during the past 12 months increased from 21% to 29% from 2001 to 2007. Still, in all study years, most of those who visited oral health care services during the past 12 months had visited a private dentist. No clear changes in the use of private dentist's care were seen from 2001 to 2007 (Table 2 in paper I, Table 6).

Table 6. Unadjusted percentages of respondents who reported having visited any oral health care services, Public Dental Services or private dentist during the past 12 months in 2001, 2004 and 2007.

		Any oral health care services			Public Dental Services			Private dentist		
		2001	2004	2007	2001	2004	2007	2001	2004	2007
	All	57	61	63***	21	26	29***	36	37	37
Year of birth	1956-70	60	63	68*	33	32	38*	30	33	34
	1946-55	60	67	67*	17	26	24**	44	45	46
	<1946	51	54	54	15	21	22***	35	35	34
Sex	Female	61	64	66*	23	29	31***	38	39	40
	Male	52	58	58**	20	23	27**	32	35	34
Income quintiles	Lowest	42	47	50	20	28	30**	21	19	22
	2.	53	63	53*	26	31	31	28	35	26*
	3.	60	67	70*	20	26	33**	40	42	42
	4.	65	69	76**	25	26	34*	43	46	51
	Highest	68	67	70	18	23	20	52	49	54
Education	Low	45	49	51*	17	23	24***	26	26	29
	Medium	58	66	64**	25	28	29	35	40	39*
	High	70	70	75	24	29	33**	48	46	47

\* p<0.05, \*\* p<0.01, \*\*\* p<0.001 Rao-Scott Chi-Squared test between study years

However, average number of visits to a private dentist during the past 12 months decreased from 2001 to 2007, particularly among dentate and those with higher income and educational level. Overall, the number of visits was more equally distributed than the use/non-use of oral health care services during the past 12 months (Table 3 in paper I).

The use of any oral health care services during the past 12 months and regular dental visiting were particularly related to older age, small number of missing teeth, low level of dental anxiety, perceived no need for dental care and self-rated good oral health in all study years (Table 4 in paper I).

The use of private dentist's care was associated with self-rated good oral health and perceived no need for care, higher household income and older age in all three study years while the use of PDS was associated with younger age, self-rated good oral health and perceived no need for care only in 2001. In 2004 and 2007, those who viewed the availability of PDS to be good were less likely to have visited a private dentist than those who considered it to be poor (Table 5 in paper I).

## 5.2 INCOME-RELATED INEQUITY IN THE USE OF ORAL HEALTH CARE SERVICES (II)

The proportion of those who visited any oral health care services during the past 12 months was disproportionately greater in higher income groups in all study years (Table 6). The distribution was not accounted by higher need for dental care in those with higher income, and so the pro-higher income inequity in the use was present in all study years (Tables 2 and 4 in paper II, Figure 3). The income-related inequity was narrower in 2004 than in 2001 or 2007, and no difference between 2001 and 2007 was seen (Table 4 in paper II, Figure 3). Distribution of the use of PDS favored those with lower income and distribution of the use of private dentist's care favored ones with higher income (Tables 2 and 5 in paper II).

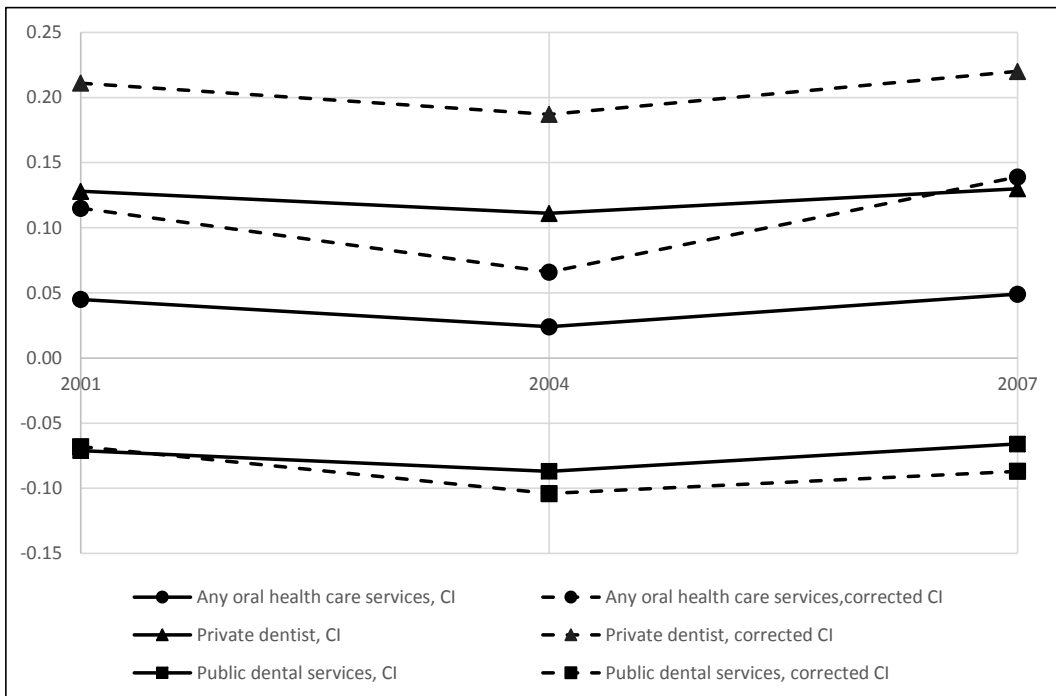


Figure 3. Income-related inequity in the use of any oral health care services, Public dental services and private dentist's care according to concentration index (CI) and corrected CI (Erreygers).

Most of the income-related inequity was related to regular dental visiting for a check-up and income itself. Contribution of the former to inequity decreased from 2001 to 2007,

whereas smaller inequity in 2004 was particularly related to temporarily decreased contribution of income to the inequity (Table 4 in paper II).

Additional analyses showed that both inequalities in visiting any dentist and other oral health care during the past 12 months and their decompositions were rather similar with each other and with those in Table 4 in paper II. When the regular dental visiting variable was excluded from the decomposition analyses, particularly contributions of self-rated oral health and income to inequality in the use increased. Overall, additional analyses did not change the overall picture.

### 5.3 INCOME-RELATED INEQUALITY IN THE OHRQOL AND PERCEIVED ORAL HEALTH (III, IV)

From 2001 to 2007, OHRQoL improved in terms of all OHIP-measures used ( $p$ -values  $< 0.09$ ). In all study years, those with higher income reported oral health impacts less frequently (lower prevalence) and also had less extent and severe burden of oral health impacts than those with lower income. Overall, the level of inequality remained rather stable from 2001 to 2007, no statistically significant differences in CIs between study years was seen (Table 1 in paper III, Figure 4).

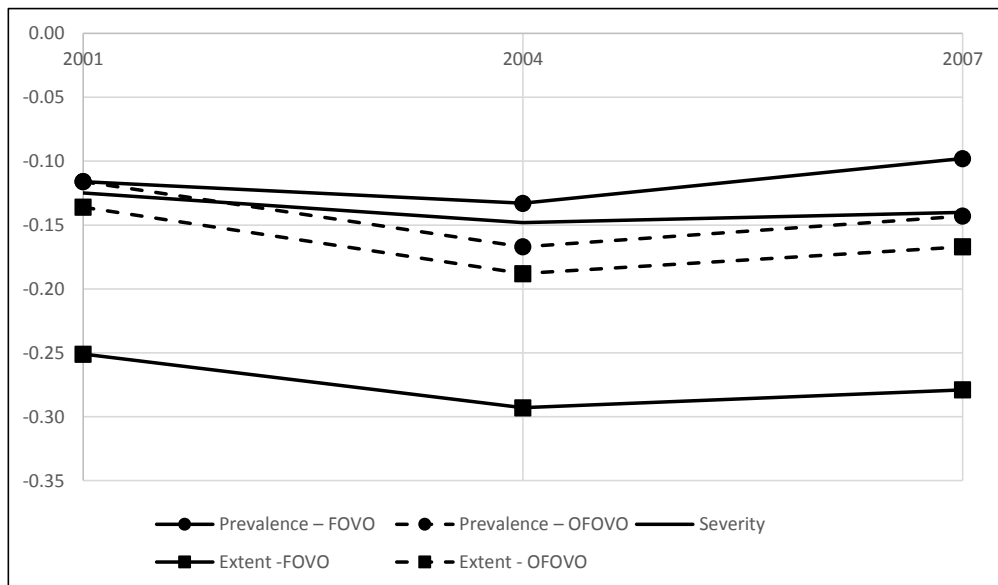


Figure 4. Concentration indices for oral health impact severity, prevalence and extent on "occasionally, fairly often, very often"(OFOVO) and "fairly often, very often"(FOVO) thresholds in 2001, 2004 and 2007.

Proportion of those who perceived need for oral health care decreased while its income-related inequality widened from 2001 to 2007, both statistically significantly. The proportion of respondents who reported of having had toothache or other oral discomfort during the past 12 months remained on a stable level, whereas the income-related inequality in it widened statistically significantly from 2001 to 2007. No clear or statistically significant changes in self-rated oral health or in its income-related inequality was seen from 2001 to 2007 (Table 1 in paper IV, Figure 5).

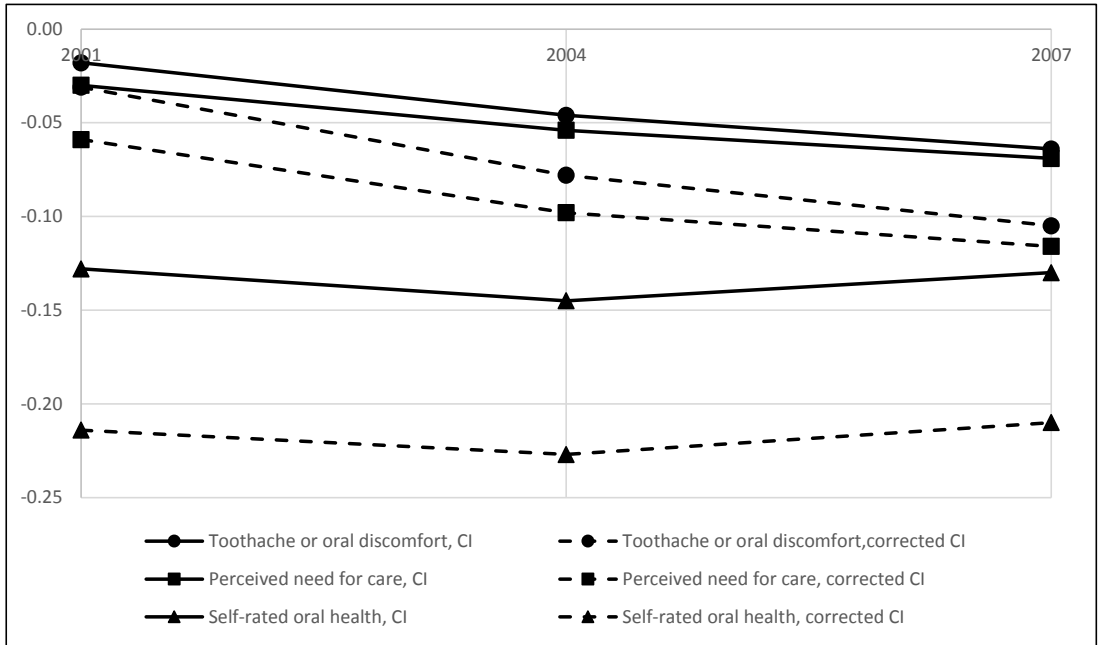


Figure 5. Concentration index (CI) and corrected CI (Erreygers) for reporting toothache or oral discomfort during the past 12 months, need for care and self-rated oral health in 2001, 2004 and 2007.

The income-related inequalities in OHIP-measures were particularly related to income itself, perceived general health and the number of missing teeth (Tables 3-5 in paper III). Whereas, the inequalities in perceived oral health were particularly related to income, perceived general health and time since last visit to a dentist (Tables 3-5 in paper IV). Contributions of time since last visit to a dentist and satisfaction with last dental treatment period to the income-related inequalities in OHIP-measures and perceived oral health measures decreased from 2001 to 2007 (Tables 3-5 in paper III and IV). Increased inequalities in reports of toothache or oral discomfort and need for care were particularly related to increased contributions of income and education (Tables 3 and 4 in paper IV). Contribution of income to inequality in self-rated oral health decreased and contribution of perceived general health increased from 2001 to 2007 (Table 5 in paper IV).

Figure 6 summarizes findings of papers I-IV and shows their relationships with each other.

#### 5.4 EDUCATION- AND INCOME-RELATED INEQUALITIES BASED ON SII AND RII MEASURES

The education- and income-related inequalities were very similar with each other and with those represented above despite different method used (Tables 7-11). However, some differences between the education- and income-related inequalities were seen:

- The use of PDS was clearly more evenly distributed by education than by income in all study years (Table 8).
- Education-related inequalities were smaller in OHRQoL-measures and narrowed from 2001 to 2007, unlike the corresponding income-related inequalities (Table 10 and 11).



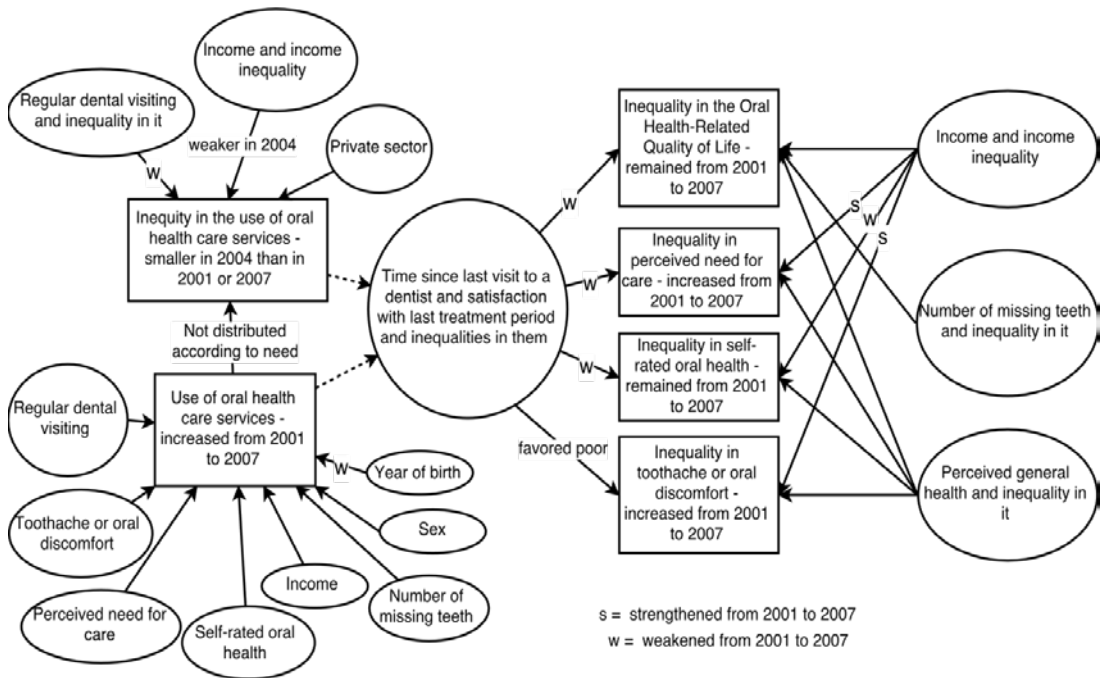


Figure 6. Summary of the findings of papers I-IV

Table 7. The use of any oral health care services and the use of private dentist's and public dentist's care during the past 12 months as well as the relative index of inequality (RII) and slope index of inequality (SII) by education and income in 2001, 2004 and 2007. Age and sex standardized.

	Any oral health care services			Private dentist			Public dentist		
	2001	2004	2007	2001	2004	2007	2001	2004	2007
<b>Education</b>									
Low	45 %	50 %	52 %	23 %	25 %	28 %	18 %	22 %	22 %
Medium	58 %	67 %	63 %	36 %	42 %	40 %	19 %	21 %	21 %
High	70 %	69 %	73 %	50 %	47 %	46 %	16 %	20 %	24 %
N	2729	2339	2241	2703	2323	2235	2703	2323	2237
SII	0.38	0.30	0.32	0.41	0.35	0.29	-0.02	-0.04	0.03
RII	0.68	0.49	0.51	1.16	0.94	0.77	-0.13	-0.17	0.13
<b>Income</b>									
Lowest	43 %	48 %	50 %	20 %	19 %	22 %	19 %	25 %	28 %
2.	51 %	62 %	53 %	28 %	34 %	25 %	18 %	27 %	23 %
3.	61 %	66 %	71 %	39 %	42 %	45 %	18 %	20 %	26 %
4.	62 %	68 %	75 %	45 %	47 %	47 %	15 %	21 %	22 %
Highest	69 %	67 %	69 %	53 %	50 %	54 %	13 %	14 %	13 %
N	2399	2029	1902	2378	2018	1895	2378	2018	1898
SII	0.32	0.22	0.30	0.42	0.37	0.43	-0.08	-0.14	-0.15
RII	0.57	0.35	0.48	1.14	0.97	1.13	-0.46	-0.66	-0.66

*Table 8.* The use of public dental services and other oral health care services during the past 12 months and the proportion of visiting oral health care regularly as well as the relative index of inequality (RII) and slope index of inequality (SII) by education and income in 2001, 2004 and 2007. Age and sex standardized.

	Public dental services			Other oral health care services			Regular dental visiting		
	2001	2004	2007	2001	2004	2007	2001	2004	2007
<b>Education</b>									
Low	19 %	25 %	26 %	2 %	5 %	6 %	49 %	53 %	54 %
Medium	21 %	26 %	26 %	4 %	6 %	8 %	61 %	64 %	63 %
High	19 %	25 %	30 %	5 %	7 %	10 %	68 %	70 %	71 %
N	2703	2323	2211	2703	2323	2213	2268	1973	1955
SII	0.01	0.01	0.06	0.05	0.03	0.06	0.29	0.25	0.26
RII	0.03	0.04	0.20	1.37	0.51	0.75	0.49	0.40	0.41
<b>Income</b>									
Lowest	21 %	29 %	30 %	2 %	7 %	3 %	40 %	41 %	52 %
2.	21 %	30 %	30 %	4 %	5 %	11 %	54 %	61 %	50 %
3.	20 %	24 %	30 %	3 %	6 %	9 %	61 %	64 %	65 %
4.	18 %	24 %	32 %	4 %	5 %	12 %	62 %	70 %	67 %
Highest	16 %	21 %	17 %	5 %	8 %	7 %	74 %	73 %	78 %
N	2378	2018	1875	2378	2018	1876	2040	1751	1672
SII	-0.05	-0.10	-0.11	0.02	0.02	0.05	0.37	0.34	0.34
RII	-0.28	-0.41	-0.40	0.72	0.26	0.60	0.63	0.53	0.54

*Table 9.* The proportions reporting toothache, need for care and poor oral health as well as the relative index of inequality (RII) and slope index of inequality (SII) by education and income in 2001, 2004 and 2007. Age- and sex-standardized.

	Toothache or oral discomfort during the past 12 months			Perceived need for care			Self-rated poor oral health		
	2001	2004	2007	2001	2004	2007	2001	2004	2007
<b>Education</b>									
Low	40 %	37 %	38 %	49 %	48 %	44 %	52 %	49 %	54 %
Medium	40 %	43 %	39 %	49 %	42 %	44 %	45 %	43 %	39 %
High	43 %	43 %	35 %	47 %	42 %	35 %	35 %	29 %	34 %
N	2694	2316	2228	2646	2275	2195	2635	2287	2197
SII	-0.03	-0.08	0.03	0.03	0.09	0.13	0.26	0.30	0.31
RII	-0.07	-0.21	0.08	0.05	0.21	0.31	0.57	0.75	0.72
<b>Income</b>									
Lowest	45 %	45 %	47 %	54 %	55 %	47 %	59 %	59 %	55 %
2.	39 %	47 %	41 %	51 %	46 %	47 %	48 %	48 %	49 %
3.	43 %	40 %	38 %	49 %	41 %	39 %	41 %	38 %	38 %
4.	41 %	39 %	38 %	49 %	39 %	39 %	41 %	33 %	38 %
Highest	38 %	35 %	29 %	42 %	42 %	34 %	31 %	29 %	33 %
N	2377	2006	1889	2337	1975	1859	2330	1984	1872
SII	0.06	0.14	0.19	0.13	0.17	0.17	0.31	0.38	0.28
RII	0.14	0.34	0.49	0.26	0.38	0.42	0.70	0.91	0.66

Table 10. The proportions reporting any oral health impacts on “fairly often, very often” (FOVO) and “occasionally, fairly often, very often” (OFOVO) thresholds as well as the relative index of inequality (RII) and slope index of inequality (SII) by education and income in 2001, 2004 and 2007. Age- and sex-standardized.

	Prevalence FOVO			Prevalence OFOVO		
	2001	2004	2007	2001	2004	2007
<b>Education</b>						
Low	22 %	17 %	15 %	59 %	52 %	45 %
Medium	18 %	14 %	15 %	50 %	47 %	45 %
High	16 %	13 %	12 %	50 %	46 %	46 %
N	2502	2119	2025	2502	2119	2025
SII	0.09	0.07	0.05	0.14	0.09	-0.02
RII	0.50	0.50	0.39	0.26	0.18	-0.05
<b>Income</b>						
Lowest	28 %	25 %	20 %	59 %	63 %	59 %
2.	21 %	16 %	20 %	57 %	53 %	52 %
3.	17 %	13 %	11 %	53 %	48 %	49 %
4.	15 %	12 %	14 %	52 %	46 %	47 %
Highest	12 %	10 %	10 %	46 %	40 %	40 %
N	2247	1888	1748	2247	1888	1748
SII	0.19	0.16	0.13	0.15	0.25	0.21
RII	0.99	1.10	0.87	0.29	0.51	0.43

Table 11. Averages of oral health impact severity, extent on “fairly often, very often” (FOVO) and “occasionally, fairly often, very often” (OFOVO) thresholds as well as the relative index of inequality (RII) and slope index of inequality (SII) by education and income in 2001, 2004 and 2007. Age- and sex-standardized.

	Severity			Extent FOVO			Extent OFOVO		
	2001	2004	2007	2001	2004	2007	2001	2004	2007
<b>Education</b>									
Low	8.84	7.35	7.07	0.84	0.60	0.54	2.56	2.04	1.93
Medium	7.14	6.26	7.00	0.59	0.47	0.59	1.97	1.78	1.98
High	6.32	5.22	5.31	0.49	0.32	0.28	1.82	1.47	1.47
N	2502	2119	2025	2502	2119	2025	2502	2119	2025
SII	3.85	3.23	2.67	0.54	0.42	0.40	1.14	0.86	0.70
RII	0.51	0.51	0.41	0.83	0.92	0.86	0.53	0.49	0.39
<b>Income</b>									
Lowest	10.69	9.68	9.02	1.27	0.96	0.84	3.11	2.93	2.58
2.	7.79	7.08	7.67	0.61	0.52	0.72	2.22	2.07	2.29
3.	6.95	6.23	6.12	0.50	0.39	0.33	1.94	1.68	1.70
4.	6.41	5.48	5.83	0.44	0.31	0.35	1.80	1.43	1.57
Highest	5.61	4.37	4.41	0.36	0.20	0.23	1.56	1.13	1.15
N	2247	1888	1748	2247	1888	1748	2247	1888	1748
SII	5.75	5.88	5.55	1.00	0.82	0.80	1.75	2.03	1.79
RII	0.77	0.91	0.84	1.57	1.78	1.63	0.82	1.12	0.96

## 6 Discussion

OHCR improved access to subsidized oral health care; affordability and availability of care improved particularly in medium and large municipalities. After the reform, age no longer determined the access to subsidized care. Financial barriers to accessing care also decreased by the reform. Overall, coverage of PDS and the NHI subsidization scheme for private oral health care costs extended; in other words, public coverage of oral health care became more universal and role of society in adults oral health care services increased clearly in Finland. However, in addition to the congested PDS after the reform, unequal regional availability of private oral health care and out-of-pocket payments in both sectors still restricted accessing the oral health care after the OHCR.

Findings of this study concerning the use of oral health care services and socioeconomic inequity in it were rather expected in light of the above considerations, national and PDS-level statistics [40,149-151] and opinions of public and private dentists [152,153] and chief dentists in PDS [37,39]. Findings indicate that the use of oral health care services during the past 12 months increased after the reform that stemmed from increased use of PDS. The use of oral health care services increased from 2001 to 2007 particularly among those with own teeth and who were born later than 1945, or had low- or middle-income and low or medium level of education. It is possible that the use of PDS became more need-based after the reform; those visited PDS were in poorer (perceived) oral health in 2004 and 2007 than in 2001 (Table 5 in paper I and Table 4 in paper II).

The socioeconomic inequity in the use was smaller in 2004 than in 2001 or 2007. In the dentate population, inequity seemed not to decrease from 2001 to 2007 (Table 3 in paper II) but in the whole population a small decrease in the inequity was seen from 2001 to 2007 (Tables 4 in paper I and Table 7). However, socioeconomic inequity in the use was still clear in 2007. There were clear education- and income-related gradients in the use in 2001, i.e. the higher the income or education, the higher the use. In 2004, two highest education groups and all income groups, excluding the lowest one, used services rather equally. In 2007, education-related gradient was again clear, whereas three highest income groups had clearly a higher level of use than the two lowest ones. This indicates that there may be threshold effects between the low-income and the rest of the population; probably affordability of care depends on income and its plausible explanation is cost of care [154,155].

There are still plenty of characteristics in Finnish oral health system that can be seen to be related to the persisting socioeconomic inequity, in addition to the aforementioned out-of-pocket-payments and disparity between supply and demand that restricts the access to PDS still in the present. Regulation of the private oral health care sector, that produces approximately half of the subsidized adult oral health care services, is minor. This partly maintains higher out-of-pocket payments, unequal regional distribution of services and commercialism in oral health care delivery, and thus also a multi-tiered system, favoring the better-off in the use [13,17,156]. Dental recalling, an important factor related to regular dental visiting and use of services, also favors the advantaged [90]. To achieve greater equity in the use, further reforming of the system is needed.

Nevertheless, there are also differences in care-seeking according to socioeconomic status. Differences in awareness and knowledge of oral health (care)-related issues affect care seeking; for example, awareness of entitlement to subsidized oral health care may vary according to socioeconomic status [50,157]. Due to a difficult situation in life, unprivileged may not have enough strength, resources and support to visit oral health care services; visiting health care for preventive reasons is more like distant hope than reality [157]. Many unprivileged report that out-of-pocket payments force them to postpone care-seeking until it is absolutely necessary [157]. On the other hand, common cultural framework through

education and social status supports interplay between the advantaged individuals and care providers, and also furthers care process and organization of system favoring the advantaged [50].

This study also showed that OHRQoL improved and perceived need for care decreased in the study population from 2001 to 2007. Socioeconomic inequalities in OHRQoL and self-rated oral health were clear in all study years, whereas the inequalities in need and toothache were very small in 2001 but widened significantly from 2001 to 2007. The improvement in OHRQoL was relatively higher among the low-educated but similar in all income groups while decreases in reporting toothache or other discomfort and need for care were greater in the more advantaged socioeconomic groups.

Number of missing teeth, perceived general health and income were the main factors related to the inequalities. The recent use of oral health care services, the satisfaction with the last dental treatment period and inequalities in them (i.e. oral health care factors) explained relatively small part (10-20%) of the inequalities in OHRQoL already in 2001, but seemed to have a greater role in explaining the inequality in perceived oral health measures. All these contributions diminished (approximately 35-85%) from 2001 to 2007. It is possible that OHCR was a major factor behind the decrease.

The contributions of these 'oral health care factors' to the inequalities were somewhat smaller than those of self-rated oral health detected in Swedish studies [60,61]. It seems likely that the difference stems from different context, methods and variables used; those Swedish studies focused on 'refraining from care/unmet need' that probably captures the inequity in access and use faced by individuals more clearly than variables used in this study. However, findings of this study imply that focusing only on the recent use of, or access to, oral health care services underestimates the role of oral health care services in the inequalities; number of missing teeth was a major factor behind the inequalities in OHRQoL in particular, and it is likely that the inequity in the access to oral health care faced by the older adults studied during the earlier decades has affected the number of teeth and its distribution by socioeconomic groups, in turn maintaining the socioeconomic inequality in OHRQoL at the present.

The inequalities in perceived oral health and OHRQoL were particularly related to income, stemming from its association with the outcomes and from income inequality. This reflects the importance of social determinants of (oral) health. Overall, income inequality seems to have many potential adverse effects on wellbeing, health and their distribution by socioeconomic groups [158]. The association of perceived general health with perceived oral health and OHRQoL and income-related inequality in general health link the inequalities in oral health to the inequalities in general health. However, it should be noted that, like perceived oral health, perceived general health not only measures actual medical status of the individual but also represents personal experience, life situation and health-related lifestyle of said individual [159], and so it is evident that the connection between perceived general and oral health is not totally explained by actual medical or dental conditions. Overall, from general health point of view, for example, measures maintaining functional ability so that the individuals manage to do oral self-care and seek for oral health care are essential to tackle oral health inequalities. Not forgetting measures supporting the working capability and employment opportunities of those plagued by poor health.

Finally, all these considerations must be enlarged upon a wider social perspective. Many global, societal, institutional and community level factors affect (oral) health care policy and system and also human life, and thus socioeconomic inequity in the oral health care services and oral health are also evidently affected by many multilevel mechanisms. For example, employment situation, income inequality, (ruling) political ideology, economic growth and social cohesion are examples of such factors. These factors are, in turn, affected by society, its institutions (including oral health care system, dental associations) and individuals (including oral health care professionals) through e.g. policies and social interaction [160]. E.g. advocacy for adequate social security should be seen as an indispensable element of

tackling health inequalities. It has been argued that social policy practiced in Finland has not worked optimally during the last decades [161-163], e.g. there are homeless people and (visible) permanent charity-based food aid services (where approximately 0.5% of Finnish adult population visit weekly) in Finland in the present despite practiced policies [162,164]. Notwithstanding, Finnish doctors view social security as being too generous significantly more frequently than their high-educated counterparts or Finnish population in general [165]. Sadly, it is likely that this applies to dental professionals too. Understanding significances of solidarity, different (redistributive) welfare state structures and social determinants of (oral) health inequalities are needed in order to develop a fair oral health care system that is also capable to promote the (oral) health equity.

## 6.1 STRENGTHS AND LIMITATIONS

Lack of evidence about tackling health inequalities through affecting social determinants is emphasized [46,57]. In addition, evaluating the effects of health policies is also seen necessary [18]. In light of these, data of this study provided a good starting point for analyses; data were gathered before and two times after major OHCR and the samples were representative and gathered with good response rates, despite decreasing trend from 2001 to 2007.

Used methods of analyses were both 'traditional' (paper I) and 'sophisticated' (papers II-IV and RII/SII). Benefits of the summary measures of inequalities over more simple methods are clear: they take into account the whole distributions of dependent variable and ranking variables in the study population and they make it possible to compare magnitudes of inequalities e.g. over time more easily. Overall, these kind of methods used here are recommended when analyzing inequalities [143].

Still, there are many limitations in the study. Follow-up time was limited in light of the fact that health care reforms or interventions affect frequently with (years of) delay [166]. In addition to the limited number of study points and repeated cross-sectional nature, the fact that it was not possible to detect individuals (not) affected by the reform, it made it impossible to use cluster-randomized trial design or to directly measure and distinguish causal effects of reform e.g. from longer-term trends in the inequalities or other macro-level changes occurred during the follow-up (e.g. increased level of relative poverty and income inequality in Finland [167]).

There are also problems related to the nature of the data. It is clear that postal surveys do not reach everyone, e.g. socially excluded people. Non-response to the income question was also relatively high (15-17%). Overall, risk of non-response bias is clear despite analysis weights were used; probably the levels of the use of oral health care services, perceived oral health and OHRQoL were lower and the inequalities were wider in reality than this study suggest.

Self-reported measures, concerning the use of oral health care services in particular, may be incorrect to some extent. The oncoming reform implementation might have affected the use of oral health care services in 2001, for example, some may have postponed their care-seeking deliberately due to the oncoming reform.

It was problematic that the use of private/public dental hygienist's care could not be distinguished and so the use of PDS was only approximated. Moreover, it was not determined that those who had a visited private dentist actually received any subsidized procedures. However, it is likely that the huge majority of visitors to a private dentist received some subsidized treatments (despite seeking for unsubsidized care, like prosthetics) because e.g. radiological and clinical examinations are subsidized. Moreover, the type of visit (e.g. treatment/preventive/both) was not considered in this study.

Measurement of OHRQoL and perceived oral health and comparing them between different time points and among individuals of different socio-economic status raises questions, such as: do individuals of different socio-economic status report oral health

impacts or certain oral health status differently; or has the basis of reporting them changed from 2001 to 2007? Evidently, the aggregate measures of OHIP used here, passes over valuable and fundamental information about oral health-related problems, clearly more meaningful than “severity, extent and prevalence of oral health impacts”. Moreover, OHIP is not trouble-free measure of OHRQoL; I think a good (oral health-related) quality of life is something more than absence of certain oral health related problems.

In addition, clinical information or variable of ‘unmet need for oral health care’ would have been valuable. Lack of these forced the use of a set of ‘need-standardization variables’ in paper II, but how these variables really represent need for care is unknown and e.g. reverse causation may also be a problem (i.e. need variables are affected by the use of services during the past 12 months). However, the results concerning the inequity in the use were very similar despite simpler need-standardization (i.e. age and sex) was used (Table 5 and 6), like Grignon et al have also found [154].

It must also be noted that it is unsolved to what extent the detected inequalities are really avoidable and so ‘unfair’, probably not all. This clearly impedes interpretation of the results. For example, to what extent is it unfair that (poor) general health and differences in it according to socioeconomic status relate to socioeconomic inequality in oral health?

Finally, it is unclear how well the findings of this study hold true today and are these findings useful in reforms planned in the present. However, presumably rather well. No major changes in oral health care system or general conditions in Finland have occurred after 2007. The level of the NHI reimbursement slightly increased in 2008 and extended to cover private dental hygienist costs in 2010. However, the economic recession, that has bothered Finland since the Great Recession (2008-2009), has been putting pressure on public economy; the government made cutbacks in the NHI reimbursements in 2015 and further cutbacks are on their way. The PDS are also still congested. Sadly, oncoming changes in oral health care system (i.e. considerable cutbacks in the NHI reimbursements, -50% of 2014 level) seem hasty solution and their effects on equity in oral health care are not known.

Despite the limitations, it appears likely that data were good and representative and the used methods produced results comparable over study years and generalizable to the adult Finnish population born in 1970 or earlier in 2001, 2004 and 2007. The results provide important information about valuable, but relatively uncommon, public oral health care system and its connection with socioeconomic inequalities in the use of services and oral health before and after a major health care system reform. However, need for further studies is evident. In addition to aforementioned ones, studies clarifying and deepening knowledge of inequities in oral health care services (e.g. vertical inequity) and clinically measured oral health are clearly needed. Follow-up of perceived oral health and the use of oral health care services should be continued, in particular, due to oncoming changes in the NHI reimbursements and major legislative changes in the Finnish health care system.

## *7 Conclusions*

Overall, the OHCR seemed to increase, although rather modestly, the use of oral health care services, in particular PDS, among the study population by improving availability and affordability of oral health care services. The reform seemed to narrow only slightly the socioeconomic inequity in the use of services from 2001 to 2007. OHRQoL improved and the perceived need for care decreased from 2001 to 2007. The socioeconomic inequalities in OHRQoL and perceived oral health remained on the same level or increased. The use of oral health care services seemed to explain only a rather small part of the socioeconomic inequalities in OHRQoL and perceived oral health. There are still characteristics of Finnish oral health system which likely maintain the socioeconomic inequity in the use of services and therefore also in oral health.



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## EERO RAITTIO

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*A major reform abolished age restrictions on subsidized oral health care in Finland in 2001–2002. This thesis focuses on how socioeconomic inequity in the use of oral health care services and inequality in perceived oral health changed among adult Finns from just before the reform to a few years after the reform. It seems that socioeconomic inequity in the use of services narrowed slightly while inequality in perceived oral health remained on the same level or increased after the reform.*



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