EEVA TORPPA-SAARINEN

Interplay Between Treatment Need, Service Use and Perceived Oral Health

A Longitudinal, Population-Based Study
INTERPLAY BETWEEN TREATMENT NEED, SERVICE USE AND PERCEIVED ORAL HEALTH

A LONGITUDINAL, POPULATION-BASED STUDY
Eeva Torppa-Saarinen

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ABSTRACT

Service need and service demand in oral health services should be at the center of oral health provision and supply in Finland. In 2001-2002 the whole adult population gained access to subsidized basic oral health services. The aim of this thesis was to evaluate the interrelationships of changes in self-assessed treatment need, service use and perceived oral health (subjective oral health and oral health-related quality of life) in the Finnish adult population after the major oral health care reform.

The changes were analyzed with longitudinal interview and questionnaire data gathered in the Health 2000 and the Health 2011 nationally representative surveys. A path analysis was applied to analyze the interrelationship between perceived oral health and regular service use. Logistic regression models were applied to find the determinants of changes of perceived oral health, and determinants of improvement or worsening of unmet oral health treatment need according to Andersen’s theory.

Perceived oral health improved over the study years, but the incorporated gender differences persisted from 2000 to 2011, that is, females had better perceived oral health. However, about half of the population reported self-assessed treatment need in both years. Good oral health-related quality of life in 2000, indicated by lack of perceived problems or symptoms, led to regular service use, which in turn led to good subjective oral health. A regular pattern of visiting the dentist was more common among females, although the changes to more habitual visiting were seen among the male birth cohorts born 1945–1955 and 1971 or after; the older age group being the one that gained access to subsidized services during the study years. Unmet self-assessed treatment need was substantial, as reported by half of the respondents. Acute treatment need seemed to have been satisfied, since those with unmet need did not particularly report pain or discomfort in either of the years, but other treatment need persisted. The favorable changes in unmet treatment need from 2000 to 2011 were less likely among those who had poor subjective oral health, basic or intermediate education level, or a poor perceived economic situation in 2000. Worsening was more likely to occur among males and participants from northern
Finland and less likely among participants from central Finland and among older birth cohorts. Thus contextual and individual characteristics described in Andersen’s behavioral model of service use both had a strong effect on the oral health service use outcomes.

The causes of unmet treatment need should be closely monitored and the health policies and practices developed according to that in order to gain better perceived oral health on the population level. The outcome of the health care provision and health care use should be evaluated with the different measures such as perceived oral health and self-assessed need. Access to non-ambulatory services and maintaining regular service use is crucial and should therefore be emphasized in oral health service planning. The legislation and service fee policy should promote regular service use and not solely concentrate on the acute care provision based on expressed need.

*National Library of Medicine Classification: WU 113, WU 30*

*Medical Subject Headings: Self-Assessment; Oral Health; Diagnostic Self Evaluation; Quality of Life; Longitudinal Studies; Surveys and Questionnaires; Health Care Reform; Finland*


Tyydyttymättömän hoidon tarpeen syitä on seurattava tarkkaan ja sen mukaisesti kehitettävä terveyspolitiikkaa ja -käytäntöjä, jotta suunterveys paranisi väästötasolla. Suun terveydenhuollon palveluja ja niiden käyttöä tulisi arvioida erilaisilla menetelmissä, kuten kartoittamalla koettua suunterveyttä ja itsearvioitua hoidon tarvetta. Lainsäädännön ja palvelumakupolitiikan tulisi edistää säännöllistä palvelun käyttöä, eikä palvelujen tarjonnan tulisi keskittyä pelkästään kysyntään perustuvan akuutin hoidon tarjoamiseen.

Yleinen suomalainen asiasanasto: suun terveys; koettu terveys; itsearviointi; elämänlaatu; palvelutarpeet; hoitotarve; terveyspalvelut; pitkittääistutkimus
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This work was carried out with permission from the Finnish Institute for Health and Welfare Oral Health Research Community of Health 2000 and Health 2011 surveys. I want to thank The Finnish Dental Society Apollonia, The Finnish Female Dentists’ Society and University of Eastern Finland for financial support during my research.

The thesis is a natural continuum to my career as a social- and healthcare leader and my interest in oral health care. Population surveys have interested me from the early years of my studies. I was one of the students guiding the Mini-Suomi-survey participants in 1979. In November 2013, I participated in Finnish Dental Association Apollonia session on the results of the Health 2000 and 2011 surveys. Professor Satu Lahti told the audience that some data from the nationally representative surveys were waiting to be analyzed and the findings interpreted. I contacted her the next week and we agreed to make plans for future research. Professor Lahti introduced me to professor Liisa Suominen. We soon had the outline for mutual interests and invited PhD Mimmi Tolvanen to join the group. In May 2014, the research plans were ready and permission for access to the data was granted. The modern means of communication have been put to practice since the research team members work and live in Kuopio, Turku, Tampere and Oulu.

I want to thank my skillful and experienced supervisors, Liisa Suominen, Satu Lahti and Mimmi Tolvanen who always have been there for me to discuss and review my work. Their experience from the population-based studies over the years has offered me new views on the subject. They have introduced me to the practice of publishing papers and communicating the findings in research congresses. These events have been enlightening and provided opportunities to widen my skills.

I want to thank the preliminary examiners, PhD Anne Nordehaug Åstrøm and PhD Finnbar Allen for their suggestions which have helped me to improve my work. Many thanks to MA Ville Laine for practical advice and help in word-processing and Professor Tarja Kvist for skillful advice with the publishing process of this dissertation. PhD Eeva Ketola I want to thank for consenting to examine my work in a public defense.

Continuing education has been an integral part of my life. In the formal studies, after graduating as DDS in 1983 and as a specialist in clinical dentistry in 1991 at University of Kuopio, I completed administrative studies at the University of Helsinki in 1995, and an MBA in social- and healthcare administration in 2009 at Tampere University of Technology. It has been very refreshing and forgiving to
embrace a student role again. I am grateful to be Finnish and to have the opportunity to do it. Combing PhD-studies, leadership in social- and primary health care services, and a civil servant of the city of Tampere has been inspiring yet challenging. I have worked most of my career in a pragmatic working environment with expectations to provide answers and solutions to more or less complicated practical questions. The role of a student and researcher has been a refreshing and I have welcomed it with joy.

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My daughter BSc Anni Saarinen has been studying at the UEF from 2015, giving us the opportunity to share student views. Anni has with her example taught me patience, perseverance and the skill of resilience for which I want to thank her. I want to thank my grandson Oliver Saarinen and his artistic and talented parents MMus Miikka Saarinen and BA Emilia Nyman for showing interest in my studies and travels and understanding my choices in schedules and occasional priorities. Kimmo, Arto and Terttu Saarinen I owe a lot and want to thank for their continuing support during my studies in the past 45 years.

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Tampere, August 28, 2020
Eeva Torppa-Saarinen
LIST OF ORIGINAL PUBLICATIONS

This dissertation is based on the following original publications:


III  Torppa-Saarinen E, Tolvanen M, Lahti S and Suominen AL Changes and determinants of unmet oral health treatment need. Submitted

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<tr>
<td>SU</td>
<td>Service use</td>
<td>SF-36</td>
<td>Short Form Health</td>
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<td>RSU</td>
<td>Regular service use</td>
<td>SIDD</td>
<td>Social Impacts of Dental Disease</td>
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<td>POH</td>
<td>Perceived oral health</td>
<td>ADHS</td>
<td>Adult Dental Health Survey</td>
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<td>SOH</td>
<td>Subjective oral health</td>
<td>THL</td>
<td>Terveyden ja</td>
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<td>OHRQoL</td>
<td>Oral health-related quality of life</td>
<td>NSAOH</td>
<td>National Survey of Adult Oral Health</td>
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<tr>
<td>OFoVo</td>
<td>occasionally, fairly often or very often</td>
<td></td>
<td>National Institute for Health and Welfare</td>
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<tr>
<td>STN</td>
<td>Self-assessed treatment need</td>
<td>SHARE</td>
<td>Survey of Health, Ageing and Retirement in Europe</td>
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<td>PA</td>
<td>Path Analysis</td>
<td>Valvira</td>
<td>Sosiaali- ja terveysalan</td>
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<td>UTN</td>
<td>Unmet treatment need</td>
<td></td>
<td>valta- ja valvontavirasto, National Supervisory Authority for Welfare and Health</td>
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<tr>
<td>FDI</td>
<td>World Dental Federation</td>
<td></td>
<td></td>
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<tr>
<td>WHO</td>
<td>World Health Organization</td>
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<tr>
<td>HRQoL</td>
<td>Health-Related Quality of Life</td>
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<td>WHO ICF</td>
<td>World Health Organization, International Classification of Functioning, Disability and Health</td>
<td>AVI</td>
<td>Aluehallintovirasto, Regional State Administrative Agency</td>
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<tr>
<td>QoL</td>
<td>Quality of Life</td>
<td>PDS</td>
<td>Public Dental Service Odds Ratio</td>
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1 INTRODUCTION

Service need and service demand in oral health services is the key to the oral health provision and supply in Finland. The oral health need assessment has been the center of legislation changes since the 1970’s, when the Finnish government decided to implement comprehensive preventive dental services to children. The approach was successful and the caries disease burden decreased rapidly, as in 1976 1/100 12-year-old children had sound teeth compared to 30/100 in 1991 (Nordblad; Suominen-Taipale; Rasilainen; & Karhunen, 2004). In 1986, oral health services were introduced to young adults, those born 1961 or after, to maintain the good results of the comprehensive and preventive care provided. By 1990, the adults born in 1956 or after were included in the publicly funded scheme. After this approach, an adult oral health reform was planned, but due to financial reasons the legislation had to wait for several years to be implemented. In 2001–2002 the rest of the adult population gained access to national health insurance that covers also basic oral health services.

In 2000 The Health 2000 Survey was conducted and a follow-up to that in 2011. The Surveys are nationally representative health surveys, which also cover social and background questions. The survey results can be utilized to develop health policies, health service provision and social security. The oral health survey included questions on perceived oral health, service use and clinical evaluations. In 2000 the national insurance did not cover dental services for the population born 1955 or before, but during the follow-up the coverage was universal. These legislation changes and the timing and the questions on surveys provide a framework for this study.

The oral health services are aimed to help the population in achieving and maintaining good oral health. Perceived oral health is a concept concentrating on the values of self-determination and self-actualization (Gift, Dayton, & Atchinson, 1997). The need to “put the patients in the driver’s seat”, that is to engage the people in decision-making, has been recognized in the EU-policies for healthcare development (Saltman; Rico; & Boerma, 2006). Evaluating perceived measures of oral health might help the governments and population in achieving the goal and developing patient-centered care that matters to the population.

This present study was designed to evaluate the interrelationships of changes in treatment need, service use and perceived oral health, in the Finnish adult population after oral health care reform.
2 REVIEW OF THE LITERATURE

In this review I present the concept of oral health followed by a theoretical basis of need with special emphasis on oral health care need assessment, I introduce the model of service use applied in this dissertation. After that I review the concepts and definitions of perceived oral health and review the oral health-related quality of life. I review the current oral health service provision and its goals, followed by the literature on previous findings on the interplay between need, service use and perceived oral health.

The concept of oral health has been defined by WHO as “a state of being free from chronic mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal (gum) disease, tooth decay, tooth loss, and other disorders that limit an individual’s capacity in biting, chewing, smiling, speaking, and psychosocial well-being.” (WHO) https://www.who.int/oral_health/en/ (https://www.who.int). The World Dental Federation, FDI has defined: “oral health is multi-faceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow and convey a range of emotions through facial expressions with confidence and without pain, discomfort and disease of the craniofacial complex.” (www.fdiworlddental.org/) (FDI World Dental Federation, 2019).

The two international definitions raise awareness of the multiple dimensions of oral health. The global challenge of oral diseases and their consequences has been reviewed recently (Peres, et al., 2019). Perceived measures are of utmost importance, since they represent both the outcome and the factors influencing need, and put the individuals in the center in defining their oral health.

There are several approaches to health service use, depending on the global context, geography, government policy, health care goals, assets, legislation, service provision system and the population characteristics. One of the most cited models of health care use has been developed by Andersen and is used as the contextual framework in this study (Andersen, 1968) (Andersen, 1995) (Andersen, 2008) (Fig1). The model was originally developed to describe and understand the multi-dimensional system and the various social and individual factors that influence access to health care. The model suggested that some individuals are more likely to use health services and that the use can be explained by predisposing, enabling and need factors. Predisposing factors existed before service use or illness, that is social class, gender and education. Enabling factors are those connected with accessibility of the services and other resources, that is cost of care and health insurance. Need factors include both perceived need by the individual and professionally and clinically evaluated need, often called the normative need. The model has been revised over the years and Andersen describes five phases of development. In the revised model from the 1990’s Andersen (1995) suggests that service use will also influence health outcomes, such as perceived oral health and satisfaction with care.
The latest model stresses that understanding health services use needs both contextual and individual determinants.
Figure 1. Andersen behavioral model of service use. Modified from (Andersen, National Health Surveys and the Behavioral Model of Health Services Use, 2008). Contextual characteristics, Individual characteristics, Health behaviors and Outcomes are outlined. The determinants presented and discussed in this thesis are highlighted.
In the literature review, the factors included and described in the behavioral model of service use are presented in relation to this study.

2.1 ORAL HEALTH CARE NEED

2.1.1 Concept of need

Both contextual and individual characteristics of service use in the Andersen’s model present need as a factor (Fig 1). I review the concept of need from general and a view specific to oral health care. I also review the concept of unmet treatment need (UTN).

Two different definitions and approaches to need are presented here. Different perspectives of need are useful in evaluating the need for healthcare. Policymakers, care providers and the population might have different views, and the two core definitions highlight the need and need assessment also in oral health.

Maslow suggested that human needs could be structured into different hierarchical categories (Maslow, 1954). The needs are prioritized and appear according to that hierarchical order (Fig 2). The services provided should also meet the needs in the order of the hierarchy. The needs are defined as physiological needs, such as food and sleep, stimulation, activity, safety needs (protection and security), love and belongingness needs (love, friendship, comradeship), Esteem needs, such as self-respect, personal worth and autonomy and self-actualization needs, which according to Maslow gives the individual the full potential. These four lower levels form the deficit-need as Maslow calls it. When the deficit needs are met there are no special feelings by the individuals. but when they are not met, they are noticed. Unmet needs lead to problems and should be satisfied. All deficit needs are important in maintaining the perceived measures of health in a good state. The theory of deficit needs is important when we are describing the steps in oral healthcare development and the changing perceived needs and demand. Practical considerations of need in oral health care are seen from the population point of view, although the theory of need is oversimplified and does not necessarily mean that the needs appear and are satisfied in the hierarchy presented.
Figure 2. Maslow’s hierarchy of need.

Another approach to need is Bradshaw’s taxonomy of need (Bradshaw, 1972), which defines different types of need. Normative need is the need which the expert or professional, administrator or social scientist defines as need in any given situation. Individual needs are compared to this standard and the need for services is decided against that. Perceived (felt) need is defined by Bradshaw as need reflecting the individual’s own assessment of his or her requirement, for example, for health care services. Comparative need is measured by reference to a person already receiving the service and expressed need (demand) as the felt need converted into action by seeking assistance (Fig 3). The figure illustrates that there might be discrepancies between normative, perceived and expressed need (demand). Normative need, clinically diagnosed disease might be unnoticed and no perceived need for treatment or oral health impacts are present. On the other hand, perceived need for oral health care might not be recognized by the professionals as an evidence-based cause for dental care. Demand for care is the felt need converted into action, that is, seeking oral health care.
Figure 3. Taxonomy of need according to Bradshaw, modified from (Bradshaw, 1972). Unmet need might be perceived but not demanded (green), not recognized by the individuals and therefore not demanded (orange), or treatment is not available (orange).

Oral health need assessment is the core of oral health care planning. The oral health care need for an individual can be detected in clinical situations at dental offices. Comprehensive national statistical approaches at dental offices can describe the diagnoses and treatments provided, but the ill-health of those not seeking care is not detected. The treatment statistics offer a narrow view into the matter and do not highlight the population needs. Population-level oral health care need should also be measured with surveys with perceived oral health measures, subjective oral health, and oral health impacts, such as oral health-related quality of life and self-assessed treatment need (Sheiham & Tsakos, 2007).

In the Western world today, marketing new products and consuming services has an essential role in the economy. Needs are created for the purpose of marketing and
promoting consumer needs also for health services, some of which do not have desired effects on the health status. Some of these procedures will not receive acceptance from the evidence-based or best practice perspective (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). Comparative needs might function as beneficial for the oral-health-outcomes, such as the need to have as fresh breath as one’s peer or the need for a high-performance electric toothbrush. Comparative need might also create false expectations, dissatisfaction and disappointments, such as the need of the public service system to provide everybody with a cosmetically flawless smile. However, the treatment offered in the Public Dental Service (PDS) has to follow the norms of society and expectations of the public. It is also essential to pay attention to the value created with the public funding and offer evidence-based services. New health technologies and new methods of delivering care have to be adopted to satisfy the need

The legislation in Finland guarantees access to oral health services after professional need assessment. In the case of deficient resources, the urgent need, such as need due to pain, infections, or accidents, is treated first. The concept has been adopted from the hospitals, and the same legislation has been applied to public oral health care (http://www.finlex.fi/en/ (Oct 25, 2019), n.d.).

The oral health care need assessment provides the means of understanding the needs and priorities of the population (Sheiham & Tsakos, 2007). The professionally evaluated need, normative need, clinically assessed disease at a dental office or in a hospital, provides an assessment of need, but does not always take into consideration oral health-related quality of life and the self-assessed treatment need.

2.1.2 Self-assessed need

Self-assessments are an important part of evaluating different multidimensional constructs. Self-assessed treatment need (STN) can also be asked using a straightforward, simple question. The STN question in surveys either asks about the STN at the present time or within a period from the past.

The questions used prior to check-ups or in epidemiological studies may also enquire about the individual’s perceptions of treatment need, also specific to treatment. The self-assessments may be structured and emphasize one aspect of oral health, such as the self-assessed need for orthodontic treatment, (Sepp, Saag, Peltomäki, Vinkka-Puhakka, & Svedström-Oristo, 2018) or self-assessed dental status (Samorodnitzky & Levin, 2005).

In a French cross-sectional cohort, in which the prevalence of self-reported dental care needs in an adult population was studied, education, income and national origin were more strongly associated with the need for dental care than insurance coverage level. No significant gender-related differences were detected (Trohel, Bertaud, Soler, Chauvin, & Grimaud, 2016). Perceived treatment need and difficulty accessing dental
services were found to be the key predictors of oral health outcomes in an analysis of a regional postal survey in the UK (Marshman, et al., 2012). Poor OHRQoL measured with OHIP-14 was significantly associated with perceived need for dental treatment among elderly persons (Jensen, Saunders, Thierer, & Friedman, 2008).

In the clinical context, self-assessments and professionally diagnosed treatment needs may vary. Diagnosed gingivitis was perceived only by half of the adult population in South American cities, (Gomez, et al., 2018) and was also less reliable with diagnosed periodontitis. However, questionnaires on number of remaining teeth and use of removable dentures gave valid results (Buhlin, Gustafsson, Andersson, Håkansson, & Klinge, 2002). In a population-based study, self-assessed good oral health was found to be a fairly good estimate for absence of clinically evaluated dental and periodontal treatment need (Tseveenjav, Suominen, Varsio, Knuttila, & Vehkalahti, 2014).

Self-assessed oral health treatment needs should lead to a professional evaluation so that the treatment need can be assessed and acceptable treatment plans and procedures can be planned. However, relying only on the expressed need to assess the need for oral health care is likely to underestimate the level of evidence-based care (Fig 3).

### 2.1.3 Professionally assessed need

The approach of need assessment puts the main responsibility of evaluation of the need for treatment on professionals. The treatment recommendations and evidence-based approaches require professional knowledge to be implemented properly. Painful conditions very often need treatment and the individual with a self-assessed need approaches the services with expressed need. The condition will be verified by a diagnosis and a treatment plan. Acute treatment need might be easily recognized by the individual, although the diagnosis and treatment needed might be very demanding. On the other hand, some of the oral diseases, such as periodontal infections and malignant conditions, might be relatively symptomless and no self-assessed treatment need is present (Fig 3). When visiting the dentist or other oral-health professional is based solely on demand, the process might lead to ill-health due to acute need and under-diagnosis of the comprehensive care needed. On the other hand, it has been claimed that professionally estimated need for future check-ups might lead to over- or undertreatment. That has been connected to poorly defined payer-provider structures. The cost-containment demands and fixed capitation fees payed to the providers might lead to underestimation of need (Hill, et al., 2017). Neither under or overtreatment is desired by individuals or in the publicly funded health care system. In the PDS it also raises the question of equity.

The dental service use paradox has been described in an observational study, where the persons who entered a dental care system during follow-up were in better dental health than those who had not. The ability of dental care need factors to
predict dental care use varied with how dental care use outcome were measured. Persons with a higher probability of new dental problems were less likely to use the services (Gilbert, Shelton, Chavers, & Bradford, 2003). The inequality of health systems and subsidies has to be identified to avoid unwise distribution of the resources.

The clinical status findings, that is the professionally assessed need, from the consecutive national surveys in the UK, reported that in 1968, 37% of the adults in the UK had been edentate, and by 2009 the prevalence was 6%. The average number of teeth among the dentate also increased from 21.9 in 1968 to 25.7 in 2009. Variations according to geography were significant in all parts of the UK (Steele, Treasure, O’Sullivan, Morris, & Murray, 2012).

Health needs assessment involves researching and describing the population and identifying the needs. After that the capacity of services provided needs to be measured to find the gaps between need and provision. There may be alternative ways the needs are met, and the service provision planning may be completed after these steps (An Oral Health Needs Assessment Toolkit, 2006). The population need assessment should ensure a capacity for all types of services needed to meet the need. Different patterns of attendance, such as adults who use the services only when having problems, may have their demands satisfied, but their perception of oral health might be poor. The regular attenders, on the other hand, may attend even more regularly than necessary. The public funds should be spent in improving population health in an effective and efficient way and therefore provide access to services. Unmet treatment need in a publicly funded system is not desired, may lead to ill-health, human suffering and to extra costs to all parties. Therefore, all means of avoiding unmet treatment need should be given close attention.

2.1.4 Unmet treatment need

The discrepancy between treatment need and service use is referred to as unmet need. When treatment need has been diagnosed professionally, the individuals report unmet treatment need when the treatment is not available. Different factors according to Andersen’s behavioral model may give an explanation for this (Fig 1). Unmet need may appear in situations where a treatment is not available, visiting a dentist is too expensive if dental insurance coverage is low or does not exist. Unmet needs may also be a consequence of extreme dental fear.

In the Survey of Health, Ageing and Retirement in Europe (SHARE) the unmet treatment needs in the southern, eastern, Bismarckian and Scandinavian systems differed, being lowest in the Scandinavian welfare system (Palencia, Espelt, Cornejo-Ovalle, & Borell, 2014). Differences in health behaviors may explain the differences between the welfare regimes in Europe (Guarnizo-Herreno, Watt, Garzon-Orjuela, & Tsakos, 2019). In Canada, the out-of-pocket payments of dental care impacted access
to dental care, due to low insurance coverage and unavailability of insurance (Ramraj, Sadeghi, Lawrence, Dempster, & Quinonez, 2013).

In a nationally representative cross-sectional survey of Canadian adults, both clinical and perceived and the unmet needs were calculated. Over one third of the population had unmet need, roughly 12 million adults (Ramraj, Azarpazhooh, Dempster, Ravaghi, & Quinonez, 2012).

Unmet need has been estimated by asking individuals about both their view on self-assessed treatment need and service utilization. The professionally defined treatment need that has not been fulfilled is also considered as unmet treatment need (Fig 3).

2.2 ORAL HEALTH SERVICE USE

2.2.1 Contextual characteristics of oral health service use

The contextual characteristics of service use in Andersen’s model are divided into predisposing and individual factors (Fig 1). I review the enabling health policies and financing from the contextual point of view with a special emphasis to Finland.

The health care systems may be divided into Beveridgean (tax-funded), Bismarckian (social insurance) and private insurance systems. Health care may be provided also as a marketed service, without any third-party subventions or payments. Health care systems have developed according to the values of the countries. All the insurance- and public systems value equal access to services and share risks, but have chosen different policies to implement these different systems. In the tax-funded system in Finland, general taxation collects funds and the public authorities plan the strategies and nationwide recommendations and regulations for the actions. The national health insurance has the same principals, but the regulations are altered according to the finances, leaving the ultimate risks to the tax-funded, community-based care.

The healthcare legislation in independent Finland developed gradually, as the social rights of the citizens were recognized, but the state policy was to give the municipalities freedom to decide about healthcare provisions. That led to differences in implementation, the history of which continued until specific laws were passed and regulations were imposed on some sectors. The four most important values in Finnish healthcare development have been efficiency, effectiveness, emphasizing local decision-making and the local policies and the relationships between the state and the municipalities (Mattila, 2011). The need and right to publicly funded adult oral health services was not recognized, and if it was recognized, there were other social- or health needs that were prioritized. The state subsidies to municipalities were not targeted to special tasks, but could be used according to the decisions of the municipalities.
In 1986, individuals born 1961 or after were entitled to dental care either at the community health centers or to national insurance coverage in private practices. At the end of the decade the system covered the individuals born in 1956 or after. Finally in 2001 those born in 1946 or after were entitled to subventions either through the community-based health care or the national insurance in oral health care, and in 2002 the rest of the population was included in the system. In relation to Andersen’s behavioral model, the predisposing and enabling factors in the Finnish oral health service use context were radically changed when in 2002 all the adult population gained access to subventions in oral health care in Finland (Primary Health Care Act 15b, 1999).

The demographic and social factors of the health behavior model in Finland include minorities and the uneven geographical distribution of the population. The current constitution (Constitution of Finland 731/1999, 1999) and health legislation aim at enabling access for everyone despite income, gender, ethnicity, language, handicap of other predisposing contextual factors that might hinder access to services. The resource allocation for social- and health services has been an issue. In the contextual characteristics, the economist approach, cost-containment, has become an important part of the national approach to healthcare, meaning combining satisfactory services with cost-effectiveness (Mattila, 2011). Terms like the capacity to benefit as well as guidelines and recommendations for procedures have been developed, partly for the cost-containment purposes, partly to educate the professionals and the public on these. The financing parties are also taking these terms into account when considering procedures that are covered by insurance or offered in public healthcare (Duodecim, 2020).

Adults in Finland have the opportunity to select a private sector dentist and the national health insurance will cover part of the costs, according to the guidelines. The government can alter the refunds according to the finances allocated for the purpose. The communities have to arrange the ambulatory dental services for twenty-four hours, seven days a week. Non-ambulatory services have to be available in 3, at maximum 6 months after the need for services has been detected by the professionals since 2005 (www.kaypahoito.fi, 2014) (Apollonia, 2014) (Duodecim, 2020). The Finnish communities have had autonomy in service provision as long as the minimum requirements have been met.

The financing system in health care has gradually developed into a two-channel system, one through the insurance system and the other through taxation and community provision. The out-of-the-pocket payments of service users in Finland are substantial (Mattila, 2011). The health care, especially dental health care, had not been a priority in the post-war society in the 1950’s. The two systems, namely the Beveridgean (tax-funded) and the Bismarckian (social insurance) healthcare have been developed side-by-side. The system-reforms are political decisions. Although initiatives to have one-channel funding have been given, the political parties have agreed to maintain both systems.
Health care system surveillance in Finland is based on the surveillance of the supervisory authorities, the National Authority, Valvira, and the Regional State Administrative Agencies (AVI). The research institution, the National Institute for Welfare and Health (THL) studies and develops health care services. THL and its predecessors have arranged surveys according to the WHO. The WHO published the first edition of “Oral health surveys: basic methods” in 1971. Later, the surveys have been modified and, in addition to the epidemiological information, the latest surveys include data on OHRQoL, service utilization, social determinants and risk factors of oral diseases (Petersen & Baez, Oral Health Surveys: basic methods, 2013). The goal of health surveillance is to provide governments, social- and health authorities and professionals with up-to-date data on the progress of disease control and the progress, impact and efficacy of the policies, programs and procedures implemented. In a multi-country comparison in the EU, a lower level of non-attendance was found in the cohort at age ≥50 in the Scandinavian welfare state regime (Listl, Moeller, & Manski, 2014).

This paragraph describes the oral health service processes and arrangements in Finland. At the time of the surveys in Finland, there were oral health care professionals available, such as dental nurses, oral hygienists, dentists and also specialized dentists. However, the workforce distribution was not even and in some regions there was a shortage of dental professionals. Most children use the public dental services, which are free of charge until 18 and many communities have recall processes to reach children and adolescents. The dental caries situation in Finland has remained stable, however the disease seems to be polarized (Apollonia, 2014). In clinical examinations at private dental clinics and community dental services, the guidelines for treatment are mutual. It is customary for the private dentist to offer their patients a recall, but most of the community services do not use recalls for adults (Nguyen, 2008).

The hospital services related to oral health are part of hospital functions, but communities have had autonomy in developing their health services and the processes of adult oral health care are not very well integrated into other social- and health services. After the time guidelines were given for service access, the need for services had to be reviewed by a professional. The need and demand, as well as difficulties in accessing the services in the PDS, were made visible and the concept of waiting lists was adopted from hospital clinics. The need for resources has been made visible to hospital governance and decision-makers, but since the time-frame implementation of legislation was first developed in hospitals, applying the same logic to oral health care and PDS has encountered challenges. In hospitals, patients may be waiting for a single surgical procedure and access to care can be measured to the time point of the first and very often also the last visit. In adult oral health care, patients are waiting for a series of procedures, not meant to be completed during one visit. Oral health need assessment by a professional is now required in publicly funded adult oral health care in Finland. The introduced guidelines have given
frameworks for how to evaluate the treatment need and normative treatment need has been given priority in community oral health care (Apollonia, 2014).

Finland has a community-based healthcare system. The communities decide how they offer the health services, as long as the timelines and requirements set in the legislation are met. Private services are available, their location is not regulated. Most of the services are located in densely populated areas. Adults visiting private dental practices are entitled to check-up and procedure benefits regulated by national public insurance. Those who use the PDS at the community health centers have access to acute care during the same day, and to semi-acute care in three days. The non-acute care is available through the waiting lists in the majority of health centers. However, preventive care, check-ups and care at home, are the cornerstones for good oral health (Apollonia, 2014).

### 2.2.2 Individual characteristics of oral health service use

The individual characteristics explaining access to and use of health services in the Andersen behavioral model are also divided into predisposing, enabling and need-factors. The predisposing factors include demographic- and social factors, such as gender and education. The individual enabling factors are individual matters in financing, such as insurances and the procedures of the service provision organization. The need factors were presented earlier.

Although Finland has a constitution and health service legislation that grants health services to all, individual factors might still impede the use of services. Demographic distribution in the country is uneven, and from the individual’s perspective access to services might be difficult for these also partly contextual reasons. In sparsely populated areas the services might be far away and in the populated areas there might be long waits for the services.

Also, financial matters affect service use, since the proportion of those who visited oral health care services in Finland during the past 12 months was disproportionally greater in high income and high education groups 2001–2007 (Raittio, Kiiskinen, Helminen, Aromaa, & Suominen, 2015). The out-of-pocket payments of adults for dental health care are relatively high. The degree of public coverage of dental services is higher and extent of inequalities is lower in countries with public coverage and thus these countries have lower levels of inequality among the population aged 50 or over (Palencia, Espelt, Cornejo-Ovalle, & Borrell, 2014).

Avoiding the use of dental services might be due to dental anxiety or dental fear. In Finland, 41% of non-attendance was found to be due to dental fear (Pohjola, Lahti, Vehkalahti, Tolvanen, & Hausen, 2007). Adults with dental fear had poorer oral health-related quality of life especially in the social, psychological and handicap dimensions (Pohjola, Lahti, & Šuominen, 2009). Age modifies the associations between number of missing teeth and dental fear. In the older age cohorts, the higher number of extracted teeth seems to lead to dental fear (Pohjola, Lahti, Vehkalahti, & Hausen, 2008). Dental fear increased nonhabitual dental attendance, and decreased
dental fear leading to increased habitual attendance in a longitudinal study in Finland (Liinavuori et al. 2019)

Adult edentulousness has declined rapidly in Finland. In 1971 31% of adults were without own teeth (Suominen-Taipale, Alanen, Helenius, Nordblad, & Uutela, 1999). The corresponding percentages in 2000 and 2011 were 15%, and 7–8% (Suominen, et al., 2018). The demand for services has increased, as the number of teeth in the adult population has increased. The number of teeth explained the change in the volume of oral health service use also between 1980–2000 (Suominen-Taipale, 2000). The dentition of Finnish generations vary. Edentulousness declined from 63% in a regional cohort born in 1919, to 21% in another cohort born 1937 and differed between the Finnish regions in 1997 (Haikola, 2014). In the Health 2000 Survey, three different cohorts according to clinical oral health were found, as 44% of those born 1935 or earlier were edentulous, the cohort born 1955–1936 had filled teeth, periodontal conditions, radiological findings and removable partial dentures, and the younger adult cohort born 1956 or after had the best clinical oral health (Suominen-Taipale, Nordblad, Vehkalahti, & Aromaa, 2004). In 2011, the younger cohorts, born in 1956 or after, had not lost their teeth in 11 years (Koskinen, Lundqvist, & Ristiluoma, 2012). The number of dental visits increased from 2000 to 2011 and the percentage of adults visiting dentists increased in the cohorts born 1955 and before (Koskinen, Lundqvist, & Ristiluoma, 2012).

In Florida, USA, dental attitudes were found to be the proximal basis for oral health disparities. Attitudinal groups cut across ethnical, gender, age and educational status. The negative attitude group received the least preventive care and had the poorest clinical status. The access to oral health care was equal compared to the group favorable to oral health. The negative attitude group delayed seeking care until the disease was more severe (Riley, Gilbert, & Heft, 2006).

Data from 13 European countries (SHARE) on adults over 50, showed that the respondents with high educational level were more likely to report a dentist visit than those with a low educational level (Schulz, Kunst, & Brockmann, 2016).

Inequality in the utilization of dental services is a considerable global challenge. In a systematic review and meta-analysis, use of services was found to be lower in the male, ethnic minority, rural, lower education and uninsured populations (Reda, Reda, Thomson, & Schwendicke, 2018).

Cross-national variations in income-related inequalities have been found, but also limitations in the use of income as a measure of social position. Income and oral health relations globally have been summarized in a meta-analysis and review, where associations were found with oral cancer, caries prevalence, any caries experience, tooth loss, periodontal disease and low OHRQoL (Singh, Peres & Watt, 2019).

A Swedish prospective cohort study of adults described the trend of oral health care utilization. Major determinants of dental visiting habits were identified using Andersen’s Behavioral Model. Regular visiting was most prevalent in socio-economically advantaged groups, among those with remaining teeth, subjects who
reported perceived problems and reported high-quality care (Åstrøm, Ekbäck, Nasir, Ordell, & Unell, 2013).

Dental attendance patterns have been reported to change over the years in the UK. In 1968, 40% of the population reported a regular attendance pattern, in 1978 43% and in 1998 59% of the population. In the 2009 UK survey, 61% of adults reported a regular attendance pattern. The increase over the years was substantial and associated with improved oral health-related behaviors. Extreme dental anxiety was reported by 12% and the cost of treatment influenced choice of treatment for 26% of adults (Hill, Chadwick, Freeman, O’Sullivan, & Murray, 2013).

In the UK, access to National Health Services (NHS) services was a concern in 2009. Although the service demand had grown, the vast majority of people found the services reasonably accessible. Extreme dental anxiety was detected and was associated with irregular attendance and potentially higher need (Watt, et al., 2013).

Service use patterns in this thesis are viewed from different perspectives. Service use in general is service use within a timeframe consisting of all types of service use, including problem-based, acute service use as well as regular service use. Regular service use (RSU) is viewed in the analyses of paths between need and service use.

### 2.3 PERCEIVED ORAL HEALTH

According to Andersen’s model of health services use, the outcomes can be divided to perceived health, evaluated health and consumer satisfaction (Fig 1). I now concentrate on the concepts on oral health-related quality of life (OHRQoL), also in relation to Quality of life (QoL), Health-related quality of life (HRQoL) and the measures of perceived oral health (POH).

The concepts of perceived health and quality of life are abstract and refer to multidimensional domains that are predominantly subjective. The meaning of health is constantly evolving and can change over time (Locker, 1997). Definitions of health and quality of life may involve personal and social judgements about what is normal and they are imbued with values (Patrick & Erickson, 1993).

The generic Quality of life scales (QoL) might search for fatigue and discomfort of the body, while disease-specific questionnaires were developed for certain purposes and finding the symptoms and impacts associated with that disease. Oral health-specific questionnaires correlate better with oral conditions than the generic QoL measure, e.g. the Short Form Health Survey (SF-36) (Lee, McGrath, & Samman, 2007). The disease-specific quality of life questionnaire on oral health concentrates on questions specific to oral health symptoms. In epidemiological studies and in population studies, the measures should be assessing oral symptoms in the population and not symptoms specific to only part of the population (Sischo & Broder, 2011). The measures should be general enough to find various kinds of oral health-related problems, but should be tested to be sensitive and specific to avoid misinterpretations. That is important if we intend to measure and monitor quality of life in the population and try to improve it.
The measures of oral health perceptions have gradually developed from the 1970s (Cohen & Jago, 1976). One of the first measures on Socio-dental indicators was The Social Impacts of Dental Disease (SIDD). It is based on the Katz and Antonovsky Interactional Model, which has predisposing, motivational and conditioning variables (Antonovsky & Katz, 1970). The impact categories scored in the model consist of functional, social interaction, comfort and self-image items. Dental impacts were fairly common, while the attendants assessed their oral health as good. The model needed further development (Sheiham, Maizels, & Maizels, 1987).

The Rand study in the 1970s used health questions also applicable to oral health. The questions used were pain, worry and social interaction. The experiment took place during 1975–77 and was representative of the US population under 62 at the sites studied. The three-item scale was found to be statistically appropriate. The findings suggested that oral health is a separate dimension of health, yet associated with other health dimensions (Dolan & Gooch, 1997).

In clinical dentistry, it is recognized that the patients are treated, not merely their teeth or their oral condition. The facts that the patients have an active role, and the evidence-based approaches need patient perspectives, as well as that many treatments fail to completely cure the disease, have led to the growing importance of QoL (Sischo & Broder, 2011). Many of the QoL measures have gained attention of after the patient’s more active role in treatment, search for evidence-based approaches and evaluating outcomes, and the fact that many treatments do not provide a cure for the disease, but relief from the symptoms and thus the outcome of the treatment must be evaluated also by the patients (Sischo & Broder, 2011) (Baiju, Peter, Varghese, & Sivaram, 2017). The concept of HRQoL has been developed after 1920s, when the first model was introduced. The most commonly used models are those of Wilson and Cleary, its revision by Ferrans and colleagues, and the WHO ICF (international classification of functioning difficulty). They offer overall conceptualization of HRQoL from biomedical, social science, individual and environmental perspectives. They are global, but further developing and do not cover non-health-related circumstances (Bakas, et al., 2012).

OHRQoL can be used as an evaluative outcome measure and is a part of patient-centered care, since it gives the patient perspective of the treatment (Wright, Jones, Spiro, Rich, & Kressin, 2009), which is in line with the Andersen Model. The seven dimensions of OHRQoL adapted from Locker and Slade are presented in Fig 4.
The subjective self-ratings of oral health have been suggested to be contextual measures. That means they could change over time as circumstances of life change and the perceptions of situations change. For example, a dental problem might be perceived as physically or emotionally limiting at a certain age or situation and differently at another time or in another context. The perceptions have been claimed to be different among different generations due to differences in expectations (Steele, et al., 2004).

The theoretical basis for Oral Health Impact Profile (the OHIP) was the 1980 WHO International Classification of Impairments, Disabilities and Handicaps (WHO World Health Organization International Classification of Impairments, disabilities and handicaps: a manual of classification, 1980). The OHIP, was developed with the aim of providing a comprehensive measure of self-reported dysfunction, discomfort and disability attributed to oral conditions. It aims to capture impacts that are related to oral health in general, not to specific conditions. All the impacts are phrased as adverse outcomes, no positive aspects of oral health are measured (Slade, 1994).

The original version of the OHIP consists of 49 questions on 7 dimensions, which are functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. A shortened (14-item) version of the OHIP was developed, tested and translations of it have been widely used in population studies, clinical evaluations and health service research (Slade, 1997).

The OHIP has been translated into several languages such as Arabic, Dutch, German, Hebrew, Sinhalese, Spanish, and Vietnamese (Al-Jundi, Szentpetery, & John, 2007) (van der Meulen, John, Naeije, & Lobbezoo, 2008) (John, Patrick, & Slade,
A statistically significant association has been found between OHRQoL and periodontal disease (Ng & Leung, 2006) and also by OHRQoL and periodontal bone loss (Jansson, et al., 2014). In an Australian cohort the OHRQoL measured with OHIP-14 was associated with having untreated caries, periodontal attachment loss and one or more teeth missing (Lawrence, Thomson, Broadbent, & Poulton, 2008). A highly significant association was found between OHIP-14 scores and chewing ability among 60 year olds in Korea (Kim, et al., 2009). In Germany, the participants with removable dentures had higher scores than those with natural teeth, and those with complete dentures had the highest scores (John, et al., 2003). Age and education had a minor effect compared to denture status in this study (John, et al., 2004). OHRQoL can be used as an outcome measure to evaluate the efficacy of treatment protocols from patients’ perspectives and thus promote patient-centered oral health care (Wright, Jones, Spiro, Rich, & Kressin, 2009).

In the UK a considerably better OHRQoL was reported in 2009 than 1998, since occasional or more frequent impacts were experienced by 41% in 2009, whilst in 1998 the prevalence had been 51% (White, et al., 2012). There was also an overall improvement in OHRQoL between 1998 and 2009, although this occurred in the section of the population that reported infrequent oral impacts. A sizeable minority of the population reported frequent and consistent oral impacts. Oral diseases were highly prevalent and impacted the OHRQoL both in 1998 and 2009 (Tsakos, et al., 2017).

Subjective oral health can be assessed with a single question. The single question is simply: How do you rate your subjective oral health? Answers are given on the scale of very poor, poor, average, good and very good. This simple and straightforward question has served well as a subjective measure of oral health (Thomson, Broadbent, & Poulton, 2012).

In a cohort study in Sweden and Norway, it was concluded that full understanding of the oral conditions of 65 year olds cannot be captured by using only clinical measures, but also subjective self-ratings are needed (Ekbaäck, Åstroom, Klock, Ordell, & Unell, 2009).

All measures of perceived health can be implemented also outside the dental offices. The current digital technologies also provide means for simple questionnaires. The subjective oral health measure and OHRQoL questionnaires have been used in surveys, and in studies evaluating treatment outcomes.

The limitation of the perceived measures is that the perceived measures have not been accepted with one voice by the professional medical and dental communities. The assessments are self-assessments, not clinical assessments of diseases. This might also be considered as a strength, since it acknowledges the general public or patient as part of the needs assessment procedure in order to understand the need as a whole.


## 2.4 NEED, SERVICE USE AND PERCEIVED ORAL HEALTH

The Andersen’s behavioral model defines perceived oral health as an outcome of service use. The paradox of service use was already described earlier (Gilbert, Shelton, Chavers, & Bradford, 2003).

There are only a few studies that report the findings and trends of service use and perceived oral health from the nationally representative health surveys, in which the clinical findings are the main points of interest. The findings from these cross-sectional surveys from United Kingdom (UK), Australia, and USA suggest that both the perceived oral health and clinically defined oral health have improved over time.

In Australia, the National Survey of Adult Oral Health in 2004–2006 reported and described the level disease in the report, Perceptions of oral health and patterns of dental health care of adult Australians (Slade, Spencer, & Roberts-Thomson, 2007). In the report, four so-called dental generations were identified and described. The generations have had different dental care needs and received different types of care. Those born before 1930, the generation which reached adulthood when the occurrence of dental caries was widespread and the treatment was extraction, are the first generation. Those born between 1930–1970 formed two generations, where historically high rates of tooth decay were treated but the teeth were retained. The generations born since 1970 have been exposed to preventive care and have not experienced as much tooth decay and tooth loss as the younger generations. The previous cross-sectional survey had been conducted 17 years earlier and the trends and changes are also presented in the reports. In 2009, approximately 6.4% had lost all their teeth, with more of these people representing the older generations. The corresponding percentage in 1988 had been 14.4. Dental insurance and a pattern of attendance as a usual check-up were associated with lower levels of tooth loss and lower frequency of denture wearing. Nearly 60% of adults had visited a dentist during the preceding 12 months in 2009; the corresponding number had been 53% in 1988. Favorable patterns for attendance were more likely among the dentate, the insured, residents of capital cities and those eligible for public dental care. Perceived need for dental treatment was markedly more frequent among those who usually attended the dentist for problems, the uninsured and those with relatively lower levels of schooling. Oral health was rated fair or poor by 16%, 15% had experienced toothache within 12 months and 17% had avoided some foods due to problems with teeth, mouth or dentures. In the Australian population, the oral health diseases were pervasive and caused a substantial amount of impacts on OHRQoL. Thirty percent had avoided treatment due to cost. The barriers were more likely among those who were uninsured, and attended the dentist for dental problems.

In the survey data gathered from the Tasmanian component of the NSAOH (National Survey of Adult Oral Health 2004–2006), a cross-sectional study, Australians over 15 years were observed for 12 months. The results showed that visiting a dentist for a check-up was significantly associated with self-reported
improvement of oral health. The results suggest that ensuring those who require multiple dental treatments have access to comprehensive dental services will improve self-perceived oral health of the community. If the resources are limited, prioritizing dental care to those who require the most treatment would do the most to improve a population’s self-reported oral health (Crocombe, Brennan, & Slade, 2012). In the Australian Defence Force, with optimal access to dental care, there was an OHRQoL social gradient between military ranks (Crocombe & Mahoney, 2016).

Worsening of oral health was found to be associated with tooth loss and dentures and oral health improvement was associated with preventive care (Brennan, Spencer & Roberts-Thomson, 2012). In Canada, the results from a nationally representative telephone survey of adults showed that those who reported regular preventive dental visits had lower Oral health impact rates than those who never visited a dentist or visited irregularly (Locker & Quinonez, 2009).

In the NHANES 2011–2014 study of US adults aged 30 or over, the role of perceived oral health and normative need defined by dentists was examined in relation to dental service utilization (Adunola, et al., 2019). The findings showed that 34% of the adults did not have a dental visit in the past 12 months. Of the respondents, 27% were unsatisfied with their oral health and 53% needed to seek care. Those unsatisfied were less likely to have visited a dentist (25%) compared to those satisfied (57%). The participants were dentate, 88% had 20 or more teeth present. Over half of the participants had immediate need for care when assessed by professionals. Those with poor perceived oral health had an Odds ratio (OR) of 2.0–3.0 for not having a dental visit within 12 months, and those with normative immediate need had an OR of 2.8 for not having visited the dentist. The findings supported the paradox of need, that is, those who needed to seek care were more likely to lack a visit within 12 months.

In the RAND (Davies, et al., 1987) health insurance experiment in the USA, the results of propensity to use dental services during the experiment was that the adults with poorer dental health status were less likely to use dental services and when they did, they spent more dollars, which means the treatments needed were more demanding. For preventive services, those who reported poorer dental health status were less likely to obtain services. For illness-related care, those who reported better health status and less impact of dental disease, were less likely to use such services. Those who were more satisfied with the care, both the cost and the service quality, spent less on illness-related care in the following year. They also found that users with less provider continuity spent significantly more on all dental services.

In Scandinavia, in a representative sample of Norwegian adults, associations between oral health-related quality of life (OHRQoL) and demographic factors, number of teeth present, dental visits, dental health behavior and self-rated oral health 35% of the sample showed no problems. Subjective oral health (SOH), frequency of dental visits, number of teeth, age and sex were significantly associated with the prevalence of having problems and frequent problems. In Norway, younger individuals had higher OHIP-14 scores than older people (Dahl, Wang, Skau, &
In Sweden, a regional age cohort born in 1942 has been studied longitudinally. In the cohort, the long-term routine dental attendance was found to contribute positively to the OHRQoL (Åström, Ekbäck, Ordell, & Nasir, 2014). After the Swedish dental reform in 2008, 75% of 16–84 year olds in a Swedish county reported fairly or very good oral health, and almost 90% claimed to be regular service users. About 8% reported refraining from service use due to financial reasons. Poor oral health was most common among the unemployed and disability pensioners, those on sick-leave and the people born outside the Nordic countries (Molarius, Engström, Flink, Simonsson, & Tegelberg, 2014). In the Norwegian and Swedish older population, encouraging regular and dentist-initiated attendance habits, as well as strengthening beliefs in keeping teeth for life, were suggested to be useful in attempts to reduce poor OHRQoL. (Gülcan, et al., 2018). Among Danish adults 20–69 years of age, a positive association between perceived oral health and dental visits was reported (Petersen, 1983). The Scandinavian welfare systems of Sweden and Denmark were found to have the lowest prevalence rates for oral impacts in Europe (Guarnizo-Herreno, Tsakos, Sheiham, & Watt, 2013).

The journal, Lancet, has invited distinguished scientist to write a series on the world oral health situation. The main messages of the papers are that the root causes for poor oral health should be given attention and the services should be integrated with health systems and the continuity of care ensured (Peres, et al., 2019) (Watt, et al., 2019).

The nationally representative cross-sectional findings on need, service use and perceived oral health provide tools for developing oral health services. Longitudinal studies would provide a better basis, but results from such studies are not available.

2.5 JUSTIFICATION FOR THE PRESENT STUDY

Finnish legislation has guaranteed the adult population access to subsidized oral health services since 2002. The goal of health services is good health for the individual and the population. Perceptions of oral health are a trigger for service demand. Findings of the changes of the population’s perceived oral health have not been published. The changes in and determinants of unmet oral health treatment need in Finland have not been studied. The changes in and interrelationships in perceived oral health measures, such as subjective oral health, oral health-related quality of life and self-assessed treatment need to be studied to evaluate the outcomes of the legislation change and service use.
3 AIMS OF THE STUDY

The general aim of the dissertation was to evaluate the interrelationships of changes in treatment need, service use, and perceived oral health in the Finnish adult population after oral health care reform.

The specific aims of studies I–III were

1. To analyze the changes of perceived oral health and self-assessed treatment need;

2. to find and analyze the pathways between perceived oral health and regular oral health service use;

3. to study the changes in unmet oral health treatment need and the determinants of changes of unmet oral health treatment need in the population.
4 POPULATION AND METHODS

4.1 STUDY DESIGN

This dissertation is based on the nationally representative health surveys, the Health 2000 and the follow-up Health 2011 survey. The survey data are not openly available. The permissions for use are evaluated and granted through the National Institute for Health and Welfare (THL).

4.1.1 The Health 2000 survey

The aim of the Health 2000 survey was to gather information on public-health and functional capacity in Finland. The survey was conducted in 2000–2001 by the National Public Health Institute (KTL). The survey population was over 18 years of age, without an upper age limit. A stratified two-stage cluster sampling design was used. University hospital districts of mainland Finland were used as strata and health centers as clusters. First, the health centers in the fifteen most populous cities were chosen and then a subsequent random selection of 65 health centers, so that the total number of health centers was 80. Participants were chosen randomly from these in the year 2000. The sample consisted of 9902 adults aged 18 years or over. The third population was attendees of the Mini-Finland Health survey conducted by KTL 20 years earlier in 1978.

To match the population sizes in different clusters and to form a nationally representative data set of adult Finns, the participants were weighted using inverse probability weighting, which is a statistical technique for calculating statistics standardized to a population different from that in which the data was collected.

The survey data were collected with interviews and questionnaires. The oral health interviews were conducted by trained interviewers of Statistics Finland. The invitations were sent by mail along with an informational brochure. The interviewer phoned the participants or sent an invitation letter with the time proposed. The interviewer invited the respondent, informed consents were gathered and the respondents were informed of the study. A background questionnaire was given to be filled out and returned via mail. Oral health questions formed one of the 10 topics of the interviews. The interviewers used an electronic database, no paper was used and there was no need for re-recording of the responses (Laiho, Nieminen, & (ed.), 2004). In 2000, 89% (n=8833) of the participants were interviewed. A questionnaire including questions on OHRQoL was given to adults aged 30 years or over (sample n=8028) and was handed out to the subjects during the health examination and
returned by 78% (n=6269) of the participants. Reports of the major findings of the survey have been published as well as the findings on oral health (Suominen-Taipale, Nordblad, Vehkalahti, & Aromaa, 2004).

4.1.2 The Health 2011 survey

The Health 2011 survey was conducted by the THL, former KTL. It was arranged as a follow-up to the Health 2000 survey. All those who had been invited in 2000 and were living in Finland were also invited in 2011 unless they had refused to participate. The updated sample in 2011 for the study was 8135. The loss in number between these samples was due to deaths, moving abroad, refusals to further surveys after having participated in the Health 2000 Survey or no available contact details. Detailed descriptions of the study design and statistical procedures have been published. The surveys have been described in detail also on the webpages of www.terveys2000.fi. A report of the major findings has been published (Koskinen, Lundqvist, & Ristiluoma, 2012).

4.1.3 Data used in the present longitudinal study

We formed three different data sets comprising the data needed (Fig 5). The data are gathered from the answers of the respondents who in both years had answered the questions. The number of individuals who have answered the questions both in 2000 and 2011 differed between the variables used in each study I–III. The number of respondents varied between the studies. Figure 5 illustrates the study designs.
Figure 5. Description of the longitudinal data in the studies I–III. They are based on The Health 2000 survey interview and questionnaire sample and the Health and the 2011 follow-up sample. Unmet treatment need (UTN) and Regular service use (RSU) are constructed variables.

4.1.4 Measurements

The questions in the surveys forming the oral health variables were chosen according to the WHO guidelines and the Mini-Finland survey in 1978 to guarantee the comparability with the previous findings (Suominen-Taipale, Nordblad, Vehkalahti, & Aromaa, 2004).
The following variables and their modifications were used in the secondary analyses:

**Subjective oral health (SOH)** was evaluated with the global question: Is the condition of your teeth and the health of your mouth at present good, fairly good, average, fairly poor, poor? SOH was dichotomized as being good when the answer to the question of SOH was very good/good. Otherwise SOH was considered poor (average, fairly poor, poor).

**Oral health service use** pattern was evaluated with the question: Do you usually go to the dentist?: regularly for check-ups, only when having pain or discomfort, or never. **Regular service users (RSU)** were defined as those answering the question of service use as “regularly for check-ups”.

Last visit to a dentist was determined by the response options: during the past 12 months, 1–2 years ago, 3–5 years ago, over 5 years ago or never.

**Self-assessed treatment need (STN)** was evaluated with the question: Do you think you are in need of treatment? Answering options were yes/no.

The variable **unmet treatment need (UTN)** was formed and consists of the participants reporting STN but not having visited the dentist in 12 months.

**Oral health-related quality of life (OHRQoL)** was measured using the validated Finnish translation of the oral health impact profile (OHIP-14) questionnaire. The following fourteen questions cover functional, physical, psychological, and social problems related to OHRQoL.

1. Have you had trouble pronouncing any words because of problems with your teeth and mouth?
2. Have you felt that your sense of taste has worsened because of problems with your teeth and mouth?
3. Have you had painful aching in your mouth?
4. Have you found it uncomfortable to eat any foods because of problems with your teeth and mouth?
5. Have you been self-conscious because of your teeth and mouth?
6. Have you felt tense because of problems with your teeth and mouth?
7. Has your diet been unsatisfactory because of problems with your teeth and mouth?
8. Have you had to interrupt meals because of problems with your teeth or mouth?
9. Have you found it difficult to relax because of problems with your teeth and mouth?
10. Have you been a bit embarrassed because of problems with your teeth or mouth?
11. Have you been a bit irritable with other people because of problems with your teeth and mouth?
12. Have you had difficulty doing your usual jobs because of problems with your teeth and mouth?
13. Have you felt that life in general was less satisfying because of problems with your teeth or mouth?
14. Have you been totally unable to function because of problems with your teeth and mouth?

The OHIP-questions were not asked from participants born in 1971 or later. For participants with one or two missing OHIP-14 values (owing to a no-response or answering ‘don’t know’) the missing values were replaced with the sample mean computed from the non-missing responses to the relevant OHIP-14 item in the relevant year. Those with more than two missing OHIP-14 values were not included in the OHIP-14 analysis. Three outcome variables were formed from the OHIP-14 answers. **Severity**, range 0–56, which is the sum of the responses and takes into account the impacts occurring occasionally or hardly ever. **Extent**, range 0–14, which is the number of items reported occasionally, fairly often, or very often (OfoVo) and is formed from the original answers to the OHIP-14 questions. **Prevalence**, which was coded 1 when at least one impact was found OfoVo and 0 for others, and describing the percentage of respondents reporting one or more items OfoVo.

The following four **change variables** for dichotomized outcomes of SOH, OfoVo prevalence and UTN were formed: stable good (good at both time points), improvement (poor at baseline, good in the end) stable poor (poor at both time points), worsening (good at baseline, poor in the end).

**General health** was evaluated with the question on self-perceived health: “What is your present state of health?” with the response options: good, fairly good, average, fairly poor, or poor. Answers were dichotomized into good (good or fairly good) or poor (average, fairly poor or poor).

**Educational level** was asked with questions about formal schooling and vocational training. Education level was categorized as basic (12 or less years of basic education), intermediate (vocational education), or higher (college or university). Educational level in 2000 was grouped into basic, intermediate and higher and used both in 2000 and 2011. The **perceived economic situation** was asked with the question: How do you describe the relationship of your income and expenditures in your household economy? The reply options were:

1. suffices our needs very well
2. suffices our needs
3. we have to cut down in consumption
4. we have to cut down a lot, but manage
5. we have to cut down on everything and do not get along on our own

Answers were grouped into three categories: very good (more than enough to cover our needs), good (enough to cover our needs), and poor (in the cases of compromising or cutting down in consumption).

**Dental fear** was assessed with the question: Do you think that visiting a dentist is: not at all frightening, somewhat frightening, or very frightening?
The area of residence was defined by the university hospital district of the participant in 2000 as Southern Finland, (Helsinki University Hospital), Western Finland, (Turku University Hospital), Central Finland, (Tampere University Hospital), Eastern Finland, (Kuopio University Hospital) or Northern Finland, (Oulu University Hospital). Pain and discomfort was determined by the question: “Have you during the past 12 months had toothache or any other trouble related to your teeth or dentures?” The response options were yes or no.

Background variables in these studies were chosen according to Andersen’s behavioral model of service use. They are age, gender, education level, perceived economic situation, area of residence, dental fear and pain or trouble with teeth or dentures. Age was categorized by year of birth: 1971 or later, 1970–1956, 1955–1946 and 1945 or earlier.

4.2 STATISTICAL APPROACH

Descriptive statistics were calculated, and point prevalences of SOH, STN, OHRQoL (OHIP-14 severity), RSU and UTN were calculated for males and females from the data sets in 2000 and 2011. The four-class change-variables for SOH, STN, OHRQoL (OHIP-14 OfoVo prevalence) and UTN were formed and gender- and birth-cohort specific variables of the distribution calculated for 2000 and 2011. The distribution of changes is presented by the change variables. The associations between UTN change variables and SOH were calculated and are presented in illustrations.

To determine if perceived oral health measured as OHRQoL or SOH affected service use or vice versa, path analyses were used (Fig 6). Path analysis is a structural equation modelling (SEM) technique that estimates how well the presumed model fits the data. It is suitable when only observed variables are available instead of several variables allowing the use of latent variables, and actual SEM cannot be performed. Multiple group path analyses were conducted to test for configurable invariance, that is, if the path model was the same across groups (unconstrained model). To assess metric invariance, that is, if the path estimates were the same across groups, a nested model with parameters constrained to be identical between the groups (structural weights model) was compared to a model where parameters were allowed to vary between the groups (unconstrained model). Grouping was done based on birth cohort and self-assessed treatment need. The fit-indices used were chi square ($\chi^2$) and its significance, normed chi-square ($\chi^2/df$), comparative fit index (CFI), normative fit index (NFI), root mean square error of approximation (RMSEA) and Akaike’s information criterion (AIC). For the model to fit, the $\chi^2$ value should be non-significant. Values $\chi^2/df<5$, NFI>0.90, CFI>0.90 and RMSEA<0.08 indicate reasonably good fit, and values $\chi^2/df<2$, NFI>0.95, CFI>0.95 and RMSEA<0.05 indicate very good fit, and the best model has the smallest AIC. For paths,
standardized estimates, which can be interpreted similarly as correlation coefficients, were calculated.

Fig 6. Theoretical models of the associations between oral health and regular service use to be tested with path analysis.

Two logistic regression models were applied to determine the effects of gender, subjective oral health, pain and discomfort, area of residence, age, education, dental fear, and economic attainment at baseline on improvement or worsening of unmet treatment need. Model 1 was applied to those who reported unmet treatment need in 2000 and evaluated the determinants for improvement, that is, not having unmet treatment need in 2011. Model 2 was applied to those who did not have unmet treatment need in 2000 and evaluated the risk factors for having it by 2011. Analyses were conducted using weighted data. The weights in 2000 were based on age, gender, living area, and mother language and updated for 2011.

The cluster design was accounted for in weighting the data using inverse probability weighting according to age, gender, and area to match the population sizes in different clusters and thus forming a nationally representative data set of adult Finns, and all analyses were conducted using weighted data.

Weights were provided by the survey. The statistical analyses were performed using IBM SPSS 23.0 or 25.0 and AMOS 23.0.
The Ethics Committee of the University Hospital Region of Helsinki, Finland, gave permission for both surveys. Informed consent was obtained from each survey participant. The personal data and identity of the participants has not been revealed to the researchers. The data used in this dissertation are provided by the THL by agreement 7.2.3.051, signed May 12, 2014, and have been available solely for the use agreed in the contract. The author of this thesis has no conflicts of interests in any aspects of the research work.

4.3 ETHICAL CONSIDERATIONS

The Ethics Committee of the University Hospital Region of Helsinki, Finland, gave permission for both surveys. Informed consent was obtained from each survey participant. The personal data and identity of the participants has not been revealed to the researchers. The data used in this dissertation are provided by the THL by agreement 7.2.3.051, signed May 12, 2014, and have been available solely for the use agreed in the contract. The author of this thesis has no conflicts of interests in any aspects of the research work.
5 RESULTS

5.1 THE CHANGES IN PERCEIVED ORAL HEALTH AND SELF-ASSESSED TREATMENT NEED

The population-level results reported are based on the baseline and follow-up findings of the longitudinal data set used (Fig 5).

5.1.1 Changes at population level

Generally, the subjective oral health (SOH) of the Finnish adult population was good and improved between 2000 and 2011 with the exception of the male birth cohort born in 1971 or after. However, there was an age-gradient of SOH: the youngest cohorts had the best SOH and the oldest cohorts had the poorest SOH. The gender differences of SOH persisted between 2000 and 2011. Females reported better SOH compared to males in all birth cohorts (Fig 7, 8).

![Figure 7. Percentages (%) of male participants reporting good subjective oral health by birth cohort in 2000 and in 2011.](image-url)
Figure 8. Percentages (%) of female participants reporting good subjective oral health in 2000 and in 2011 by birth cohort.

The self-assessed treatment need (STN) was substantial. Generally males in all birth cohorts reported a higher proportion of treatment need than females, with the exception of the female 1946–1955 cohort. The youngest male cohort reported more treatment need in 2011 than in 2000 (Fig 9, 10).

Figure 9. Percentages (%) of male participants reporting self-assessed treatment need in 2000 and in 2011 by birth cohort.
The OHRQoL of the Finnish adult population was better in 2011 than in 2000. The OHIP-14 severity scores were lower in all birth cohorts in 2011 compared to 2000. The OHIP-questions were not asked from the youngest cohort. There was an age-gradient between the cohorts. The youngest had the lowest and the oldest had the highest scores, indicating that the OHRQoL was better among the younger cohorts. In the youngest and oldest cohorts females reported lower scores than males, indicating that OHRQoL was better among females than among males (Fig 11, 12).
Figure 11. Mean values of male Oral Health Impact Profile (OHIP-14) severity scores in different birth cohorts in 2000 and in 2011.

Figure 12. Mean values of Oral Health Impact Profile (OHIP-14) severity scores by birth cohorts of females in 2000 and in 2011.
5.1.2 Changes at individual level

There was a gender difference in the changes of subjective oral health (SOH) and OHIP-14 impacts from 2000 to 2011. Females had a more stable, good-situation of SOH and reported less impacts occasionally or more often (OFoVo) than males and reported less stable poor situations. Males reported more self-assessed treatment need and worsening of the situation between 2000 and 2011 (Fig 13).

![Chart showing distributions of 4-class change variables for SOH, STN, and OFoVo prevalence](chart.png)

Figure 13. Distributions of 4-class change variables for subjective oral health (SOH), self-assessed treatment need (STN) and oral impacts occurring at least occasionally in 2000–2011 for all, and separately for males and females.

In the birth cohorts, there was a clear age-gradient both in subjective oral health and oral health-related quality of life (OHRQoL), that is, the prevalence of adverse impacts were reported occasionally or more often (OFoVo). The youngest cohort had the best SOH and the most of the stable good, good at both time points results. The SOH improvement also showed an age-gradient. Proportionally SOH improved the most in the oldest birth cohort and the least in the youngest cohort. Stable poor SOH was least common in the youngest cohort and had likewise an age gradient. Worsening SOH was reported by the same proportion in all the birth cohorts. OHRQoL followed the same pattern as SOH. All the age cohorts reported good OHRQoL, with the best results in the younger cohorts. The improvement of OHRQoL was proportionally more common among the older cohorts. All the cohorts reported a substantial amount of self-assessed treatment need (STN). The two youngest cohorts reported STN more frequently than the older cohorts. The change in STN towards more treatment need was seen in the youngest cohort (Fig 14).
Changes in subjective oral health (SOH) followed the same pattern between genders in all the birth cohorts. Women reported good SOH in 2000 and 2001 by 7–13 percentage points more often compared to males. SOH improvement was 10–20% within the age cohorts, the smallest percentages in the youngest group. The SOH improvement among males was slightly more common than among females. A gender-difference in poor SOH was seen in all birth cohorts. Men more often reported poor SOH. The percentages of stable poor SOH in the male age cohorts varied from 8% in the youngest to 19% in the oldest. The worsening of SOH varied from 8–16 percentage points. The greatest worsening of SOH was seen inside the youngest birth cohort.

The amount of no STN reported varied between 25–39% of the gender and birth cohorts. Over half of the two youngest male cohorts reported STN in 2011 (51% and 52%). STN at both points, stable poor, was reported by 20–32% of the gender and birth cohorts. The most of stable poor STN was reported by the second youngest male cohort and the least by the oldest female cohort. Worsening of STN was also very common, since 18–27% in the cohorts reported that. The biggest percentage of worsening was in the youngest birth cohort.

OHIP-14 was questions were not asked from the youngest cohort. The majority of the birth- and gender cohorts did not report impacts occasionally or more often (OFOVo) (51–64%). The OFOVo prevalences improved by 13–19 percentage points, the biggest improvement was in the male cohort of 1946–1955. The cohort reported
the least of impacts in 2011. Impacts were reported by 12–17% in the gender and age cohorts. The least impacts were reported by the 1956–1970 cohort and the largest amount by the males in the oldest cohort (Fig 15).

<table>
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<th>60%</th>
<th>80%</th>
<th>100%</th>
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Figure 15. Age- and gender-specific distributions of 4-class change variables for subjective oral health (SOH), self-assessed treatment need (STN) and oral impacts occurring at least occasionally.

All measures of the perceived oral health variables were interrelated (p-values <.001 for all the associations), but the strengths of the associations varied. The associations between SOH and STN were the highest (OR 5.2 in 2000 and 4.2 in 2011) and the lowest between STN and OfoVo prevalence (OR 2.3 in 2000 and 2.5 in 2011) (I. Table 5).
5.2 THE PATHWAYS BETWEEN PERCEIVED ORAL HEALTH AND ORAL HEALTH SERVICE USE

5.2.1 Changes at population level

Regular service use was more common in all birth cohorts in 2011 than in 2000, with the exception of the oldest male cohort. Women used services more regularly than men in both years. In the youngest birth cohort the difference between female and male regular service use was 17 percentage points in 2000 and 14 percentage points in 2011. In the other age cohorts the difference was 3–15 percentage points. The most non-regular users were in the youngest male group and the most regular users in the two female middle age cohorts (Fig 16, 17).

![Chart showing percentages of male participants reporting regular service use in different birth cohorts in 2000 and 2011.]

Figure 16. Percentages (%) of male participants reporting regular service use in different birth cohorts in 2000 and 2011.
Figure 17. Percentages (%) of female participants reporting regular service use in different age groups in 2000 and 2011.

5.2.2 Changes at individual level

The path analyses conducted in age groups born before 1956 or in 1956 or after indicated that lower OHIP-14 severity scores in 2000 led to regular service use in 2011. That path was stronger than for regular service use in 2000 leading to better OHRQoL in 2011 (Fig 18).
Figure 18. Standardized estimates from multigroup path analyses between OHIP-14 severity score and regular service use according to self-assessed treatment need (no/yes) and age group (born >1956 vs. ≤1956). (Article II)

The result of the path analysis between regular service use and subjective oral health (SOH) showed that regular service use in 2000 led to better SOH in 2011 rather than better SOH leading to regular service use (Fig 18). The fit indices in these path models were very good (Article II Table 3).

Figure 19. Standardized estimates from longitudinal multigroup path-analyses between service use and subjective oral health according to self-assessed treatment need (STN: no vs. yes) and age group (born >1956 vs. ≤1956). (Article II)
5.3 THE CHANGES IN UNMET ORAL HEALTH TREATMENT NEED AND ITS DETERMINANTS

5.3.1 Changes at population level

The unmet treatment need in the Finnish adult population diminished between 2000 and 2011. The unmet need reported was lower in both genders in 2011 compared to 2000. In 2011, males reported on average 23% of unmet need, the same amount as the females in 2000. The average male percentage in 2011 was 5% lower than in 2000. The prevalence of unmet need varied in the birth cohorts. The lowest prevalences were in the older cohorts (Fig 20, 21).

![Figure 20](image)

Figure 20. Percentages (%) of male participants reporting unmet treatment need in different birth cohorts in 2000 and 2011.
5.3.2 Associations between UTN and perceived oral health

Changes in unmet treatment need and subjective oral health were associated in both genders. Those with unmet treatment need in both years more often had poor subjective oral health and those with no unmet treatment need had good subjective oral health (Fig 22).
Figure 22. Changes in unmet treatment need (UTN) categories according to changes in subjective oral health (SOH) in 2000 and 2011.

Of males reporting unmet treatment need in both years, 25% reported good subjective oral health in both years and 47% reported poor subjective oral health in both years. Of those not reporting it, 66% reported good subjective oral health and 10% poor subjective oral health in both years (Fig 23).
Figure 23. Changes in unmet treatment need (UTN) categories among males according to changes in subjective oral health (SOH).

Of females reporting unmet treatment need both in 2000 and 2011, 34% reported good subjective health and 31% poor subjective oral health in both years. Of those not reporting it in 2000 or 2011, 70% reported good subjective oral health and 8% poor subjective oral health in both years (Fig 24).

5.3.3 The determinants of change in UTN

Those with unmet treatment need in 2000 were less likely to report improvement in 2011 if they had poor subjective oral health, basic or intermediate education level, or poor perceived economic situation in 2000. Those who did not have unmet treatment need in 2000 were more likely to have it in 2011 if they were males or from northern Finland and less likely if they came from central Finland or belonged to older birth cohorts (III Table 5).
6 DISCUSSION

6.1 MAIN RESULTS

The general aim of this thesis was to evaluate the interrelationships of changes in perceived oral health, treatment need and service use in the Finnish adult population after oral health care reform. The majority of the adult population had good subjective oral health (SOH) and did no report adverse impacts affecting their oral health-related quality of life occasionally or more often (OFoVo) in 2000 or 2011. The changes towards good or poor SOH and less or more adverse OHIP-14 impacts were similar in the population. Changes in the self-assessed treatment need (STN) were different from the changes in SOH and OFoVo prevalence. Only one third of the population did not report treatment need. The result of the path analysis showed that those who did not report adverse impacts in the OHIP-14 questions, used the services regularly in 2011. The result of the path analysis between regular service use and SOH showed that regular service use in 2000 led to better SOH in 2011 rather than better SOH leading to regular service use. Unmet treatment need (UTN) for oral health care in the Finnish adult population diminished between 2000 and 2011, but was substantial as reported by 25% of the population in 2000 and by 20% in 2011. Those with unmet treatment need in 2000 were less likely to report improvement in 2011 if they had poor subjective oral health, basic or intermediate education level, or a poor perceived economic situation in 2000. Those who did not have unmet treatment need in 2000 were more likely to have it in 2011 if they were males or from northern Finland and less likely to report it if they came from central Finland or belonged to the older birth cohorts.

6.2 STRENGTHS AND WEAKNESSES OF THE STUDY

A major strength of the study is that it is based on a nationally representative longitudinal data, which is gathered prior to and after the legislation changes in Finland. The timing of the study was very good, since changes in service use were anticipated and they occurred. The response rate was good among all the surveyed birth cohorts and over 70% had attended both surveys, which is exceptionally high in longitudinal surveys. The response rates to all the posed questions were good. The lowest participation rates were seen among the youngest men. The loss between 2000 and 2011 in the responding groups was moderate. Also, the use of multiple well established variables of need, perceived oral health variables and service use with timelines are major strengths.
A major strength of the study is the use of path analysis to determine if perceived oral health measured as OHRQoL or SOH affected service use or vice versa. It allowed us to find the paths in the situation where only observed variables were available. Another strength of the study is that it uses the Andersen behavioral model, which provides a model for health service utilization studies and has proven to be useful (Baker, 2009). Implementation of Andersen’s model requires creative and challenging conceptualization. Longitudinal and experimental study designs need innovative types of statistical analyses (Andersen, 2008). The rich data provided by the survey allowed use of Andersen’s model of health services use to be implemented with the data. The longitudinal nature of the data also allows the use of feedback loops between the variables as illustrated in Figure 1. The Andersen model has been used also in an analysis of perceived treatment need in Swedish adults. They concluded that the Andersen model can be a useful theoretical tool for the study of perceived treatment need (Lundegren, Axtelius, Isberg, & Åkerman, 2013). The individual’s everyday experiences are important and they should be combined to be used in policy and service development.

A weakness of the study is the possible response bias, which always is a risk in this type of study. This would mean that respondents with poor oral health did not attend and give answers to the questions. In spite of using weights, that might cause some bias.

Self-reporting the oral health service use may be incorrect to some extent. However, the questions posed on service use open multiple opportunities to assess the time and the cause of service use. The timeline used to determine unmet treatment need was set to 12 months, since it has been used in surveys such as the Survey on Health, Ageing and Retirement, the European Union Survey of Income and Living Conditions, and the WHO Study on global ageing and adult health, SAGE. The equal timelines are a strength in our study. Attention to co-occurring risk factors for poor access to needed care should be given in order to reduce disparities among populations.

The concept of self-assessed treatment need has weaknesses as it might miss oral diseases present without symptoms that can be better assessed by professionals. Self-assessed treatment need is not clearly defined, and it is clearly context-dependent. However, the aim of this dissertation is to study the changes in perceived measures of oral health and regular service use.

In the Health 2000 survey, the OHIP-14 questions used to report (OHRQoL) had not been asked from the respondents born in 1971 or after. That limits the data of OHRQoL to the older age cohorts, which is a weakness of this study.
6.3 RESULTS IN RELATION TO PREVIOUS STUDIES

6.3.1 The changes in need and perceived oral health

The perceived oral health in the Finnish female adult population was very good in 2011. Both the subjective oral health (SOH) and the oral health-related quality of life (OHRQoL) improved in the majority of the Finnish adult population. Self-assessed treatment need (STN) was substantial, as it was reported by over 50% of the population. The findings of the changes in SOH and OHRQoL behaved similarly from 2000 to 2011 in the population. Subjective oral health measures the overall perception of oral health. It gives a fairly good estimate, and has been shown to give similar results compared to OHIP-14 and clinical results in middle-aged adults (Thomson, Broadbent, & Poulton, 2012) (Kaprio, Suominen, & Lahti, 2012). International population-based studies elsewhere, the oral health-related quality of life and perceived oral health have also been reported to improve over a period of 11 years, as the findings of the cross-sectional surveys from the UK, Australia, and USA suggest (White, et al., 2012). The number of teeth and the location of occluding teeth have impacts on OHRQoL, as the review from 2004–2015 has concluded (Tan, Peres, & Peres, 2016). Similarly the Finnish dentate adult population had an improvement of OHRQoL. The OHIP-14 severity scores trend differently to some other countries, since the reported acceptance of limitations at older age seems to be missing in my findings (Steele et al. 2004). The older generations in Finland were aware of their perceptions and reported them repeatedly. The clinical situation of the respondents is not known, but we do know that edentulousness has declined rapidly in the Finnish population (Suominen-Taipale, Nordblad, Vehkalahti, & Aromaa, 2004). Also, the type of prosthodontic treatment has an effect on the OHRQoL of the patients. Needs in the older generations should be recognized and out-of-date suggestions or regulations in subventions may be short-sighted, since a recent review of literature concludes that multiple-missing teeth replaced with implant-supported fixed prostheses resulted in the best OHRQoL (Ali, Baker, Shahrabf, Martin, & Vettore, 2019).

The findings on the changes in self-assessed treatment need behaved differently from the SOH and OHRQoL, as at the same time those improved, the treatment need experienced was more frequently reported. The growing perceived need at the same time perceived oral health improves seems to be a paradox. It could be explained by the concepts of need defined by Maslow and Bradshaw (Maslow, 1954) (Bradshaw, 1972). The basic needs have been satisfied, and the perceived need might have reached new levels of expectations towards oral health care. In a clinical situation or when oral health care professionals evaluate clinical status, being healthy, having good health, meaning the absence of disease, and therefore no treatment need, may be considered synonyms. This study shows that good subjective oral health and good oral health-related quality of life does not mean that the patient does not assess her/
or himself as being in need of treatment. Self-assessed treatment need was reported in a large proportion of the population. The type of treatment need was not asked in the survey. The focus on oral health in Finland has been on the caries-free dentition. The sound or filled teeth in the oral cavity might be considered healthy, which they are, but the periodontal ligament is the part of the oral cavity not yet very well recognized. The questions on perceived oral health, the perceptions like ability to eat and confidence in social situations, might lead the focus to periodontal health and appearance of the dentition (Barbosa, Gaviao, & Mialhe, 2015) (Ng & Leung, 2006). The appearance of good dentition and acceptable functioning of it has been under discussion over the years. The orthodontic treatment in the public oral health service requires a treatment need evaluated with a 0–10 point scale. The self-assessed treatment need might also be partly due to cosmetic and functional reasons. The need for orthodontics among adults has been found to be considerable, since more than half of the adult population examined was in need in a German cohort (Bock, Czarnota, Hirsch, & Fuhrmann, 2011). The concept of self-assessed treatment need is very broad and thus not easy to use in healthcare planning. The public opinion and public voice influences health policies. The public perception of the oral health status asked in questionnaires and as feedback from service-use is a meaningful indicator of service value in Finland. The funding for services could in the future be dependent on the value experienced by the service users.

The legislation change in Finland removed the age barriers in adult oral health care just after the first survey in 2000. The perceived oral health of the population improved and the self-assessed treatment need diminished in a part of the population that had gained access to the subsidized services during the oral health care reform. However, there has to be reasons influencing the growing perceived treatment need in the younger cohorts of the population. In general practice, the inverse care law suggested by Hart in 1971 seems to have been true also in the British NHS where the financial barriers in general health care have been largely removed. That means other determinants had been influencing the inequality in health care delivery (Watt, 2002).

The education level and the income level have developed favorably in Finland, but polarization and gaps in the health status, also oral health status, have shown signs of widening (Tanner, et al., 2013). In my study, it was surprising and alarming to find the younger cohorts in more self-assessed treatment need than the older cohorts. That might be partly due to the contextual system change, where the age limits were abolished, and the older cohorts were in great need of services. The younger generations may in turn have greater expectations, due to the fact that the basic needs have been met and there is room for more. The greater self-assessed treatment need might therefore be mirrored also in the light of need theories by Maslow and Bradshaw (Maslow, 1954) (Bradshaw, 1972). The expectations for the outcome of care and the public health system seem to have changed.
6.3.2 The pathways between perceived oral health and service use

In this study, the findings of the paths between perceived oral health and regular service use showed that those with less oral health impacts used the services regularly. I found that the regular service users in 2000 had good subjective oral health in 2011. On the other hand, those in need of services, the need based on OHIP-14 impacts in 2000, did not become regular service users. My findings confirm the phenomenon called dental paradox, as persons with a higher probability of new oral health problems are less likely to seek oral health care (Gilbert, Shelton, Chavers, & Bradford, 2003). The attitudes toward oral health were found to be the proximal basis for oral health disparities in Florida, USA, when the access to care was equal among the group compared (Riley, Gilbert, & Heft, 2006). In that study, the negative attitude group delayed seeking care until the condition was more severe. They also received the least preventive care and had the poorest clinical status. I studied the OHRQoL and subjective oral health and my results are similar, although attitudes were not studied. The attendance pattern to oral health services changed toward a more regular attendance pattern. My findings are similar to those reported from the UK (Hill, Chadwick, Freeman, O’Sullivan, & Murray, 2013). In my findings from Finland, the gender differences of attendance patterns were substantial and consistent over the study period, a finding not reported in the UK. In the Tasmanian component of the NSAOH 2004–2006, the findings were similar to mine, since visiting a dentist for a check-up, which is similar to regular attendance, was associated with self-reported improvement of oral health (Crocombe, Brennan, & Slade, 2012). The authors concluded that ensuring those who require multiple dental treatments have access to comprehensive dental services will improve self-perceived oral health of the community. The acute care tends to be more expensive both for the commissioner and the patient. Already the Rand experiment showed similar results (Davies, et al., 1987). The money spent on public services in oral health care should be spent in efficient ways. Waiting for the need for care to develop into pain and discomfort is not the best way to achieve good oral health outcomes.

I divided the adults into four cohorts based on their year of birth and the eligibility for subventions in oral health care. The cohorts behaved differently in relation to perceptions on oral health and service use. Those who had been entitled to public dental care from 1972 onwards were not visiting the dentist for regular check-ups. The birth cohorts that gained access to services increased their use of regular services after the reform in 2002. My findings are similar to reports from Australia, where four so-called dental generations have been identified and described (Slade, Spencer, & Roberts-Thomson, Australia’s dental generations: the national Survey of Adult Oral Health 2004–2006, 2007). In the population surveys, the number of teeth has been reported to differ between generations. A similar development has been seen in Finland. The dentate adult generations need a different approach to service provision than the former edentulous generations did.
The path analysis offers a means of determining if perceived oral health measured as OHRQoL or SOH affected service use or vice versa. It allowed us to find the paths in the situation where only observed variables were available.

### 6.3.3 Unmet oral health treatment need and its determinants

Unmet treatment need (UTN) for oral health care in the Finnish adult population diminished between 2000 and 2011, but was substantial as it was reported by a quarter of the population in 2000 and by one fifth in 2011. The lowest prevalence of UTN was in the older cohorts and females reported less UTN in both years. Those having no unmet treatment need also reported better subjective oral health. The persisting 8% of UTN were determined by basic or intermediate education, poor subjective oral health, and perceived economic difficulties at baseline. The determinants of change varied depending on the direction of the change, since those with no unmet treatment need in 2000 also were less likely to have it in 2011 if they lived in central Finland or belonged to the older birth cohorts and conversely, males or those living in northern Finland were in turn more likely to have gained unmet treatment need in 2011.

My findings suggest that during the 11-year period the changes in contextual enabling factors seemed to be effective in diminishing unmet treatment need. The contextual change in service provision seems to have provided opportunities for dental care, as need for care due to pain and other dental problems. Of these contextual factors, equitable access was also found to be important in reducing social inequality in a Swedish cohort study after their health care reform in 2008 (Molarius, Engström, Flink, Simonsson, & Tegelberg, 2014). Area of residence, gender, and education were strong determinants of unmet treatment need. They also determined the changes in unmet treatment need. Perceived economic troubles, living in Eastern or Northern Finland, male gender, dental fear, and intermediate or basic education level in 2000 led to higher prevalence of unmet treatment need in 2011. Similar findings to mine have been reported in a study in Sweden in which factors such as long-term illness and financial problems were associated with refraining from seeking dental care among adults. The pain or discomfort related to teeth or dentures need factor seemed to lead to service use, but those without this factor in 2000 more often had unmet treatment need in 2011. Due to the persistence of unmet treatment need, the outcome and organization of urgent care should be examined also in Finland, as suggested by a recent review. Some further changes should be implemented to target these contextual factors and the changing need for services.

The gender differences in service use and edentulism seem to be typical in Finland. The differences have been reported also in the previous population studies in Finland, and the differences seem to persist despite the contextual changes. The different birth cohorts have behaved differently in other countries, as reported also from the Australian national studies (Slade, Spencer, & Roberts-Thomson, 2007). In the UK, access to National Health Services (NHS) services had been a concern in 2009.
Although the service demand had grown, the vast majority of people found the services reasonably accessible. Those very much afraid had more often unmet treatment need in my studies (III). High dental anxiety has been associated with irregular attendance and potentially higher need (Watt, et al., 2013), (Liinavuori et al., 2019). The service fees for oral health services in Finland are high. A cross-national comparison of income gradients in OHRQoL in four welfare states found the inequalities were least pronounced in Germany, where the benefits were related to earnings (Sanders, et al., 2009). The findings in this dissertation support these findings, since UTN was determined by the perceived economic situation. Contextual factors, like education level, and financial situation also determined the situation of UTN. The differences in these explain the differences in the regional findings of UTN changes.

I constructed the variable UTN from the questions of self-assessed treatment need and service use, which had not taken place within the previous 12 months. The timeline used was set to 12 months, since it has been used in other population surveys, such as the Survey on Health, Ageing and Retirement (SHARE), the European Union Survey of Income and Living Conditions (EU SILC), and the WHO Study on global ageing and adult health, SAGE.

6.4 PRACTICAL IMPLICATIONS, RECOMMENDATIONS FOR ACTIONS AND FURTHER RESEARCH

The challenges in general healthcare and dental healthcare are mutual and the resources seem to fail the expectations and demand of the public. The resources allocated for health care are a major political issue. The freedom to choose a doctor or dentist also from the private sector has historically been given as an answer by the government, and the two-channel finance system has been implemented. On the other hand, the public coverage through the national health insurance is limited due to financial reasons and therefore the freedom to choose might not be available to all. Professionally evaluated need is the prerequisite to service use in the PDS. Concentrating on urgent care need is crucial, but with a possible general lack of services, it leads to postponement of the care of patients with non-urgent needs. I concluded that regular use of services leads to good subjective oral health. The goal of the oral health services, perceived oral health, cannot be reached by implementing solely the paradigm of urgent care to oral health care. There will always be someone in urgent need and the comprehensive, preventive, non-urgent need is foregone. Adult oral health care should be based on a comprehensive clinical status, a treatment plan with preventive approaches and an individually planned recall. This policy change could make a difference in the efforts of trying to achieve the goal of good perceived adult oral health and should be researched further.

When measuring perceived oral health, multiple measures should be used, since they measure different aspects of perceived oral health. The perceived measures are important both in reporting contextual and individual characteristics of service need
and in evaluating the outcomes of service use. The people reporting oral health impacts or poor subjective oral health in interviews or questionnaires should be encouraged and enabled to use oral health services. The current fees for services and their implementation in the municipal oral health systems might lead to forgone care, since the fees are high. New ways of reaching the population with poor perceived oral health are needed. This requires integration of the oral health services with general health and social services.

The insurance system or the regulations of the PDS might also restrict the care provision. The professionally evaluated need and treatment proposals might be out of reach for the patients. In the system of substantial out-of-pocket payments, the cheapest treatment option might become the golden standard, since the payer needs to either reduce the expenses or restrict the cost. Cost-containment has been an important cornerstone in the national healthcare development. Quality and long-lasting treatment options available, for instance instead of molar composite fillings and crowns, ceramic fillings and prosthetic crowns might be a longer-lasting choice and should be considered for wider use in the future. Self-assessment of treatment need in the situations described might be reported as an unmet need.

Perceived oral health should be closely monitored at the national level. The SOH and OHRQoL variables and STN should be considered as outcomes of the service utilization to set and monitor goals for value-based oral health care. In other words, in the commissioning of the oral health services the quality of care, the quality of patient-related outcomes and the self-assessed oral health of the patients should be used as a part of the evaluation process. The questions used in this study could be used for this purpose. Questionnaires can be easily and with reasonable costs sent to targeted individuals also digitally. At the moment, the most advanced technology to do that is digitally via smart phones or other devices. The data can be gathered also with questionnaires. The repository options for the perceived oral health-data should be nationally planned and implemented. The monitoring systems for clinical data and service use are under development. The PDS data is currently transferred to the Kanta-repository (Patient data repository, 2020) for archiving and can be used with the consent of the patient. A law enabling the secondary use of the data for monitoring and planning purposes has been passed, and now needs to be carefully planned for implementation (Alkula, et al., 2019). The inclusion of perceived measures and oral health habits is needed for planning and monitoring purposes. The oral health care outcome should be further researched by means of perceived oral health.

The contextual system guarantees access to non-ambulatory services in three to six months. However, the system does not guarantee comprehensive service for those most in need. The concept of continuing and comprehensive dental care is not clearly included in the current legislation. The service provision in public dental health services relies on the same principles as in the hospital services. The access times to procedures are beneficial, but the legislation guaranteeing access to services on the basis of professionally evaluated need for care might not be the most optimal
for the oral health care services. The paradox of need also gives evidence to the system change needed. The concept in public oral health care should be further improved and altered. The system change in the child oral health care provision in Finland in the 1970’s is a good example of an effective system change in oral health service organization (Nordblad;Suominen-Taipale;Rasilainen;& Karhunen, 2004). The service commissioner should also have an incentive for that based on the results of previous findings. The patient incentives should also be developed. I did not compare the changes in perceived oral health on the actual service-use figures between 2000 and 2011. We know from the national statistics, that oral health service use in the adult population grew between the study years. My data from the interviews shows that regular service use grew between the study years. There is also a clear path from regular service use to good subjective oral health. The policy changes in the Finnish oral healthcare system seem to have accomplished changes in perceived oral health. Those in most need should be offered recalls to improve their timely access to care and a comprehensive care-plan for years to come should be offered. This would be beneficial in targeting the unmet needs and non-regular service use.

The substantial self-assessed treatment need in the population with good SOH should be further studied. There might be new perceived treatment needs which the current service provision does not recognize. The perceived needs should be researched further to establish reliable indicators for service planning. Discussion with the public is essential in developing a service supply and provision in the PDS that is satisfactory to the public. The integration of services could facilitate the access for those with poor self-assessed oral health and poor OHRQoL to the services when the need for treatment is recognized also outside the dental offices.

There is an income-related inequity in the use of oral health services. The municipalities or other commissioners have been given the maximum fees for services. The fees for preventive services should be lowered to the same level as they are in general health practices. Also, those in disadvantaged economic situations should be given services at reasonable out-of-pocket fees. The bureaucracy in the fee collection should be integrated with the other fee collection in health care. That is important for fee monitoring and also for equity and non-stigmatizing service provision. It should not interfere with the patient relations at the dental office. The flat rates in PDS should be reconsidered and changed to income-related fees in Finland to diminish inequalities.

Unmet treatment need determinants in the adult population were poor SOH, low education level and the perception of a poor economic situation. Those determinants can be detected outside the dental offices. The integration of oral health care to other social and health care services is crucial in the efforts of perceived oral health improvement of the population. There is much debate over the need for integration of oral health services more closely with PDS, general practice, mental health, substance abuse services and social services, especially with welfare services. Also,
the services for the older people could benefit from these subjective evaluations and self-assessments.

It was not long ago in our country when extraction of permanent molars was the treatment of choice, since endodontics was not possible due to lack of resources. The edentulousness of the generations born between 1900–1930 dates back to the treatments used at those times. The current number of teeth considered as a functional dentition, 20 teeth, might also be changing rapidly towards a dentition consisting of also molar teeth. The Maslow hierarchy of need is seen also in the need in oral health care. When the basic physiological needs have been met and the painless oral health status is a basic status, and the oral health care system provides safety, other needs, such as needs of esteem and self-actualization, such as the need for cosmetics and a pleasant smile, are approaching. The different dental generations with a different oral health status may express different self-assessed needs based on differences in the need experienced. The Bradshaw taxonomy of need describes the differences in professionally evaluated need, perceived need, and demand for services. Their interplay has been changing over time, both because of the development of the clinical recognition of diseases, new treatments and medications and also to the changing values and needs of the population as discussed also earlier in relation to the hierarchy of needs.
7 CONCLUSIONS

The perceived oral health of the Finnish adult population consisting of oral health-related quality of life and subjective oral health improved during the study period. Females perceived their oral health to be better than males did. However, there was a substantial minority of adults who perceived their oral health as poor. Self-assessed treatment need was common. Those with no adverse impacts on their oral health-related quality of life used the oral health services on a regular basis at the beginning of the surveillance period and they reported good oral health at the end. However, those with poor oral health-related quality of life did not use the services regularly in the beginning. The paradox in the oral health service use was apparent: those with adverse impacts did not use the services regularly and their subjective oral health did not improve. The adults did not suffer from pain and discomfort from their dentition. That implies that ambulatory services to receive treatment for acute problems were used. Self-assessed treatment need was reported by half of the population. Unmet treatment need, measured by having self-assessed treatment need but not having visited a dentist in the previous 12 months was frequent, as reported by one quarter of the population in 2000 and by one fifth in 2011. The prevalence of UTN varied among birth cohorts, the lowest prevalence was in the older cohorts in both years. The persisting UTN was determined by basic education, poor SOH and perceived economic difficulties at baseline.

Understanding the interplay between treatment need, service use and perceived oral health, according to Andersen’s model of service use is important in service planning and service evaluation. The system change in Finnish oral health care has provided essential services to the adult population but has not managed to change the pattern of service use to a regular service use. The implementation of professional need evaluation also in oral health care has given priority to ambulatory services and the demand seems to be met. As a result, experiencing pain and discomfort was not frequent. However, according to my study, regular oral health service use led to good perceived oral health in the population. When attending services is based only on demand and a professional evaluation of acute need, the non-effective service use pattern is reinforced. Service use should be based on need evaluation during the previous treatment period and recall procedures should be implemented even though no apparent need exists to promote regular service use. The Finnish oral healthcare system would benefit from early preventive oral healthcare and early detection of disease. Cost containment is one of the cornerstones of the Finnish healthcare system, and the adult oral healthcare should also be based on continuous care and preventive services, and not on the demand for ambulatory services. The discrepancy between self-assessed treatment need and service use, the unmet treatment need, has to be faced. The legislation on oral health care, service fees and service planning need to be updated to meet the needs of the population.
8 REFERENCES


The aim of this thesis was to evaluate the interrelationships of changes in self-assessed treatment need, service use and perceived oral health in the Finnish adult population after a major oral health care reform. Perceived oral health improved. Good oral health-related quality of life led to regular service use, which in turn led to good subjective oral health. Unmet self-assessed treatment need was substantial. The health policies and practices should be developed according to these findings in order to gain better perceived oral health on the population level.