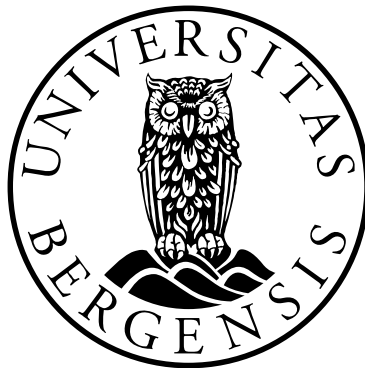


**SATISFACTION WITH ORAL HEALTH AND
ASSOCIATED FACTORS IN SWEDEN AND NORWAY –
CROSS-SECTIONAL AND LONGITUDINAL
PERSPECTIVES**

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Satisfaction with oral health and associated factors in Sweden and
Norway – cross-sectional and longitudinal perspectives

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ACRONYMS

CPITN: Community Periodontal Index of Treatment Needs

DMFT: Decayed Missing Filled Teeth

DSa: Decayed Surface approximal

GEE: Generalised Estimating Equation

HRQoL: Health Related Quality of Life

ICD10: International Statistical Classification of Diseases and Related Health Problems 10th Revision

ICIDH: International Classification of Impairments, Disabilities and Handicaps

ICF: International Classification of Functioning, Disability and Health

OHRQoL: Oral Health-Related Quality of Life

OIDP: Oral Impacts on Daily Performance

PA: Percentage Agreement

QoL: Quality of Life

SDI: Socio-Dental indicator

SIP: Sickness Impact Profile

TBC: Tuberculosis

WHO: World Health Organization

LIST OF PAPERS

This thesis is based on the following papers:

- I. Ekbäck, G., Åstrøm, A. N., Klock, K., Ordell, S., and Unell, L. Self-perceived oral health among 19-year-olds in two Swedish counties. *Swed Dent J* 2008;32(2):83–93.
- II. Ekbäck, G., Åstrøm, A. N., Klock, K., Ordell, S., and Unell, L. Variation in subjective oral health indicators of 65-year-olds in Norway and Sweden. *Acta Odontol Scand* 2009 Apr 24:1–11.
- III. Ekbäck, G., Nordrehaug-Astrøm, A., Klock, K., Ordell, S., and Unell, L. Satisfaction with teeth and life course predictors: a prospective study of a Swedish 1942 birth cohort. *Eur J Oral Sci* 2010 Feb;118(1):66–74.

These papers will be referred to as Paper I, II and III respectively.

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ABSTRACT

Background

Oral health is defined as a broader concept than oral disease, concerning individuals' optimal functioning, social and psychological wellbeing. Thus, oral disease affects oral health by its functional, psychological and social consequences for the individual. There seems to be a need to assess information about self-reported oral health for such measures to be valid supplements for the conventional clinical measures.

Aims

The main objective of this thesis was to contribute to the validation of a single global measure of oral health in the context of younger and older age groups in Sweden and Norway. Specifically, this study assessed the level of oral health satisfaction in younger and older Swedish age groups, examined associations of self reported oral satisfaction with socio demographic, clinical and non-clinical variables across 65-year-olds in Norway and Sweden and examined changes and predictors of changes in oral health satisfaction of a cohort of Swedes as they aged from 50 to 65 yr.

Method

The papers of the present thesis are based upon three structured questionnaire surveys. Survey I applies to paper I and was conducted in 2006 involving a census of 19-year-olds attending dental clinics in Örebro and Östergötland. Data were collected by questionnaires and an oral clinical examination. The second survey, (Survey II) is a prospective cohort study initiated in 1992 among all 50-year-olds (born 1942) resident in Örebro and Östergötland. Survey II applies to Papers II and III. Data were collected in 1992, 1997, 2002 and 2007 at ages 50, 55, 60 and 65 yrs, respectively. The survey started as a collaborative project and the counties

were chosen by convenience and not with the purpose of being representative for Sweden as a whole. Survey III was conducted in 2007 among a census of the 1942 cohort currently residing in three counties of Norway, Hordaland, Sogn & Fjordane and Nordland. The Norwegian counties were chosen purposively to represent not only the rural and urban parts of the country, but also variability in oral conditions and dental service offered. Survey II and III were based on a similar questionnaire.

Results

The aim of Paper I (based on Survey I) was to investigate clinical- and self-perceived oral health indicators among 19-year-olds, using a single global question on oral health and one clinical indicator in terms of D_{Sa}. Four subscales (function, knowledge, quality of life and social) were used to identify predictors for self perceived oral health. The results revealed that 87,5% of the 19 yr old participants (n=3,658) was satisfied with their teeth. Females reported more serious problems than males in the social and quality of life dimensions and responders from Östergötland showed better knowledge about oral disease than responders from Örebro (94,4% versus 90,1%). The strongest predictors of satisfaction with oral health were social aspects and quality of life. Statistically significant two-way interactions occurred between county and knowledge and between county and quality of life. In Östergötland knowledge varied systematically with satisfaction, whereas function did not and in Örebro the opposite result was found. Thus, some or good knowledge was more strongly associated with satisfaction in Östergötland than in Örebro, whereas good function was more strongly associated with satisfaction in Örebro.

The aim of paper II (based on Survey II and III) was to assess the prevalence of self-reported oral health satisfaction and to examine its relationship with sociodemographic-, behavioural

and subjective oral health indicators. In addition, this study examined the extent to which the abovementioned relationships were consistent across Sweden and Norway as reported by 65-year-olds. A total of 76.8% of the Swedish and 76.5% of the Norwegian participants were satisfied with their oral health. Multiple logistic regression analysis revealed that subjects who perceived bad general health, smoked daily, had missing teeth, experienced toothache, had problems with chewing, bad breath and oral impacts were less likely than their counterparts in the opposite group to be satisfied with their oral health status. The corresponding odds ratios ranged from 0.08 (problems chewing) to 0.2 (oral impact). No statistically significant two-way interactions occurred and the model explained 46% of the variance in oral health satisfaction across the countries (45% in Sweden and 47% in Norway).

The aim of paper III (based on Survey II) was to assess the stability or change of self-reported satisfaction with teeth in subjects as they age from 50 to 65 and to assess the impacts of socio-demographic, clinical and non-clinical oral health-related factors on tooth satisfaction throughout that period. The result showed that altogether, 63% females and 66% males remained satisfied with their teeth between the ages of 50 and 65. The corresponding figures, with respect to dissatisfaction, were 7% and 6%. GEE models revealed a decline in the odds of being satisfied with advancing age, and this was particularly important in subjects with lower education, tooth loss and in smokers. Remaining all teeth and the absence of chewing problems were the strongest predictors of satisfaction with teeth between ages 50 and 65.

Conclusions and implications

A single global question on oral health satisfaction was applicable in terms of having acceptable psychometric properties in the context of younger and older age groups across Sweden and Norway. This supports the notion that to ascertain information about patients'

oral health, both self-reported oral health measures and conventional clinical measures are needed. Such self-reports can be administered in different ways. To ask a single global oral health question (and register the answer) at the time when patients undergo their regular examination is inexpensive and straightforward. The implementation of such a question is a technical matter for the care provider where there are different possibilities to introduce it directly into the medical record or in adhering it in medical history or risk group registration.

1. INTRODUCTION

1.1 Preface

There are some days when I think I'm going to die from an overdose of satisfaction.

Salvador Dali

During all the years of meeting patients my strongest feeling of satisfaction always came when I could make a real impact for them. Sorry to say, it was usually me who decided how important this was for my patient. Of course, our common goal was their good oral health, but I never followed up the patient's own assessment of their satisfaction with their oral health. Nobody ever asked for it either.

But something began to change. It started with a growing interest about the definitions and concepts of sickness, disease, health and quality of life (QoL). The change in scientific theory did not begin with oral health, but the change reached this area, making self-perceived oral health and oral QoL concepts of growing interest. Why this sudden interest and what factors were important for this change? QoL is still a concept with an enormous diffusion to all parts of the community. Perhaps it is a political ordering, a necessary step to investigate the result of the past year's investment in welfare. The world's sociologists and social scientists have taken this enormous task of defining the concepts of welfare and QoL by finding instruments to measure these phenomena. Health care also contributes to a patient's QoL. That stance has in Sweden received official status by the government priority investigation and its report "The difficult choices in Care 1995". The study, which is the basis for the Revision of Health Care Act (1997), states that improved QoL is a goal for health care ¹.

This thesis is my belated contribution to the attempts to understand (and increase the knowledge

about) what oral health satisfaction means for people and how it can be of practical use in dentistry. It concerns the extent and distribution of subjective oral health focusing on 19-year-olds in Sweden and 65-year-olds in Norway and Sweden. To achieve knowledge about subjective oral health among younger and older age groups in two Nordic countries, one single global measure of oral health satisfaction has been utilised. This thesis also concerns a test of the validity of this single global oral health measure in the context of 19- and 65-year-olds in Sweden and Norway.

The measure of oral health satisfaction is based on many people's responses to numerous questions that can be experienced and interpreted differently. The descriptions in the following chapters intend to clarify the interpretation of oral health satisfaction in this thesis. The language itself is never static. Words and expressions, despite good translations, can change between people, countries and continents and over time. It is common that words change meaning over time, but a change in the content of the words also provides a practical illustration of how the individual, society and the world all also change over time. Language is one of the most important ingredients of any communication between people and the very reason why it is necessary to describe the key terms used in this thesis. To improve communication, it is also important to define the stipulative meaning (special significance) of the discussed terms and related terms by various ways to clarify their bearing when used (Figures 1–4) ². Another important aspect to improve understanding is also to give the ontological and epistemological views of researchers ². This background is especially important when discussing wide concepts without clear consensuses ³. The following sections in the introduction will further discuss these concepts and views both from a general and a historical aspect as well as their specific significance in this thesis.

1.2 Oral disease, oral health and oral health-related quality of life (OHRQoL)

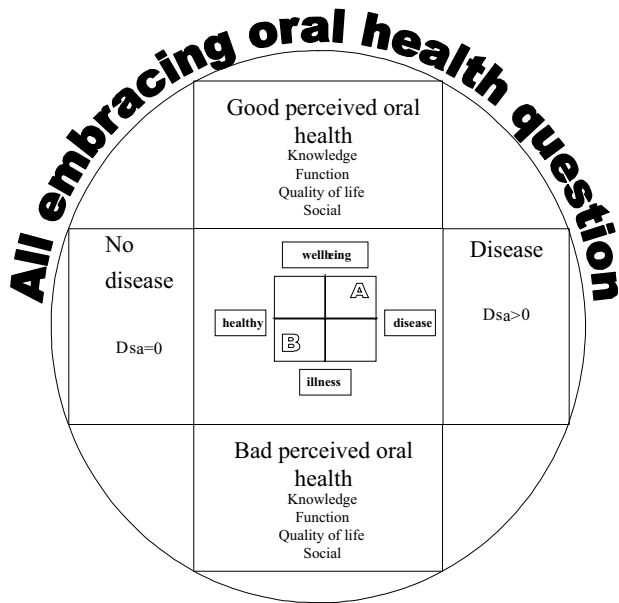
The concepts of oral disease, oral health and OHRQoL are commonly used and interpreted as similar concepts, although it has been acknowledged that they are distinct conceptually as well as empirically. Thus, the recognition that oral disease and oral health are two distinct concepts is in accordance with the theory and empirical evidence and has implications for how oral health is defined and measured. There are many overlapping definitions relating to these concepts. Highly significant concepts for the development of oral-related concepts are general health, health-related quality of life (HRQoL) and quality of life (QoL). This chapter will discuss some of these further because of their importance for the discussion and because they have been referred to in the three papers constituting this thesis.

1.2.1 Oral disease and oral health

Oral disease, as a biological concept applied to the body and body parts, is what the profession can register and provide with a diagnostic code, such as ICD10⁴. This concept belongs to the biomedical paradigm. The concept of oral health was introduced by the World Health Organization (WHO) and has been applied interchangeably and concomitantly with the concept of dental health⁵. In this thesis, oral health and dental health will be used as synonymous concepts. Oral health is a much broader concept than oral disease and involves concerns about optimal functioning, social and psychological wellbeing. It belongs to the socio-environmental paradigm⁶ or the holistic approach⁷. As such, oral health is a psychological and sociological concept referring to individuals and populations. Oral health as applied in this thesis is in line with a Swedish definition from 2002: "Oral health is part of the general health and contributes to physical, mental and social well being by experienced and adequate oral functions in relation to individual circumstances and the absence of disease"⁸. It is also in line with the health definition by Dolan⁹ in terms of being a condition of comfortable and functional dentition that allows individuals to continue their desired social roles. Locker⁶ summarised his view in the following

way: “When talking about oral health, our focus is not on the oral cavity itself but on the individual and the way in which oral diseases, disorders and conditions, whether confined to the oral cavity or linked to other medical conditions, threaten or impact on health, wellbeing and quality of life”. This seems to imply that oral disease affects oral health by its functional, psychological and social consequences for the individual. As such, oral health can vary, notwithstanding the possible presence of oral disease. Individuals might report good oral health in spite of, for instance, having tooth loss, as shown by several studies ¹⁰⁻¹¹. In a representative study of Norwegian adults in 2004, 47% of those being edentulous reported good oral health ¹². The relationship between oral disease and oral health is also illustrated by the conceptual model presented in Paper I (Figure 1). This model assumes that oral health captures both the patient's self-perceived oral health and their disease status, which in turn might vary with age, clinical and psychosocial status and social environment and these two dimensions covariate with each other. One person (A) can perceive good oral health in spite of having a disease, whereas another person (B) can perceive bad oral health despite the absence of disease (Figure 1) ^{8, 13}.

Figure 1. Conceptual model of oral health (adapted with revision from the Swedish National Institute of Public Health).



According to a 2005 study in Canada by Locker and Gibson¹⁴, there is a degree of discordance between self-rated oral health and oral health satisfaction among older people that has been attributed to the expectations imbued in the concept of satisfaction. Consequently, someone with low expectations because of, for instance, bad oral hygiene and older age might experience bad oral health in terms of functional and psychological disease consequences but still be satisfied. Thus, half of older Canadian participants who reported that their oral health was poor, still reported that they were satisfied with their oral health condition.

1.2.2 General health and QoL

Oral health is recognised to be part of general health. General health is described by the WHO (1948) in terms of a state of physical, psychological and social wellbeing and not merely as the absence of disease. This definition has continuously been modified in various reports, such as those from Lalonde (1974) in the Ottawa charter (1986), as well as in the declaration from Sundsvall (1991) and in the report from the Bangkok charter (2005). Medin and Alexanderson⁷ described different concepts and theories of health and provided the historical background for these concepts (Table 1).

Table 1. Different concepts of health.

Biomedical	Mixed form	Humanistic
Biostatic (1)*	Psychosomatic (1)*	Holistic (1)*
Mechanic (1)*	Homeostatic (1)*	Salutogen (2)*
	Behaviouristic	Ecological (2)*
		Theological

* Answers the questions about what health is? (1) and how can health be achieved? (2)

The different theories that exist about health can generally be divided into a biomedical or humanistic orientation (Table 1). According to the biomedical orientation, characterised by its reductionism, health is mainly seen as the absence of disease. The humanistic approach of health is characterised by the fact that health is seen as something more than merely the absence of disease or a diagnostic measure. Individuals are active and creative and are also part of the context in which they appear and live⁷.

But what is meant by the concept of QoL? Is it distinct from that of health? A definition which has adopted the meaning of the concept of QoL at a personal level states that QoL concerns the degree to which individuals enjoy the important possibilities of life or simply “how good is your life for you?”⁶. According to Cohen and Jago¹⁵, the most important implication of dentistry is

its contribution to individuals' QoL. However, in spite of 50 years of research and thousands of scholarly papers, the concept of QoL is still without consensus regarding its definition and measurement. Nevertheless, the concept is recognised to be part of a broader health concept with meaning only at the individual level ⁶.

1.2.3 HRQoL and OHRQoL

In an effort to make QoL more useful for health researchers, HRQoL was born as a new concept in the 1960s ¹⁶. Although clinical conditions and health- and oral health-related problems might impact on health and QoL, it is not necessarily the case that they do so ⁶. Bowling ³ stated that "health-related quality of life is a major concept in relation to the experiences of illness and the outcome of health services". It is a multidimensional construct with several major domains including the physical, social and emotional functioning of the individual with the importance of those domains varying across age groups ¹⁷. It is a concept that is of great interest for clinicians and clinical research because it relates specifically to a person's health ¹⁸. One way to illustrate this concept and link it to clinical variables is by using classification schemes for different measures of health outcomes ¹⁸. But even this concept has a history of a multitude of definitions ¹⁹. To avoid these problems, some authors have suggested that the notion HRQoL should be replaced with subjective health status ²⁰.

It is evident from the literature that the concept of OHRQoL appeared in the early 1980s, much later than the general concept of HRQoL ¹⁶. There is no strict definition of OHRQoL ²¹. The characteristics of OHRQoL are that it is dynamic, subjective and can change over time ²². Assumingly, OHRQoL should be based on the same reasoning as HRQoL ²³. Still, some of the critical scrutiny about the base assumptions in medicine is missing in dentistry ²⁴. Locker and Allen ²⁴ stated that "the claim that oral disorders affect the quality of life has yet to be clearly demonstrated". They also discussed the fact that although health can be compromised it does not

automatically mean that QoL is deteriorated, contrary to the assumptions embodied in the concept and measures of OHRQoL²⁴. If that is the case, self-reported oral health status is not the same as OHRQoL, and OHRQoL can be defined as the impact of oral disorders on an individual's life as measured from their own point of view. This is in line with the suggestion that people assess their OHRQoL by comparing their expectations and experiences²⁵. There is no reason to believe that OHRQoL differs from HRQoL in any decisive way with respect to these properties. In this way, it becomes less important to try to find a precise definition of the term. Instead, one might accept a fluid definition in which OHRQoL can be defined as the "cyclical and self-renewing interaction between the relevance and impact of oral health in everyday life"²². This aspect of OHRQoL implies that it is not only the patient's self-perceived oral health (i.e. the social, psychological and functional consequences of oral disease) but rather their perception of how relevant and important those impacts are. Finally, and despite diverse applications of this concept, the most important aspect of OHRQoL is to bring a patient rather than a body/mouth perspective into focus in the research field of oral health²⁶.

1.3 How to measure oral health and OHRQoL

Traditional disease measurements do not offer much information about oral health and OHRQoL. According to Locker⁶, "from the point of view of contemporary definitions of health, epidemiological measures in terms of DMFT [decayed missing filled teeth] and CPITN [community periodontal index of treatment needs] have serious limitations in that they tell us nothing about the functioning of the oral cavity or the person as a whole and nothing about subjectively perceived symptoms such as pain and discomfort"¹⁰.

1.3.1 Measures of HRQoL

There are two basic approaches to measure health and HRQoL: generic instruments, which provide a summary of HRQoL, and specific instruments²⁷. Examples of specific instruments are Inflammatory Bowel Disease Questionnaire (disease-specific instrument for inflammatory bowel disease)²⁸, and Parkinson's Disease Questionnaire (disease-specific instrument for Parkinson's disease)²⁹, Lancashire QoL profile (instrument for persons with mental health problems)³⁰ and McGill's quality of life questionnaire (specific QoL instrument for persons with life-threatening illnesses)³¹. The strengths of these specific instruments can be their capacity to be clinically sensible even if they do not allow cross-condition comparisons²⁷.

Generic instruments can be divided into single instruments and health profiles. A single-item question in terms of “how do you rate your health status” is an example of a generic measure of health²⁷. Single global health measures have been shown to be reliable and valid and have been recommended for use in health monitoring by the US Centres for Disease Control, the WHO and the European Commission³²⁻³³. This single global health question is also recommended as a surveillance tool in the American public health plan Healthy People 2010³⁴. But even if different age groups and groups with different levels of education will chose different ways to relate to this question (the global health status item) “it functions largely as intended because it pulls together or summarizes the various components that make up the health status domain”³⁵.

Health profiles are instruments “that attempt to measure all important aspects of HRQoL”²⁷. The sickness impact profile (SIP) is a well-known example and includes a physical dimension, a psychosocial dimension and five independent categories including eating, work, home-management, sleep and rest, as well as recreations and pastimes. Its major advantage is its

ability to be used in any population ²⁷. Other examples are The World Health Organization Quality of Life (WHOQoL Bref), EuroQoL-5D (EQ-5D) and SF-36 ³¹.

1.3.2 Measures of OHRQoL

Measurements of oral health and OHRQoL have expanded in a similar way as health and HRQoL ^{26, 36}. During the past 30 years a number of multi-item instruments have been used in addition to single global oral health measures in the assessment of OHRQoL. These multi-item inventories are called socio-dental indicators (SDIs). With few exceptions, their application has been limited to cross-sectional studies, with the aim of establishing psychometric properties and estimating the prevalence of oral impacts in populations of different socioeconomic statuses and oral conditions ³⁷⁻⁴⁰. Specific impacts, such as pain, impaired speech, taste and appearance, are commonly cited in surveys of oral health status and needs for dental care ⁴¹⁻⁴². Still, there are vast differences in the total number of studies on OHRQoL and HRQoL. According to the ICI web of knowledge (on February 24 2010), the number of entries with OHRQoL and HRQoL in their topic was 458 and 27,944 respectively.

One problem regarding the relevance of these OHRQoL instruments for policymakers is their complexity (Table 2). In contrast to these instruments, the single-item global oral health question (“how do you rate your oral health status?”) is easier to understand. It is used in the same context but not to the same extent as the global health question. Pattussi ⁴³ stated that “despite its use in medical studies, a single question of self rated oral health has seldom been used as the primary outcome in dental studies”. A summary of studies where single-item global oral health measures in terms of self-reported oral health and oral health satisfaction have been used as outcome variables is provided in Table 3. Dolan ⁴⁴ stated that “the single item global rating is an economical way of summarizing the state of a person’s oral health”. This measure is commonly used as gold standard in tests of the validity of multi-item SDIs ⁴⁵⁻⁵⁷. Pattussi ⁴³

described this question as a simple and easy way to collect dental health information in adolescents. Locker and Jokovic ²⁴ stated “that these single item measures provide a summary of how people perceive their health, both objective and subjective, and that they may be as useful as more complex multi-item scales and indexes in health status assessments”.

Table 2 depicts a review of various multi-item SDIs. One of the more commonly applied SDIs that is also used in this study is oral impacts on daily performances (OIDP) ⁵⁸. OIDP was originally developed to be used in cross-sectional surveys to assess the impacts on an individual's ability to perform daily activities. OIDP has been shown to have acceptable validity ^{57, 59}. In its original form, OIDP scores are calculated by multiplying frequency and severity scores of daily performances. The severity scores weight the relative importance of respondents' impacts within different performances. Compared with using only OIDP frequency or severity scores, the applications of the multiplicative OIDP scores revealed no significant improvement ⁶⁰. Thus, it has been suggested to use one (e.g. frequency scores) or the other (e.g. severity scores) for simplicity and efficiency ⁶⁰. Different versions of OIDP have been developed for adults and children, and both generic and condition-specific forms have been presented in the research literature ⁶¹.

Table 2. OHRQoL instruments used in research between 1985 and 2009 (adapted with revision from Skaret et al., Mac Entee, Locker et al., Johansson et al. ^{21, 62-64}). There are also country-specific variants of several models, but these have not been included in this table.

Instrument	Abbrev.	No. of items	Original reference	Long/ interv.	Studies	Conceptual structure
Social Impact of Dental Disease	SIDD	14	Cushing et al. ⁶⁵		Cushing et al. ⁶⁵	SIP Eb*
Sickness Impact Profile	SIP	73	Bergner et al. ⁶⁶		Reisine et al. ⁴¹	Unknown
Geriatric (General) Oral Health Assessment Index	GOHAI	12	Atchison & Dolan ³⁹ +		Atchison & Dolan ³⁹ , Kressin et al. ⁶⁷ , Dolan ⁶⁸ , Dolan et al. ⁴⁴ , Locker et al. ⁶⁹ , Locker & Allen ⁷⁰ , Wong et al. ⁷¹ , Jones et al. ⁷²	ICIDH & SIP Eb*
OHRQoL	The DELTA	6	Kressin et al. ⁷³ , Jones et al. ⁷²		Kressin et al. ⁷³ , Jones et al. ⁷²	Unknown
Rand Dental Health Index		3	Dolan et al. ⁷⁴		Dolan et al. ⁷⁴	SIP
Dental Impact Profile	DIP	25	Strauss & Hunt ⁷⁵		Strauss & Hunt ⁷⁵	SIP Eb*
Psychosocial impact score		42	Locker & Miller ⁷⁶		Locker & Miller ⁷⁶	Unknown
Oral Health Impact Profile	OHIP-49	49	Slade & Spencer ⁷⁷ +		Locker ⁷⁸ , Slade ⁷⁹ , Allison et al. ⁸⁰ , Allen et al. ⁸¹ , Broder et al. ⁸² , Awad et al. ⁸³ , Awad et al. ^{84,85} , Jones et al. ⁷² , Allen & McMillan ⁸⁶ , Locker & Allen ⁷⁰ , Allen & Locker ⁸⁷ , Wong et al. ⁷¹	ICIDH Eb*

* Empirically-based (information derived from open-ended interviews)

Table 2 continued.

Oral Health Impact Profile	OHIP-14	14	Slade ⁸⁸	+++++	Locker et al. ⁶⁹ , Locker & Allen ⁷⁰ , Locker et al. ⁵² , Robinson et al. ⁸⁹ , Robinson et al. ⁹⁰ , Allen & Locker ⁸⁷ , Hegarty et al. ⁹¹ , Llewellyn & Warakulasuriya ⁹² , McGrath et al. ⁹³⁻⁹⁴ , Awad et al. ⁸⁴ , Ekanayake & Perera ⁹⁵ , Perera & Ekanayake ⁹⁶	ICIDH
Oral Health Impact Profile (OHIP-EDENT)	OHIP-20	20	Allen & Locker ⁸⁷	++	Allen & Locker ⁸⁷ , Awad et al. ⁸⁴ , Heydecke et al. ⁹⁷ , Allen et al. ⁴⁶	ICIDH
OHRQoL measure	OHRQoL	3	Kressin et al. ⁷³		Kressin et al. ⁷³	ICIDH & SIP
Dental Impact on Daily Living	DIDL	36	Leao & Sheiham ⁹⁸		Leao & Sheiham ⁹⁸	SIP Eb*
OIDP	OIDP	9(8)	Adulyanon & Sheiham ⁵⁸		Robinson et al. ⁸⁹ , Robinson et al. ⁹⁰ , Cortes et al. ⁹⁹ , Tsakos et al. ⁶⁰ , Sheiham et al. ¹⁰⁰ , Melas et al. ¹⁰¹ , Åström & Okullo ⁴⁰ , Masalu & Åström ¹⁰² , Masalu & Åström ¹⁰³	ICIDH
The Oral Health QoL Inventory	OH-QoL	56	Cornell et al. ¹⁰⁴		Cornell et al. ¹⁰⁴	SIP
The Oral Health QoL Inventory	OH-QoL	15	Cornell et al. ¹⁰⁴		Cornell et al. ¹⁰⁴	SIP
Subjective Oral Health Status Indicators		42	Newman ¹⁰⁵		Newman ¹⁰⁵	Multiple
The OHRQoL instrument for dental hygiene			Gadbury-Amyot et al. ¹⁰⁶		Gadbury-Amyot et al. ¹⁰⁶	Multiple
Orthogenetic QoL Questionnaire	OQoLQ	22	Cunningham et al. ¹⁰⁷	+	Cunningham et al. ¹⁰⁷	

* Empirically-based (information derived from open-ended interviews)

Table 2 continued.

UK OHRQoL measure	OHRQoL -UK	16	McGrath & Bedi ¹⁰⁸	++++	McGrath & Bedi ¹⁰⁹ , Hegarty et al. ⁹¹ , McGrath et al. ^{93-94,110} , Dini et al. ¹¹¹	ICIDH2 Eb*
Child Oral Health QoL Instrument	COHQoL		Jokovic et al. ⁴⁹		Tapsoba et al. ¹¹² , Jokovic et al. ¹¹³	Unknown
Child Perceptions Questionnaire	CPQ 11-14	36	Jokovic et al. ¹¹⁴		Jokovic et al. ¹¹⁴	Unknown
Parental-Caregiver Perceptions Questionnaire	P-CPQ	31	Jokovic et al. ¹¹³		Jokovic et al. ¹¹³	Unknown
Family Impact Scale	FIS	14	Locker et al. ⁷⁰		Locker et al. ⁷⁰	Unknown
Child-OIDP			Gherunpong et al. ¹¹⁵		Gherunpong et al. ¹¹⁵	ICIDH
DENTAL	DENTAL	15	Bush et al. ¹¹⁶			Un-specified
Liverpool Oral Rehabilitation Questionnaire	LORQ	25	Pace-Balzan et al. ¹¹⁷		Pace-Balzan et al. ¹¹⁷	SIP
Surgical Orthodontic Outcome Questionnaire	SOOQ	33	Locker et al. ¹¹⁸		Locker et al. ¹¹⁸	Unknown
Self-perceived Oral Health	POH	3	Östberg & Hakeberg ⁵⁷		Östberg & Hakeberg ⁵⁷ , Östberg et al. ¹¹⁹	ICIDH
Oral Health Index	OHS		Burke et al. ¹²⁰		Burke et al. ¹²⁰	Unknown
Child Perceptions Questionnaire	CPQ 8-10		Jokovic et al. ⁴⁸		Jokovic et al. ⁴⁸	Unknown
Subjective Oral Health Status Indicators	SOHSI	34	Locker and Miller ⁶³		Locker and Miller. ⁶³ , Tickle et al. ¹²¹⁻¹²² , Richards ¹²³ , Newton et al. ¹²⁴	Unknown
Early childhood oral health impact scale	ECOHIS	13	Pahel et al. ⁵⁴		Tesch et al. ¹²⁵ , Li et al. ¹²⁶ , Li et al. ⁵¹ , Lee et al. ¹²⁷	Unknown
Child Oral Health Impact Profile	COHIP		Broder ¹²⁸		Broder et al. ^{129,130} , Calis et al. ¹³¹ , Dunlow et al. ¹³²	Unknown

* Empirically-based (information derived from open-ended interviews)

Table 3. Prevalence of individuals reporting oral health satisfaction and good oral health perceptions. Review of studies during the period 2000–2010.

Author/year	Country	Study group /age	Study result
Hennequin et al. ¹³³	France	204 children (mean age 9.6 years) parental evaluation	0-8 years. DS=0: 83.6% good oral health >8 years. DS=0:75.0% good oral health
Jokovic et al. ¹³⁴	Canada	123 children (11–14-year-olds)	77.2% good oral health
Kieffer & Hoogstraten ¹³⁵	The Netherlands	118 adolescents	81.4% good oral health
Kim & Patton ¹³⁶	Korea	1,173 adults aged 65+	46.8% good/fair oral health
Li et al. ¹²⁶	France	101 parents of 0–5-year-old children	Global transition judgments: 51.1% reported improvement. 42.6% reported no change and 6.4% reported deterioration following treatment
Locker et al. ¹³⁷	Canada	Longitudinal study 907 (50+), 611 (50+) and 334 (50+)	Global transition judgments: rating oral health as poor 24.6% (baseline) 24.7% (after three years) and 20.8% (after seven years)
Locker & Jokovic ¹³⁸	Canada	498 dentate subjects (53 years and older)	76.1% good oral health
Locker & Gibson ¹⁴	Canada	225 (50+) and 541 (50+)	Two single-item global indicators of oral health outcomes (oral health and satisfaction) Study 1: 67.4% good oral health; 80% satisfied with oral health Study 2: 76.2% good oral health; 75.8% satisfied with oral health
Åstrøm et al. 2006 ¹³⁹	Norway	1,309 16–79-year-olds	90.5% good oral health

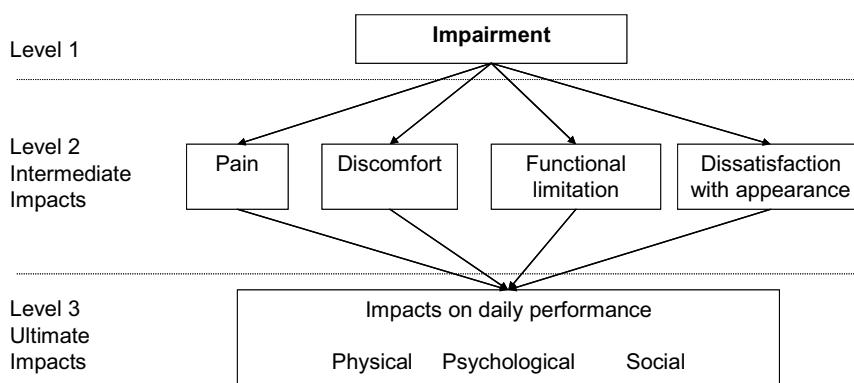
* Searches performed in PubMed with ((global question) AND "oral health") and ((global item) AND "oral health"). Searches also performed in Cinahl and with help of a professional medical librarian. From reading these articles and abstracts and some of their references, articles have been chosen as representing studies with oral health satisfaction as an outcome variable. In general, it has been difficult to find any adequate search strategy for studies with oral health measured by a global item.

1.3.3 Conceptual models

The expanding field of research on SDIs that is assumed to measure OHRQoL draws on the theoretical and empirical work of Cohen and Jago¹⁵, Sheiham and Croog¹⁴⁰ and Reisine⁴¹. Most of these instruments are derived from theory and other instruments but a few have been modified from the input of non-experts. The most influencing theory is Parsons' sick-role

theory, which has had a profound influence of the structural origins of most SDIs, such as the SIP and the WHO's International Classification of Impairments, Disabilities and Handicaps, (ICIDH) (Figure 2) ¹⁴¹⁻¹⁴².

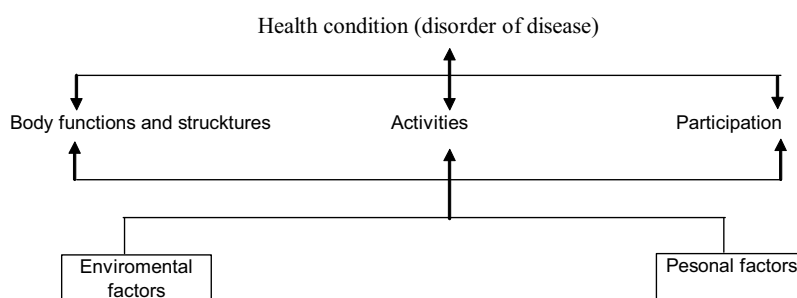
Figure 2. Current understanding of the framework of the ICIDH (adapted from Locker ¹⁴³).



The ICIDH provides a basis for the empirical exploration of the links between different dimensions or levels of consequence variables and consists of the following key concepts: impairments, functional limitations, pain and discomfort and disability and handicap. Impairments refer to the immediate biophysical outcomes of disease, commonly assessed by clinical indicators. Functional limitations are concerned with limitations in the functioning of body parts, whereas pain and discomfort refer to the experiential aspects of oral conditions in terms of symptoms. They comprise the possible earliest negative impacts and the intermediate impacts caused by oral health status. Finally, the ultimate outcomes of disability and handicap refer to any difficulties in performing activities of daily living and broader social disadvantages.

According to the ICIDH model ¹⁴², the key concepts and any measures that derive from them are linked in a linear sequence going from disease via impairments to disability. This appears to imply that associations between measures of adjacent concepts (e.g. satisfaction with dental appearance and disability) should be stronger than those between measures of those concepts at the extremes (e.g. impairments and disability) of the linear sequence ¹⁴⁴. Since its publication the ICIDH has been frequently used across the world and translated into several languages internationally. Disability-related research suggested the need for a revision of the ICIDH framework ¹⁴⁵. Therefore, a second version of the ICIDH model, labelled the International Classification of Functioning, Disability and Health (ICF) (Figure 3), replaced the concepts of disability and handicap by *capacity* and *performance* ¹⁴⁶. The ICF has already made an impact on the way in which data concerning disability are conceptualised, collected and processed in general ¹⁴⁷.

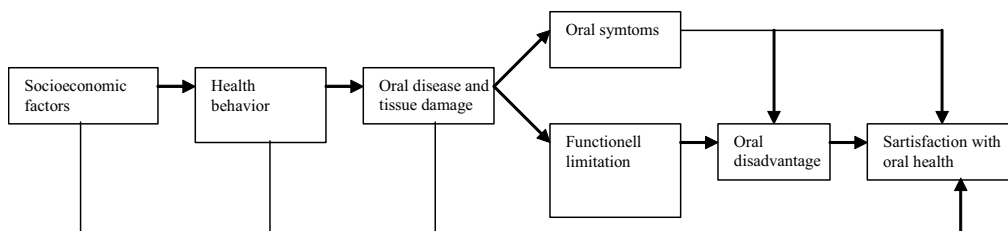
Figure 3. Current understanding of the framework of the ICF (adapted from Dahl ¹⁴⁸).



In addition to the ICIDH and ICF conceptual frameworks, other conceptual models illustrating causal relationships among various domains of oral health outcomes have been presented including by Locker ¹⁴⁴, Wilson and Cleary ¹⁸ and Gilbert et al. ^{23, 149-150}. The latter model is

depicted in Figure 4 and was described in detail in Paper II of this thesis. For a review of studies applying various conceptual models see Table 4.

Figure 4. Conceptual models of oral health showing associations between oral health constructs (adapted with revisions from Gilbert et al. ²³).



This model was proposed by adapting the work of Locker ²⁴ and Johnson and Wolinsky ¹⁵¹ and was evaluated in the Florida Dental Care study ¹⁵⁰. In accordance with this model, studies of oral health address the following main concepts: biological and physiological variables in terms of oral diseases, symptoms, functional limitations and oral disadvantage. Within this terminology, oral disease and tissue damage refers to disorders at the organic level or tissue loss. Oral symptoms and functional limitation denotes the immediate consequences of disease and tissue damage for dysfunctions such as pain and the inability to chew food adequately. Oral disadvantage refers to the psychosocial and behavioural consequences of oral disease, such as difficulties performing daily activities. Impacts on daily performances might also be assessed by the OIDP developed to measure impacts that seriously affect a person's daily life ⁵⁹. These conceptual models have been used in numerous studies globally to assess the relationship between the various concepts as hypothesised by the model. A review of the literature with conceptual models is presented in Table 4.

Table 4. Review of studies using the conceptual models in oral health (1988–2010).

Authors	Title	Year of publication	Model
Locker ¹⁴⁴	Measuring oral health; a conceptual framework	1988	Locker (with revision from ICIDH)
Johnson & Wolinsky ¹⁵¹	The structure of health status among older adults; disease, disability, functional limitation and perceived health	1993	Johnson and Wolinsky
Locker & Slade ¹⁴³	Association between clinical and subjective indicators of oral health status in an older adult population	1994	ICIDH
Locker & Miller ⁶³	Evaluation of subjective oral health status	1994	Locker
Wilson & Cleary ¹⁸	Linking clinical variables with HRQoL. A conceptual model of patient outcomes	1995	Wilson and Cleary
Chen & Hunter ¹⁵²	Oral health and QoL in New Zealand	1996	Chen and Hunter
Gilbert et al. ¹⁵³	Multidimensionality of oral health in dentate adults	1998	Gilbert (with revision from Locker and Wolinsky)
Locker et al. ¹³⁷	Self-perceived oral health status, psychological wellbeing and life satisfaction in an older adult population	2000	Wilson
Locker et al. ¹⁴	Discrepancies between self-ratings of and oral health satisfaction in two older populations	2005	Wilson and Cleary
Sousa & Kwok ¹⁵⁴	Putting Wilson and Cleary to test: analysis of a HRQOL conceptual model using structural equating modelling	2006	Wilson and Cleary
MacEntee ¹⁴⁷	An existential model of oral health from evolving views on health, function and disability	2006	MacEntee (With revision from ICF)
Baker et al. ³⁸	Utility of two OHRQoL measures in patients with xerostomia	2006	Wilson and Cleary
Kida et al. ¹⁵⁵	Chewing problems and dissatisfaction with chewing ability: a survey of older Tanzanians	2007	Gilbert
Baker et al. ¹⁵⁶	Testing a conceptual model of oral health: a structural equation modelling approach	2007	Wilson and Cleary
Baker et al. ¹⁵⁶	Testing relationships between clinical and non-clinical variables in xerostomia	2007	Wilson and Cleary
Pattussi et al. ⁴³	Clinical, social and psychosocial factors associated with self-rated oral health in Brazilian adolescents	2007	Pattussi
Fisher-Owens et al. ¹⁵⁷	Influences on children's oral health: a conceptual model	2007	Fisher-Owens
Åstrøm et al. ¹⁵⁸	Perceived dental treatment need among older Tanzanian adults – a cross-sectional study	2007	Wilson and Cleary
Åstrøm et al. ¹⁵⁹	Factor structure of a conceptual model of oral health tested among 65-year olds in Norway and Sweden	2010	Gilbert

* Literature searches performed in PubMed with ((Gilbert) AND "oral health") AND model, ((Wilson and Cleary) AND "oral health") AND model. From reading these articles and abstracts and some of their references, some articles were chosen as representing studies with oral health satisfaction as an outcome variable.

1.4 Justification for this thesis

The demographics in western countries include an increasing proportion of older people. Because of accumulated experience on oral disease, older people are likely to report numerous functional impacts that might deteriorate their overall oral health ratings. Documenting variation in oral disease as well as in self-reported aspects of oral health provides important information for the planning and evaluation of oral health care services in older as well as younger sub-groups of the population. Yet, few studies have applied single global items of self-reported oral health as their main outcome variable. Moreover, although the concept of oral health should be understood in the context of relevant theory, few studies have identified determinants of oral health using an explicit theoretical framework. Research investigating oral health within a longitudinal study design is rare, and studies published until now have been predominately cross-sectional and descriptive. Thus, there seems to be a compelling rationale for examining ratings of oral health including simultaneously the spectrum of influencing factors as defined by a conceptual model, cross-sectional as well as longitudinally. This might increase the interpretability of the oral health concept and in turn its usefulness within the clinical setting for being considered in treatment decisions and evaluations of treatment interventions together with traditional clinical outcomes measures.

2. AIM AND PURPOSES

2.1 Overall aim

This study aimed to contribute to the validation of a single global measure of oral health in the context of younger and older age groups in Sweden and Norway. Specifically this study assessed the level of oral health satisfaction in younger and older Swedish age groups, examined associations of oral satisfaction with sociodemographic, clinical and non-clinical variables across 65-year-olds in Norway and Sweden and examined changes and predictors of changes in oral health satisfaction of Swedes as they age from 50 to 65.

2.2 Specific aims

Paper I. Self-perceived oral health among 19-year-olds in two Swedish counties.

The aim of this study was to investigate clinical and self-perceived oral health indicators among 19-year-olds attending dental clinics in the Swedish counties of Örebro and Östergötland.

Paper II. Variation in subjective oral health indicators of 65-year-olds in Norway and Sweden.

In this study, it was hypothesised that any difference between countries in oral health satisfaction would be related to sociodemographic differences and underlying variations in the reported number of remaining teeth. Guided by the conceptual framework of Gilbert et al.²³ this study:

(1) assessed the prevalence of subjective oral health indicators as reported by 65-year-olds in Sweden and Norway;

- (2) examined the relationship of sociodemographic factors and behavioural and subjective oral health indicators on 65-year-olds' satisfaction with their oral health status; and
- (3) examined the extent to which the abovementioned relationships were consistent across Sweden and Norway.

Paper III. Satisfaction with teeth and life course predictors: a prospective study of a Swedish 1942 birth cohort.

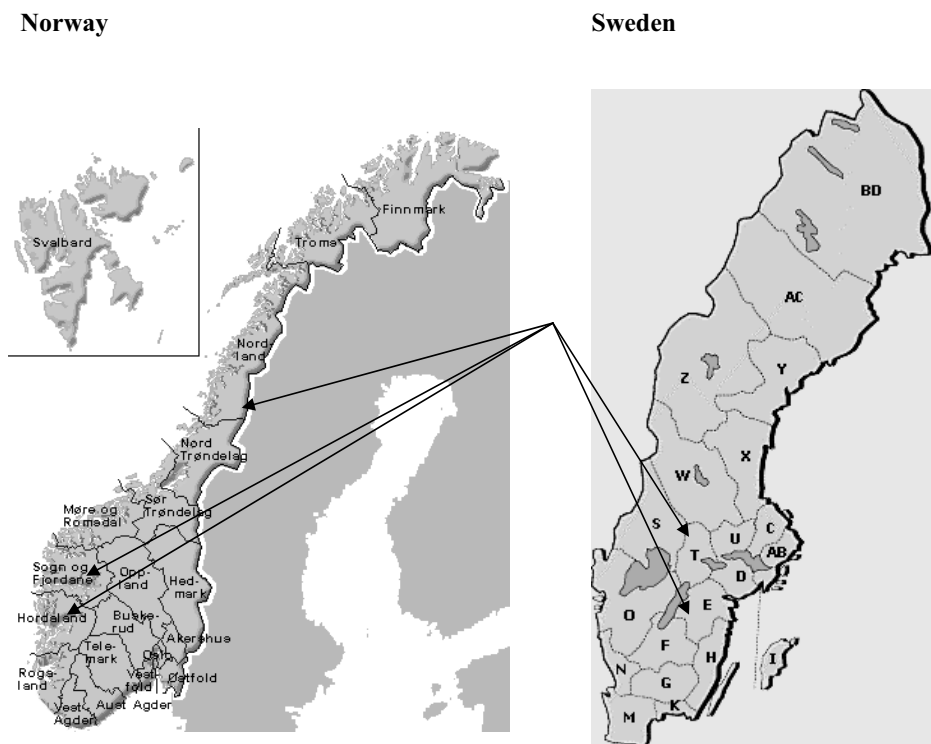
This study used a prospective cohort design to assess the stability or change of self-reported satisfaction with teeth and associated factors in subjects as they age from 50 to 65. Guided by the conceptual model of Gilbert et al. ²³, this study assessed the impacts of sociodemographic, clinical and non-clinical oral health-related factors on tooth satisfaction at ages 50, 55, 60 and 65 years.

3. MATERIALS AND METHODS

This thesis is based on two separate Swedish surveys: the 1987 cohort survey conducted in 2006 (Survey I) and the 1942 cohort survey conducted in 1992–2007 (Survey II). Two counties of Sweden – Örebro and Östergötland – were included in both surveys. Moreover, this thesis includes a Norwegian study of the 1942 cohort resident in three counties of Norway in 2007: Hordaland, Sogn & Fjordane and Nordland (Survey III).

3.1 Study area

Figure 5. Counties participating in Surveys I, II (Sweden) and III (Norway).



Örebro has 278,739 inhabitants (2009) living in both rural and more densely populated areas. There is one city with more than 100,000 inhabitants. Östergötland looks rather similar with

426,808 inhabitants (2009) and two cities with more than 100,000 inhabitants ¹⁶⁰. Hordaland has 469,681 inhabitants (2009) and one big city (Bergen) with more than 200,000 inhabitants. Sogn & Fjordane and Nordland have 106,457 and 235,380 inhabitants (2009) respectively and encompass mainly rural areas ¹⁶¹.

Table 5a. Sociodemographic characteristics in the counties of Örebro and Östergötland and Sweden as a whole in 2008 ¹⁶⁰.

Variable	Örebro County	Östergötland County	Sweden
Ill health*	42.2%	36.3%	36.2%
University competence**	86.3%	89.8%	89.1%
Income comparison***	207,800	207,800	212,000

* Ill health is estimated to be the percentage of people contributing to this index (The sum of days with sickness benefit, occupational injury sickness benefit, rehabilitation and days with activity and sickness compensation divided by the population aged 16–64)

** Percentage of 19-year-olds with competence for university study

*** Median income per person. Age 20+ (Swedish kronor)

Table 5b. Sociodemographic characteristics in the counties of Hordaland, Sogn & Fjordane and Nordland and Norway as a whole in 2007 ¹⁶¹.

Variable	Hordaland County	Sogn & Fjordane County	Nordland County	Norway
Ill health *	20.1%	19.7%	23.7%	20.4%
Primary education	29.3%	30.2%	37.5%	30.9%
Secondary education	43.9%	48.8%	42.7%	43.2%
College/university**	26.8%	21.0%	19.8%	25.9%
Income***	376,700	383,100	352,800	365,500

* Total sickness absence reported per case beyond the employer period per 1000 persons in the labour force

** Education level of persons 16 years of age and older (Hordaland N=350,850, Sogn & Fjordane N=81,132, Nordland N=183,322 and Norway N=3,602)

*** Median income per household (Norwegian kroner)

3.2 Survey I

3.2.1 Selection procedure and study profile

The material of Survey I, which applies to Paper I, was collected from January to December 2006 (Table 6). The study population comprised a census of 19-year-olds attending dental clinics in Örebro and Östergötland. This age group was chosen because they are the oldest

individuals to be offered comprehensive and free dental care in Sweden. The total number of 19 yr olds in these two counties was 9,089. Because some dentists and 19-year-olds did not consent to participate, the eligible number of 19-year-olds invited to participate in a routine clinical oral examination and a questionnaire survey was 7,866. The total response rate was 46.5%. The gender distribution of the participating 19-year-olds was similar to the corresponding distribution in the total population of 19-year-olds in Örebro and Östergötland, which indicates representativity of study participants with respect to gender. See Table 6 for an overview of characteristics pertaining to Survey I.

3.2.2 Ethical clearance

The ethical considerations in this study were in accordance with the principles of the Declaration of Helsinki and all respondents were informed that participation was voluntary¹⁶². All data were registered anonymously. The project did not include research in 3-4 § § Act (2003:46) for ethical review, which requires ethical approval in Sweden¹⁶³.

3.2.3 Clinical examination

A full mouth clinical examination was carried out in fully equipped dental clinics by general dentists using X-ray (bite-wing). There were no calibrations between them. Caries were recorded as manifest caries reaching the dentin. This registration of caries was done by dentists after the ordinary consecutive clinical examinations. To enable analysis of self-reported and clinical oral health indicators pertaining to the same individual, a decision was made to mark the value of the DSa (decayed surface aproximal) values on each questionnaire form before it was handed by the dentist to the participant for completion. DSa was coded between 0 and 12 and the cut-off point for dichotomisation was set between (0) 'free of caries' and (>0) 'with caries experience'. To decrease the risk of incorrectly registered DSa values, extreme values (1.9% of all completed forms with clinical data) were excluded from the analysis. The limit for extreme values was set to

the same level as the highest value for DSA observed in the official statistics in Örebro County (DSA=12).

3.2.4 Self-administered questionnaires

The questionnaire included 13 questions, divided into four global dimensions in terms of knowledge, quality of life, social situation and function. The knowledge subscale was measured by five questions: do you know the mechanism behind cavities, do you know how to avoid cavities, do you know the mechanisms behind tooth loss/periodontal disease, do you know how to avoid tooth loss/periodontal disease and do you know that it is important to use fluoridated toothpaste? The function subscale was measured by three questions: do you have difficulties chewing food because of problems with your teeth or mouth, do you suffer headaches because of problems with your teeth or mouth and do you suffer shooting pain from warm or cold food or drink? The quality of life subscale was measured by two questions: have you ever felt bad or been ashamed of your teeth or mouth and have you ever felt depressed because of your teeth or mouth? Finally, the social subscale was measured by three questions: have you ever avoided laughing because of your teeth or your mouth, have you ever avoided normal socialising because of your teeth or mouth and have you ever felt embarrassed because of your teeth or your mouth?

The social dimension needed a different scale because it contained questions considering both time and quantity. Thus, it was necessary to construct a new global scale from a contingency table with one aspect on the X-axis and the other aspect on the Y-axis. From this table an optional pattern was constructed. The result was a customised scale, created from a cross-tabulation between a question with a time dimension and a question with a quantity dimension. This new scale measured the dimension with a six-grade scale, with a cut-off point for dichotomisation between two and three. Social was dichotomised into (0) 'No problems or small problems' and (1) 'Rather bad problems or very bad problems'. The scoring method was based

on the theory and procedure described by Svensson¹⁶⁴⁻¹⁶⁵. There was also one single global item in this paper called the ‘all-embracing’ oral health question (" In general, how satisfied are you with your mouth and teeth?"), one question about gender and finally information about clinically registered disease in the form of caries. After anonymous completion of the structured questionnaire, participants left their forms in a box at the clinic.

3.3 Survey II

3.3.1 Selection procedure and study profile

The data for Survey II, which applies to Papers II and III, were collected in 1992, 1997, 2002 and 2007. The data were then used as a tool for planning dental health care services in Örebro and Östergötland. In 1992, a questionnaire was sent to all 50-year-olds (born 1942) in the two counties. The survey started as a collaborative project and the counties were chosen by convenience and not for the purpose of being representative of Sweden as a whole. Names and addresses were obtained from public records (Statistics Sweden). Individuals who did not respond within two weeks were sent a reminder letter. Those still not answering after an additional two weeks were sent a new questionnaire. This study was the start of a longitudinal study of the 1942 cohort using similar sample design and survey instruments in 1997, 2002 and 2007. Table 6 and Figure 6 provide an overview of the sample characteristics of Survey II. The longitudinal study was based on four separate data collections conducted at age 50 (1992) and again after five (1997), 10 (2002) and 15 years (2007) (Figure 6).

A total of 4,143 individuals answered the questionnaire in 1992, 1997, 2002 and 2007 (Paper III), whereas 6,078 individuals participated in 2007 (Paper II). The final response rate in the longitudinal study was 65.0% (n=4,143) of those who answered the first study in 1992 (N=6,346) or 54.5% of those who received the questionnaire at all times (N=7,605). Among

the 6,346 respondents in 1992 (response rate 71.4%) females were over-represented (50.2%). The proportion of gender in dropouts and 1992, 1997, 2002 and 2007 cohort participants differed, since 52% of the follow-up participants versus 47% of the dropouts were females ($p<0.001$). Based on their reporting in 1992, dropouts were less likely than the cohort participants to be native Swedes, married, with a perception of good oral health, who brush more than twice a day, maintain all teeth and are satisfied with their teeth and more likely to be daily smokers ($p<0.001$). See Table 6 and Figure 6 for details on response rates of the longitudinal cohort study (Paper III) and the cross-sectional study (Paper II). The county politicians and the population of these two counties (born 1942) received a short report about the results after each study.

3.3.2 Ethical clearance

The ethical considerations in this study were in accordance with the principles of the Declaration of Helsinki and all respondents were informed that participation was voluntary. The 1992 questionnaire and the 1992 clinical study were approved by the ethics committees in Örebro and Östergötland ¹⁶⁶. All following studies are part of a cohort study that was approved by the ethics committees in Örebro and Östergötland when initiated in 1992 ¹⁶². An ethical application for 2007 is attached (Appendix 1).

3.3.3 Self-administered questionnaires

The original questionnaire in 1992 comprised 53 questions with 123 items divided into six sections ¹⁶⁶.

- general socioeconomic status;
- general health;
- oral conditions;
- attitudes concerning function and appearance of teeth;

- experience and use of dental care; and
- questions about most recent visit to a dentist.

The following questionnaires were similar and in 2007 the eight-item OIDP frequency inventory was added.

3.4 Survey III

3.4.1 Selection procedure and study profile

The material of Survey III, which applies to Paper II, was collected during the period April-June 2007. The study population comprised a census of 65-year-olds resident in Hordaland, Sogn & Fjordane and Nordland. The counties were chosen purposively to represent not only the rural and urban parts of the country, but also variability in oral conditions and dental service offered. See Table 6 for details about survey characteristics and response rates. Responders and non-responders differed statistically significantly with respect to educational level with more individuals with a university level education among the participating individuals. The survey started as a collaborative project and the questionnaire, initially developed in Sweden, was translated into Norwegian and back into Swedish. It was mailed to all persons who were born in 1942 and currently residing in these three regions in Norway. Their names and addresses were obtained from public records (Statistics Norway) and the data were collected by them. Individuals who did not respond within two weeks were sent a reminder by mail.

3.4.2 Ethical clearance

The ethical considerations in this study were in accordance with the principles of the Declaration of Helsinki and all respondents were informed that participation was voluntary¹⁶². The ethical application for Survey III is shown in Appendix 2.

3.4.3 Self-administered mailed questionnaires

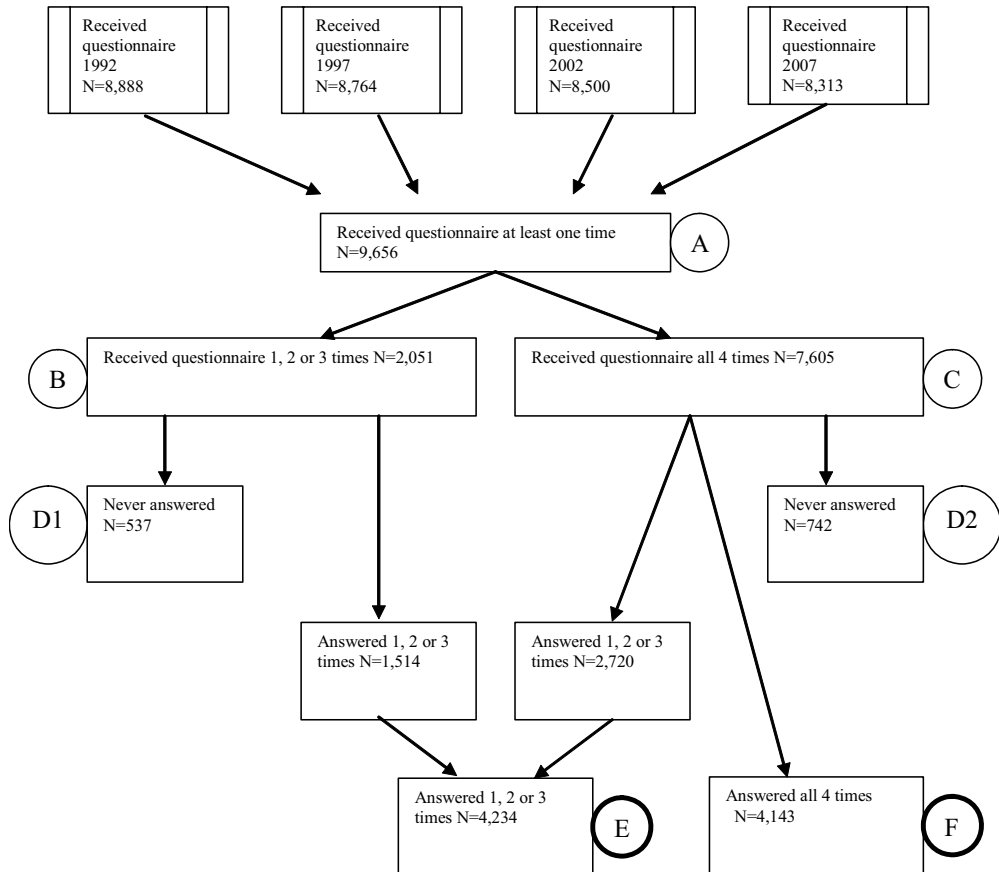
The content of the Norwegian questionnaire was identical to the Swedish questionnaire used in 2007.

Table 6. Characteristics of Surveys I, II and III.

<i>Survey</i>	<i>Age group</i>	<i>Year</i>	<i>Study area County (country)</i>	<i>N*</i>	<i>Response rate (%)</i>	<i>Sample profile</i>	<i>Measurements</i>	<i>Study design</i>
I (1987 cohort)	19	06	Örebro(S) Östergötland (S)	3,077 4,789	51.5 43.3	Census	Questionnaire Clinical examination	Cross-sectional
II (1942 cohort)	50–65	07	Örebro (S) Östergötland (S)	3,377 4,936	63.4 66.6	Census	Questionnaire	Longitudinal
Sweden	50–65	92	Örebro (S) Östergötland (S)	3,633 5,255	71.2 71.6			Cross-sectional
		97	Örebro (S) Östergötland (S)	3,559 5,205	73.6 74.8			
		02	Örebro (S) Östergötland (S)	3,405 5,095	74.1 75.5			
		07	Örebro (S) Östergötland (S)	3,377 4,936	72.4 73.6			
III (1942 cohort)	65	07	Hordaland (N) Sogn & Fjordane (N) Nordland (N)	3,831 975 2,442	59.0 58.9 56.4	Census	Questionnaire	Cross-sectional
Norway								

* N= total number of questionnaires issued in each county

Figure 6. This flow chart depicts the participation in all four waves in survey II, the number of times they received questionnaires (A, B, C) and is divided into responders (F), partial responders (E) and non-responders (D).



3.5 Data analysis and statistical methods

Table 7. Statistical tests and methods used in Paper I, II and III.

Statistical test/method	Paper 1	Paper 2	Paper 3
Chi-squared test	+	+	+
Spearman correlation	+		
Logistic regression	+	+	
Cronbach's alpha	+	+	
Cochran's Q test			+
Generalised estimating equation (GEE)			+

Several different statistical methods were used (Table 7). The data were presented in frequency tables. Statistical significance was indicated as $p < 0.05$, 0.01 or 0.001. Binary logistic regression was applied using method enter and Nagelkerke's R^2 explained the variance. The binomial logit function and unstructured correlation matrix were applied to the GEE and the corrected quasi likelihood under independence model criterion, indicating the explained variance. Data were analysed using the 15.0 Statistical Packages for the Social Sciences (SPSS), (Chicago, Illinois, USA).

4. RESULTS

4.1 Paper I. Self-perceived oral health among 19-year-olds in two Swedish counties

The findings of this study were that females reported more serious problems than males in the social and quality of life dimensions and that there were differences between counties in knowledge about oral disease. The group with poor self-reported oral health in the ‘all embracing’ question had significantly more problems in all global dimensions, especially quality of life and social dimensions. Statistically significant two-way interactions occurred between county and knowledge and between county and quality of life.

4.2 Paper II. Variation in subjective oral health indicators of 65-year-olds in Norway and Sweden

Altogether, 76.8% of the Swedish and 76.5% of the Norwegian participants reported oral health satisfaction. Corresponding figures for toothache were 48.1% (Sweden) versus 51.5% (Norway), and for temporo-mandibular joint symptoms 10.9% (Sweden) versus 15.1% (Norway). Multiple logistic regression analysis revealed that subjects who perceived that they had bad health, smoked daily, had missing teeth, experienced toothache, had problems with chewing, bad breath and oral impacts and were less likely than their counterparts in the opposite group to be satisfied with their oral health status. The corresponding odds ratios ranged from 0.08 (problems chewing) to 0.2 (oral impact). No statistically significant two-way interactions occurred and the model explained 46% of the variance in oral health satisfaction across the countries (45% in Sweden and 47% in Norway).

4.3 Paper III. Satisfaction with teeth and life course predictors: a prospective study of a Swedish 1942 birth cohort

Altogether, 63% females and 66% males were satisfied with their teeth between the age of 50 and 65. The corresponding figures, with respect to dissatisfaction, were 7% and 6%. GEE models revealed a decline in the odds of being satisfied with advancing age, and this was particularly important in subjects with lower education, tooth loss and smokers. Consolidation in oral health perception starts before 50, suggesting early intervention before that age. The promotion of a healthy adult lifestyle and improved access to quality oral health care might increase the likelihood of people being satisfied with their teeth throughout the third age period in both genders.

5. DISCUSSION

5.1 Methodological considerations

The data used in this thesis were collected in two cross-sectional surveys and one longitudinal survey using an oral clinical examination and self-administered questionnaires. Sample surveys were designed by definition to provide estimates of the characteristics of a defined population¹⁶⁷. One study population consisted of 19-year-olds in the Östergötland and Örebro counties of Sweden. The second survey was based on a 1942 birth cohort from the Örebro and Östergötland counties in Sweden, and the third survey was based on a 1942 birth cohort from the Hordaland, Sogn & Fjordane and Nordland counties of Norway. The main strength of this thesis, as one of the advantages of a survey approach, is that it yields information on many variables about a large number of people at a relatively low cost¹⁶⁷. A further strength of this thesis is the use of a population-based prospective data set and its addressing of the younger and older age groups, the latter comparatively across two Nordic countries. However, this thesis might be subject to various sources of error, which might bias the results and the conclusions provided¹⁶⁸. Bias is any systematic error in the data and occurs as two major categories¹⁶⁹. Selection bias stems from study participants (e.g. non-response) and information bias or misclassification stem from errors in the information collected from participants (e.g. recall and social desirability bias in self-reports and misclassifications in clinical registrations). The methodological problems associated with this approach are discussed in detail in the separate papers, but some of the most important limitations are discussed below.

5.1.1 Validity

There are two main aspects of validity: *internal validity* and *external validity*. Internal validity deals with the question of whether a true measure is obtained for the subjects under study or the degree to which the results are correct for the participants studied¹⁷⁰. Internal validity

might be divided into content validity, construct validity or criterion validity. Content validity refers to the extent to which a particular method of measurement includes the dimension one intends to measure, construct validity refers to correlations between different instruments constructed to measure same areas and criterion validity refers to correlations between an instrument and the true reality ¹⁷⁰. *External validity* relates to whether the findings can be generalised to a wider population ¹⁶⁷.

Internal validity – The papers in this thesis are based on large study groups providing mostly statistically significant relationships. This is so even when the strength of the relationship is weak and thereby might be less clinically meaningful. By having large sample sizes, even small and less clinically meaningful relationships might be deemed unlikely to be caused by chance. This problem was solved by using confidence intervals. Most of the statistical significant associations observed showed substantial magnitude. Although evaluating the role of chance is important, evaluating the role of bias as an alternative explanation for an observed relationship is another necessary step when interpreting results. Although the clinical examinations were conducted in fully equipped dental clinics by dentists and using X-rays, the possibility of misclassification in caries registrations cannot be ruled out. Moreover, the dentists participating in Survey I was not calibrated and intra- and inter-examiner consistency was not assessed. Thus, the consistency of the clinical measures could not be evaluated.

The validity of self-reported number of teeth has been confirmed by Unell in terms of observing high correlations between subjective and clinical measures ¹⁶⁶. Accordingly, many studies have found a close agreement between clinically recorded and self-reported number of teeth. Thus, it seems unlikely that the use of self-reported teeth biased the results ¹⁷¹. Common threats to the validity of self-reported measures are information bias, in terms of recall, and

social desirability bias ¹⁶⁸. Retrospective studies are always prone to recall bias, and participants' ability to recall past events and interpret the questions might have influenced the validity of their answers. In addition, there is a possibility that socially desired and undesired behaviours have been over- and underestimated in Surveys I, II and III. There is no way to exclude all such biases. How far it is possible to avoid bias depends on the preparation of the questionnaires and how questions are constructed. Evidence suggests that social desirability biases do occur more frequently in some types of questions than others. This bias is also deemed more likely to occur in interviews compared with self-administered questionnaires. It has been suggested that responses to factual questions are less prone to influence from social desirability than questions of a more evaluative and emotional nature. In fact, previous research has shown that in general self-reported health behaviours are accurate ¹⁷².

The global question was applied as a dependent variable across the three papers of this thesis. This is a well-known instrument and commonly used as a gold standard for assessing the validity of multi-item OHRQoL instruments ^{43, 45-56, 173-174}. For example, OIDP is an instrument validated among different subgroups and in different countries. As reported in Paper II, there was a strong relationship between the single global question of oral health and OIDP, indicating good construct validity when used among 65-year-olds in Sweden and Norway. Finally, since validity (i.e. construct validity) is dependent on theory, the observed associations harmonising the propositions of the Gilbert et al. ¹⁵⁰ model (papers II and III) are as much a test of theory as of the validity of the measurements.

Content validity deals with the competence of an instrument to cover all components of a target area ¹⁷⁵⁻¹⁷⁷. It can also refer to logical validity, when experts deem the questions to be logical, or face validity, when questions reflect the supporting theory ¹⁴¹. Three questionnaires were

used in this thesis. The questionnaire used in Survey I was based on a report from the Institute of Economy and Statistics at Örebro University and especially designed for this age group ¹⁷⁴. It was created out of a need to follow up the 19-year-olds with more than the regular caries epidemiology. Questions and subscales were constructed with adaptations from OHIP-49 and OHIP-14. In addition, several questions about perceived knowledge were added. This instrument has the advantage of being age-specific but also the weakness of including the subscale knowledge, which is not usually seen as a core dimension in oral health, thereby showing the weakest correlation with the single global item. It also lacks the support of earlier studies, thereby contributing to its validation in different contexts.

Papers II and III were based on a well-known questionnaire from 1992, thereby indicating high acceptability ¹⁶⁶. In both papers, the single global question on oral health satisfaction was used as an indicator of oral health. Although validity reflects clarity and the relevance of the questions in the instrument, it is also dependent on the theoretical basis. This means that there can be a general problem when comparing OHRQoL instruments because so many of them have their foundation in the same theory (sick-role theory), thereby making comparisons between the instruments from different theories impossible. Another weakness is that so many have been developed without advice from non-experts or lay folk ¹⁴¹. However, validity is neither present nor absent. The description of the instruments used, sources of bias and actions to minimise those biases provides ground for the reader to decide on the degree of validity ²⁷.

External validity – In all three surveys it was important to consider how representative the study groups were of their respective populations. In other words, did non-responses affect the characteristics of the total census initially targeted in each county?

Obtaining high response rates usually lowers the probability of serious non-response bias ¹⁶⁸. Response rate can be discussed in terms of unit response or item response ¹⁶⁹. Survey I had a unit response rate of 46.5% but a very low item non-response, less than 2%. The corresponding unit response rates for Surveys II and III (performed in 2007) were 73.1% and 56.0%, respectively. Item response rate was generally higher in Surveys II and III compared with Survey I. Nevertheless, despite a lower response rate, the dropout might have occurred at random, thereby having a minor influence in terms of non-response bias ¹⁷⁵. Locker ¹⁷⁵ stated that response rates as low as 30% do not necessarily compromise the results of oral health studies if the responses are evenly distributed. In Survey I, there were no indications of non-response bias when D_{Sa} measures and the gender distribution of the study group were compared with the general population of 19-year-olds. One possible explanation for the low response rate could be that the dentists forgot to ask their patients to participate in the questionnaire survey. By contrast, participants of Survey II (conducted in 2007) differed from the general population on several characteristics, making the 65-year-olds investigated less representative of the populations in the Swedish and Norwegian counties with respect to country of birth, place of residence, education and marital status.

Non-response and dropout attrition could be a major problem in most longitudinal studies. In the 1942 cohort study conducted in Sweden, considerable efforts were made to minimise this attrition rate. To motivate participants into responding, short reports were provided to the study group after each study (1992–2007). Regardless, every new study in this survey tended to widen the differences between the response group and non-response group given the socioeconomic differences. Moreover, for each study wave, survey reminders or follow-ups were utilised.

5.1.2 Reliability

Reliability means repeatability or consistency. A measure is considered reliable if it provides the same result over and over again assuming that measures remain constant ^{167, 176}. Measurement error plays a key role in reducing reliability, and a reliable instrument minimises the error component and maximises the true component. All instruments contain error and true components, but in different mixtures.

In this study, several actions were taken to ensure data quality. Besides the examination of data from “Markör” (Sweden) and Statistics Norway, all data were checked by several examiners to minimise errors due to coding and logical inconsistencies. Some questions might have had slightly different wording in 1992 compared with 2007. Despite that, the problems seemed minimal and would not have affected the results to any great extent.

Inter-rater reliability can arise when the observers or performers are well calibrated. In this thesis, there was no calibration between the dentists in Survey I. In spite of that, the results might be considered reliable when the registrations were performed by many dentists to provide the real mean value for all registrations of this age group.

Test–retest reliability is another way to estimate reliability and involves administering the same test to the same sample on two different occasions. This approach assumes that there is no substantial change in the construct being measured between the two occasions and that the amount of time allowed between measures is critical ¹⁶⁷. Percentage agreement (PA) is an easy and understandable way to measure the reliability ¹⁷⁷. The 1987 cohort questionnaire was tested for reliability in a small pre-study in 2003. Five questions had a PA of 100%, eight questions had a PA of 96% and one question had a PA of 92% ¹⁷⁴. This test–retest approach

was not applied further in any of the studies simply because of restricted resources in terms of time and money.

Cronbach's alpha was applied to assess the internal consistency reliability. The more homogeneous the items comprising a scale, the higher the inter-item correlation, thereby the more reliable the measure, indicating that it reflects the same underlying concept. In Papers I and II, coefficient alpha¹⁷⁸ was used to assess the internal consistency reliability in terms of the homogeneity of the items comprising a scale. It is recommended that the items should correlate with a total score above 0.6 for an instrument to be reliable. Alpha coefficients above 0.8 are exemplary, in the range between 0.70 and 0.79 extensive and coefficients in the range between 0.60 and 0.69 indicate moderate internal consistency¹⁷⁹. In Paper I, the Cronbach's alphas of the four subscales (function, knowledge, quality of life and social) were 0.44, 0.66, 0.70 and 0.65, respectively. The subscale function had a low alpha, probably partly because of the limited number of items comprising that scale. OIDP has previously been tested for validity and reliability in population-based studies in Sweden and Norway^{57, 180}. This study confirmed previous findings by showing Cronbach's alphas of 0.90 and 0.89 in Sweden and Norway, and thereby indicating the high internal consistency reliability of the OIDP inventory.

Each type of reliability estimate provides a different piece of information about the basic behaviour of the instrument¹⁸¹. Low reliability tends to result in weak associations between variables. The magnitude of the present correlations, the consistent findings and the conclusions harmonising with the applied theories all indicate an acceptable reliability and validity of the results presented.

5.2 Discussion of major findings

5.2.1 Choosing 19- and 65-year-olds as the main study groups

Nineteen-year-olds belong to the so-called caries-free or future generation in Sweden ¹⁸². Olhede ¹⁸² described this age group as the first generation who will reach older ages with no or only few restorations. This age group is also of particular interest because they represent the final result or outcome of a dental service that is free of charge for children and adolescents in Sweden. Until recently there has been no regular recording of their oral health in responsible counties by other indicators than in terms of dental caries. Their perceived view of oral health, including psychological concerns, has not been taken into consideration.

The younger elderly in Sweden and Norway (born 1942; 65-year-olds) belong to a rapidly growing group of the population. This situation pertains to both Sweden and Norway as well as globally and is a consequence of the increasing birth cohorts from 1933 to 1946, increasing life expectancy and higher immigration. The number of elderly people will continue to increase in the future ¹⁶¹. At the same time, their oral health status has improved and the number of teeth they retain will also increase ¹⁸³. A larger proportion of elderly people have their own teeth compared with only a few decades ago. This population will also demand ageing with quality, and successful ageing is synonymous with maintenance of QoL ^{100, 184}. Several publications have shown that the use of professional dental health services is limited among elderly, especially those with a low socioeconomic status ¹⁸⁵⁻¹⁸⁶. Compared with adults of other age groups, few studies have considered oral health programmes for the elderly. The WHO has also urged national health authorities to set oral health goals for elderly people ¹⁸⁷. The younger elderly in Sweden and Norway (65-year-olds), with an improved dentition status in terms of increased number of natural teeth, will have an increasing need for dental care. However, despite several similarities between Sweden and Norway they represent two populations with

significant differences in oral health status, public funding to dental care and the organisation of oral health care services. In Sweden the 65-year-olds, like other adults, get a high cost protection. In Norway the 65-year-olds have to pay out of pocket and visit private practitioners, with the exception of those who are living in an institution or have got home care. They are offered free dental care by the Public dental care system in a similar way in both countries. The proportion of gross domestic product budgeted for dental care are also different between Sweden and Norway (Sweden 0.68% and Norway 0.41%)¹⁸⁸.

5.2.2 Cross-sectional comparative and longitudinal life course perspectives

Papers I and II are based on a cross-sectional design; thus, the relationship between different variables has been investigated at one point in time. With this study design it is not possible to identify causal relationships. Nevertheless, cross-sectional designs are inexpensive and applicable when the purpose is to compare groups and generate hypotheses.

Paper I provides information about the extent to which clinically recorded and self-reported oral health indicators affect oral health satisfaction. Although the amount of explained variance was low to moderate, clinical variables in terms of caries experience explained 2% of the variance in the all-embracing oral health question for the 19-year-olds. This low association between caries and satisfaction with oral health is in line with other studies¹⁸⁹ and has been attributed to conceptual differences between clinically recorded and self-reported oral health. It might be emphasised, however, that satisfaction with oral health among Swedish 19-year-olds seems to be good, regardless of the group they might be compared with.

International comparisons of oral health surveys have highlighted the effects of social and cultural factors¹⁹⁰. Sweden and Norway represent two populations sharing a common historical and cultural heritage, although there are important differences between the two

countries in the organisation of oral health care services ^{64, 191-194}. At the time of planning this thesis, no study had compared subjective oral health indicators between older adults in Scandinavia using a standardised, comprehensive questionnaire technique. The results of Paper II suggested that the oral condition of 65-year-olds in Norway and Sweden significantly affected their wellbeing and that there were substantial variations between the two countries in respect to some oral health perceptions but not others. Most notable was the absence of any inter-country differences regarding overall oral health perceptions, with 76.8% of the Swedish and 76.5% of the Norwegian participants reporting good oral health. Although Norwegian 65-year-olds were more likely to have all their own teeth (19.6% versus 13.7%), they were also more likely than their Swedish counterparts to report oral impacts (30.2% versus 28.4%) and oral symptoms. The inter-country differences concerning oral health indicators might have several explanations. The participants of Paper II were born and raised during World War II, a period in history with dramatic social changes that differently affected the economies of the two countries. Moreover, there is a history of substantial difference in the level of subsidies for dental care that these cohorts have received from their respective governments. Within each country, the responses of the participants to their oral health statuses were strongly influenced by their sociodemographic context, suggesting that immigrants, smokers, single persons and those with a lower level of education were less likely than their counterparts in opposite groups to be satisfied with their oral health. Socioeconomic inequality in oral health status has been shown to persist in the adult population in Norway despite general efforts from the Norwegian government to reduce or eliminate it ¹³⁹. Similar studies and results have recently been presented in Sweden ¹⁹⁵⁻¹⁹⁶.

Some authors have highlighted the need for longitudinal study designs to further increase the knowledge of the predictors of self-rated oral health ⁴³. The study design utilised in Paper III

was longitudinal, following the Swedish 1942 cohort from age 50 until 65. Using a life course perspective, Paper III concerned the extent to which oral health at older ages is influenced by earlier life events and how changes in social and financial circumstances throughout the transition beyond middle age (e.g. retirement from the labour force, diminished pension and reduced social networks) influence oral health indicators. Over past years, there has been increasing interest in conceptualising disease aetiology within a life course framework, defined as the “study of long-term effects on chronic disease risk of physical and social exposures” during different periods of life ¹⁹⁷. There have also been similar approaches to measuring QoL in the elderly ¹⁹⁸. The advantages of a life course perspective are the possibility to “place greater emphasis on the integration of both biological and social experiences at different stages of life than the current lifestyle” ¹⁹⁹, with important implications for public health interventions. Growing literature has demonstrated life course influences on health at older ages. Paper III revealed significant long-term impacts on tooth satisfaction at age 65 from measures of social position and clinical and perceived oral health, some of which might be amenable to change or adaptation. Level of education and country of birth, reflecting social position in early life, varied systematically with tooth satisfaction at age 65 but acted primarily by contributing to tooth status in middle age ²⁰⁰⁻²⁰¹. This might illustrate the process of life course accumulation of disadvantages, for instance social mobility, leading to stunted and antagonistic networks and attenuated social support ¹⁹⁸. Accordingly, a recently conducted cohort study in the UK demonstrated the persistence of early life stage social variables on tooth loss at age 50 ²⁰². Other studies have drawn similar conclusions. Blane et al. ¹⁹⁸ studied life course influences on QoL in the early old age in 300 individuals aged 65–75 years in the UK. The results indicated that “quality of life in old age appears to be influence of the life course primarily by current contextual factors //...// with the influence of life course limited mostly to its shaping of an individual's circumstances in later life”.

5.2.3 Oral health satisfaction

In this thesis, a global single question of oral health satisfaction was used as an outcome measure across Papers I, II and III. Locker and Gibson ¹⁴ earlier documented the difference between oral health satisfaction and self-perceived oral health generally, the former more than the latter taking into account subjects' expectations and values. Furthermore, Benyamini and colleagues ²⁰³ stated that oral health satisfaction is more strongly related to comprehensive measures of OHRQoL than the traditional single global items of oral health perception.

Oral health satisfaction in 19-year-olds in Sweden is an important measure that can be used as an indicator together with clinical measurements for measuring the outcomes of an organised free of charge dental health care service for children. A total of 87.5% of the 19-year-olds investigated reported satisfaction with their teeth and mouth in general. Accordingly, Jokovic ¹³⁴ reported that 77.2% of 11–14-year-olds in Canada rated their oral health excellent, very good or good. When using another global question ("How much does the condition of your teeth lips, jaws or mouth affect your life overall?") on the same age group, 93.5% reported that they were not at all, very little or some affected. Oscarson et al. ¹⁸⁹ explored OHRQoL in 19-year-olds from Sweden. The global question "How much does the condition of your teeth, lips, jaws and mouth affect your life overall?" suggested that 53.3% (high-risk caries group) and 59.6% (low-risk caries group) reported that they were not at all, very little or some affected. Kieffer ¹³⁵ assessed oral health among 118 psychology students (mean age 21.2 years) at the University of Amsterdam using a global question (not specified). A total of 81.4% rated their oral health as good or very good.

A total of 76.8% of the Swedish and 76.5% of the Norwegian 65-year-old participants reported oral health satisfaction. Benyamini et al. ²⁰³ examined 850 well-educated elderly people at a retirement community (mean age 73 years). When using the global question "How would you

describe the overall condition of your teeth, dentures or gums?” they found that 76% rated their oral health as excellent, very good or good. Locker and Gibson ¹⁴ studied two groups (n=225; mean age 83 years) and (n=541; mean age 66 years) and compared their answers on global items of oral health status and oral health satisfaction. In the first and second group, 67.4% and 77.2% rated their oral health as good respectively. Locker ²⁰⁴ earlier studied individuals’ satisfaction with their oral health status. In a population of adults aged 50 and older living independently in the community, 24.1% were edentulous, 30.5% were unable to chew one or more type of foods, 37.2% reported oral or facial pain in the previous four weeks and 67.5% experienced one or more other oral symptoms. Despite that, only 30.8% were dissatisfied with some aspect of their oral health status. Matthias et al. ²⁰⁵ reported that 75.9% of an elderly population rated their oral health excellent, very good or good. The study group consisted of 550 individuals in Los Angeles with a mean age of 74.5 years and the key question was “How would you rate your overall dental health?”. Dolan et al. ⁴⁴ studied oral health among non-institutionalised elderly people living in California, aged 75 and over, and found that 73.3% rated their oral health as excellent, very good or good. All these studies concluded that elderly people in different circumstances are generally satisfied with their oral health. Thus, 65-year-olds in Sweden and Norway were almost as satisfied with their oral health as the 19-year-olds in Sweden. This indicates that being satisfied with oral health is a matter of the clinical condition as well as of social, cultural and behavioural circumstances.

Changes over time and their relationships with age offer many possibilities to investigate different factors. These factors could be changes caused by age but they might also involve special external events over time. Ahacic and Thorslund ²⁰⁶ discussed such effects and their relevance for oral health. They called them period effects (effects during study time) and cohort effects (effects before study time). In Paper II, the number of teeth is an example of an age effect

but also a cohort effect. This age group visited a dentist in the mid-1960s when it was highly accepted to “drill and fill” small caries defects in the enamel. This cohort effect gave them other circumstances with respect to i.e. filled teeth, than an age group born in 1987. It is also evident that with the passing of time the exposure effects cannot be separated clearly from each other²⁰⁶.

According to the results of Paper III, oral health satisfaction deteriorated with increasing age. This result was consistent with several other studies but in contrast to the results reported among others by Steele et al.²⁰⁷, who stated that the impact of oral health problems on QoL deteriorated with increasing age thereby causing an improved oral health among elderly. This conclusion was drawn from cross-sectional studies of adults (30–70-year-olds and over) in Australia and the UK and might be cohort-dependent even though the groups investigated might also historically have the lowest expectations. The same explanation is also relevant for the differences in oral health satisfaction observed among Swedish 19-year-olds and Swedish and Norwegian 65-year-olds. Åstrøm et al.¹³⁹ studied the influence of age, number of missing teeth and sociodemographic factors among 16–79-year-olds in Norway and found improved OHRQoL scores with increasing age after controlling for dental status. Dolan et al.⁴⁴ studied self-rated oral health among 258 subjects (75-years and older) in California during three years. In the baseline rating, 73.3% rated their oral health good. After three years just over 20% reported deterioration in oral health, 10% reported an improvement and 68.5% reported the same rating. This study used a repeated cross-sectional design. Ståhlacke et al.²⁰⁸ studied self-rated oral health between 1992 and 1997 using a Swedish cohort and found that it was stable across those years. In that study, oral health was measured with a composite index.

5.2.4 Strengths and weaknesses

The main strength of the present thesis, as one of the advantages of a survey approach, is that it yields information on many variables of a large number of people at a relatively low cost. A further strength is the use of a population based prospective data set, and the issue of addressing the younger and early older age periods, the latter comparatively across two Sweden and Norway.

Surveys I and II were conducted primarily to fulfil the county council's obligations for planning and measuring health status for local inhabitants as well as for scientific purposes²⁰⁹. All questionnaire studies in this thesis are census surveys. Statistics Sweden and Statistics Norway offer continuously detailed and updated information about actual inhabitants in the country, and all inhabitants born at a certain time in different counties were selected from the official statistics and invited to participate. A census study minimises some problems with selection bias and can be practical if the population is limited²¹⁰. It will also provide unique possibilities for longitudinal studies.

The longitudinal approach in Survey II from 1992 to 2007 with a response rate between 70% and 75% for each wave is another important advantage. This possibility for a prospective cohort study is also considered an ideal design for using a life course perspective¹⁹⁹. A longitudinal approach brings statistical challenges depending on repeated measures and the failure to incorporate correlations can lead to incorrect estimations of regression model parameters. A strength of this longitudinal approach is the use of GEE as a method to deal with those problems²¹¹. This approach can tackle the main problem with repeated measures of data. Furthermore, this model has same basic components as other generalised linear models. There is a need to specify a link function, a distribution and a linear predictor and in addition consider

how observations within individuals are correlated²¹². Ballinger²¹³ stated that “users of GEE can also be more confident in their statistical conclusions regarding data that arise from longitudinal and nested researcher design”.

Another strength is the application of a conceptual framework (model adapted with revision from Gilbert et al.²³). This approach is recommended for handling complex hierarchal inter-relationships between determinants of disease and drawing conclusions about mediating factors^{201, 214}. Victora et al.²⁰¹ stated that “a decision on which factors to include in the model should be based on a conceptual framework describing the hierarchical relationships between risk factors”. Åstrøm et al.¹⁵⁹ using confirmatory factor analysis demonstrated that the construct validity of Gilbert's model was supported with Norwegian and Swedish 65-year-olds.

A weakness of the study is that when the study began in 1992 there were no well-tested relevant questionnaire-based instruments available in Swedish. This has resulted in longitudinally consistent use of some original questions that are less than ideal.

There is always a possibility that many important influencing factors of self-reported oral health are missing and thereby do not contribute to the explanatory models. However, the model fit in terms of Nagelkerke's R^2 for all independent variables together was 0.27 in Paper I and 0.46 in Paper II. This indicates a fairly good explanation of the outcome by the models used.

General problems with self-reported data are always important to consider. In addition, there is always a possibility that behaviours with a positive or negative attribution have been over- or underreported.

5.3 Conclusions and implications

A single global item of oral health satisfaction was applicable in terms of having acceptable psychometric properties in the context of younger and older age groups across Sweden and Norway. A total of 87.5% of the 19-year-old Swedes investigated were satisfied with their oral health. Corresponding figures for Swedish and Norwegian 65-year-olds were 76.8% and 76.5%.

Among 19-year-olds, oral health satisfaction co-varied with active caries and indicators of self-perceived oral health, but varied differently according to county of residence and gender. This suggests that knowledge was statistically more strongly associated with satisfaction in Östergötland, whereas function was most strongly associated with satisfaction in Örebro. In the same way, knowledge was statistically more strongly associated with satisfaction among females, whereas function was more strongly associated with satisfaction among males.

The oral condition of 65-year-olds in Norway and Sweden produced numerous impacts that varied substantially between the two countries, reflecting sociocultural differences. Satisfaction with oral health varied by sociodemographics as well as clinical and subjective oral health indicators, suggesting that a full understanding of the oral health and treatment needs of older people in Norway and Sweden cannot be captured by clinical measures alone.

The proportion of Swedish adults satisfied with their teeth was stable and high between the ages of 50 and 65, suggesting that consolidation in OHRQoL starts before 50 and that interventions before then are defensible. Country of origin might be an important social factor with long-term effects on tooth satisfaction. The promotion of a healthy adult lifestyle and improved oral health care to increase tooth retention throughout early old age might improve OHRQoL in both

genders. In addition, the present data suggest potential benefits for the cessation of smoking in males and improved general health care during middle age.

This thesis suggests that to ascertain information about patients' oral health, self-reported oral health measures are needed to support conventional clinical measures. Such self-reports can be administered in different ways. To ask a single global oral health question (and register the answer) at the time when patients undergo their regular examination is inexpensive and straightforward. The implementation of such a question is a technical matter for the care provider where there are different possibilities to introduce it directly into the medical record or in adhering it in medical history or risk group registration. Such an example has recently been presented from the county of Västra Götaland ²¹⁵. As a positive side effect, patients might take more interest in their oral health and what type of treatment they want.

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7. PAPERS I-III

