

A SALUTOGENIC PERSPECTIVE TO ORAL HEALTH

Sense of coherence as a determinant of oral and general health behaviours, and oral health-related quality of life

**JARNO
SAVOLAINEN**

Faculty of Medicine,
Institute of Dentistry,
Department of Periodontology
and Geriatric Dentistry,
University of Oulu

OULU 2005



JARNO SAVOLAINEN

**A SALUTOGENIC PERSPECTIVE
TO ORAL HEALTH**

Sense of coherence as a determinant of oral
and general health behaviours, and
oral health-related quality of life

Academic Dissertation to be presented with the assent of
the Faculty of Medicine, University of Oulu, for public
discussion in Auditorium I of the Institute of Dentistry,
on November 11th, 2005, at 12 noon

OULUN YLIOPISTO, OULU 2005

Copyright © 2005
University of Oulu, 2005

Supervised by
Professor Matti Knuuttila
Docent Antti Uutela

Reviewed by
Professor Heikki Murtooma
Docent Sakari Suominen

ISBN 951-42-7880-1 (nid.)
ISBN 951-42-7881-X (PDF) <http://herkules.oulu.fi/isbn951427881X/>
ISSN 0355-3221 <http://herkules.oulu.fi/issn03553221/>

OULU UNIVERSITY PRESS
OULU 2005

Savolainen, Jarno, A salutogenic perspective to oral health Sense of coherence as a determinant of oral and general health behaviours, and oral health-related quality of life

Faculty of Medicine, University of Oulu, P.O.Box 5000, FIN-90014 University of Oulu, Finland, Institute of Dentistry, Department of Periodontology and Geriatric Dentistry, University of Oulu, P.O.Box 5281, FIN-90014 University of Oulu, Finland
2005
Oulu, Finland

Abstract

Dental diseases such as dental caries and periodontal disease could well be seen as being behaviour-related. The high prevalence of periodontal disease in the Finnish adult population mirrors the need for improving oral health behaviours in a comprehensive manner. Thus far, scant attention has been drawn to the underlying psycho-social factors that could, in part, explain oral health and oral health behaviours. Deficiencies in oral health behaviour may also be indicative of an individual's poor health behaviour in general. The aim of this study was to introduce the salutogenic approach, called sense of coherence, into the domain of oral health and health behaviour.

The present study uses data from the nationally representative Health 2000 survey carried out in 2000–2001 by the National Public Health Institute of Finland. The subjects of this study numbered 4175 in article I, 4131 in article II, 4039 in article III, and 4096 in article IV, and were 30- to 64-year-old dentate men and women. The cross-sectional data was collected via home interviews, self-administered questionnaires, or clinical examinations.

Sense of coherence was positively associated with oral health behaviours, such as dental attendance and tooth-brushing frequency. In addition to tooth-brushing frequency, sense of coherence was also positively associated with the level of oral hygiene. The association between sense of coherence and level of oral hygiene weakened only marginally after controlling for tooth-brushing frequency. A strong sense of coherence was strongly associated with a positive oral health-related quality of life (OHIP). Sense of coherence was also associated with all of the OHIP sub-scales, and the association was most evident in the psychological discomfort, psychological disability and handicap sub-scales. Among males, health behaviours seemed multidimensional, whereas they tended to be unidimensional among females. A strong sense of coherence was a common determinant of healthy behaviours in general, as well as of a good subjective health status.

The present study recognizes the sense of coherence as a common health-promoting determinant of oral and general health behaviours, good oral health, and a good oral health-related quality of life. The results thus suggest that the role of psycho-social factors should not be underestimated in health promotion.

Keywords: health behaviour, oral health-related quality of life, sense of coherence

To my wife

Acknowledgements

The research presented in this thesis was carried out during the years 2001-2005, at the Department of Periodontology and Geriatric Dentistry, Institute of Dentistry, University of Oulu, in cooperation with the Department of Epidemiology and Health Promotion, National Public Health Institute of Finland.

I wish to express my deepest gratitude to my supervisor, Professor Matti Knuuttila, for giving me the opportunity to work on this thesis during my undergraduate years, and for introducing me to the field of dental science. Our constructive conversations and his inspiring and never-ending encouragement and expertise made this research very captivating for me.

I wish to express my respect to my other supervisor, Docent Antti Uutela, for guiding me to the world of epidemiology and health promotion. His expertise and help have been indispensable throughout this work.

I wish to express my warm thanks to the National Public Health Institute of Finland, and especially to Professor Arpo Aromaa and all the members of Oral Health committee, and in particular to the president of the committee, Docent Anne Nordblad, for giving me the opportunity to work with the astonishing Health 2000 data.

I am grateful to Professor Heikki Murtomaa and Docent Sakari Suominen for their careful reviewing of, and valuable comments on, this thesis. I also wish to thank Docent Anthony Heape for his careful revision of the language of the four original articles and this thesis.

I warmly thank my co-author Liisa Suominen-Taipale, DDS, PhD, for sharing her knowledge in statistics and dental science, and for her patience in putting up so well with my questions. Our e-mail "conversations" have been rather important to me.

I am truly grateful to all my co-authors for their contribution to the original papers. The researchers, Professor Arpo Aromaa, Päivi Harju, DDS, Professor Hannu Hausen, Tommi Härkänen, PhD, Tuija Martelin, PhD, Mirka Niskanen, DDS, PhD, Anne Nordblad, DDS, PhD, and Liisa Suominen-Taipale, DDS, PhD, have all made precious contributions to this research.

I also express my thanks to all of the personnel of Institute of Dentistry, and particularly to Head of the Institute of Dentistry, Professor Kyösti Oikarinen, for providing me with facilities to work on my thesis during my dental studies.

I am also indebted to my colleague Hanna-Leena Mettovaara, DDS, for all the cheerful conversations we have had.

I am truly grateful to all my friends, my dental mates Timo and Vesa, for making my dental studies so “boring”, my dear friends in Joensuu, Ville, Jarno, Anssi and Juha, and my dear friends in Oulu, Annina and Saku, Hannaleena and Mikko, and Marja and Pete, for showing me what friendship is all about.

I am deeply indebted to my dear parents, Leena and Kari, for their endless support and encouragement throughout my whole life. I also express my dearest thanks to my dear sister Hanne and brother Jyri, for providing me with the pleasant challenge of setting an example as a big brother for you to follow.

I am also grateful to my Maritta and Tony, for all the moments we have shared during the past years, and Tanja and Sonia, it has been a pleasure to see you growing.

Finally, I express my greatest thanks and love to the sunshine of my life, my wife, Heini. Your endless love, enthusiasm and dedication to your beliefs and goals in life and in research have given me the strength to carry on. Without you, this would not have come true.

This research was financially supported by the Finnish Dental Society and the Emil Aaltonen Foundation. The permissions to republish material from the original papers were granted by the Community Dental Health, the European Journal of Oral Sciences and the Journal of Periodontology.

Oulu, October 2005

Jarno Savolainen

Abbreviations

KTL	National Public Health Institute of Finland
OECD	Organization of Economic Co-operation and Development
OHIP	Oral Health Impact Profile
PPS	Probability-Proportional-to-Size
SOC	Sense of Coherence

List of original articles

This thesis is based on the following papers, referred to in the text by their Roman numerals:

- I Savolainen J, Knuuttila M, Suominen-Taipale L, Martelin T, Nordblad A, Niskanen M & Uutela A (2004) A strong sense of coherence promotes regular dental attendance in adults. *Community Dent Health* 21: 271-276.
- II Savolainen J, Suominen-Taipale L, Uutela A, Martelin T, Niskanen M & Knuuttila M (2005) Sense of coherence as a determinant of tooth-brushing frequency and level of oral hygiene. *J Periodontol* 76: 1006-1012.
- III Savolainen J, Suominen-Taipale L, Hausen H, Harju P, Uutela A, Martelin T & Knuuttila M (2005) Sense of coherence as a determinant of the oral health-related quality of life – a national study in Finnish adults. *Eur J Oral Sci* 113: 121-127.
- IV Savolainen J, Suominen-Taipale L, Uutela A, Aromaa A, Härkänen T & Knuuttila M. Sense of coherence as a common health-promoting determinant for oral and general health behaviours. *Community Dent Oral Epidemiol* (Revised manuscript submitted).

Contents

Abstract	
Acknowledgements	
Abbreviations	
List of original articles	
Contents	
1 Introduction	15
2 Review of the literature	17
2.1 Sense of coherence	17
2.1.1 Definition of sense of coherence	17
2.1.2 Development and stability of sense of coherence	18
2.1.3 Measuring sense of coherence	19
2.1.4 Sense of coherence, other psycho-social factors, strain and life-events	20
2.2 Sense of coherence and health behaviours	21
2.2.1 Health-promoting mechanisms of sense of coherence	21
2.2.2 Sense of coherence and health behaviours	22
2.2.3 Sense of coherence, oral health and oral health behaviours	23
2.3 Sense of coherence and health	23
2.4 Oral health behaviours	24
2.4.1 Dental attendance	24
2.4.2 Tooth-brushing frequency	26
2.4.3 Relationship between oral and general health behaviours	26
2.4.4 Psycho-social factors related to oral health and oral health behaviours	28
2.5 Oral health-related quality of life	29
2.6 Implications of previous research for the present study	30
3 Aims of the present study	32
4 Material and methods	33
4.1 Subjects and procedures	33
4.2 Home interview and questionnaires	34
4.2.1 Sense of coherence scale	35
4.2.2 Distribution of the SOC scores in quintiles	35
4.2.3 Oral health behaviours	37

4.2.4 Socio-economic and demographic factors	37
4.2.5 Smoking.....	38
4.2.6 Physical activity (article IV).....	38
4.2.7 Oral Health Impact Profile scale (article III)	38
4.2.8 Subjective oral and general health (article IV)	38
4.3 Oral examinations.....	39
4.4 Statistical analyses	39
5 Results	41
5.1 Sense of coherence and dental attendance (I)	41
5.2 Sense of coherence, tooth-brushing frequency and level of oral hygiene (II)	43
5.3 Sense of coherence and oral health-related quality of life (III)	45
5.4 Oral and general health behaviours and health, and sense of coherence (IV).....	47
6 Discussion	50
6.1 Methodological considerations	50
6.1.1 Sample.....	50
6.1.2 Sense of coherence	51
6.1.3 Oral and general health behaviours	51
6.1.4 Socio-economic and demographic factors	52
6.2 Sense of coherence, oral health behaviours and level of oral hygiene.....	53
6.3 Oral and general health behaviours and sense of coherence.....	55
6.4 Sense of coherence as a determinant of oral health-related quality of life and subjective oral and general health status	56
7 Conclusions and implications	58
References	
Appendices	

1 Introduction

Dental diseases such as dental caries and periodontal disease could well be seen as being related to lifestyle. Clinical follow-up studies suggest that twice-a-day tooth-brushing, regular dental attendance and the use of dental floss are largely capable of preventing the progression of these diseases (Axelsson & Lindhe 1981, Axelsson *et al.* 1991, Rosling *et al.* 2001 Axelsson *et al.* 2004). However, the increasing number of remaining natural teeth, and a concurrent high prevalence of periodontal disease, in the Finnish adult population emphasize the need to enhance preventive oral health behaviours (Tervonen 1988, Vehkalahti *et al.* 1991, Suominen-Taipale *et al.* 2004). During the past three decades, however, no significant improvement has been made in these behaviours (Vehkalahti *et al.* 1991, Murtomaa & Metsäniitty 1994, Suominen-Taipale *et al.* 2004).

Positive oral health behaviours have been found to associate with female gender, high socio-economic status, white ethnic group, absence of dental fear or anxiety (Nuttall 1997), and good oral health status (Norlen *et al.* 1991, Suominen-Taipale *et al.* 2004), but associations such as these cannot fully explain oral health behaviour differences between individuals. Only minor attention has been given to possible underlying psycho-social concepts that might also partly explain oral health and oral health behaviours. Oral health behaviour deficiencies may also relate to an individual's poor health behaviour in general. Thus, acquiring psycho-social background information on oral health behaviour might be proactive to the promotion of oral and general health.

Antonovsky's theory of salutogenesis may be seen as a mechanism involved in the achievement and maintenance of good somatic health. The theory seeks to explain health-promoting factors as being distinct from the factors that cause the risks of specific diseases. The theory's central construct is the sense of coherence (SOC), which seeks to explain the relationship between stressors and subjective evaluations of health. An individual with a strong SOC has the ability to define life events as less stressful (comprehensibility), to mobilize resources to deal with encountered stressors (manageability), and to possess the motivation, desire and commitment to cope (meaningfulness) (Antonovsky 1987a).

A strong SOC has previously been found to associate with positive general health behaviours, such as healthy food choices (Larsson & Setterlind 1990), low alcohol consumption (Midanik *et al.* 1992), and high frequency of physical activity (Hassmen *et*

al. 2000, Kuuppelomäki & Utriainen 2003). In recent years, the theory has also been introduced into dental science studies of adolescents (Freire *et al.* 2001, 2002), but no large-scale studies of the association between SOC, and oral and general health behaviours of adults are available. This thesis aims to provide such information.

2 Review of the literature

2.1 Sense of coherence

2.1.1 Definition of sense of coherence

When studying survivors of Nazi concentration camps, Aaron Antonovsky noticed that some of them were in remarkably good health and had coped well with their horrific experiences. This formed the basis for generating the salutogenic theory of health, which seeks to explain health as a position on the health ease/dis-ease continuum. In contrast with the biomedical construction of the term disease, dis-ease reflects both a subjective and an objective evaluation of the health status. The central construct of the theory is the sense of coherence (SOC), which seeks to explain the relationship between health and stressors of life (Antonovsky 1979, 1987a). Antonovsky formally defined SOC as follows:

“A global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that ¹the stimuli deriving from one’s internal and external environments in the course of living are structured, predictable, and explicable; ²the resources are available to one to meet the demands posed by these stimuli; and ³these demands are challenges, worthy of investment and engagement” (Antonovsky 1987a).

The above subcategories are now seen as the three core components of SOC; comprehensibility, manageability and meaningfulness. First, an individual with a high sense of comprehensibility perceives information and stimuli as ordered, consistent and predictable. When traumatic life events occur, such as death or failure, an individual with a high sense of comprehensibility may be able to make sense of them. Next, an individual with a high sense of manageability does not victimize him-herself in events where life treats him/her unfairly, and will therefore be able to cope. Finally, an individual with a high sense of meaningfulness feels life making sense emotionally, so that posed demands can be seen to be worthy of investing energy and commitment (Antonovsky 1987a). These three components of SOC are closely linked theoretically and, in cases of differing levels of the components for an individual, there would be a pressure towards

establishing equal levels between components (Antonovsky 1987a). The theory of SOC has been suggested to be highly applicable in the public health area, since it is directed not only towards cure, but also towards prevention (Geyer 1997).

The salutogenic theory proposes that the stronger SOC the individuals and groups possess, the more adequately they may cope with the stressors and maintain their health status in the course of living (Antonovsky, 1979, 1987a).

2.1.2 Development and stability of sense of coherence

SOC has been proposed to be a fairly stable dispositional orientation of the personality (Antonovsky 1987a, b, 1990, Sagy *et al.* 1990). Thus, SOC begins to develop already at an early age. During childhood and adolescence, a tentatively strong SOC can be achieved, which may be useful for short-range prediction about coping with stressors and health status. Upon entry into adulthood, with long-range commitments to people, social roles and work, the experiences of childhood and adolescence are then either reinforced, or reversed (Antonovsky 1987a).

Whereas SOC is not entirely developed during adolescence, it is assumed to be fully developed at the age of 30 and, having grown strong, to remain rather stable thereafter. Antonovsky also emphasized the dynamic nature of SOC that points out that minor, or slow changes may occur in the level of SOC, “fluctuations around a mean level”, (Antonovsky 1987a).

In a cross-sectional setting, the stability of SOC has been supported in two studies of the elderly. Antonovsky *et al.* (1990) and Sagy *et al.* (1990) found group means of SOC to remain unchanged, while the individual levels of SOC were not reported in these studies that may allow large variations.

The stability of SOC has been discussed in only a few previous longitudinal studies. In adult samples, SOC has been found to be a moderately stable personality factor over time (Feldt 2000, Kivimäki *et al.* 2000, Schnyder *et al.* 2000, Suominen *et al.* 1999). In comparison, a few studies have found significantly positive correlations between SOC scores and age (Larsson & Setterlind 1990, Carnsten & Spangenberg 1997, Sack *et al.* 1997, Schnyder *et al.* 2000). A study of adolescents over an 18-month period concluded that there was a certain degree of stability of SOC during middle to late adolescence (Buddeberg-Fischer 2001). This was supported in a study of undergraduate students (Frenz *et al.* 1993). In contrast, a three-stage follow-up study conducted among medical students showed a systematic decrease in SOC scores over time as the workload of studies increased (Carmel & Bernstein 1990). In a 5-year follow-up study, Feldt (2000) also found that SOC is not more stable among older subjects than in subjects of less than 30 years of age. The stability of SOC in adulthood is still open to debate, due to the lack of empirical evidence (Geyer 1997).

Epidemiological data regarding possible gender differences in the level of SOC are inconsistent. However, there appears to be a tendency towards male subjects showing higher SOC scores than females (Antonovsky 1993, Anson *et al.* 1993, Larsson & Kalleberg 1996, Buddeberg-Fischer 2001).

2.1.3 Measuring sense of coherence

The Orientation to Life Questionnaire was developed as a cross-cultural tool for measuring the sense of coherence. Antonovsky devised the scale after intensive interviews with 51 persons who had experienced severe trauma with inescapable major consequences for their lives, and coped remarkably well with their experiences. He drew up a response profile with words and phrases used by respondents who were judged to have either a strong, or a weak sense of coherence. Then he made a theoretically guided choice to have each item include one of the three items of SOC (comprehensibility, manageability, meaningfulness). He also suggested that a strong SOC can be observed in any cultural setting, and suspected that it is always culturally acceptable to believe that stressors can be comprehended, managed and worthy of engagement. Therefore, to obtain a high score on the Orientation to Life Questionnaire, an individual is not required to assent to specific content-laden criteria to determine comprehensibility, ways of manageability and reasons for meaningfulness (Antonovsky 1987a, Feldt 2000).

The Orientation to Life Questionnaire is most commonly used in two forms, with either 29, or 13 items. Respondents are asked to select a response on a 7-point semantic differential with respect to anchoring phrases. The longer form is made up of eight manageability, eleven comprehensibility and ten meaningfulness items. The 13-item form is proposed for use when time or space limitations prevent the use of the longer form (Antonovsky 1987a). It contains four meaningfulness, five comprehensibility and four manageability items. It has also been suggested to measure SOC only with three items (Lundberg 1997), one item measuring each SOC component, but the reliability and validity of the results were not encouraging (Schumann *et al.* 2003). Slightly modified scales have also been used (Suominen *et al.* 1999).

On the whole, the results of these studies support the reliability (Cronbach alpha) and the validity of the scale, and provide preliminary support for the usefulness of the underlying construct. Cronbach alphas of the 29-item version have ranged from 0.85 to 0.95 (Antonovsky 1993, Bishop 1993, Callahan & Pincus 1995, Cohen 1997, Frenz *et al.* 1993, Gallagher *et al.* 1994, Langius & Björvell 1993, Söderberg *et al.* 1997). Cronbach alphas of the 13-item version have also emerged as high, ranging from 0.74 to 0.91 (Antonovsky 1993, Brooks 1998, George 1996, Kivimäki *et al.* 1998, Klang *et al.* 1996, Korotkov 1993, Langius & Björvell 1993, Larson & Kallenberg 1999, Shanani *et al.* 1993, Steiner *et al.* 1996).

The validity of the 29-item questionnaire has been supported in several studies. Strong positive associations have consistently been detected between scores on the Orientation to Life Questionnaire and different kinds of scales of health and well-being (Carnstens & Spangenberg 1997, Coward 1996, Langius & Björvell 1993, Söderberg *et al.* 1997). The score of the 29-item scale has also been positively related with perceived resources (Kalimo & Vuori 1991), other psycho-social theories, such as locus of control, hardiness and self-esteem (Kravetz *et al.* 1993, Petrie & Brook 1992, Viviers 1997, Williams 1990), and health behaviours (Gallagher *et al.* 1994, Lajunen & Summala 1995). The Orientation to Life Questionnaire has been associated with perceived stressors (Kalimo & Vuori 1991) and type A behaviour (Söderberg *et al.* 1997).

The tendency for the validity of the 13-item scale has been similar. The score of the 13-item scale was found to positively associate with various scales of health and well-being (Antonovsky 1993, Coward 1996, Kivimäki *et al.* 1998, Klang *et al.* 1996, Steiner *et al.* 1996) and psycho-social factors, such as self-esteem, self-transcendence and hardiness (Coward 1996, Korotkov & Hannah 1994). A negative association has been shown with perceived stressors (Kivimäki *et al.* 1998, Ryland & Greenfeld 1991) and poor coping strategies (Klang *et al.* 1996).

The Orientation to Life Questionnaire is mostly used as a monodimensional measure, not envisaging its three components, comprehensibility, manageability and meaningfulness. Antonovsky emphasized that the components of the SOC are interrelated and, therefore, should not be measured as distinct constructs, and he also claimed that all of the components are needed for successful coping (Antonovsky 1987a). High intercorrelations between these components have also been described (Bishop 1993, Flannery & Flannery 1990, Hart *et al.* 1991, Kravetz *et al.* 1993, Petrie & Brook 1992, Sandell *et al.* 1998).

2.1.4 Sense of coherence, other psycho-social factors, strain and life-events

A salutogenic perspective has been proposed to explain socio-economic differentials in health (Charlton & White 1995, Lundberg 1997). This has also been supported by a notion of a strong SOC associating with high levels of education and income (Larsson & Kallenberg 1996).

In one of the earliest studies of SOC, the latter was suggested to be the pathway to life satisfaction (Sagy *et al.* 1990). Antonovsky has repeatedly proposed that the salutogenic orientation is a completely new perspective, distinct from other psycho-social theories (Antonovsky 1987a). This view has not gained unanimous support, however. In his review, Geyer (1997) suggested that Kobasa's theory of hardiness (Kobasa 1979, 1982) had the greatest overlap with SOC. Both theories seek to answer the question as to why some individuals fall ill under strain, while others do not. Antonovsky discussed Kobasa's notion of hardiness in relation to SOC, but accentuated the theories' differences and suggested that they were distinct (Geyer 1997).

Another theory that could relate to SOC is the theory of self-efficacy proposed by Bandura (1977). Self-efficacy relates to a person's conviction that he/she is able to exhibit certain behaviours in order to attain goals, or to cope with a stressor (Bandura 1977, Geyer 1997). If individuals have experienced success on several occasions, and have acquired the skills to master similar ones in the future, what is meant by high self-efficacy is close to a strong SOC. Nevertheless, they should be separated, because, in order to be maintained, self-efficacy needs to be repeatedly confirmed, while SOC is assumed to be intact on its own (Geyer 1997).

In addition to the above-mentioned theories, SOC has been found to correlate significantly and positively with a wide variety of other psycho-social characteristics, such as self-esteem (Petrie & Brook 1992, Johnson 2004), locus of control (Johnson 2004), self-motivation inventory (Björvell *et al.* 1994), self-transcendence (Coward 1996)

and general motivation (Langius *et al.* 1992), and inversely with negative affectivity (Carmel & Bernstein 1990, Flannery & Flannery 1990, Kravetz *et al.* 1993), depression (Carstens & Spangenberg 1997, Buchi *et al.* 1998, Ristner *et al.* 2000, Tselebis *et al.* 2001, Engelhard *et al.* 2003), psychological distress and anxiety (Sagy & Antonovsky 1986, Frenz *et al.* 1993, Kaiser *et al.* 1996, Klang *et al.* 1996).

A large body of previous research suggests that there is a link between SOC and arduous life events and health problems, or symptoms (Sarason *et al.* 1985, Bishop 1993, Brown & Harris 1989, Brown 1993, Kivimäki *et al.* 1997, Vahtera *et al.* 1997, Lundman & Norberg 1993, Suominen 1993, Ogava *et al.* 2001, Toppinen-Tanner & Kalimo 2003).

A few studies have investigated the relationship between life events and alterations in the SOC. In a recent study by Snekkevik and co-workers (2003), the SOC scores of an individual were not stable over time after severe multiple traumas, while the median SOC scores were fairly stable. Separate analyses for men and women have shown that recently experienced life events negatively affect women's health, and that the SOC has no significant counterbalancing effect on their health. Among men, however, an opposite pattern was found; their health is not affected by recently experienced life events, but is significantly affected by their SOC (Carmel *et al.* 1991).

Wolff and Ratner (1999) proposed that recent traumatic life events are inversely related to SOC. The Canadian National Population Health Survey carried out in 1994-1995 concluded that those subjects who reported at least one traumatic event had a weaker SOC than those who reported none (Hood *et al.* 1996). It has also been suggested that a strong SOC can buffer the negative influence on life satisfaction after a trauma (Anke & Fugl-Meyer 2003).

2.2 Sense of coherence and health behaviours

2.2.1 Health-promoting mechanisms of sense of coherence

According to the original theory (Antonovsky 1987a), SOC can contribute to the health status through three different pathways. The first is a physiological, health-maintaining pathway, which assumes that stimuli encountered by an individual are comprehensible, predictable and meaningful, activating the brain to give commands to other organs to maintain homeostasis.

The second route, and the most interesting in context of the present study, is the selection of health-promoting behaviours through which the SOC can function. An individual with a strong SOC is more likely to comprehend stimuli as non-stressors, and to avoid such stressors that could adversely affect his/her ability to successfully cope. Furthermore, an individual with a strong SOC is more likely to seek treatment, to follow professional guidance, to seek information relevant to health, and to disallow poor health behaviours.

The third route relating SOC to health is the successful coping with stressors. According to Antonovsky, in the first stage of appraisal, a stimulus is defined as a stressor. In the second stage of appraisal, a person with a strong SOC defines the

encountered stressor as structured, or even as a welcome challenge, and has confidence that it will be handled well. In the third stage of appraisal, an individual with a strong SOC is capable of realizing the nature of a problem, and is eager to encounter it.

The fourth stage is reappraisal. In this stage, an individual with a strong SOC is open to feedback and to the possibility of corrections (Antonovsky 1979, 1987a).

2.2.2 Sense of coherence and health behaviours

SOC is hypothesized to be a salutogenic resource influencing the aetiology of, and recovery from, disease through effective coping. Based on Kivimäki and co-authors (2000), this kind of coping may include the avoidance of behaviours that directly interfere with health, such as smoking, excessive drinking, an unhealthy diet and a sedentary lifestyle.

SOC has been associated with several health behaviours. In a recent pilot study of Finnish polytechnic students, physical activity was related to the strength of SOC, but no association was found with smoking and drinking behaviours (Kuuppelomäki & Utriainen 2003). In another study, SOC was shown to correlate significantly with dietary habits, but not with exercise, smoking and alcohol consumption (Larsson & Setterlind 1990). In a cross-sectional study conducted by Hassmen and co-workers (2000), higher SOC levels were found among subjects who reported physical activity at least twice a week than among individuals exercising less frequently. It has also been suggested that in subjects who have never smoked, an improvement in exercise enhance natural killer cell activity through an increased SOC (Nakamura *et al.* 2003). Midanik *et al.* (1992) found significantly higher SOC levels in a subsample of lighter drinkers who reported no alcohol problems in the last year compared to a subsample of heavier drinkers who reported at least one alcohol problem in the last year.

In a study of homeless, or drug-abusing minority women in a drug recovery programme, it was revealed that subjects with stronger SOC levels reported significantly fewer high-risk behaviours, such as using intravenous drugs, frequent unprotected sex, or a history of a sexually transmitted disease (Nyamathi 1991).

The relationship between SOC and smoking behaviour is still ambiguous. Among pregnant women, a significant difference in SOC scores was shown between smoking and non-smoking women in indicators of poor health. Women who relapsed to smoking had a weaker level of SOC, particularly in the manageability component (Abrahamsson & Ejlertsson 2002). In contrast, a study of sexually abused women (Luszczynska 2002) and a cohort study of 194 subjects (Runeson *et al.* 2003) showed no direct relationship between SOC and smoking. It has also been shown that chronic cannabis users generally have weaker SOC scores, but after six weeks of treatment the scores increased to the same ranges observed in the normal control group (Lundqvist 1995). SOC has also been found to associate with more general indices of lifestyle (Ogava *et al.* 2001).

A recently published longitudinal study supports the notion that a weakened SOC accompanying smoking and alcohol consumption may partially cause a pathogenic process following a negative life event in initially healthy participants (Kivimäki *et al.* 2002a).

2.2.3 Sense of coherence, oral health and oral health behaviours

In the dental scientific literature, there are only two publications studying the relationship between SOC, oral health and oral health-related behaviours (Freire *et al.* 2001, 2002). Both were performed with a group of Brazilian adolescents (n = 664) and their mothers.

In a previous study, Freire and co-workers (2001) analysed the role of adolescents' SOCs in relation to several oral health-related variables. They found that subjects with a weak SOC were more likely to visit the dentist only in the event of problems than those with a strong SOC. Adolescents' weak SOCs were also associated with their experience of caries in anterior teeth, but the relationship was no longer significant after controlling for other factors (Freire *et al.* 2001).

Further in the latter study, the authors analysed the relationship between the mothers' SOCs and their children's oral health. It was found that adolescents whose mothers had stronger levels of SOC had fewer dental caries and less gingival bleeding after probing, and they were also less likely to visit the dentist only in the event of problems compared with those adolescents whose mothers had a lower level of SOC. Here again, this association was no longer significant after adjusting for other factors (Freire *et al.* 2002).

2.3 Sense of coherence and health

A strong SOC is stated to decrease the likelihood of perceiving the social environment as stressful. This reduces the susceptibility to health-damaging effects of chronic stress by lowering the probability of repeated adverse neurophysiological reactions and negative emotions related to stress perceptions (Antonovsky 1987a). However, it is also assumed that an individual's health may influence his SOC, i.e. the causality between SOC and health may also operate inversely. Health represents one of the sources responsible for the maintenance and development of the level of SOC (Antonovsky 1987a).

It has been consistently shown that a strong SOC is associated with good health and a high degree of well-being (Kalimo & Vuori 1990, Ryland & Greenfeld 1991, Chamberlain & Zika 1992, Pasikowski *et al.* 1994, Suominen *et al.* 1999, 2001, 2005, Nilsson *et al.* 2000). SOC was positively related to health status and perceived health among older adults (Forbes 2001), and to the self-reported quality of life in patients with total spinal cord transection (O'Carroll *et al.* 2003). In a recent study by Surtees *et al.* (2003), a strong SOC was associated with a 30% reduction in mortality from cardiovascular disease and cancer. Furthermore, white-collar workers with a strong SOC have been found to be protected against coronary disease (Poppius *et al.* 1999). SOC has also been found to be consequentially associated with neck-shoulder pain in a life-long prospective study (Viikari-Juntura *et al.* 1991).

In patients with rheumatic disorders, SOC has also been reported to negatively relate to the Arthritis Impact Measurement Scales anxiety and depression scores, and to clinical variables of rheumatic disorders (Hawley *et al.* 1992), and the SOC scale was found to explain part of the variation in the clinical status of patients with rheumatoid arthritis (Callahan & Pincus 1995).

A study of American war veterans aged 55 years, or more, showed that a strong SOC predicted a variety of positive health measures six months later, especially the measure of mental health (Coe *et al.* 1990). In two longitudinal studies by Kivimäki and co-workers (2000), a weak SOC, but not a strong SOC, was associated with health prospects. In spite of the SOC's cross-sectional association with psychological and somatic health complaints, SOC could not predict later complaints at the five-year follow-up. In a recent follow-up study by Runeson *et al.* (2003), subjects with a weak SOC developed more symptoms of sick building syndrome during the follow-up period.

It has also been suggested that a salutogenic perspective can explain socio-economic differentials in health (Charlton & White 1995, Lundberg 1997). SOC does not, however, mediate the effect of childhood factors on adult health (Lundberg 1997). Furthermore, Ing & Reutter (2003) suggested that SOC is a psycho-social factor that intervenes in the income and health relationship. A strong SOC has also been found to associate with high education and income levels, although the authors added that their results indicated that SOC was more strongly related to health indicators than age, education and income levels (Larsson & Kallenberg 1996).

An association has also been reported between a weak SOC and type 2 diabetes in middle-aged Swedish women (Agardh *et al.* 2003). SOC has also been described to be a psychological background factor partially underlying the adverse effect of hostility on ill health in female municipal employees (Kivimäki *et al.* 2002b). It has also been proposed that the SOC scale may serve as an evaluation tool in a rehabilitation program (Langius *et al.* 1994), and could be a determinant of psychological adjustment after serious injury (O'Carroll *et al.* 2003).

2.4 Oral health behaviours

The present study focuses on only two oral health behaviours: dental attendance and tooth-brushing frequency.

2.4.1 Dental attendance

Dental attendance is a pattern that has been defined in several ways in the literature (Richards 1971). The most widely known categories describing dental attendance are regular dental attendance, occasional check-up and those who attend only with trouble. These categories originated from a national dental survey carried out in the United Kingdom in 1968 (Gray *et al.* 1970) and have been found to be useful ever since. An alternative categorization is that of symptomatic and asymptomatic attenders, or the frequency of dental visits during one or two years (Nuttall 1997).

In general, the proportion of regular dental visitors has been increasing over the years (Nuttall *et al.* 2001). In the Health 2000 survey in Finland, it was found that regular dental attendance was practiced by 57 % of subjects, and was reported to be more common among females (64 %), than among males (50 %). The level of education was also found to associate significantly with regular dental attendance; 69 % of those with a high level of education, 57 % of those with middle level of education, and only 46 % of

those with a low level of education, claimed to be regular dental attenders. Regular dental attendance was not found to be dependent on the age group, except among the two oldest groups, 65-74 and 75 and over (Suominen-Taipale *et al.* 2004).

During the period 1978 to 1997, the self-reported use of dental services in the Finnish population increased from 53 % to 64 %. Women and persons belonging to the youngest age groups were the most frequent visitors, while older persons were the least frequent attenders, due, for example, to the greater prevalence of edentulousness. In 1997, significant predictors for the utilisation of services included the number of missing teeth, age, gender, occupation and tooth-brushing frequency (Suominen-Taipale *et al.* 2000). The utilisation of dental services in Finland, however, is still at a markedly lower level than in other Nordic countries, where figures of 80-85 % are reported (Kronstrom *et al.* 2002).

In the United States, the proportion of those who had visited a dentist during the past 12 months was 55 % in 1983, and 58 % six years later (National Center for Health Statistics 1991). Comparable percentages for annual dental visits were observed in Canada (Brodeur *et al.* 1990). In Denmark, the proportion of regular dental attenders has increased from 56 to 76 % over the 15-year period, 1975-1990 (Schwartz 1991). In the United Kingdom, 70 % of persons in the higher social classes claimed regular dental visits, while only 27 % in low social classes did so (Ritchie *et al.* 1981). Claimed attendance behaviour, as assessed during the UK adult dental health surveys, has been compared with the observed frequency of NHS dental attendance in Scotland over the five years following the 1978 adult survey. Only 31 % of those who claimed to go for regular dental check-ups attended on a more or less annual basis (Eddie 1984).

A study in the United States has identified age and gender as significant factors in the use of dental services, while factors such as the level of education and income were assessed to be non-significant (Reisine 1987).

Österberg *et al.* (1998) reported that the relative risk for not visiting a dentist during the previous 12 months, adjusted for age, gender and dental state, was higher among edentulous subjects with low income and education, among those not married, not native-born, living in rural areas, smoking, and with low social and physical activity.

The frequencies of oral health behaviours were examined among 749 Danes aged 25-44 years. Regular dental visits were reported by 86 %. Dental visits varied according to education, income, shift-work, gender and self-assessment of dental health, while tooth-brushing habits were affected by urbanization, sex, education, number of children in the family and self-assessment of dental health (Petersen 1986).

Cross-cultural differences of self-reported oral health behaviour between Japanese and Finnish dental students have also been reported. Only 2 % of Finnish students reported that they put off going to the dentist until they had a toothache, compared to 56 % of Japanese students. A higher level of dental health awareness among Finnish dental students upon entry to dental school was suggested (Kawamura *et al.* 2000).

Although there have been efforts to even the accessibility to dental services for all population groups in Finland and other Nordic countries, socio-economic disparities in the utilization of dental services have not yet disappeared. Dental services are still used more commonly by those with higher family incomes or levels of education (Suominen-Taipale *et al.* 2004).

2.4.2 Tooth-brushing frequency

Tooth-brushing is the principal method of oral self-care used for maintaining oral hygiene and, thus, for preventing dental diseases, such as periodontal disease and dental caries. Tooth-brushing, carried out with an appropriate frequency, is a simple and effective way of reducing levels of dental plaque and gingivitis (Sheiham 1970). A frequency of twice a day has been the commonly accepted recommendation (Sheiham 1977). Tooth-brushing with fluoride toothpaste is particularly likely to reduce dental caries (Marinho *et al.* 2003).

The effectiveness of oral self-care habits cannot be determined only by the frequency of tooth-brushing. The results of these procedures have to be a clean mouth and clean teeth, which can only be measured clinically, mainly by probing for the presence of dental plaque (Suominen-Taipale *et al.* 2004).

Since 1978, the National Public Health Institute (KTL) of Finland has annually monitored the regularity and frequency of daily tooth-brushing in the working-age population (Helakorpi *et al.* 2003). Similar time-series have been conducted every ten years in England and Wales since 1968 (Kelly *et al.* 2000), and in Denmark in the years 1987 and 2002 (Christensen *et al.* 2003). The common finding in these studies is that females reported to be more active tooth-brushers than males. According to these studies, 68 % of females and 39 % of males brushed their teeth at least twice a day in Finland, while the corresponding proportions were respectively 83 and 64 % in England, and 77 and 59 % in Denmark.

In the Health 2000 survey in Finland, 61 % of the subjects claimed to brush their teeth at least twice a day. The gender difference in tooth-brushing frequency that has been noticed since the 1970s still existed. 76 % of females and 45 % of males claimed to be at least twice-a-day brushers. Differences were also observed between levels of education. The proportion of at least twice-a-day brushers was 76 % among the high level, 58 % in the middle level, and 50 % in the low level of education (Suominen-Taipale *et al.* 2004).

During a six-year follow-up study of Finnish adolescents, it was found that those adolescents who brushed their teeth more than once a day at the age of 12, were more stable in their behaviour during the following six years than those who brushed their teeth less often. The authors concluded that, although tooth-brushing frequency will be gradually adopted as a health habit as the adolescents mature, between 12 and 18 years, only half of the girls and one-fifth of the boys adopt the recommended frequency (Kuusela *et al.* 1996).

Among 749 Danes aged 25-44 years, 83 % declared that they brush their teeth at least twice a day, and tooth-brushing after breakfast was reported by 51 % (Petersen 1986).

2.4.3 Relationship between oral and general health behaviours

The question as to whether health behaviour is unidimensional, or multidimensional has been the subject of several studies. A view of unidimensionality implies that an individual with a good health practice would probably act similarly towards other health behaviours.

In contrast, a view of multidimensionality assumes that certain health behaviours tend to occur together, while others may be independent (Patterson *et al.* 1994).

The findings of Steele and McBroom (1972) suggest that health behaviour is not unidimensional. A view of multidimensionality has also been supported by Kannas (1981), who investigated 1546 young men, in order to clarify the cumulative nature of health behaviours, and by Hölund and Rise (1988), who examined the relationship between dietary, dental health behaviours, and other health-related behaviours, using factor analysis among Danish adolescents.

Roysamb *et al.* (1997) suggested that health-related behaviour can be conceptualised as being concurrently multidimensional, few-dimensional and unidimensional. In a sample of 1190 residents in Western Norway, it was concluded that oral and general health behaviours are two distinct behavioural domains, but that they should be approached jointly in health promotion programmes (Astrom & Rise 2001). The conceptualization of oral health behaviour as a distinct dimension was also proposed in a study by Toneatto and Binik (1990).

A study of 1648 adolescents lent support to the hypothesis of bidimensionality. Two factors were discerned: addictive behaviours and health-enhancing behaviours (Aaro *et al.* 1995). It has also been suggested that two sets of dimensions exist with respect to oral health behaviours: a health-related dimension and a health-focused dimension. The health-related dimension means that tooth-brushing, for example, could not be thought of simply as one form of behaviour, but as two, both representing different attitudinal dimensions. For example, tooth-brushing may have positive direct health consequences, but is performed for reasons other than improvements in health, such as to look attractive. In comparison, health-focused behaviours are actions carried out in the belief that they will benefit health, e.g. tooth-brushing reducing gingival bleeding (Freeman & Linden 1995).

In a study of 179 subjects in Finland, a strong positive correlation has also been found between the frequencies of tooth-brushing and hand-washing mirroring unidimensional hygienic behaviour (Pippola-Hatakka *et al.* 1992). In addition, people who are regularly active in sports also take better care of their dental hygiene and use fewer pain-killers (Ylinalo 1976). It has also been proposed that young people who take care of their teeth behave in ways that also promote other dimensions of their health (Wannamethee *et al.* 1998).

Payne and Locker (1996) investigated the relationships between general and oral health behaviours among 1050 adult Canadians, and found a significant, but weak, correlation ($r=0.13$; $p<0.001$) between oral and general health behaviours. The oral health behaviour of females, older respondents, and those with higher levels of income, were more likely to engage in higher levels of health behaviours. A similar relationship between general and oral health behaviours was found among type 2 diabetic patients (Kawamura *et al.* 2001).

Among 1012 55-year old residents in Finland, it was found that lifestyle (dietary habits, smoking habits, alcohol consumption, physical activity) was associated independently with dental caries (Sakki *et al.* 1994) and periodontal health (Sakki *et al.* 1995). It was also found that females and people with a healthy lifestyle brushed their teeth more often (Sakki *et al.* 1998).

In a recently published study, Tada and Matsukubo (2003) analyzed the relationship between oral health and general health behaviours among 2467 adults. They found that additive indices for oral and general health behaviours were significantly correlated. Tooth-brushing frequency was significantly correlated with smoking, drinking, exercise, eating breakfast and having medical check-ups. In addition, having dental check-ups was found to correlate with having medical check-ups. Similar results had been obtained earlier by Hayward *et al.* (1989), who concluded that persons who had dental check-ups during the past year also demonstrated higher frequencies of other preventive health procedures, such as mammography, breast examinations and routine medical examinations. In contrast, Sabbah and Leake (2000) found that the determinants of visiting a dentist and those of visiting a family physician were not consistent in Canadians.

The examination of the relationship between oral health behaviour and general health habits revealed that 20- to 64-year-old males with high scores in general health habits tended to have positive oral hygiene behaviours (Fukai *et al.* 1999).

In another Finnish study of 1500 subjects aged from 15 to 64 years old, it was found that non-smokers reported more frequent healthy oral health behaviours than daily smokers. However, no difference in tooth-brushing frequencies existed among women (Telivuo *et al.* 1995).

Recently, it has also been found that oral and general health behaviours were associated with both cardiovascular risk factors and self-reported dental diseases among adult respondents in the 1966 Northern Finland birth cohort (Ylöstalo *et al.* 2003b).

2.4.4 Psycho-social factors related to oral health and oral health behaviours

Several other psycho-social models of varying complexity have been proposed in an attempt to explain the occurrence of oral diseases, particularly dental caries and periodontal diseases, and oral health behaviours (Wolfe *et al.* 1991, Regis *et al.* 1994, Macgregor *et al.* 1997, Stewart *et al.* 1997, Genco *et al.* 1999).

Self-efficacy concerning tooth-brushing and flossing have been found to associate with the frequencies of tooth-brushing, flossing and dental visiting (Stewart *et al.* 1997), but not with the oral hygiene status (Wolfe *et al.* 1991). Self-efficacy scales have been found to relate with corresponding behaviours, and a poor dental self-efficacy scale has also been found to correlate with an increasing occurrence of dental caries among patients with insulin-dependent diabetes mellitus (Knecht *et al.* 1999b).

Good oral health has been found to associate with both internal (Kent *et al.* 1984) and external loci of control (Wolfe *et al.* 1991). Dental locus of control beliefs have also been suggested to be practicable for determining health behaviour and health status (Knecht *et al.* 1999a).

It has been found that a high self-esteem associates with frequent tooth-brushing (Knecht *et al.* 2001).

In a cross-sectional study of 1426 25 to 74-year-old subjects, it was concluded that psycho-social measures of stress associated with financial strain, and distress manifested

as depression, are significant risk indicators for more severe periodontal disease (Genco *et al.* 1999). Dentate women with higher rates of depressive symptoms had a more negative attitude towards preserving their natural teeth, used sugary products more frequently, and reported longer intervals since their last dental visit, than the non-depressed dentate women (Anttila *et al.* 2001).

Active coping and optimism have been found to relate with different dental health behaviours (Ylöstalo *et al.* 2003a). It has also been proposed that psycho-social factors may be involved in the aetiology of inflammatory periodontal diseases, which, in turn, would relate to the clinical management of these conditions (Monteiro da Silva *et al.* 1995).

The common risk factor approach (Sheiham & Watt 2000) has been introduced as an alternative rational basis for promoting oral health, as the oral health programmes tend to concentrate on individual behavioural changes, and largely ignore the influence of socio-political factors as key determinants of health. It addresses risk factors common to many chronic conditions, both oral and general, within the context of the wider socio-environmental milieu. Oral health is determined by diet, hygiene, smoking, alcohol use, stress and trauma. As these factors also increase the risk of a number of other chronic diseases, such as heart disease, cancer and stroke, adopting a collaborative approach is more rational than one that is disease-specific (Sheiham & Watt 2000). The potential benefits of such an approach are far greater than isolated interventions for oral health promotion (Watt 2005).

The new century model (Inglehart & Tedesco 1995) sees oral health promotion as a function of oral health-related affect, behaviour and cognition, time and situation. It starts by analysing the interaction of a patient with the oral health-care provider. It suggests that three aspects of this situation are significant. Specifically, in any consideration of oral health promotion, the oral health-care provider has to understand the patient's relationship with oral health promotion in its full complexity (oral health-related affect, behaviour and cognition of the patient), see the relevance of these issues in the time perspective of this patient's life, and include the situation in which the patient's life is embedded, and structural factors.

2.5 Oral health-related quality of life

David Locker (1997) outlined the shift in health-care from a disease-centered, biomedical approach, to a patient-centered, biopsychosocial approach. The terms disease and health should be useful to conceptualise, not as endpoints of a single dimension, but as independent, significant dimensions in the human experience. For example, despite having hypertension, an individual might perceive his, or her, own health as excellent. Locker stated that quality of life is a much broader concept than health, and is determined both by the characteristics of the person, and by non-medical factors (Locker 1997).

Health-related quality of life is defined as a person's assessment of how the following types of factors affect his, or her, well-being; functional factors, psychological factors, social factors and experience of discomfort, or pain. Oral health-related quality of life is

assessed when these considerations center around orofacial concerns (Inglehart & Bagramian 2002).

The Oral Health Impact Profile (OHIP) (Slade 1997) is a measure of the oral health-related quality of life that was developed in Australia, but it is being increasingly used in other populations. It was developed with the aim of providing a comprehensive measure of self-reported dysfunction, discomfort and disability attributed to oral conditions. Furthermore, the OHIP aims to capture impacts that are related to oral conditions in general, rather than impacts that may be attributed to specific oral disorders. The items of the OHIP are constructed to consist of seven subscales (functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, handicap) that measure only negative aspects of oral health (Slade 1997). The OHIP has been found to be significantly associated with self-rated oral health, self-perceived need for dental care, and dissatisfaction with oral health status (Allen & Locker 1997).

Among older adults in Canada, the OHIP was only weakly associated with clinical indicators of oral disease, and social factors were found to be as important as clinical factors in explaining the health outcome of oral disorders (Locker 1995).

In a study comparing two national samples from the United Kingdom and Australia, it was found that increasing age was associated with higher OHIP scores in both populations. It was also stated that the independent effect of tooth loss was that the worst scores were found where there were fewer than 17 natural teeth in the UK and fewer than 21 teeth in Australia. People with 25 or more teeth, averaged much better scores than all other groups (Steele *et al.* 2004).

In a recent study of 249 fully edentulous patients with complete dentures, it was concluded that wearing conventional complete dentures has a significant impact on the oral health-related quality of life, as measured with the OHIP. In addition, it was stated that physical pain was the most prevalent impact of their oral conditions (Heydecke *et al.* 2004).

It has also been concluded that the sensitivity to change of the OHIP is good (Allen *et al.* 2001). Psycho-social factors, such as personality, have also been found to associate significantly with quality of life ratings (Kressin *et al.* 2001); for example, a weak SOC was found to associate with a high score on the sickness impact profile scale (Langius *et al.* 1994).

2.6 Implications of previous research for the present study

The roles of socio-economic and demographic factors have been well documented with respect to oral health behaviours. Nevertheless, the underlying mechanisms of health differentials premised on socio-economic status have remained largely covert. Sense of coherence, as one of the psycho-social factors, has been identified as a possible mechanism mediating the effect of socio-economic status on health (Charlton & White 1995, Lundberg 1997, Ing & Reutter 2003). Two studies have been published on this subject (Freire *et al.* 2001, 2002), both involving adolescents and their parents in a cross-sectional study design.

There is a clear need for future research to delve further into the analysis of oral health behaviours, specifying, for example, additional determinants of oral health behaviours, such as psycho-social factors.

Previous studies have also concentrated on rather limited sets of factors that are associated with oral health-related quality of life. The suggested direction for future research is the identification of additional determinants of an oral health-related quality of life, including psychological and social variables and those describing the organization of health-care systems.

This study aims to introduce SOC as a novel characteristic related to oral health and oral health behaviours among 30- to 64-year-old adults, i.e., in the age range where the SOC should already have stabilized. There are theoretical grounds to expect that the level of SOC evolves concurrently with oral health factors over the years preceding the 30th birthday, lending some support to the notion of a causal role for the SOC. In addition, this thesis provides a well-augmented opportunity to evaluate the significance of SOC in relation to both oral and general health and health behaviour, concurrently among the same subjects.

3 Aims of the present study

A strong sense of coherence (SOC) is a determinant of positive oral and general health behaviours, and of an oral health-related quality of life. The general aim was to study SOC as a determinant of oral and general health behaviours, and an oral health-related quality of life among Finnish adults.

This aim was more specifically approached by investigating the SOC in relation to:

1. dental attendance,
2. tooth-brushing frequency and the professionally measured level of oral hygiene,
3. the oral health-related quality of life, and
4. oral and subjective general health and health behaviours, concurrently among the same subjects.

4 Material and methods

4.1 Subjects and procedures

A nationally representative Health 2000 survey was carried out in 2000-2001, by the National Public Health Institute of Finland. The original sample of the survey comprised 8028 subjects, aged 30 years and older. Of these, 6986 (87 %) subjects were interviewed in their home, or in an institution. The number participating in the health examination proper was 6354, while 416 took part in the health examination at home, or at an institution (Aromaa & Koskinen 2004).

A two-stage, stratified, cluster sampling design was planned by Statistics Finland. The sampling frame comprised adults aged 30 years and over, living in mainland Finland. This frame was regionally stratified according to the five university hospital regions, each containing roughly one million inhabitants. Sixteen health-care districts were sampled as clusters from each university hospital region. The largest 15 health centre districts in the country were all selected in the sample with probability 1, and the remaining 65 health centre districts were selected by systematic PPS sampling in each stratum. Thus, the 80 health centre districts were the primary sampling units. The ultimate sampling units were persons who were selected by systematic sampling from the health centre districts. For the 15 largest health centre districts, the sample sizes were proportional to the population size (PPS). In the 65 sampled PPS clusters, the sample sizes were equal within each university hospital region, so that the total number of persons drawn from a university hospital region was proportional to the corresponding population size. The Social Insurance Institution selected the sample that comprised 8028 persons aged 30, or over. The smallest sample size in the 65 small health centre districts was 50, and the largest was 100 (Aromaa & Koskinen 2004).

For the data of the present study, edentate subjects and subjects of 65 years of age, or older, were excluded. Subjects were considered dentate if they had at least one natural tooth observed during the clinical oral examination (article III), or if they had reported having at least one natural tooth (articles I, II & IV). The number of excluded subjects varied slightly between articles, due to the variables used in the article. In all articles, those who lived permanently in institutional care, and those who had four or more

missing values on the SOC scale, were excluded. Those who had missing answers, or observations concerning socio-economic and demographic variables, oral health behaviours, OHIP-14 scale, smoking habits, physical activity frequency and clinically examined variables (level of oral hygiene, number of teeth, use of removable dentures), were also excluded from the analysis presented in the articles. Thus, the final sample populations of this study comprised, 4175 30- to 64-year-old dentate individuals in article I, 4131 in article II, 4039 in article III, and 4096 in article IV.

Table 1. Summary of the use of variables as outcome, or explanatory variables in the articles of the present study. Articles are referred to by their roman numerals.

Variables	Used as an outcome variable	Used as an explanatory variable
Socio-economic and demographic factors		
Gender		I, II, III, IV
Age		I, II, III, IV
Level of education		I, II, III, IV
Family income bracket		I, II, III
Marital status		I, II, III
Urbanization		I
Region		I
Oral health behaviour variables		
Dental attendance	I, IV	III
Tooth-brushing frequency	II, IV	II, III
General health behaviour variables		
Smoking	IV	II
Physical activity	IV	
Health variables		
Number of teeth		II, III
Level of oral hygiene	II	
Use of removable dentures		III
Subjective oral health	IV	
Subjective general health	IV	
Oral Health Impact Profile	III	
Sense of coherence		I, II, III, IV

4.2 Home interview and questionnaires

Trained interviewers from Statistics Finland carried out the home interviews. The interviewer first checked that the address was right and then contacted the interviewee by letter, proposing a time for the interview. During the interviews, the respondents were handed an information leaflet and an informed consent form that was returned after signing. The interviewers also left a questionnaire (questionnaire 1) that interviewees were asked to fill in and bring along to the health examination. The mean duration of the

home interview was 90 minutes. Questionnaires 2 and 3, comprising a symptom interview and a dietary questionnaire, were filled in during and after the health examination, and were returned to the National Public Health Institute by mail. Interview was used as a method to gather basic information, background and socio-economic and demographic information, information about health and illnesses, including the use of medicines, use of health services, lifestyle and health behaviours, environment, functional capacity, work and work capacity, and the need for help and rehabilitation. Questionnaire 1 retrieved information on functional capacity, symptoms, use of time and leisure activities, physical activity, alcohol consumption, mental health, as well as perceived strain at work and burnout. Questionnaire 2 mainly contained questions on infections and vaccinations, and was not used in the present study. Questionnaire 3 included questions on sleeping and living habits, psycho-social and behavioural variables, such as the SOC scale, and health-related quality of life variables, such as the OHIP-14 scale (see, Aromaa & Koskinen 2004). Symptom interview and dietary questionnaire results were also included, but they were not used in the present study. The functions of the variables used in the present study as outcome, or explanatory variables are been described in Table 1.

4.2.1 Sense of coherence scale

The questionnaire included a SOC scale, including 12 seven-point, Likert-type items with descriptive end-points derived from the short version of the SOC scale (SOC-13) proposed by Antonovsky (1987, Appendix 1). All three components of the SOC, including comprehensibility, manageability and meaningfulness, were measured by four items each, in order to give equal importance to all components. The missing item of the SOC scale was “Does it happen that you have feelings inside you would rather not feel?” Mean SOC scores were calculated for each individual; higher scores indicate stronger SOC. If a subject had three, or less, missing values on the SOC items, they were replaced by the mean value of the remaining SOC items of the individual. The practice of replacement with mean values has been described previously by Suominen *et al.* (2001). The SOC sum was then categorized into quintiles. There were many subjects with equal scores at the quintile limits resulting in the slightly varying number of subjects in each SOC quintile. Due to the varying number of exclusions due to missing answers in each paper, the number of subjects belonging to each SOC quintile also varied slightly between papers. The number of subjects belonging to each SOC quintile, and the SOC quintile limits, are given in Table 2. Those subjects scoring fewer points were designated as having the lower levels of SOC (1st quintile), while those with the highest scores possessed the highest level of SOC (5th quintile).

4.2.2 Distribution of the SOC scores in quintiles

The SOC scores ranged from 18 to 84, with a mean of 65.8 (SD = 9.6), and a median of 67.0. The proportions of subjects distributed into quintiles by gender, age, level of education, family income category and marital status, are shown in Table 2. The

distributions of subjects in each SOC quintile in each article, and the limit scores of each quintile, are described in Table 3.

Table 2. Proportions of subjects in the SOC quintiles, in relation to gender, age group, level of education, family income bracket and marital status.

Explanatory variables	N	The quintiles of SOC (%)				
		1 st	2 nd	3 rd	4 th	5 th
		Weakest SOC			Strongest SOC	
Total	4289	21	19	20	22	19
Gender						
Male	2006	20	18	21	21	19
Female	2283	21	20	19	22	18
Age group						
30-39	1319	19	17	20	24	20
40-49	1386	21	18	21	22	19
50-59	1163	23	21	19	20	17
60-64	421	21	21	22	19	17
Level of education						
Low	1156	28	19	19	19	15
Middle	1600	19	19	21	23	18
High	1532	15	19	21	23	22
Missing	1					
Family income category						
Low	1391	28	20	18	18	17
Middle	1376	21	19	20	21	19
High	1412	15	18	22	25	20
Missing	110					
Marital status						
Married, or cohabiting	3219	17	19	21	23	20
Single, divorced, or widowed	1070	31	19	18	17	14

Table 3. Numbers of subjects belonging to SOC quintiles in each paper and SOC quintile limits.

Sense of coherence	Article I	Article II	Article III	Article IV
1 st (18-57.6)	867	847	824	842
2 nd (58.8-64.8)	793	779	767	776
3 rd (65-69.8)	848	838	821	836
4 th (70-74)	897	895	871	882
5 th (74.2-84)	770	772	756	760
Total N	4175	4131	4039	4096

4.2.3 Oral health behaviours

There were two self-reported variables of oral health behaviours used in the present study: dental attendance and tooth-brushing frequency. These were used as both outcome and explanatory variables. Dental attendance was used as an outcome variable in articles I and IV, and as an explanatory variable in article III. Tooth-brushing frequency was used as an outcome variable in articles II and IV, and as an explanatory variable in article III, and also in article II.

Dental attendance pattern was measured with the question; “Do you usually go to a dentist 1. regularly for check-ups; 2. only when you have a toothache, or some other trouble; and 3. never?”. The answers two and three were combined when the data were analysed.

Tooth-brushing frequency was measured with the question; “How often do you usually brush you teeth?, with possible answers that included 1. more often than twice a day; 2. twice a day; 3. once a day; 4. less frequently than every day; and 5. never”. For the analyses, categories one and two, and four and five were combined, to yield a three-class variable in article II. For the analyses of article IV, the answers were dichotomised by combining categories one and two, and three, four and five (Appendix 2).

4.2.4 Socio-economic and demographic factors

Socio-economic and demographic factors used in the present study were gender, age, level of education, family income categories, marital status and urbanization.

Age was classified into four categories: 30-39 years old, 40-49 years old, 50-59 years old and 60-64 years old.

Education was categorized into three levels. The lowest category included subjects who had less than a high-school education and who did not have formal vocational education. The middle category included those who had graduated from high school, or vocational school, and the highest category included those with a university degree, or who had graduated from vocational high school.

The family income categories were generated by ranking the population from the poorest third to the best-off third, such that each tertile contained as equal a number of persons as possible. The OECD equivalence scale, which assigns a weight of 1 for the first adult, 0.7 for other adults, and 0.5 for each child, was used (OECD, 1982).

Marital status was dichotomised. The first category consisted of subjects who were married, or cohabiting, the second category consisted of divorced, widowed, or single subjects who were not cohabiting.

Urbanization was divided into three categories, comprising larger towns, smaller towns and rural areas. Larger towns had 15000 or more inhabitants, and at least 90 % of all inhabitants lived in the population centre area. Smaller towns had less 15000 inhabitants, and 60-90 % of all inhabitants lived in the population centre area. Rural areas either had less than 15000 inhabitants, and less than 60 % of all inhabitants lived in the population centre area, or had less than 4000 inhabitants, of which 60-90 % lived in the population centre area.

4.2.5 Smoking

Smoking was used in article II as an explanatory variable, and article IV as an outcome variable. Smoking was measured with the question; “Do you smoke nowadays 1. daily; 2. occasionally; 3. not at all?” In article II, it was used in three categories.

In article IV, smoking habits were dichotomised; categories one and two were combined when the data was analysed.

4.2.6 Physical activity (article IV)

Physical exercise was measured with the question “How often do you exercise in your leisure time at least for half an hour so that you are at least slightly out of breath and sweating?, with possible answers including 1. daily; 2. four to six times a week; 3. two to three times a week; 4. once a week; 5. two to three times a month; 6. a couple of times a year, or more seldom?”. For the analyses, categories one to three, and four to six were combined, to yield a dichotomous variable.

4.2.7 Oral Health Impact Profile scale (article III)

In article III, oral health-related quality of life was measured with a self-administered version of the OHIP scale, with 14 five-point items (Appendix 4). Each item was attributed possible answers as follows: 1. very often; 2. fairly often; 3. sometimes; 4. very seldom; 5. not at all; 6. do not know. The options were grouped for the analysis; each answer was recorded as oral health-related problems, or no problems. Answers one, two and three were indicative of oral problems, while answers four, five and six indicated no oral problems. The number of problems was summed over all 14 items for each individual. As the distribution of the OHIP extent variable was skewed to the right (with 69 % reporting no problems), it was categorized into three groups as follows: no problems, one or two problems, and three or more problems, respectively. For the subsequent analyses, 14 OHIP items were also divided into seven sub-scales, where each sub-scale was measured with two items. The subject was considered to have problems in a specific OHIP sub-scale if he, or she, reported having problems very often, fairly often, or sometimes, in at least one of the two items included in the sub-scale. The division of the OHIP items into sub-scales has been described previously by Slade (1997), and is also given in Appendix 4.

4.2.8 Subjective oral and general health (article IV)

Subjective oral health and general health were measured with the questions “Is the condition of your teeth and the health of your mouth at present/Is your present state of health”, 1. good; 2. rather good; 3. moderate; 4. rather poor; or 5. poor? The answers one

and two, and the answers three and five were combined for the analyses, to yield a dichotomous variable. The answers one and two were considered to indicate good subjective health, and answers three, four and five, as being indicative of poor subjective health (Appendix 3).

4.3 Oral examinations

During the health examination, a dentist performed a comprehensive examination of oral health. From the examinations, the level of oral hygiene (article II) and the number of teeth (articles II & III) were used in the present study.

During the clinical oral examinations, the level of oral hygiene was visually assessed from three teeth at one site each as follows; from the buccal surface of the posterior tooth in the right upper jaw-quarter (teeth 17-14), from the lingual surface of the posterior tooth in left lower jaw-quarter (teeth 37-34), and the buccal surface of tooth 33 (the third tooth of the left lower jaw-quarter). Each site was given a score ranging from zero to two, where zero indicated no dental plaque at the site, one indicated dental plaque at the gingival margin of the site, and two indicated dental plaque also elsewhere at the site. The scores were categorized into three groups using the following criteria: in group one, scores ranged from zero to one, which indicated that there was no dental plaque, or that there was dental plaque at the gingival margin of only one of the assessed teeth. In group two, scores ranged from two to three, indicating that there was dental plaque at the gingival margin of at least two of the assessed teeth, or there was dental plaque also elsewhere at the site of one of the assessed teeth. In group three scores ranged from four to six indicating that there was dental plaque also elsewhere than at the gingival margin of the site in at least two of the assessed teeth. In case of a missing tooth, it was replaced by the mean value of the assessed teeth of the individual. Lower dental plaque scores indicated better levels of oral hygiene.

The total number of teeth was counted during the clinical examinations, and was used as an explanatory variable. In paper III, the subjects were grouped into three categories, 1-9 teeth, 10-19 teeth, and 20+ teeth. In article II, the number of teeth was used as a continuous variable.

The use of removable dentures was used in the present study from the self-reported oral health measures. The subjects were divided into two sub-categories; those who reported using removable dentures, and those who did not (article III).

4.4 Statistical analyses

A stratified, two-stage cluster sampling design was used in the survey. Thus, the corresponding weights were used for correcting the effect of non-response. Weighting of the sample was based on post-stratification with gender, age and region. The level of significance was set at $p < 0.05$.

Pearson's chi-square test was used in bivariate analyses to determine the significances of the interdependencies between the variables, such as the SOC, the OHIP, socio-

economic and demographic factors, and oral and general health behaviours (articles I, II, III & IV).

Interaction terms were employed to explore the interaction between the SOC and socio-economic and demographic factors in relation to dental attendance patterns (article I).

Logistic regression analysis (Hosmer & Lemeshow 1989) by the enter method was used to test the significances of the discovered relations, taking into account the effect of possible confounding variables when the outcome variable was in dichotomous form. The aim of using the logistic regression model was to find concise models with relatively few parameters. Due to the nature of SOC, there are no preset cut-off points and the odds ratios provide supplementary information (articles I, II & III). Ordinal logistic regression analysis was used when the outcome variable was classified into more than two, or in these cases, three categories (articles II & III).

Gender and age-adjusted, and gender, age and level of education-adjusted prevalences were calculated to minimize the confounding effect of these socio-economic and demographic factors (article IV). Adjusted prevalences were calculated using logistic regression models (Lee 1981, Graubard & Korn 1999).

More detailed descriptions of the analysis strategies are given in the original articles.

5 Results

5.1 Sense of coherence and dental attendance (I)

Regular dental attendance was more common among those with a stronger SOC. Female gender, high level of education, high family income bracket and subjects that were married or cohabiting, but not age or urbanization, were positively related with dental attendance, as shown in Table 4. In a separate analysis, a strong SOC was positively associated (chi-square test, $p < 0.05$) with high level of education, high family income category, being married or cohabiting, and living in larger towns (data not shown). The proportions of regular dental attendance increased from 54 % to 67 % in the total sample, from 46 % to 62 % among males, and from 60 % to 71 % among female subjects, when moving towards stronger SOC quintiles.

A logistic regression model was used to reveal the association between SOC and the dental attendance pattern when controlling for gender, age, level of education, marital status and urbanization. The odds ratio for the strongest SOC was 1.4 relative to the weakest SOC quintile, with 95 % confidence intervals of 1.2 - 1.8. A significant interaction term was also found between SOC and level of education (Table 5) and, for this reason, logistic regression models were constructed separately within the three educational categories. The association between SOC and dental attendance pattern was found to be significantly stronger among those with middle and high education levels, with an OR = 2.0 (1.4 - 2.9) than among those having a low education level, OR = 1.2 (0.8 - 1.8) in Table 6.

Table 4. Proportions of regular dental attenders in relation to gender, age, education, family income category, SOC, marital status and urbanization.

Explanatory variables	N	Proportion of regular check-up attenders (%)	P
Gender			
Male	1994	54	
Female	2269	68	< 0.001
Age			
30-39	1311	61	
40-49	1376	62	
50-59	1160	60	
60-64	416	60	0.681
Level of Education (missing 1)			
Low	1147	51	
Middle	1592	59	
High	1523	70	< 0.001
Family income category (missing 87)			
Low	1390	50	
Middle	1375	61	
High	1411	71	< 0.001
Sense of coherence			
5 th (Strongest SOC)	793	67	
4 th	919	65	
3 rd	860	60	
2 nd	808	59	
1 st (Weakest SOC)	883	54	< 0.001
Marital status			
Married/cohabiting	3206	63	
Divorced, widowed, single	1057	55	< 0.001
Urbanization			
Larger towns	2751	63	
Smaller towns	598	57	
Rural areas	914	57	0.092

Table 5. Adjusted ORs (CI 95%) of regular dental attendance in relation to SOC and p-values for interaction terms. Odds ratios adjusted for gender, age, level of education, marital status and urbanization.

Variables	Adjusted OR (95% CI)	P
Sense of coherence		
5 th (Strongest SOC)	1.4 (1.2-1.8)	
4 th	1.3 (1.1-1.6)	
3 rd	1.1 (0.9-1.4)	
2 nd	1.1 (0.9-1.3)	
1 st (Weakest SOC)	1	0.004
Interaction terms *)		
SOC * Gender		0.602
SOC * Age group		0.849
SOC * Level of education		0.041
SOC * Family income bracket		0.283
SOC * Marital status		0.085
SOC * Urbanization		0.289

* Interactions between the SOC and all the explanatory variables were tested by constructing separate models by adding and removing each interaction term one by one.

Table 6. Logistic regression analysis: regular dental attendance in relation to SOC in each level of education. Odds ratios adjusted for gender and age.

Sense of coherence	Level of Education					
	Low		Middle		High	
	Adjusted OR (95% CI)	P	Adjusted OR (95% CI)	P	Adjusted OR (95% CI)	P
5 th (Strongest SOC)	1.2 (0.8-1.8)	0.534	1.8 (1.3-2.5)	0.021	2.0 (1.4-2.9)	< 0.001
4 th	1.2 (0.8-1.7)		1.5 (1.1-2.1)		1.8 (1.2-2.5)	
3 rd	0.9 (0.6-1.3)		1.3 (1.0-1.9)		1.5 (1.1-2.2)	
2 nd	1 (0.7-1.4)		1.4 (1.0-1.9)		1.2 (0.9-1.8)	
1 st (Weakest SOC)	1		1		1	

5.2 Sense of coherence, tooth-brushing frequency and level of oral hygiene (II)

The proportions of twice-a-day tooth-brushing frequency and good levels of oral hygiene, by gender and the SOC, are presented in Table 7. Of those belonging to the strongest SOC quintile, 73 % reported their brushing frequencies to be at least twice a day, while only 57 % of subjects belonging to the weakest SOC quintile did so. A similar trend was observed with regards to the level of oral hygiene. The relationship between tooth-brushing frequency and level of oral hygiene is given in Table 8.

Table 7. The proportions of twice-a-day tooth-brushing frequency and good levels of oral hygiene, by gender and SOC.

Variables	N	Frequency of tooth brushing (%)		P	Level of oral hygiene (%)	
		Twice or more a day			Group 1 (good)	
All	4131	63			60	
Gender						
Female	2203	79		< 0.001	69	
Male	1928	47			51	
Sense of coherence						
5 th (Strongest SOC)	772	73		< 0.001	65	
4 th	895	63			61	
3 rd	838	62			63	
2 nd	779	63			60	
1 st (Weakest SOC)	847	57			51	

Table 8. Tooth-brushing frequency and level of oral hygiene in relation to each other.

Variables	N	Frequency of tooth-brushing (%)			Level of oral hygiene (%)		
		Twice or more a day	Once a day	Less frequently	Group 1 (Good)	Group 2	Group 3 (Poor)
Frequency of tooth-brushing							
Twice or more a day	2651				65	29	6
Once a day	1225				55	35	10
Less Frequently	255				35	36	29
Level of oral hygiene							
Group 1 (Good)	2499	69	27	4			
Group 2	1284	60	33	7			
Group 3 (Poor)	348	42	36	22			

Ordinal logistic regression models were constructed to describe the comprehensive relationship between tooth-brushing frequency and SOC. The models showed that increasing tooth-brushing frequency related to a stronger SOC and that the association was only slightly attenuated when gender, age, level of education, marital status, number of teeth and smoking habits were controlled for. The odds ratios for each SOC quintile of the final model are shown in Table 9.

Table 9. The association of SOC and tooth-brushing frequency. Ordinal logistic regression model including all explanatory variables (gender, age, level of education, marital status, number of teeth and smoking habits) simultaneously. Cumulative odds ratios (COR) for brushing teeth twice a day, or more often.

Sense of coherence	Adjusted COR (95% CI)	P
5 th (Strongest SOC)	1.9 (1.5-2.5)	< 0.001
4 th	1.2 (1.0-1.4)	
3 rd	1.2 (1.0-1.5)	
2 nd	1.3 (1.0-1.6)	
1 st (Weakest SOC)	1	

According to the results presented in Table 10, strong and moderate levels of SOC were related to an improved level of oral hygiene. For the strongest SOC quintile, the odds ratio was 1.7 (1.4 - 2.1) compared with the weakest quintile of SOC. In addition to gender, age, level of education, marital status, number of teeth and smoking habits, the frequency of tooth-brushing was also controlled for in the analysis.

Table 10. The association of SOC, tooth-brushing frequency and level of oral hygiene. Ordinal logistic regression model including all explanatory variables (gender, age, level of education, marital status, number of teeth, smoking habits and frequency of tooth-brushing) simultaneously. Cumulative odds ratios (COR) for good oral hygiene.

Variables	Adjusted COR (95% CI)	P
Frequency of tooth-brushing		
Twice or more a day	2.4 (1.8-3.2)	< 0.001
Once a day	2.1 (1.6-2.7)	
Less frequently	1	
Sense of coherence		
5 th (Strongest SOC)	1.7 (1.4-2.1)	< 0.001
4 th	1.4 (1.2-1.8)	
3 rd	1.6 (1.3-1.9)	
2 nd	1.4 (1.2-1.8)	
1 st (Weakest SOC)	1	

5.3 Sense of coherence and oral health-related quality of life (III)

Subjects with a strong, or moderate SOC had significantly fewer oral problems (OHIP extent) than those with a weak SOC. Strengthening of SOC was paralleled by a decreasing number of oral problems. Lower ages, higher levels of education, higher family incomes, regular dental attendances, a tooth-brushing frequency of twice-a-day and a higher number of remaining natural teeth, also significantly associated with a decreasing number of oral problems (Table 11).

Table 11. Proportion of subjects in OHIP extent “no problems”-category by gender, age, socio-economic variables and SOC.

Explanatory variables	N	OHIP Extent	P
		No Problems (%)	
All	4039	69	
Gender			
Male	1899	69	0.533
Female	2140	70	
Age			
30-39	1268	74	< 0.001
40-49	1292	69	
50-59	1091	65	
60-64	388	63	
Level of education			
Low	1056	64	< 0.001
Middle	1508	68	
High	1475	74	
Family income category			
Low	1337	63	< 0.001
Middle	1329	71	
High	1373	74	
Sense of coherence			
5 th (Strongest SOC)	756	83	< 0.001
4 th	871	77	
3 rd	821	70	
2 nd	767	66	
1 st (Weakest SOC)	824	51	

In model D (Table 12), the adjusted cumulative odds ratio of the SOC was 4.6 (3.7-5.8) for the highest level of SOC compared to the weakest level of SOC (1.0). The reported dental attendance and the number of teeth were also related to the OHIP extent variable. There was no gender difference in the OHIP.

Table 12. Four separate ordinal logistic regression models describing the association between OHIP extent and gender, age, and oral behavioural, oral health and SES variables, or SOC. Cumulative odds ratio estimates over 1.0 indicate a decreasing number of oral problems.

Sense of coherence	OHIP Extent	P	OHIP Extent	P	OHIP Extent	P	OHIP Extent	P
	Model A ¹		Model B ²		Model C ³		Model D ⁴	
	Unadjusted		Adjusted		Adjusted		Adjusted	
	CORs		CORs (95% CI)		CORs		CORs	
	(95% CI)		(95% CI)		(95% CI)		(95% CI)	
5 th	5.2	<	5.1	< 0.001	4.7	< 0.001	4.6	< 0.001
(Strongest SOC)	(4.1-6.5)	0.001	(4.1-6.4)		(3.7-5.9)		(3.7-5.8)	
4 th	3.6		3.4		3.3		3.3	
	(3.0-4.3)		(3.0-4.3)		(2.7-4.0)		(2.7-4.0)	
3 rd	2.5		2.5		2.4		2.4	
	(2.1-3.1)		(2.1-3.1)		(2.0-2.9)		(2.0-2.9)	
2 nd	2.0		2.1		2.0		2.0	
	(1.7-2.5)		(1.7-2.5)		(1.6-2.5)		(1.6-2.5)	
1 st	1		1		1		1	
(Weakest SOC)								

¹Model A shows unadjusted cumulative odds ratios for SOC in relation to the OHIP extent variable.

²Model B is adjusted for gender, age and SOC.

³Model C is adjusted for gender, age, oral behavioural (dental attendance and frequency of tooth-brushing) and health (number of teeth, use of removable dentures) variables and SOC.

⁴Model D is adjusted for all explanatory variables (gender, age, oral behavioural and health variables, level of education, family income category, and SOC).

The proportions of subjects belonging to the strongest SOC quintile with oral problems were notably smaller than those of subjects belonging to the weakest SOC quintile in all seven OHIP sub-scales. The SOC was also found to associate with all of the OHIP sub-scales, and the association was most evident in the psychological discomfort (OR = 5.2 with 95 % confidence intervals from 3.8 to 7.2), psychological disability (OR = 5.8 (3.5 - 9.5)) and handicap (OR = 8.0 (4.5 - 14)) sub-scales.

5.4 Oral and general health behaviours and health, and sense of coherence (IV)

Overall, among general health behaviours, 75 % of those subjects who exercised more often than once a week also claimed not to be current smokers. Among oral health behaviours, the corresponding prevalence was smaller: 67 % of those who brushed their teeth at least twice a day also claimed to be regular dental attenders. Subjective oral and general health were significantly associated, with 75 % of those who claimed to have a good general health, also reporting having a good oral health.

Table 13. Age-, and level of education-adjusted prevalences (%) for those with positive health behaviours in relation to each other by gender.

Prevalence (95% CI)	At least twice-a-day tooth- brushing frequency		Non-smokers		Physical activity more than once a week	
	Males (n=919)	Females (n=1722)	Males (n=1245)	Females (n=1603)	Males (n=1083)	Females (n=1323)
	Adjusted prevalence	Adjusted prevalence	Adjusted prevalence	Adjusted prevalence	Adjusted prevalence	Adjusted prevalence
	95 % CI	95 % CI	95 % CI	95 % CI	95 % CI	95 % CI
Dental attendance						
Regularly	61 57-64	71 68-73	61 58-63	70 67-72	60 56-63	70 67-73
Tooth- brushing frequency						
Twice-a-day			50 47-53	79 76-81	54 51-57	83 80-85
Smoking						
Non-smoker					72 70-75	77 75-79

Table 13 presents age- and level of education-adjusted prevalences, by gender, for those with positive health behaviours in relation to each other. Positive health behaviours tended to occur together significantly more often among females than among males. Thus, 83 % of females who exercised more than once a week and 79 % of non-smoking females also brushed their teeth at least twice a day, while the corresponding prevalences were only 54 % and 50 %, respectively, among males. The gender difference was also evident with respect to good subjective oral and general healths in relation to a twice-a-day, or more, tooth-brushing frequency (Article IV, Table 4).

In Table 14, a strong SOC is shown to be a common health-promoting factor for health behaviours. In all health behaviours, the unadjusted, and gender and age-adjusted and gender, age and level of education-adjusted prevalences of those with positive health behaviours were greater among subjects belonging to the strongest SOC quintile than among those belonging to the weakest SOC quintile. The differences of unadjusted prevalences varied from 7 to 15 %.

Table 14. The prevalences (%) of those belonging to the strongest SOC quintile (n = 760), or to the weakest SOC quintile (n = 842), and reporting regular dental attendance, twice-a-day tooth-brushing frequency, non-smoking habits, or physical activity more than once a week. The prevalences are given unadjusted, adjusted for gender and age, and adjusted for gender, age and level of education.

Prevalence (95 % CI)	Unadjusted	Adjusted for gender and age	Adjusted for gender, age and level of education
Regular dental attendance			
Weakest SOC	54 (50-57)	54 (50-57)	55 (52-59)
Strongest SOC	66 (63-70)	67 (63-70)	66 (62-70)
Twice-a-day tooth-brushing frequency			
Weakest SOC	58 (54-61)	57 (54-61)	59 (56-63)
Strongest SOC	73 (70-76)	73 (70-77)	73 (70-76)
Non-smoking habits			
Weakest SOC	64 (61-67)	64 (60-67)	65 (62-68)
Strongest SOC	73 (70-77)	74 (71-77)	74 (71-76)
Physical exercise more than once a week			
Weakest SOC	54 (50-58)	54 (50-58)	54 (51-58)
Strongest SOC	61 (58-65)	62 (58-65)	61 (58-65)

A strong SOC was also shown to be a positive determinant for subjective oral and general healths (Table 15).

Like the female gender, a strong SOC tended to associate to an unidimensionality of health behaviours. This was most evident between the tooth-brushing frequency and general health behaviour variables. Only 59 % of those who belonged to the weakest SOC quintile and had non-smoking habits also brushed their teeth at least twice a day, while the corresponding percentage for non-smokers in the strongest SOC quintile 75. The corresponding percentages for the weakest and the strongest SOC quintile for those exercising more than once a week, were 66 and 79, respectively.

Table 15. Prevalences (%) of those belonging to the strongest, or the weakest SOC quintile and reporting good oral, or general health. Prevalences are given unadjusted, adjusted for gender and age, and adjusted for gender, age and level of education, with 95% confidence intervals.

Prevalence (95 % CI)	Unadjusted	Adjusted for gender and age	Adjusted for gender, age and level of education
Good subjective oral health			
Weakest SOC	57 (53-60)	57 (53-60)	58 (55-62)
Strongest SOC	78 (75-81)	78 (75-81)	78 (75-81)
Good subjective general health			
Weakest SOC	54 (50-57)	55 (51-58)	56 (53-59)
Strongest SOC	83 (80-86)	82 (79-85)	82 (79-85)

6 Discussion

6.1 Methodological considerations

6.1.1 Sample

The present study inherently includes a high external validity due to a nationally representative sample of the Finnish adult population, and a high participation rate (88 %) in the Health 2000 survey. The high participation rate is probably due to the intensive efforts made in trying to get responses from those who initially remained silent. Thus, during the home visits, interviewers conducted a comprehensive health interview and made appointments for the examination proper. This probably helped to increase the participation in the health examination. Furthermore, the use of post-stratum weights, based on gender, age, region and language, for correcting the non-response bias can be expected to increase the external validity.

For this study, some subjects from the original sample were excluded. First, only dentate subjects were included. Second, the studied age-range was limited to only 30- to 64-year-olds, corresponding to the working-age population. These exclusions were performed, because dentate and edentate subjects were seen to be unequally distributed in relation to the outcome variables. The exclusion of edentate subjects can also be seen as a limitation. On the other hand, the inclusion of edentate subjects would have had a confounding effect on results relating to oral health items, such as dental attendance, tooth-brushing frequency and the OHIP. In practice, however, dentate and edentate subjects would have had to be analysed separately on several occasions. For example, the method of evaluating the level of oral hygiene between dentate and edentate subjects would have been different. In addition, dentulousness and a low number of teeth have previously been reported to be the strongest predictors for not visiting a dentist (Gift & Newman 1993, Grytten 1992, Joshipura *et al.* 1996).

The large sample ensured that the variations in the SOC scores and outcome variables were representative of the working-age population in Finland. The main objective of the present study was to investigate the mutual relationship between psycho-social concepts

and oral health and not to yield descriptive epidemiological information. Due to the theory-backed stability of the SOC in the studied age range, and despite the cross-sectional design of the study, the latter supports the interpretation that SOC influences oral health rather than the other way round, which shall be discussed in more detail later.

6.1.2 Sense of coherence

The SOC was measured by means of 12 items derived from the Antonovsky (1987a) short SOC scale (SOC-13). The short scale of SOC has been proposed for use when time, or space limitations prevents the use of the full scale (SOC-29). For the present study, the short SOC scale was chosen. The item “Does it happen that you have feelings inside you would rather not feel?” was dropped from the scale, to yield an even number of items for all subscales. The reliability of the present study’s SOC scale seems to be maintained, since the distribution of the individuals’ mean SOC scores were comparable to previous Finnish SOC studies (Poppius *et al.* 1999, Suominen *et al.* 1999). For example, Poppius and co-authors (1999) used the full version of the SOC scale, resulting in similar distributions of mean SOC scores. Although Antonovsky (1987a) suggested that the SOC is passable in any cultural setting, the SOC scores may, and do, vary between cultures. Therefore, comparisons of the SOC scores between the present study and studies conducted among other nationalities should be made with reserve.

The low number of missing values of SOC items in all papers in the present study also contributes to the reliability of the SOC scale. For example, in paper IV, there was only one missing value for 77 cases, two missing values for seven cases, and three missing values for seven other cases.

During the analyses, it was possible to stratify the data into several subcategories. To obtain more representative results, the SOC was divided into quintiles, as there are no accepted limits for SOC score cut-off points. The quintiles were also seen to be adequately diverging in relation to the SOC scores. Using the pure statistical criterion for the SOC limits also contributes to the reliability of the results, as this prevents the “fishing” of the best possible cut-off points to yield the highest differences between the SOC categories. In addition, using categories of the SOC was considered to give a more concrete view of the observed associations than would have been obtained if the SOC had been used as a continuous variable.

6.1.3 Oral and general health behaviours

One of the main objectives of this study was to investigate the mutual relationship between the SOC and oral health behaviours. By selecting regular dental attendance as an outcome variable, it was intended to emphasize the individual’s own activity towards the use of dental services, and one’s valuation and understanding with respect to one’s oral conditions. Regular dental attendance may also be misleading, since there exists a recall system of dental attendance in Finland, whose importance is difficult to evaluate.

To measure oral hygiene practices comprehensively, both tooth-brushing frequency and the level of oral hygiene were chosen as outcome variables. In the case of tooth-brushing frequency, subjects may answer in a socially accepted way. Therefore, the level of oral hygiene was also included, thereby enhancing the reliability of the measurement of oral hygiene practice as an outcome variable, and allowing to evaluate the quality of the tooth-brushing. On the other hand, the measurement of the level of oral hygiene can also be quite sensitive. The reliability of the findings was also enhanced by using the two oral hygiene practice variables, and categorizing the responses into three classes instead of two.

Smoking and the frequency of physical activity were chosen for the analysis with respect to general health behaviours, since they have different backgrounds. Smoking represents a routine, with well-known harmful effects, well comparable to not tooth-brushing. Physical activity, on the other hand, demands expenditure of energy and thus functions like regular dental attendance. Since the oral and general health behaviours used in the present study were chosen as having different origins, it also increased the scope of the relationships studied.

The validity of the health behaviour variables is difficult to evaluate, because they are self-reported variables. Nevertheless, self-reporting has been found to lead to useful results in Finnish lifestyle and health studies (Aromaa & Koskinen 2004), although some inaccuracy in the results is caused as far as prevalences are concerned. Patients with a high socio-economic status, or a strong, or moderate SOC, may be more likely than others to give excessively positive answers, in order to avoid the guilt and anxiety that they might encounter otherwise. On the other hand, it is also reasonable to assume that the subjects who did not participate in the study, even though they were chosen in the sample, may have weaker SOC and less healthy lifestyles than those who did participate. This suggests that, in reality, the observed associations might be even stronger.

The cut-off points for dichotomization of the oral and general health behaviour, and subjective oral and general health variables were chosen carefully based on the criterion that they have been successfully used in previous studies. The cut-off points for regular dental attendance in relation to SOC have previously been used by Freire and co-authors (2001, 2002). In the case of the tooth-brushing frequency, it has been suggested that a frequency of twice a day is the commonly accepted recommendation (Sheiham 1977). The used dichotomization of smoking habits (Abrahamsson & Ejlertsson 2002), as well as the frequency of physical activity (Hassmen et al. 2000) in relation to SOC have also been used previously.

6.1.4 Socio-economic and demographic factors

The co-linearity between explanatory variables was studied by constructing several models, using different interaction terms between the SOC and other variables. Based on these analyses, a significant interaction was revealed between the SOC and the level of education. Other socio-economic and demographic factors were also included in the analyses, since they had no significant interactions with SOC.

Age was kept in the models, even though the SOC has been proposed to be quite stable after the age of 30 (Antonovsky 1987a). Gender was also controlled for, because previous results have shown a tendency for stronger SOC scores among males compared to females (Antonovsky 1993, Anson *et al.* 1993, Larsson & Kallenberg 1996, Buddeberg-Fischer 2001). Level of education and/or family income level had to be controlled for, since, according to previous findings, the level of education is associated with both SOC (Larsson and Kallenberg 1996) and oral health, subjective health, and oral and general health behaviours (Larsson & Setterlind 1990, Midanik *et al.* 1992, Suominen *et al.* 1999, Hassmen *et al.* 2000, Freire *et al.* 2001, 2002, Suominen *et al.* 2001, 2005).

6.2 Sense of coherence, oral health behaviours and level of oral hygiene

The results of the present study indicate that subjects with a strong SOC reported a more regular dental attendance, and that this association was most evident among subjects with a high level of education. It was also found that a tooth-brushing frequency of twice, or more, a day, and a good level of oral hygiene, were more common among those who had a strong SOC, compared with those who had a weak SOC.

Despite the cross-sectional nature of the study, theoretical considerations suggest that the results lend support to a causal interpretation. The associations observed between the SOC and the oral health behaviours were consistently found to be parallel in nature: the stronger the SOC, the better the oral health behaviour. Support is also given through the theory-backed stability of the SOC in the studied age range, that included 30- to 64-year-olds (Antonovsky 1987a). In addition, it can be seen that oral health behaviours are contextually closely related with all three SOC sub-categories. According to the definition of SOC, a person with a strong SOC experiences the challenges of daily life in a manner that is more structured, predictable and worthy of investment, and has the resources to encounter them. These aspects can also be seen to be beneficial when considering oral health behaviours. For example, dental attendance embodies components of anxiety and unpleasantness, and a visit to the dentist may invariably be associated with the development, or continuation of symptoms, which can be even more demanding on mental resources. Furthermore, the health benefits of practicing twice-a-day tooth-brushing, and of maintaining a good level of oral hygiene, may not be immediately noticeable. Consequently, oral health behaviours and the concept of SOC seem to involve parallel motivations.

Can the association between SOC and tooth-brushing frequency be spurious? Is it based on a reporting routine learnt in childhood? Probably not, because the SOC was also associated with objectively defined levels of oral hygiene, after controlling for tooth-brushing frequency. This suggests that the level of SOC indeed precedes the quality of tooth-brushing behaviour. The fact that the association between the SOC and both of these outcome variables remained even after controlling for several confounding factors, strengthens this conclusion.

Psycho-social factors can be seen in a wider socio-economic context. When examining the impact of the SOC on oral health from this perspective, it can be an issue of an independent effect, or of an indirect effect canalized through different pathways, i.e., through an individual's socio-economic status, social environment, or perceived values. A good example of this type of a pathway is the level of education, which partially encompasses all of the above-mentioned routes. In the present study, the association between the SOC and dental attendance was more evident among those with high, or middle levels of education than among those with a low level of education. A strong SOC has also been shown to associate with a high level of education (Charlton & White 1995, Lundberg 1997). This was also supported in a study reporting the SOC to have a salutogenic effect against coronary heart disease among Finnish white-collar workers, but not among Finnish blue-collar workers (Poppius *et al.* 1999). A high level of education, as well as financial resources, can be seen to associate with positive attitudes and values towards one's health. In addition to positive oral self-care practices, those who have a high level of education have the knowledge to use dental services in order to promote their oral health. A high level of education may promote the development of a strong SOC, but a strong SOC may, in turn, make the person hungry for more education. The overlap between the SOC and the level of education could also be an indication of the SOC being a more extensive mental resource associated with good health via different routes. The notion that a strong SOC functions through the selection of health-promoting behaviours (Antonovsky 1987a) also supports the above-mentioned idea. A weak SOC may have harmful effects through different health behaviours; for example, through smoking, which is discussed below in more detail.

These findings also support the observation that there are grave socio-economic oral health differentials in Finland (Suominen-Taipale *et al.* 2004), and suggest an approach to solve the problem, by identifying the underlying psycho-social factors that bond with the socio-economic status.

The results give support to, and extend, previous findings that the SOC associates with several separate general health behaviours, such as dietary habits (Larsson & Setterlind 1990), drug recovery (Nyamathi *et al.* 1990), alcohol consumption (Midanik *et al.* 1992), physical activity (Hassmen *et al.* 2000, Kuuppelomaki & Utriainen 2003) and smoking (Abrahamsson & Ejlertsson 2002, Kivimäki *et al.* 2002b).

The association between the SOC and oral health behaviours is also in agreement with the studies of Freire *et al.* (2001, 2002), who found an association between the SOC of adolescents, that of their mothers, and the dental attendance pattern of the adolescents. Contrary to our findings, Freire *et al.* (2001) did not find a significant association between the SOC, tooth-brushing frequency, and the level of oral hygiene among adolescents. This may be due to the fact that the latter study solely comprised adolescent subjects, whose tooth-brushing frequency and level of oral hygiene is still more or less influenced by their parents, and whose personal SOC is still under development (Freire *et al.* 2001).

In the present study, the SOC, considered as a psycho-social characteristic, was found to associate with oral health behaviours. This is in accordance with previous findings that relate oral health with psycho-social aspects. Self-efficacy (Stewart *et al.* 1997, Wolfe *et al.* 1991, Knecht *et al.* 1999b), locus of control (Wolfe *et al.* 1991, Regis *et al.* 1994, Macgregor *et al.* 1997), self-esteem (Regis *et al.* 1994, Macgregor *et al.* 1997, Knecht *et*

al. 2001), symptoms of depression (Genco *et al.* 1999, Anttila *et al.* 2001), and active coping and optimism (Ylöstalo *et al.* 2003a), have all been found to be positive psycho-social determinants of oral health and oral health behaviour. A relationship between the level of oral hygiene and some psycho-social factors has also been reported previously (Monteiro da Silva *et al.* 1998, Kurer *et al.* 1995, Deinzer *et al.* 1998, 2001, Croucher *et al.* 1997). Our findings not only lend support to the notion of an overlap between the SOC and the psycho-social characteristics in question (Geyer 1997), but they also highlight the value of the SOC as a psycho-social factor.

6.3 Oral and general health behaviours and sense of coherence

The results of the present study supported both the unidimensional and multidimensional characters of oral and general health behaviours. Among males, the results favoured multidimensionality, but female health behaviours tended to be unidimensional. A strong SOC had health-promoting characteristics common to both oral and general health behaviours.

Similar findings were reported by Roysamb and co-authors (1997), who suggested that health-related behaviour may be concurrently conceptualised as multidimensional, few-dimensional and unidimensional. The findings of Steele and McBroom (1972) clearly indicated that health behaviour is not unidimensional. Astrom and Rise (2001) have suggested that oral and general health behaviours represent two distinct behavioural domains. This appears to imply that oral and general health behaviours should be approached jointly in health promotion programmes. The concept that oral health behaviour could be a dimension distinct from that of general health behaviour was also proposed by Toneatto and Binik (1990).

The present findings suggest that, by concentrating health promotion on only one health behaviour, an improvement could be achieved in several others. This phenomenon is most evident among subjects whose health behaviours tend to be unidimensional. In contrast, among subjects that envisage a multidimensional spectrum of health behaviours, the implementation of a similar intervention does not lead to equally encouraging results. Smoking is an excellent example of a detrimental health behaviour that is difficult to change, and whose effects are well known to the general public to be common risk factors for several oral and general diseases. Smoking has also been noted in a common risk factor approach (Sheiham & Watt 2000). It also has the potential needed to be a form of health behaviour through which improvements in several other health behaviours could be mediated.

The SOC has been shown to associate with several separate oral and general health behaviours, such as dietary habits (Larsson & Setterlind 1990), drug recovery (Nyamathi *et al.* 1990), alcohol consumption (Midanik *et al.* 1992), physical activity (Hassmen *et al.* 2000, Kuuppelomaki & Utriainen 2003), smoking habits (Abrahamsson & Ejlertsson 2002, Kivimäki *et al.* 2002) and dental attendance pattern (Freire *et al.* 2001, Freire *et al.* 2002). These findings, together with those of the present study showing the rather universally positive effect of the SOC on several health behaviours, lends support to the

notion that the changing of health behaviours could partly be accomplished via a psycho-social factor.

Regardless of whether health behaviours are uni-, or multidimensional, it is reasonable to identify a health-promoting factor, such as SOC, common to several health behaviours, and to attempt to support the development of this factor during adolescence by creating, for example, an adequate social environment; this could lead to a wide-ranging improvement of health behaviours. This impact may also benefit the actual state of health and, more generally, contribute to the welfare and empowerment of individuals.

Our findings truly emphasize the role played by gender. Previous studies analysing, or revealing, gender differences between oral and general health behaviours are rare. Gender difference is supported by a recent study demonstrating that female smokers tend to display less effective oral health behaviours than non-smokers. In fact, it has also been revealed that males with good general lifestyle habits tend to exhibit positive oral hygiene behaviours (Fukai *et al.* 1999). However, positive health behaviours are generally more common among females (Ostberg *et al.* 1999, Astrom & Rise 2001), which partly contributes to the likelihood of unidimensionality among them. Aesthetic values, and social pressures created by the environment, may support more positive health behaviours among females. Women may also have the ability – because of their educational background and cultural factors - to visualize the concept of health and health-related factors more comprehensively than men, and this can also partially influence positively on their health behaviours.

In order to acquire a view of health behaviours as comprehensive as possible, we selected the health behavioural items to vary in character. Their origin can be located in time, i.e. tooth-brushing frequency is a routine that is usually acquired in early childhood (Ostberg 2002), while dental attendance, smoking habits and physical activity are acquired a little later. Furthermore, it can be seen that the implementation of certain health-enhancing behaviours, such as a regular dental attendance and a high frequency of physical activity, demands more initiative from an individual than other positive health behaviours, such as brushing teeth twice a day, or smoking.

6.4 Sense of coherence as a determinant of oral health-related quality of life and subjective oral and general health status

Individuals with a strong, or moderate SOC had significantly fewer oral problems than those with a weak SOC. The SOC was also found to associate with all of the sub-scales of the OHIP, and the association was most evident in the psychological discomfort, psychological disability and handicap sub-scales. A strong SOC was also found to associate with good subjective oral and general health.

The results suggest that the SOC is a factor that has a wide-ranging impact on an individual's subjective assessment of health. The concepts of OHIP and subjective health status cannot be interpreted in the same way; the OHIP measures only the negative aspects related to oral health, while the subjective health variables have a broader character. In addition, the treatment decisions for individual patients are compromises between objective findings and the patient's subjective experiences of his, or her,

symptoms. The OHIP can be understood to efficiently reflect subjective oral health-related experiences, and a person's perceptual experience of illness and symptoms as problems. These experiences can vary between patients in the context of similar objective findings. In fact, SOC might be interpreted as describing a person's psycho-social ability to promote his/her health, instead of falling ill. These ideas also validate the function of the SOC as a health-promoting factor. The similarities in content of the OHIP and the SOC, and the previously found association between the SOC and the Sickness Impact Profile (Langius *et al.* 1994), also support the notion of their close relationship.

This is the first study to explore additional determinants of an oral health-related quality of life by introducing SOC. Our results suggest that, as a phenomenon, health-related quality of life is of much broader scope than has been shown thus far, and that the introduction of psycho-social factors into this context is useful. This leads to the assumption that oral health could also play an essential part in the broader concept of health-related quality of life. The OHIP is also known to be relevant to oral health (Inglehart & Bagramian 2002). The comprehensive association of SOC and OHIP emphasizes that SOC could be a determinant of oral health.

A strong SOC was also associated with good oral and general subjective health. These findings are partly new, and partly in agreement with numerous earlier studies reporting associations between the SOC, general health and well-being (Kalimo & Vuori 1990, Sagy *et al.* 1990, Ryland & Greenfeld 1991, Chamberlain & Zika 1992, Lundman & Norberg 1993, Pasikowski *et al.* 1994, Poppius *et al.* 1999, Suominen *et al.* 1999, 2001, 2005, Nilsson *et al.* 2000, Forbes 2001, Surtees *et al.* 2003).

7 Conclusions and implications

The sense of coherence was associated with oral health behaviours, such as dental attendance pattern and tooth-brushing frequency. The association between the sense of coherence and the dental attendance pattern was more evident among subjects with middle, or high levels of education.

Besides tooth-brushing frequency, the sense of coherence was also associated with the level of oral hygiene, although this association weakened slightly after controlling for tooth-brushing frequency. This suggests that the sense of coherence has an impact on both the quantity and the quality of tooth-brushing.

The sense of coherence was strongly associated with the oral health-related quality of life (OHIP), and with all of the OHIP sub-scales. The association was most evident in the psychological discomfort, psychological disability and handicap sub-scales. The sense of coherence could thus be a determinant of oral health-related quality of life.

Health behaviours were multidimensional among males, while they tended to be unidimensional among females. A strong sense of coherence was associated with positive health behaviours, and with good oral and general subjective health statuses.

The present study emphasizes that, in addition to socio-economic and demographic factors, psycho-social resources are related with inequities in health. It is also emphasized that the SOC, as psycho-social resource, is a feature that interacts with several different factors and, therefore, that there are no direct procedures available to strengthen it. In addition, in this kind of interaction pattern, it is barely possible to evaluate the importance of a single factor, although multivariate analysis methods were used. On the other hand, on the basis of the present study, the assumption of SOC being a truly significant factor with respect to health gained support, although it was noted that the impact of SOC was as strong as the impact of the level of education in several instances.

These findings suggest that the essential pathway to strengthen the SOC is through the strengthening of its surrounding network. This can be implemented, for example, by supporting the social environment of children and adolescents.

This study also emphasizes that psycho-social resources, such as the SOC, are capable of facilitating the motivation for positive health behaviours and the understanding of its health benefits. These resources, along with socio-economic and demographic factors, can create an environment that is partially responsible for the individuals' cognitive and

physical functions. These functions express themselves as the individuals' well-being and positive health behaviours.

Sense of coherence could provide help in planning health promotion strategies, but, for this, further research is needed, using, for example, longitudinal study designs.

References

- Aaro LE, Laberg JC & Wold B (1995) Health behaviours among adolescents: towards a hypothesis of two dimensions. *Health Education Res* 10(1): 83-93.
- Abrahamsson A & Ejlertsson G (2002) A salutogenic perspective could be of practical relevance for the prevention of smoking amongst pregnant women. *Midwifery* 18: 323-331.
- Agardh E, Ahlblom A, Andersson T, Efendic S, Grill V, Hallqvist J, Norman A & Östenson CG (2003) Work stress and low sense of coherence is associated with type 2 diabetes in middle-aged Swedish Women. *Diabetes Care* 26;3:719-724.
- Allen PF & Locker D (1997) Do item weights matter? An assessment using the oral health impact profile. *Comm Dent Health* 14(3): 133-8.
- Anke A & Fugl-Meyer A (2003) Life satisfaction several years after severe multiple trauma--a retrospective investigation. *Clin Rehab* 17(4): 431-42.
- Anson O, Paran E, Neumann L & Chernichovsky D (1993) Gender differences in health perceptions and their predictors. *Soc Sci Med* 36(4): 419-427.
- Antonovsky A (1979) *Health, stress and coping: New perspectives on mental and physical well-being*. Jossey-Bass, San Francisco.
- Antonovsky A (1987a) *Unraveling the mystery of health. How people manage stress and stay well*. Jossey Bass, San Francisco.
- Antonovsky A (1987b) Health promoting factors at work: the sense of coherence. In Kalimo R, Elbatawi M & Cooper C (Eds.) *Psychosocial factors at work and their effects on health* (pp. 153-167). Geneva: WHO.
- Antonovsky A (1990) Pathways leading to successful coping and health. In Rosenbaum M (Eds.) *Learned resourcefulness on coping skills, self-control, and adaptive behaviour* (pp. 31-63). New York: Springer Publishing Company.
- Antonovsky A (1993) The structure and properties of the sense of coherence scale. *Soc Sci Med* 36: 725-733.
- Anttila SS, Knuutila MLE & Sakki TK (2001) Relationship of depressive symptoms to edentulousness, dental health, and dental health behaviour. *Acta Odontol Scand* 59: 406-412.
- Aromaa A & Koskinen S, ed. (2004) *Health and functional capacity in Finland. Baseline results of the Health 2000 health examination survey*. Publications of the National Public Health Institute B12/2004. Helsinki.
- Astrom AN & Rise J (2001) Socio-economic differences in patterns of health and oral health behaviour in 25 year old Norwegians. *Clin Oral Investigations* 5(2): 122-8.
- Axelsson P & Lindhe J (1981) Effect of controlled oral hygiene procedures on caries and periodontal disease in adults. Results after 6 years. *J Clin Periodontol* 8: 239-248.

- Axelsson P, Lindhe J & Nyström B (1991) On the prevention of caries and periodontal disease. Results of a 15-year longitudinal study in adults. *J Clin Periodontol* 18: 182-189.
- Axelsson P, Nyström B & Lindhe J (2004) The long-term effect of a plaque control program on tooth mortality, caries and periodontal disease in adults. Results after 30 years of maintenance. *J Clin Periodontol* 31(9):749-57.
- Bandura A (1977) Self-efficacy: toward a unifying theory of behavioural change. *Psychol Review* 84: 191-215.
- Bengtsson-Tops A & Hansson L (2001) The validity of Antonovsky's Sense of Coherence measure in a sample of schizophrenic patients living in the community. *J Adv Nurs* 33(4): 432-438.
- Bishop GD (1993) Sense of coherence as a health resource in dealing with stress. *Psychologia* 36: 259-265.
- Björvell H, Aly A, Langius A & Nordström G (1994) Indicators of changes in weight and eating behaviour in severely obese patients treated in a nursing behavioural program. *International J Obesity* 18: 521-525.
- Brodeur JM, Naccache H, Simord PL & Lussier JP (1990) Quebec dental manpower and demand for dental care from 1985-88. *Can Dent Assoc J* 56: 773-6.
- Brooks JD (1998) Salutogenesis, successful aging and the advancement of theory of family caregiving. In McCubbin HI, Thompson EA, Thompson AI & Fromer JE (eds.) *Stress, coping and health in families. Sense of coherence and resiliency*. Pp. 227-248. California: Sage publications.
- Brown GW & Harris TO (1989) *Life events and illness*. New York: Guilford Press; 1989.
- Brown GW (1993) Life events and affective disorder: replications and limitations. *Psychosom Med* 55:248-59.
- Buchi S, Sensky S, Allard S, Stoll T, Schnyder U, Klaghofer R & Buddeberg C (1998) Sense of coherence - a protective factor for depression in rheumatoid arthritis. *25(5): 869-875*.
- Buddeberg-Fischer B, Klaghofer R & Schnyder U (2001) Sense of coherence in adolescents. *Soz Präventivmed* 46(6):404-10.
- Callahan LF & Pincus T (1995) The sense of coherence scale in patients with Rheumatoid Arthritis. *Arthritis Care and Research* 8(1): 28-35.
- Carmel S & Bernstein J (1990) Trait anxiety, sense of coherence and medical school stressors: observations at three stages. *Anxiety Research* 3:51-60.
- Carmel S, Anson O, Levenson A, Bonneh DY & Maoz B (1991) Life events, sense of coherence and health: gender differences on the kibbutz. *Soc Sci Med* 32(10): 1089-96.
- Carnstens JA & Spangenberg JJ (1997) Major depression: a breakdown in sense of coherence? *Psychol Rep. Jun;*80(3 Pt 2):1211-20.
- Castro FG, Newcomb MD & McCreary C (1989) Cigarette smokers do more than just smoke cigarettes. *Health Psychol* 8:107-29.
- Chamberlain K & Zika S (1992) Stability and change in short subjective well-being over short time periods. *Social Indicators Res;* 26:101-117.
- Charlton BG & White M (1995) Living on the margin: a salutogenic model for socio-economic differentials in health. *Public Health;* 109: 235-243.
- Christensen LB, Petersen PE, Krstrup U & Koller M (2003) Self-reported oral hygiene practices among adults in Denmark. *Community Dent Health* 20: 229-235.
- Coe RM, Romeis JC, Tang B & Wolinsky FD (1990) Correlates of a measure of coping in older veterans: a preliminary report. *J Community Dent* 15: 287-96.
- Cohen O (1997) On the origins of a sense of coherence: sociodemographic characteristics, or narcissism as a personality trait. *Soc Behav Personality* 25: 49-58.
- Coward DD (1996) Self-transcendence and correlates in a healthy population. *Nursing Res* 45(2): 116-121.

- Costakis CE, Dunnagan T & Haynes G (1999) The relationship between stages of exercise adoption and other health behaviours. *Am J Health Promotion* 14(1): 22-30.
- Croucher R, Marcenes WS, Torres MC, Hughes F & Sheiham A (1997) The relationship between life-events and periodontitis. A case-control study. *J Clin Periodontol* 24(1):39-43.
- Deinzer R, Ruttermann S, Mobes O & Herforth A (1998) Increase in gingival inflammation under academic stress. *J Clin Periodontol* 25(5):431-3.
- Deinzer R, Hilpert D, Bach K, Schawacht M & Herforth A (2001) Effects of academic stress on oral hygiene -a potential link between stress and plaque-associated disease? *J Clin Periodontol* 28(5):459-64.
- Eddie S (1984) Frequency of attendance in the general dental service in Scotland. A comparison with claimed attendance. *Br Dent J* 157: 267-270.
- Engelhard IM, van den Hout MA & Vlaeyen JW (2003) The sense of coherence in early pregnancy and crisis support and posttraumatic stress after pregnancy loss: a prospective study. *Behav Med* 29(2):80-4.
- Feldt T (2000) Sense of coherence – Structure, stability and health promoting role in working life. Jyväskylä: University of Jyväskylä.
- Flannery RB & Flannery GJ (1990) Sense of coherence, life stress, and psychological distress: a prospective methodological inquiry. *Journal of Clinical Psychology*. 46: 415-420.
- Forbes DA (2001) Enhancing mastery and sense of coherence: important determinants of health in older adults. *Geriatric Nursing* 22(1): 29-32.
- Freeman R & Linden G (1995) Health directed and health related dimensions of oral health behaviours of periodontal referrals. *Comm Dent Health* 12: 48-51.
- Freire MCM, Sheiham A & Hardy R (2001) Adolescents' sense of coherence, oral health status, and oral health-related behaviours. *Community Dent Oral Epidemiol* 29: 204-12.
- Freire MCM, Hardy R & Sheiham A (2002) Mothers' sense of coherence and their adolescent children's oral health status and behaviours. *Comm Dent Health* 19: 24-31.
- Frenz AW, Carey MP & Jorgensen RS (1993) Psychometric evaluation of Antonovsky's sense of coherence scale. *Psychological Assessment* 5: 145-153.
- Fukai K, Takaesu Y & Maki Y (1999) Gender differences in oral health behaviour and general health habits in an adult population. *Bull Tokyo Dent Coll* 40(4): 187-93.
- Gallagher TJ, Wagenfeld MO, Baro F & Haepers K (1994) Sense of coherence, coping and caregiver role overload. *Soc Sci Med* 39: 1615-1622.
- Genco RJ, Ho AW, Grossi SG, Dunford RG & Tedesco LA (1999) Relationship of stress, distress and inadequate coping behaviours to periodontal disease. *J Periodontol* 70: 711-723.
- George VD (1996) Field-workers' sense of coherence and perception of risk when making home visits. *Public Health Nursing* 13: 244-252.
- Geyer S (1997) Some conceptual considerations of the sense of coherence. *Soc Sci Med* 44(12): 1771-1779.
- Gift HC & Newman HF (1993) How older adults use oral health care services: results of a national health interview survey. *J Am Dent Assoc* 124: 89-93.
- Graubard BI & Korn EL (1999) Predictive margins with survey data. *Biometrics* 55(2): 652-659.
- Gray PG, Todd JE, Slack GL & Bulman JS (1970) Adult dental health in England and Wales in 1968. London: HMSO.
- Grytten J (1992) Supplier inducement – its relative effect on demand and utilisation. *Community Dent Oral Epidemiol* 20: 6-9.
- Hassmen P, Koivula N & Uutela A (2000) Physical exercise and psychological well-being: a population study in Finland. *Prev Med* 30(1):17-25.
- Hawley DJ, Wolfe F & Cathey MA (1992) The sense of coherence questionnaire in patients with rheumatic disorders. *Journal of Rheumatology* 19(12): 1912-1918.

- Hayward RA, Meetz HK, Shapiro MF & Freeman HE (1989) Utilization of dental services: 1986 patterns and trends. *J Public Health Dent* 49(3): 147-152.
- Helakorpi S, Patja K, Prättälä R, Aro A & Uutela A (2003) Suomalaisen aikuisväestön terveyskäyttötäytyminen ja terveys, kevät 2003. Kansanterveyslaitoksen julkaisu B17/2003, Helsinki.
- Heydecke G, Tedesco LA, Kowalski C, Inglehart MR (2004) Complete dentures and oral health-related quality of life – do coping styles matter? *Comm Dent Oral Epidemiol* 32(4): 297-306.
- Hood SC, Beudet MP & Catlin G (1996) A healthy outlook. *Health Rep* 7(4): 25-32, 27-35.
- Hosmer DW & Lemeshow S (1989) *Applied logistic regression*. Wiley, USA.
- Höglund U & Rise J (1988) Dimensions of dietary and other health-related behaviours in a group of Danish adolescents. *Community Dent Oral Epidemiol* 16: 278-81.
- Ing JD & Reutter L (2003) Socioeconomic status, sense of coherence and health Canadian women. *Canadian J Public Health* 95(3): 224-228.
- Inglehart MR & Bagramian RA (2002) *Oral health-related quality of life*. Quintessence Publishing, Chicago.
- Inglehart MR & Tedesco LA (1995) Behavioural research related to oral hygiene practices: a new century model of oral health promotion. *Periodontol* 2000 8: 15-23.
- Johnson M (2004) Approaching the salutogenesis of sense of coherence: The role of 'active' self-esteem and coping. *Br J Health Psychol* 9(Pt 3):419-32.
- Joshiyura A, Douglass C, Feldman H, Mitchell P & Jette A (1996) Consequences of success: Do more teeth translate into more disease and utilization? *J Public Health Dent* 4: 190-197.
- Kaiser CF, Sattler DN, Bellack DR & Dersin J (1996) A conservation of resources to a natural disaster: sense of coherence and psychological distress. *J Social Behav and Personality* 11(3): 459-476.
- Kalimo R & Vuori J (1990) Work and sense of coherence - resources for competence and life satisfaction. *Behav Med* 16:76-89.
- Kalimo R & Vuori J (1991) Work factors and health: the predictive role of pre-employment experiences. *J Occup Psychol* 64: 97-115.
- Kannas L (1981) The dimensions of health behaviour among young men in Finland. *Int J Health Educ* 24: 146-55.
- Kawamura M, Honkala E, Widström E & Komabayashi T (2000) Cross-cultural differences of self-reported oral health behaviour in Japanese and Finnish dental students. *Int Dent J* 50: 46-50.
- Kawamura M, Tsurumoto A, Fukuda S & Sasahara H (2001) Health behaviours and their relation to metabolic control and periodontal status in type 2 diabetic patients: a model tested using a linear structural relations program. *J Periodontol* 72(9): 1246-1253.
- Kelly M, Steele J, Nuttall N, Bradnock G, Morris J, Nunn J, Pine C, Pitts N, Treasure E & White D (2000) *Adult dental health survey: oral health in United Kingdom 1998*. Her Majesty's Stationery Office, London.
- Kent GG, Matthews RM & White FH (1984) Locus of control and oral health. *J Am Dent Assoc* 109: 67-69.
- Kivimäki M, Feldt T, Vahtera J & Nurmi JE (2000) Sense of coherence and health: evidence from two cross-lagged longitudinal samples. *Soc Sci Med* 50: 583-597.
- Kivimäki M, Vahtera J, Elovainio M, Lillrank B & Kivimäki MV (2002a) Death or illness of a family member, violence, interpersonal conflict, and financial difficulties as predictors of sickness absence: longitudinal cohort study on psychological and behavioral links. *Psychosom Med*. Sep-Oct;64(5):817-25.
- Kivimäki M, Elovainio M, Vahtera J, Nurmi JE, Feldt T, Keltinkangas-Järvinen & Pentti J (2002b) Sense of coherence as a mediator between hostility and Seven-year prospective study on female employees. *J Psychosom Res* 52: 239-247.

- Kivimäki M, Vahtera J, Thomson L, Griffiths A, Cox T & Pentti J (1997) Psychosocial factors predicting employee sickness absence during economic decline. *J Appl Psychol* 82:858-972.
- Kivimäki M, Kalimo R & Toppinen S (1998) Sense of coherence as a modifier of occupational stress exposure, stress perception, and experienced strain: a study of industrial managers. *Psychological Reports* 83:971-981.
- Klang B, Björvell H & Clyne N (1996) Quality of life in predialytic uremic patients. *Quality of Life Research* 5: 109-116.
- Knecht MC, Keinänen-Kiukaanniemi SM, Knuutila MLE & Syrjälä AMH (2001) Self-esteem as a characteristics of adherence to diabetes and dental self-care regimens. *J Clin Periodontol* 28(2):175-80.
- Knecht MC, Syrjälä AMH & Knuutila MLE (1999a) Locus of control beliefs predicting oral and diabetes health behaviour and health status. *Acta Odontol Scand* 57: 127-131.
- Knecht MC, Syrjälä AMH, Laukkanen P & Knuutila MLE (1999b) Self-efficacy as a common variable in oral health behaviour and diabetes adherence. *Eur J Oral Sci* 107: 89-96.
- Kobasa SC (1979) Stressful life events, personality, and health. *J Personality and Soc Psychol* 37: 1-11.
- Kobasa SC (1982) The hardy personality: toward a social psychology of stress and health. In *Social Psychology of Health and Illness*. Pp. 3-32. Sanders GS, Suls J. Erlbaum: Hillsdale.
- Koivusilta L, Honkala S, Honkala E, Rimpelä A (2003) Toothbrushing as part of the adolescent lifestyle predicts education level. *J Dent Res* 82(5): 361-366.
- Korotkov D (1993) An assessment of the (short-form) sense of coherence personality measure: issues of validity and well-being. *Person Individual Diff* 14: 575-583.
- Korotkov D & Hannah E (1994) Extraversion and emotionality as proposed superordinate stress moderators: a prospective analysis. *Person Individual Diff* 16: 787-792.
- Kravetz S, Drory R & Florian V (1993) Hardiness and sense of coherence and their relation to negative affect. *European Journal of Personality* 7: 233-244.
- Kressin NR, Reisine S, Spiro A 3rd & Jones JA (2001) Is negative affectivity associated with oral quality of life? *Comm Dent Oral Epidemiol* 29(6):412-23.
- Kronstrom M, Palmqvist S, Soderfelt B, Vigild M (2002) Utilization of dental health services among middle-aged people in Sweden and Denmark. *Acta Odontol Scand* 60(5):276-80.
- Kurer JR, Watts TL, Weinman J & Gower DB (1995) Psychological mood of regular dental attenders in relation to oral hygiene behaviour and gingival health. *Journal of Clinical Periodontology* 22(1):52-5.
- Kuuppelomäki M & Utriainen P (2003) A 3 year follow-up study of health care students' sense of coherence and related smoking, drinking and physical exercise factors. *Int J Nurs Stud*. 2003 May;40(4):383-8.
- Kuusela S, Honkala E & Rimpelä A (1996) Toothbrushing frequency between the ages 12 and 18 years – longitudinal prospective studies of Finnish adolescents. *Community Dent Health* 13: 34-39.
- Lajunen T & Summala H (1995) Driving experience, personality, and skill and safety-motive dimensions in drivers' self-assessments. *Person Individual Diff* 19: 307-318.
- Langius A, Björvell H & Antonovsky A (1992) The sense of coherence concept and its relation to personality traits in Swedish samples. *Scand J Caring Sci* 6(3): 165-171.
- Langius A & Björvell H (1993) Coping ability and functional status in a Swedish population sample *Scand J Caring Sci* 7: 3-10.
- Langius A, Björvell H & Ling MG (1994) Functional status and coping in patients with oral and pharyngeal cancer before and after surgery: *Head & Neck* 16: 559-568.
- Larsson G & Kallenberg K (1999) Dimensional analysis of sense of coherence using structural equation modelling *Eur J Personality* 13: 51-61.

- Larsson G & Kallenberg KO (1996) Sense of coherence, socioeconomic conditions and health. Interrelationships in a Nation-Wide Swedish Sample. *Eur J Public Health* 6:175-180.
- Larsson G & Setterlind S (1990) Work load/ work control and health: moderating effects of heredity, self-image, coping and health behaviour. *Int J Health Sciences* 1-2: 79-88.
- Lee J (1981) Covariance Adjustment of Rates Based on the Multiple logistic regression model. *J Chronic Diseases* 34: 415-426.
- Locker D (1995) Health outcomes of oral disorders. *Int J Epidemiol* 24(1): 85-9.
- Locker D (1997) Concepts of oral health, disease and quality of life. In Slade GD (ed). *Measuring oral health and quality of life*. Chapel Hill: University of North Carolina – Dental ecology 11-24.
- Lundberg O (1997) Childhood conditions, sense of coherence, social class, and adult ill health: exploring their theoretical and empirical relations. *Soc Sci Med* 44(6): 821-831.
- Lundman B & Norberg A (1993) The significance of a sense of coherence for subjective health in persons with insulin-dependent diabetes. *Journal of Advanced Nursing* 18:381-386.
- Lundquist T (1995) Chronic cannabis use and the sense of coherence. *Life Sciences* 56: 2145-2150.
- Luszczynska A (2002) Sense of coherence and smoking in a sample of abused women. *Psychological Reports* 90: 1123-1128.
- Marinho V, Higgins J, Sheiham A & Logan S (2003) Fluoride toothpastes for preventing dental caries in children and adolescents (Cochrane Review) *The Cochrane Library*, Issue 1.
- Midanik LT, Soghikian K, Ransom LJ & Polen MR (1992) Alcohol problems and sense of coherence among older adults. *Soc Sci Med* 34: 43-8.
- Monteiro da Silva AM, Newman HN & Oakley DA (1995) Psychosocial factors in inflammatory periodontal diseases. *J Clin Periodontol* 22: 516-526.
- Murtomaa H & Metsäniitty M (1994) Trends in toothbrushing and utilization of dental services in Finland. *Community Dent Oral Epidemiol* 22(4):231-4.
- Nakamura H, Matsuzaki I, Sasahara S, Hatta K, Nagase H, Oshita Y, Ogawa Y, Nobukuni Y, Kambayashi Y & Ogino K (2003) Enhancement of a sense of coherence and natural killer cell activity which occurred in subjects who improved their exercise habits through health education in the workplace. *J Occup Health* 45(5):278-85.
- National Center for Health Statistics (1991) *Health, United States, 1990*. Hyattsville, Maryland: Public Health Service.
- Nilsson B, Holmgren L & Westman G (2000) Sense of coherence in different stages of health and disease in northern Sweden: Gender and psychosocial differences. *Scand J Prim Health Care* 18: 14-20.
- Norlen P, Ostberg H & Bjorn AL (1991) Relationship between general health, social factors and oral health in women at the age of retirement. *Community Dent Oral Epidemiol* 19(5):296-301.
- Norman RMG (1985) Studies of the interrelationships amongst health behaviours. *Can J Public Health* 76: 407-10.
- Nuttall N (1997) Review of attendance behaviour. *Dent Update* 24: 111-114.
- Nuttall N, Bradnock G, White D, Morris J & Nunn J (2001) Dental attendance in 1998 and implications for the future. *Br Dent J* 190(4): 177-82.
- Nyamathi AM (1991) Relationship of resources to emotional distress, somatic complaints, and high-risk behaviours in drug recovery and homeless minority women. *Res Nursing and Health* 14: 269-277.
- O'Carroll RE, Ayling R, O'Reilly SM & North NT (2003) Alexithymia and sense of coherence in patients with total spinal cord transection. *Psychosom Med* 65:151-155.
- OECD (1982), *The OECD List of Social Indicators*. Paris, 1982.
- Ogawa Y, Nakamura H, Nagase H, Ogino K, Ooshita Y & Tsukahara S (2001) Structural analysis for psychosocial factors including health locus of control (HLC) and sense of coherence (SOC) associated with lifestyle-related diseases. *Japanese J Hygiene* 55: 597-606.

- Ostberg AL, Halling A & Lindblad U (1999) Gender differences in knowledge, attitude, behavior and perceived oral health among adolescents. *Acta Odontol Scand* 57(4):231-6.
- Ostberg AL (2002) On self-perceived oral health in Swedish adolescents. *Swedish Dental Journal Suppl.* 155:1-87.
- Pasikowski T, Sek H & Scigala I (1994) Sense of coherence and subjective health concepts. *Polish Psychological Bulletin* 25(1): 15-23.
- Patterson RE, Haines PS & Popkin BM (1994) Health lifestyle patterns of U.S. adults. *Prev Med* 23(4):453-60.
- Payne BJ & Locker D (1996) Relationship between dental and general health behaviours in a Canadian population. *J Public Health Dent* 56(4): 198-204.
- Petersen PE (1986) Dental health behaviour among 25-44-year-old Danes. *Scand J Prim Health Care* 4:51-7.
- Petrie K & Brook R (1992) Sense of coherence, self-esteem, depression and hopelessness as correlates of reattempting suicide. *British Journal of Clinical Psychology* 31: 293-300.
- Pippola-Hatakka M, Honkala E, Tuutti H & Saastamoinen M (1992) Health habits in a Finnish village 88(3-4):131-7.
- Poppius E, Tenkanen L, Kalimo R & Heinsalmi P (1999) The sense of coherence, occupation and the risk of coronary heart disease in the Helsinki Heart Study. *Soc Sci Med* 49: 109-120.
- Reisine S (1987) A path analysis of the utilization of dental services. *Community Dent Oral Epidemiol* 15: 119-124.
- Richards ND (1971) Utilization of dental services. In: Richards ND & Cohen LK, eds. *Social sciences and dentistry: a critical bibliography*. The Hague: Netherlands: A Sijthoff.
- Ristner G, Andersson R, Johansson LM, Johansson SE & Ponzer S (2000) Sense of coherence and lack of control in relation to outcome after orthopaedic injuries. *Injury* 31(10):751-6.
- Ritchie J, Jacoby A & Bone M (1981) *Access to primary health care*. London: HMSO.
- Rosling B, Serino G, Hellstrom MK, Socransky SS & Lindhe J (2001) Longitudinal periodontal tissue alterations during supportive therapy. Findings from subjects with normal and high susceptibility to periodontal disease. *J Clin Periodontol* 28(3):241-9.
- Roysamb E, Rise J & Kraft P (1997) On the structure and dimensionality of health-related behaviour in adolescents. *Psychology and Health* 12: 437-452.
- Runeson R, Norbäck D & Stattin H (2003) Symptoms and sense of coherence – a follow-up study of personnel from workplace buildings with indoor air problems. *Int Arch Occup Environ Health.* 76(1):29-38.
- Ryland E & Greenfeld S (1991) Work stress and well-being: an investigation of Antonovsky's Sense of Coherence model. *Journal of Social Behaviour and Personality.* 6: 39-54.
- Sabbah W & Leake JL (2000) Comparing characteristics of Canadians who visited dentists and physicians during 93/94: a secondary analysis. *J Can Dent Assoc* 66: 90-5.
- Sack M, Kunsebeck HW & Lamprecht F (1997) Sense of coherence and psychosomatic treatment outcome. An empirical study of salutogenesis. *Psychother Psychosom Med Psychol* 47(5):149-55.
- Sagy S & Antonovsky H (1986) Adolescents' reactions to the evacuation of the Sinai settlements: a longitudinal study. *J Psychol* 120(6):543-56.
- Sagy S, Antonovsky A & Adler I (1990) Explaining life satisfaction in later life: the sense of coherence model and activity theory. *Behav Health Aging* 1(1): 11-25.
- Sakki T, Knuuttila MLE, Vimpari SS & Kivelä S-L (1994) Lifestyle, dental caries and number of teeth. *Comm Dent Oral Epidemiol* 22: 298-302.
- Sakki T, Knuuttila MLE, Vimpari SS & Hartikainen MSL (1995) Association of lifestyle with periodontal health. *Comm Dent Oral Epidemiol* 23: 155-8.
- Sakki T, Knuuttila MLE & Anttila SS (1998) Lifestyle, gender and occupational status as determinants of dental health behaviour 25: 566-570.

- Sandell R, Blomberg J & Lazar A (1998) The factor structure of Antonovsky's sense of coherence scale in Swedish clinical and nonclinical samples. *Personality and Individual Differences* 24: 701-711.
- Sarason IG, Sarason BR, Potter EH & Antoni MH (1985) Life events, social support and illness. *Psychosom Med* 47:157-63.
- Schnyder U, Buchi S, Sensky T & Klaghofer R (2000) sense of coherence: trait or state? *Psychother Psychosom* 69(6):296-302.
- Schumann A, Hapke U, Meyer C, Rumpf HJ & John U (2003) Measuring sense of coherence with only three items: a useful tool for population surveys. *Br J Health Psychol* 8(4):409-21.
- Schwartz (1991) Concomitant changes in dental service utilization and in public reimbursements for dental care in Denmark 1975-90. Annual Meeting of Scand Ass Dent Research, Abstract no. 37, Helsinki.
- Shanani C, Weiner R & Streit MK (1993) An investigation of the dispositional nature of the time management construct. *Anxiety, stress and coping* 6: 231-243.
- Sheiham A (1970) Dental cleanliness and chronic periodontal disease. *British Dental Journal* 129: 413-418.
- Sheiham A (1977) Prevention and control of periodontal disease. In: International conference on research in the biology of periodontal disease. Ed. Klavan et al., pp. 309-368. Chicago: University of Illinois.
- Sheiham A & Watt RG (2000) The common risk factor approach: a rational basis for promoting oral health. *Community Dent Oral Epidemiol* 28, 399-406.
- Slade GD (1997) The oral health impact profile. In Slade GD, ed. *Measuring oral health and quality of life*. Chapel Hill: University of North Carolina, Dental Ecology.
- Slade GD (2002) Assessment of oral health-related quality of life. In Inglehart MR & Bagramian RA. *Oral health-related quality of life*. Quintessence Publishing, Chicago.
- Snekkevik H, Anke AG, Stanghelle JK & Fugl-Meyer AR (2003) Is sense of coherence stable after multiple trauma? *Clin Rehabil* 17(4):443-53.
- Sobal J, Revicki D & DeForge BR (1992) Patterns of interrelationships among health promotion behaviours. *Am J Prev Med* 8: 351-9.
- Steele JL & McBroom WH (1972) Conceptual and empirical dimensions of health behaviour. *J Health Soc Behav* 13: 382-92.
- Steele JG, Sanders AE, Slade GD, Allen PF, Lahti S, Nuttall N & Spencer AJ (2004) How do age and tooth loss affect oral health impacts and quality of life? A study comparing two national samples. *Comm Dent Oral Epidemiol* 32(2): 107-14.
- Steiner A, Raube K, Stuck AE, Aronow HU, Draper D, Rubenstein LZ & Beck JC (1996) Measuring psychological aspects of well-being in older community residents: performance of four short scales. *The Gerodontologist* 36: 54-62.
- Stewart JE, Strack S & Graves P (1997) Development of oral hygiene self-efficacy and outcome expectancy questionnaires. *Comm Dent Oral Epidemiol* 25: 337-342.
- Suominen S (1993) Perceived health and life control. A theoretic review and empirical study about connections between health and life control determined according to the strength of the sense of coherence. National research and development centre for welfare and health. Research reports 26. Gummerus Kirjapaino Oy, Jyväskylä.
- Suominen S, Blomberg H, Helenius H & Koskenvuo M (1999) Sense of coherence and health – does the association depend on resistance resources? A study of 3115 adults in Finland. *Psychol and Health* 14: 937-948.
- Suominen S, Helenius H, Blomberg H, Uutela A & Koskenvuo M (2001) Sense of coherence as a predictor of subjective state of health. Results of 4 years of follow-up of adults. *J Psychosom Res* 50: 77-86.

- Suominen S, Gould R, Ahvenainen J, Vahtera J, Uutela A & Koskenvuo M (2005) Sense of coherence (SOC) and disability pensions. A nation-wide, register-based prospective population study of 2196 adult Finns. *J Epidemiol Comm Health* 59:455-459
- Suominen-Taipale AL, Nordblad A, Vehkalahti M & Aromaa A (Eds.) (2004) Suomalaisten aikuisten suun terveys. Kansanterveyslaitoksen julkaisuja. KTL B16/2004. Helsinki.
- Suominen-Taipale AL, Widström E, Alanen P & Uutela A (2000) Trends in self-reported use of dental services among Finnish adults during two decades. *Community Dent Health* 17: 31-37.
- Surtees P, Wainwright N, Luben R, Khaw KT & Day N (2003) Sense of coherence and mortality in men and women in the EPIC-Norfolk United Kingdom prospective cohort study. *Am J Epidemiol* 158: 1202-1209.
- Söderberg S, Lundman B & Norberg A (1997) Living with fibromyalgia: sense of coherence, perception of well-being, and stress in daily life. *Res Nursing Health* 20: 495-503.
- Tada A & Matsukubo T (2003) Relationship between oral health behaviours and general health behaviours in a Japanese adult population. *J Public Health Dent* 63(4): 250-4.
- Telivuo M, Kallio P, Berg MA, Korhonen HJ & Murtomaa H (1995) Smoking and oral health: a population survey in Finland. *J Public Health Dent* 55(3): 133-8.
- Tervonen T (1988) Dental treatment needs of adults in Ostrobothnia, Finland. *Acta Universitatis Ouluensis*.
- Toneatto A & Binik YM (1990) Internal structure of prevention and dental health behaviours. *J Behav Med* 13(5): 481-487.
- Toppinen-Tanner S & Kalimo R (2003) Psychological symptoms and competence at three organizational levels of industrial design: the main and moderating role of sense of coherence. *Psychological Reports* 92: 667-682.
- Tselebis A, Moulou A & Ilias I (2001) Burnout versus depression and sense of coherence: study of Greek nursing staff. *Nurs Health Sci* 3(2):69-71.
- Vahtera J, Kivimäki M & Pentti J (1997) Effect of organisational downsizing on health of employees. *Lancet* 350:1124-8.
- Vehkalahti M, Paunio I, Nyysönen V & Aromaa A (Eds.) (1991) Suomalaisten aikuisten suunterveys ja siihen vaikuttavat tekijät. Kansaneläkelaitoksen julkaisuja AL:34, Helsinki ja Turku.
- Viikari-Juntura E, Vuori J, Silverstein A, Kalimo R, Kuosma E & Videman T (1991) A life-long prospective study on the role of psychosocial factors in neck-shoulder pain and low-back pain. *Spine* 16(9): 1056-1061.
- Viviers AM (1997) Salutogenesis in organizational context. A paper presented in Fifth European Congress of Psychology. July 6th-11th. Dublin, Ireland.
- Wannamethee SG, Shaper AG, Walker M & Ebrahim S (1998) Lifestyle and 15-year survival free of heart attack, stroke, and diabetes in middle-aged British men. *Arch Intern Med* 158: 2433-2440.
- Watt RG (2005) Strategies and approaches in oral disease prevention and health promotion. *Bulletin of the World Health Organization* 83: 711-718.
- Williams SJ (1990) The relationship among stress, hardiness, sense of coherence and illness in critical care nurses. *Medical Psychotherapy* 3: 171-186.
- Wolfe GR, Stewart JE & Hartz GW (1991) Relationship of dental coping beliefs and oral hygiene. *Community Dent Oral Epidemiol* 19: 112-115.
- Wolff AC & Ratner PA (1999) Stress, social support, and sense of coherence. *West J Nurs Res* 21(2):182-97.
- Ylimentalo P (1976) Jyväskylän kaupungin aikuisväestön terveyskäyttäytyminen. Kansanterveyden laitoksen julkaisuja, 30. Jyväskylä: Jyväskylän yliopisto.
- Ylöstalo P, Ek E & Knuutila M (2003a) Coping and optimism in relation to dental health behaviour – a study among Finnish young adults. *Eur J Oral Sci* 111(6): 477-82.

- Ylöstalo PV, Ek E, Laitinen J & Knuuttila MLE (2003b) Optimism and life satisfaction as determinants for dental and general health behavior-oral health habits linked to cardiovascular risk factors. *J Dent Res* 82(3):194-9.
- Österberg T, Lundgren M, Emilson CG, Sundh V, Birkhed D & Steen B (1998) Utilization of dental services in relation to socio-economic and health factors in the middle-aged and elderly Swedish population. *Acta Odontol Scand* 56: 41-47.

Appendices

Appendix 1

SENSE OF COHERENCE

How do you feel? Circle from options 1 to 7 the one best describing your opinion.

Until now your life has had:

No clear goals or no purpose at all Very clear goals and purpose

1.....2.....3.....4.....5.....6.....7

Do you have the feeling that you don't really care about what goes on around you?

Very seldom or never Very often

1.....2.....3.....4.....5.....6.....7

Has it happened in the past that you were surprised by the behaviour of people you thought you knew well?

Never happened Always happened

1.....2.....3.....4.....5.....6.....7

Has it happened that people whom you counted on disappointed you?

Never happened Always happened

1.....2.....3.....4.....5.....6.....7

Do you have the feeling that you're being treated unfairly?

Very often Very seldom or never

1.....2.....3.....4.....5.....6.....7

Do you have the feeling that you are in an unfamiliar situation and don't know what to do?

Very often Very seldom or never

1.....2.....3.....4.....5.....6.....7

Doing the things you do everyday is:

A source of deep pleasure and satisfaction A source of pain and boredom

1.....2.....3.....4.....5.....6.....7

Do you have very mixed-up feelings and ideas?

Very often Very seldom or never

1.....2.....3.....4.....5.....6.....7

Many people – even those with a strong character – sometimes feel like sad sacks (losers) in certain situations. How often have felt this way in the past?

Never

Very often

1.....2.....3.....4.....5.....6.....7

When something happened, have you generally found that:

You over- and underestimated its importance

You saw things in the right proportion

1.....2.....3.....4.....5.....6.....7

How often do you have the feeling that that there's little meaning in the things you do in your daily life?

Very often

Very seldom or never

1.....2.....3.....4.....5.....6.....7

How often do you have feelings that you're not sure you can keep under control?

Very often

Very seldom or never

1.....2.....3.....4.....5.....6.....7

Appendix 2

ORAL HEALTH BEHAVIOUR AND ORAL HEALTH ITEMS

Do you usually go to a dentist:

1. regularly for check-up
2. only when you have toothache or some other trouble
3. never?

How often do you usually brush your teeth:

1. more often than twice a day
2. twice a day
3. once a day
4. less frequently than every day
5. never?

Do you wear removable dentures:

1. complete dentures (no own teeth neither roots)
2. partial dentures and own teeth
3. no dentures, have own teeth
4. no dentures, no teeth?

Is the condition of your teeth and the health of your mouth at present:

1. good
2. rather good
3. moderate
4. rather poor
5. poor?

Appendix 3

GENERAL HEALTH BEHAVIOUR AND GENERAL HEALTH ITEMS

How often do you exercise in your leisure time so that you are at least slightly out of breath and sweating?

1. daily
2. 4 - 6 times/week
3. 2 - 3 times/week
4. once a week
5. 2 - 3 times a month
6. few times a year or even more rarely

Do you smoke nowadays?

1. daily
2. occasionally
3. not at all

Is your present state of health:

1. good
2. rather good
3. moderate
4. rather poor
5. poor?

Appendix 4

ORAL HEALTH AND QUALITY OF LIFE

How often have you had the problem during the last month?

1 = very often, 2 = fairly often, 3 = occasionally, 4 = hardly never, 5 = never, 6 = don't know

FL. Have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?

1.....2.....3.....4.....5.....6

FL. Have you felt that your sense of taste has worsened because of problems with your teeth, mouth and dentures?

1.....2.....3.....4.....5.....6

P1. Have you had painful aching in your mouth?

1.....2.....3.....4.....5.....6

P1. Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth and dentures?

1.....2.....3.....4.....5.....6

P2. Have you been self-conscious foods because of problems with your teeth, mouth and dentures?

1.....2.....3.....4.....5.....6

P2. Have you felt tense because of problems with your teeth, mouth and dentures?

1.....2.....3.....4.....5.....6

D1. Has your diet been unsatisfactory because of problems with your teeth, mouth and dentures?

1.....2.....3.....4.....5.....6

D1. Have you had to interrupt meals unsatisfactory because of problems with your teeth, mouth and dentures?

1.....2.....3.....4.....5.....6

D2. Have you found it difficult to relax because of problems with your teeth, mouth and dentures?

1.....2.....3.....4.....5.....6

D2. Have you been a bit embarrassed because of problems with your teeth, mouth and dentures?

1.....2.....3.....4.....5.....6

D3. Have you been a bit irritable with other people because of problems with your teeth, mouth and dentures?

1.....2.....3.....4.....5.....6

D3. Have you had difficulty doing usual jobs because of problems with your teeth, mouth and dentures?

1.....2.....3.....4.....5.....6

H. Have you felt that life in general was less satisfying because of problems with your teeth, mouth and dentures?

1.....2.....3.....4.....5.....6

H. Have you been totally unable to function because of problems with your teeth, mouth and dentures?

1.....2.....3.....4.....5.....6

FL	Functional Limitation
P1	Physical Pain
P2	Psychological Discomfort
D1	Physical Disability
D2	Psychological Disability
D3	Social Disability
H	Handicap