Sense of coherence associates with oral and general health behaviours

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Objective: Our aim was to investigate the mutual relationship between oral and general health behaviours and oral and general subjective health among adults, and to explore whether sense of coherence (SOC) could be a common health-promoting correlate for them. ***Participants:*** The present study included data for 4,096 30- to 64-year-old dentate adults (2,177 females and 1919 males). ***Basic research design:*** In the nationally representative, cross-sectional sample including 8,028 persons aged 30, or more, 88% were surveyed. The questionnaire and home interview included information about socio-economic and demographic factors, behavioural and psycho-social variables. Chi-square test and logistic regression models were used in the data analysis. ***Main outcome measures:*** The main outcome measures were oral health behaviours (regular dental attendance, twice a day tooth-brushing frequency), general health behaviours (non-smoking habits, physical activity at least twice a week), subjective oral and general health and the SOC (12-item) scale. ***Results:*** Among females, positive health behaviours tended to occur together significantly more often than among males. Thus, 83 % of females with more than once a week physical exercise frequency, and 79 % of the non-smoking females, brushed their teeth at least twice a day, while the corresponding figures for the males were merely 55 % and 50 %. A strong SOC was associated with uniformly positive health behaviours and subjective oral and general health. ***Conclusions:*** Our results suggest that a strong SOC has a universal positive association with several health behaviours and subjective health measures, also concerning oral health. Thus, the role of psycho-social factors should not be underestimated in health promotion.

Key words: Dental attendance, physical activity, psycho-social, sense of coherence, smoking, subjective health, tooth-brushing

Introduction

When designing health-promotion programmes, especially for oral health, the question whether or not oral and general health behaviours are related is of concern. For example, smoking has negative effects on both oral and systemic diseases (Hujoel *et al*., 2002). In addition, smoking and low tooth-brushing frequency have been found to associate (Tada *et al*., 2003). This suggests that consistent patterns of health-enhancing or health-harming behaviours may affect the association of oral and systemic disease. In relation to this, the common risk factor approach related to both dental and general diseases has been introduced previously (Sheiham and Watt, 2000). Oral health behaviours have, however, seldom been included when the relationships between, and among, health behaviours has been examined. Oral and general health behaviours have been found to be associated (Tada *et al*., 2003). So far, little mention has been made about the common determinants that may be responsible for the association. This kind of knowledge would have implications for health promotion. It has also been suggested, though, that general and oral health behaviours are distinct dimensions (Astrom and Rise, 2001).

Antonovsky's theory of salutogenesis maintains that sense of coherence is the resource for achievement and maintenance of good somatic health. The theory seeks to explain health-enhancing factors as distinct from the factors that cause the risks of any specific disease. The notion of sense of coherence (SOC) is central; 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 possesses the motivation, desire and commitment to cope with stressors (meaningfulness). The three aspects mentioned above are the sub-dimensions of SOC. The theory purports that the level of SOC that an individual achieves is determined at the age of 30, after which it remains relatively stable (Antonovsky, 1987). The stability of SOC, however, has also been challenged in the previous literature (Kranz and Ostergen, 2004).

Antonovsky (1987) emphasized that SOC can promote health via the selection of health-enhancing behaviours. An individual with a strong SOC is more likely to comprehend stimuli as non-stressors, and is more likely to avoid those stressors that could be inconvenient to successfully cope with. Furthermore, an individual with a strong SOC is more likely to seek treatment, to adhere to professional

guidance, to seek information relevant to health, and to disallow poor health behaviours (Antonovsky, 1987). SOC has been found to associate with several health behaviours, such as alcohol consumption (Midanik *et al.*, 1992), dietary habits (Larsson and Setterlind, 1990), physical activity (Hassmen *et al.*, 2000), smoking (Abrahamsson and Ejlertsson, 2002), dental attendance (Freire *et al.*, 2001, Freire *et al.*, 2002, Savolainen *et al.*, 2004), and tooth-brushing frequency (Savolainen *et al.*, 2005). The positive association of the SOC and health has also been well described (Suominen *et al.*, 2001).

Coherently, our aim was to investigate the mutual relationship between oral and general health behaviours and oral and general subjective health among adults, and to explore the relationship between oral and general health behaviours from a new angle and, thus, to introduce the theory of salutogenesis into this domain.

Methods

The nationally representative Health 2000 health examination survey, including 8,028 persons aged 30, or more, sampled by using a two-stage stratified cluster sampling design was carried out in 2000-2001 by the National Public Health Institute of Finland. The two-stage stratified cluster sampling design was planned by Statistics Finland. The sampling frame comprised adults above 30 years of age living in mainland Finland. This frame was regionally stratified according to the five university hospital regions, each containing roughly one million inhabitants. From each region 16 health care districts were sampled as clusters. Thus the 80 health centre districts were the primary sampling units. The ultimate sampling units were subjects who were selected by systematic sampling from the health centre districts. This sampling method was chosen because it allows applying more efficient estimation methods than random sampling in cases where available. Persons aged 80 years and over were over sampled by doubling the sampling fraction. A sizeable network of researchers, coordinated by the above-mentioned institute, was responsible for the planning and execution of the study. Permission for the study was given by the ethics committees of the University Hospital Region of Helsinki and Surroundings and the National Public Health Institute.

The survey consisted of clinical health examination, home interview and several questionnaires. The interviews were carried out by trained interviewers of Statistics Finland and included information about socio-economic and demographic factors, behaviours such as dental attendance pattern, tooth-brushing frequency, smoking habits and subjective oral and general health (n=6,354, 80%). Two separate self-administered postal questionnaires included, e.g., the SOC scale (n=6,269, 79%), and items probing physical activity frequency (n=6,736, 84%).

The data in this study was obtained from subjects who had participated the interview, and returned the two self-administered postal questionnaires (n = 6,089). The subjects in this study were considered as dentate if they reported having any natural teeth. Edentate subjects and subjects who were 65 years old, or more (n = 1,815), were excluded from the total sample. Those who lived permanently in institutional care (n = 4), or had missing values on more than three items of the SOC scale (n = 25), or those who had missing data concerning questions on the level of education, dental attendance pattern, tooth-brushing frequency, smoking habits, physical exercise frequency, subjective oral and general health (n = 149), were also excluded. Thus, the final data comprised 4,096 individuals (2,177 females and 1919 males) representing 70% of 30 – 64-year-olds of the sample.

SOC was measured by means of 12 items from the Antonovsky (1987) short SOC scale (SOC-13). 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. Twelve items of SOC are represented in Figure 1. The item not included from the SOC-13 scale was "Does it happen that you have feelings inside you would rather not feel?". The Cronbach alpha for the 12-item SOC scale was 0.86. The 12-item SOC formula has previously been successfully used by authors (Savolainen *et al.*, 2004, Savolainen *et al.*, 2005).

The mean SOC scores were calculated, the higher scores indicating stronger SOC. If the number of missing values was not more than three, they were replaced by the scale mean of the individual. In all, there were one missing value for 77 cases, two for seven cases, and three for another. After the sum score for SOC was computed for each individual, it was categorized into quintiles as well as possible. As there were many subjects with equal scores at the quintile limits exact categorization was not possible. The similar method was used in previous publications of authors (Savolainen *et al.*, 2004, Savolainen *et al.*, 2005) where the distribution of the sum scores, and their mean and median values are given.

The six outcome variables studied were dental attendance pattern, tooth-brushing frequency, smoking habits, physical exercise frequency and subjective oral and general health. Dental attendance was measured with a question: "Do you usually go to a dentist, 1. regularly for check-ups; 2. only when you have toothache, or some other trouble; or 3. never?". The answers two and three were combined for the analyses to yield a dichotomous variable.

Tooth-brushing frequency was measured with a question: "How often do you usually brush your teeth, 1. more often than twice a day; 2. twice a day; 3. once a day; or 4. less frequently than every day; 5. never?" The variable was dichotomised by combining the answers one and two, and answers from three to five.

Smoking habits were dichotomised to smokers and non-smokers. The smoker category consisted of subjects who reported being either a regular or occasional smokers. The non-smoker category consisted of subjects who reported being non-, or ex-smokers.

Physical activity was measured with a question "How often do you exercise in your leisure time so that you are at least slightly out of breath and sweating, with alternative 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; or 6. few times a year or even more rarely?". For the analyses, the variable was dichotomised by combining answers from one to three, and from four to six.

Subjective oral health and general health were measured with the questions: "Is the condition of your teeth

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

1. 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

2. 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

3. 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

4. Has it happened that people whom you counted on disappointed you?
Never happened   Always happened
1.........2.........3.........4.........5.........6.........7

5. Do you have the feeling that you're being treated unfairly?
Very often   Very seldom or never
1.........2.........3.........4.........5.........6.........7

6. 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

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

8. Do you have very mixed-up feelings and ideas?
Very often   Very seldom or never
1.........2.........3.........4.........5.........6.........7

9. Many people – even those with a strong character – sometimes feel like sad sacks (losers) in certain situations. How often you have felt this way in the past?
Never   Very often
1.........2.........3.........4.........5.........6.........7

10. 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

11. 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

12. 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

Figure 1. *The items of SOC.*

and the health of your mouth at present/Is your present state of health", with alternative answers including 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 dichotomous variables. The answers one and two were considered as good subjective health, and answers three, four and five, as poor, respectively.

Background variables used in this study were gender, age, and level of education. Age was classified into four categories: 30-39 years old, 40-49 years old, 50-59 years old and 60-64 years old. Level of education was assessed using information on formal schooling and vocational training. For the analyses, education was categorized into three classes; low, middle and high education. Those with no formal vocational training or senior secondary

education were classified as having low education; those who had completed vocational training or passed the matriculation examination were considered as having middle education; high education comprised degrees or diplomas from higher vocational institution polytechnics or universities.

Statistical methods

The complications due to the clustered data were handled by using the SUDAAN software, version 8.0.2. Poststratum weights, based on gender, age, region and language, were used for correcting the non-response. Model adjustment by using predicted marginals was a method used for assessing differences in prevalences (or means) caused by some factor while controlling the effects of confounding factors by using a (logistic) regression model. Model-adjusted prevalences were calculated as an average of individual predicted probabilities, which are calculated by using the expit (or anti-logit) transformation and linear predictors, which are formed by the estimated regression coefficients and individual covariate values (Lee, 1981).

We first examined the unadjusted and age and level of education adjusted prevalences of subjects with positive health behaviours, or good subjective health, by using the chi-square test separately in both genders. Next, age and level of education adjusted prevalences were calculated for positive health behaviours, or good subjective health, in relation to each other, stratifying by gender. Next, the significance of the SOC was examined by comparing the unadjusted and gender, age, and level of education adjusted prevalences of subjects having positive health behaviour and subjective health who belonged either to the strongest, or to the weakest SOC quintile. Finally, the gender, age and level of education adjusted prevalences of subjects with positive health behaviours, or good subjective oral and general health, were calculated, separately and together, among subjects belonging to the strongest and the weakest SOC quintiles. Age, and level of education-adjusted, and gender, age and level of education-adjusted prevalences are given with 95% confidence intervals.

The aim of our analysis strategy was to emphasize the significance of the SOC in relation to several health variables. Therefore, the prevalences of subjects belonging only to the strongest and weakest SOC quintiles have been shown. Data analysis was performed with SAS (version 8.0) software using the SUDAAN (2001) programme.

Results

Table 1 represents the distribution of study subjects in relation to gender, age group and level of education (Table 1).

Table 2 gives the unadjusted and the age and level of education adjusted prevalences of those with positive health behaviours or good subjective oral or general health respectively by gender. Among females, all positive health behaviours tended to occur together significantly more often than among males (Table 2).

Table 3 represents age and level of education adjusted prevalences of those with positive health behaviours and good subjective oral or general health in relation to each other, by gender. Among females, positive general health behaviour tended to associate with good oral health behaviour, whereas a similar pattern was not found as strong among males. For example, 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 for males were only 54 % and 50 %, respectively (Table 3).

In Table 4, a strong SOC was shown to be a common positive correlate for health behaviours and the two health dimensions. The unadjusted, and the gender, age, and level of education adjusted prevalences of positive health behaviours and subjective health dimensions were greater among those subjects belonging to the strongest SOC quintile than among with those belonging to the weakest SOC quintile. The difference was most evident on the subjective oral and general health dimensions. 78 % and 82 % of subjects belonging to the strongest SOC quintile reported good subjective oral and general health, while the corresponding prevalences were 58 and 56 for those belonging to the weakest SOC quintile, respectively (Table 4)

Positive health behaviours and the two good subjective health dimensions associated more strongly among those belonging to the strongest SOC quintile compared to those belonging to the weakest SOC quintile (Table 5).

Discussion

The results of the present study showed that among females, positive health behaviour in general tended to go together with good oral health behaviours particularly, whereas a similar pattern was not found among males. A strong SOC was found to be associated with positive oral and general health behaviours and good subjective oral and general health.

To our knowledge, this is the first study exploring the health-promoting role of SOC in relation to general and oral health behaviours, as well as oral and general subjective health among same subjects. Although this study involves a cross-sectional design, this study supports the view that developing positive health behaviours could partly be influenced by psycho-social factors. These results need, however, be confirmed using a longitudinal study design.

To obtain a comprehensive view of health behaviours, they were selected to vary in character. This is supported by a recent study suggesting that health behaviours are multidimensional in nature (Petersen *et al.*, 2008). For example, it can be seen that the implementation of certain health-enhancing behaviours, such as regular dental attendance and high physical activity frequency, demand more initiative from an individual than other positive health behaviours such as brushing the teeth twice a day.

Our results also emphasize the role played by gender. Positive health behaviours are, generally, more commonly found among females, as shown in Tables 2 and 3, respectively. Young females who brush their teeth twice a day are more likely to practice also other positive health behaviours later, while among males the corresponding pattern may not emerge. These gender differences in

Table 1. Distribution of the study subjects in relation to gender, age group, level of education (n = 4,096).

	%	n
Gender		
male	49	1919
female	51	2177
Age group		
30-39	30	1268
40-49	32	1318
50-59	28	1112
60-69	10	398
Level of education		
low	27	1084
middle	37	1527
high	36	1485

Table 2. The unadjusted, and age and level of education-adjusted prevalences (%) with 95% confidence intervals (CI) of those with positive health behaviours and good subjective health separately in males and females (n=4,096).

Prevalence (95 % CI)	Unadjusted	Adjusted for age and level of education
Regular dental attendance	*61 (59-63)*	
Males	54 (52-56)	55 (52-57)
Females	68 (65-70)	67 (64-70)
Twice-a-day tooth-brushing frequency	*64 (62-66)*	
Males	48 (45-50)	49 (47-51)
Females	79 (77-81)	78 (76-81)
Non-smoking status	*69 (68-71)*	
Males	65 (63-67)	66 (63-68)
Females	74 (72-76)	73 (71-75)
More than once a weekphysical exercise frequency	*59 (57-60)*	
Males	56 (54-59)	57 (54-59)
Females	61 (59-63)	60 (59-62)
Good subjective oral health	*68 (67-70)*	
Males	64 (62-66)	65 (63-67)
Females	72 (70-74)	71 (69-74)
Good subjective general health	*71 (69-72)*	
Males	69 (66-71)	69 (67-71)
Females	73 (71-75)	73 (71-74)

Table 3. Age and level of education adjusted prevalences (%) with 95% confidence intervals (CI) of those with positive health behaviours and good subjective health in relation to each other separately in males and females.

Prevalence (95 % CI)	RDA	TBF	NSH	PEF	SOH	SGH
Regular dental attendance (RDA)						
Male (n=1,035)		55 (51-58)	73 (70-75)	62 (59-64)	80 (78-83)	74 (71-76)
Female (n=1,470)		83 (80-85)	76 (74-78)	63 (61-65)	82 (80-84)	76 (74-78)
Twice-a-day tooth-brushing frequency (TBF)						
Male (n=919)	61 (57-64)		67 (64-70)	63 (60-66)	69 (66-72)	72 (69-75)
Female (n=1,722)	71 (68-73)		74 (72-76)	64 (61-66)	75 (72-77)	76 (73-78)
Non-smoking habits (NSH)						
Male (n=1,245)	61 (58-63)	50 (47-53)		62 (60-65)	70 (67-73)	71 (68-739
Female (n=1,603)	69 (67-72)	79 (76-81)		63 (61-66)	73 (70-75)	73 871-75)
More than once a week						
More than once a week physical exercise frequency (PEF)						
Male (n=1,083)	59 (56-63)	54 (51-57)	72 (70-75)		69 (66-72)	72 (70-75)
Female (n=1,323)	70 (67-73)	83 (80-85)	77 (75-79)		74 (72-77)	76 (74-79)
Good subjective oral health (SOH)						
Male (n=1,231)	67 (65-70)	52 (50-55)	71 (68-73)	60 (58-63)		76 (74-79)
Female (n=1,572)	77 (74-80)	81 (79-84)	75 (73-77)	63 (61-65)		79 (77-81)
Good subjective general health (SHG)						
Male (n=1,316)	58 (55-61)	52 (49-54)	67 (65-70)	60 (57-62)	72 (69-74)	
Female (n=1,600)	70 (67-73)	81 (79-83)	74 (71-76)	63 (61-66)	77 (75-80)	

Table 4. The unadjusted, and gender, age and level of education-adjusted prevalences (%) with 95% confidence intervals (CI) of those belonging to the strongest, or the weakest SOC quintile, and having positive health behaviours and good subjective health.

Prevalence (95 % CI)	Unadjusted	Adjusted for gender, age and level of education
Regular dental attendance		
Weakest SOC (n=842)	54 (50-57)	55 (52-59)
Strongest SOC (n=760)	66 (63-70)	66 (62-70)
Twice-a-day tooth-brushing frequency		
Weakest SOC	58 (54-61)	59 (56-63)
Strongest SOC	73 (70-76)	73 (70-76)
Non-smoking habits		
Weakest SOC	64 (61-67)	65 (62-68)
Strongest SOC	73 (70-77)	74 (71-76)
More than once a week physical exercise frequency		
Weakest SOC	54 (50-58)	54 (51-58)
Strongest SOC	61 (58-65)	61 (58-65)
Good subjective oral health		
Weakest SOC	57 (53-60)	58 (55-62)
Strongest SOC	78 (75-81)	78 (75-81)
Good subjective general health		
Weakest SOC	54 (50-57)	56 (53-59)
Strongest SOC	83 (80-86)	82 (79-85)

Table 5. Age, gender and level of education adjusted prevalences (%) with 95% confidence intervals (CI) of those with positive health behaviours and good subjective health in relation to each other separately in subjects belonging to the strongest or the weakest SOC quintile.

Prevalence (95 % CI)	RDA (n=2505)	TBF (n=2641)	NSH (n=2848)	PEF (n=2406)	SOH (n=2803)	SGH (n=2916)
Regular dental attendance (RDA)						
Weakest SOC		66 (61-70)	69 (65-73)	59 (54-639	74 (69-78)	60 (56-65)
Strongest SOC		79 (75-82)	78 (74-81)	65 (61-69)	89 (86-92)	84 (81-87)
Twice-a-day tooth-brushing frequency (TBF)						
Weakest SOC	61 (60-66)		66 (61-70)	59 (55-64)	61 (57-66)	59 (55-63)
Strongest SOC	71 (68-75)		76 (72-79)	67 (54-71)	82 (79-85)	83 (80-86)
Non-smoking habits (NSH)						
Weakest SOC	59 (55-63)	59 (55-64)		58 (54-62)	61 (57-66)	56 (51-60)
Strongest SOC	70 (65-74)	75 (72-79)		67 (63-71)	81 (77-84)	84 (81-87)
More than once a week physical exercise frequency (PEF)						
Weakest SOC	61 (56-65)	66 (62-71)	70 (66-74)		63 (59-68)	60 (55-64)
Strongest SOC	69 (65-74)	79 (75-83)	80 (77-84)		81 (78-85)	85 (82-88)
Good subjective oral health (SOH)						
Weakest SOC	70 (65-74)	62 (58-67)	69 (65-73)	59 (54-63)		61 (56-65)
Strongest SOC	76 (72-79)	77 (73-80)	76 (73-80)	64 (61-68)		88 (85-90)
Good subjective general health (SHG)						
Weakest SOC	59 (54-64)	63 (58-67)	66 (61-70)	57 (53-62)	63 (59-68)	
Strongest SOC	68 (65-72)	74 (71-77)	75 (72-78)	64 (60-67)	83 (80-86)	

general can be biological, social or a combination of both (Doyal, 2003). It is estimated that alcohol use and smoking together explain about half of the difference between male and female life expectancies (Martelin *et al.*, 2006).

Since the socio-economic and demographic factors correlate with health behaviours (Koivusilta *et al.*, 2003), the results have been presented in the form of age and level of education adjusted prevalences. The nationally representative sample ensured the wide variation socio-economic and –demographic variation of subjects. On the other hand, it is important to notice that socio-economic and demographic factors may also interact with both health behaviours and the SOC (Savolainen *et al.*, 2004).

In the choice of health behaviours to be examined the aim was to emphasize such health behaviour variables that have a well-established association to health. Second, it was attempted to avoid inclusion of such health behaviours that have only marginal prevalence of subjects, e.g., health-harmful excessive alcohol consumption was excluded. Third, we did not select such health behaviours that correlated too strongly to each other. The results also support the previous findings using SOC as a theoretical framework in relation to several separate health behaviours, such as dietary habits (Larsson and Setterlind, 1990), physical activity (Hassmen *et al.*, 2000), smoking habits (Abrahamsson and Ejlertsson, 2002, dental attendance (Freire *et al.*, 2001, Freire *et al.*, 2002, Savolainen *et al.*, 2004), or tooth-brushing frequency (Savolainen *et al.*, 2005), and health (Suominen *et al.*, 2001).

It is relevant to note that a strong SOC has a universal positive association with several health behaviours and subjective health measures. Thus, the role of psycho-social factors should not be underestimated in health promotion. Strengthening of SOC in childhood and adolescence has highly significant consequences to the life course and well-being of individuals, and it may also be seen as proactive for the efficacy of health promotion programmes. The benefit of SOC may also be comprehensive since the SOC has positive effect on both oral and general health.

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