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Sense of coherence as a predictor of health-related behaviours among patients with coronary heart disease

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Abstract

Aims: A high sense of coherence (SOC) has been found to be associated with favourable health-related behaviours. However, evidence is for the most part lacking on the influence of SOC on health-related behaviours among coronary heart disease patients. The aim of this study was to explore the association between SOC at baseline and smoking status, nutrition behaviour, physical exercise and alcohol consumption of coronary heart disease patients 12–28 months after they had undergone different cardiac treatments.

Methods: A total of 179 coronary heart disease patients (mean age 58.32±6.54 years, 19% female) were interviewed before coronary angiography and 12–28 months after. Self-report data about health-related behaviours were obtained via a structured interview. SOC was measured using the 13-item Orientation to Life Questionnaire. The relationship between SOC and health-related behaviours was examined using regression and cross-lagged path analyses.

Results: SOC at baseline predicted non-smoking and quitting smoking: odds ratio (OR) (95% confidence interval (CI)) per unit increase (over range 38–91) was 1.11 (1.03–1.19) and 1.09 (1.01–1.17), respectively. Moreover, baseline SOC predicted healthy nutrition behaviour among percutaneous coronary intervention patients: the OR per unit increase was 1.08 (95% CI: 1.01–1.15). Lastly, SOC at baseline predicted improvement in alcohol consumption at follow-up among coronary artery bypass grafting patients (standard score result: –0.15, $p<0.05$).

Conclusion: Coronary heart disease patients with a low SOC before treatment are less likely to improve health behaviours after cardiac treatment and should thus get additional attention in health promotion.

Keywords

Coronary disease, health behaviour, health promotion, longitudinal studies, sense of coherence

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Introduction

Health-endangering behaviours have been identified as important risk factors for coronary heart disease (CHD), and improvement in these behaviours may provide considerable benefit to patients with CHD.[1] Relevant improvements include stopping smoking,[2] making healthier food choices,[3] becoming more physically active,[4] reducing excess weight[5] and consuming a moderate level of alcohol.[6] A review of the literature on the prevention of recurrence of CHD concluded that non-pharmacological secondary prevention is safe and effective; increased exercise and non-pharmacological interventions consisting of more than one component (e.g. targeting exercise, diet and smoking)

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reduced mortality most substantially. However, studies concerning the effectiveness of diet and smoking interventions are still scarce.[7]

Antonovsky hypothesised that sense of coherence (SOC), i.e. the way people view their life, influences their health behaviours and thus their health.[8–10] He qualified this statement by stressing that people with a high SOC have a lower tendency to turn to inappropriate coping strategies (e.g. smoking, excessive alcohol consumption) than people with a low SOC. SOC is defined as a global personal disposition that expresses a person's ability to manage demanding situations; it is postulated to have three components – comprehensibility, manageability and meaningfulness.[9] Comprehensibility means that internal and external stimuli are perceived as orderly, consistent, structured and predictable (represents a cognitive processing pattern). Manageability represents the extent to which an individual perceives that the resources needed to handle a challenge are at his or her disposal (represents a cognitive-emotional processing pattern). Meaningfulness represents the motivation to solve a problem or to address it as a challenge worthy of the investment of energy (an emotional investment in life).[8,9] According to Antonovsky,[9] people develop their SOC throughout their entire life span but mainly in the first decades of life, when people learn how to deal with life in general. Until recently SOC was seen as a rather stable predisposition,[8,9] however, several empirical studies have concluded that SOC could be altered by improving one or more of the three core components via evidence-based psychosocial interventions.[11–14] In empirical studies, SOC has been found to be related to a range of health behaviours: the higher the SOC, the healthier is behaviour in general.[15] Correlations between higher SOC and behaviours such as non-smoking,[16] healthier food choices,[3] more physical exercise[17] and lower alcohol consumption[18] have been demonstrated.

Little research has been done on the influence of SOC on health-related behaviours and health among CHD patients.[19] Longitudinal studies on SOC and the risk factors of CHD are scarce.[20,21] Additionally, results of previous studies suggest that all patients with CHD might benefit from health promotions targeted on health-related behaviours.[22–24] However, evidence is lacking on changes over time in health-related behaviours among patients with different types of cardiac treatment. Thus, the aim of this study was to determine whether SOC at baseline predicts the health-related behaviours (smoking, diet, physical exercise and alcohol consumption) of patients with invasive and non-invasive treatment of CHD 12–28 months after coronary angiography (CAG). Further, we explored the association between SOC at baseline and the improvement in health-related behaviours at 12–28 months follow-up. These associations were adjusted for age, gender and income because of their association with SOC.[20,25,26]

Methods

Sample and procedure

The study sample consisted of patients who had been referred by their cardiologist for CAG in accordance with the European Society of Cardiology guidelines,[27] and who had an abnormal CAG. The procedure was performed in the East Slovakian Institute for Cardiac and Vascular Diseases in Kosice, Slovakia, where patients from the whole East Slovakian region (about 1.5 million inhabitants) are referred to for diagnosis and treatment. Patients were enrolled in the study between November 2004–September 2008. The inclusion criteria were being referred for CAG and age less than 75 years. Above that age, mortality in a longitudinal design may be expected to be very high, as the life expectancy (in years) in Slovakia in 2004 was 70.3 among men and 77.8 among women. Exclusion criteria were a diagnosis of severe cognitive impairments in the medical history, diagnosed psychiatric disorders in the medical history, cardiovascular problems other than CHD (e.g. valve disease), normal CAG, and a serious co-morbidity (such as malign tumours and nervous system diseases).[28–30]

Data collection consisted of two measurements: a baseline measurement (the day preceding the CAG) and a follow-up examination (performed 12–28 months after the CAG). The baseline measurement consisted of an interview with each participant during hospitalisation for the CAG, conducted by a psychologist or trained research assistant in order to obtain information about sociodemographic characteristics and health-related behaviours, operationalised in this study as smoking, diet, physical exercise and alcohol consumption. Furthermore, during the baseline examination, medical data were retrieved from the medical records, and the CAG patients also completed a self-administered questionnaire the day before on SOC. The type of therapeutic intervention following the CAG – percutaneous coronary intervention (PCI), coronary artery bypass grafting (CABG) or pharmaceutical treatment – was determined by cardiologists based on the results of CAG independently of participation in this study.

For the follow-up examination patients were invited individually via postal mail. The follow-up examination consisted of a personal interview, a self-administered SOC questionnaire and a medical examination (e. g. blood tests and electrocardiography).

Between November 2004–September 2008 approximately, 1500 patients scheduled to undergo a CAG and mostly living in eastern Slovakia satisfied the inclusion criteria for this study. We randomly selected 482 potential participants after stratification by socioeconomic status (defined as educational level: low, middle, high) to obtain equal numbers per stratum. Subsequently, 110 (22.8%) patients were excluded due to having normal CAG, and eight (1.7%) patients refused to participate in the baseline examination. In addition, 66 patients provided incomplete questionnaires (Figure 1).

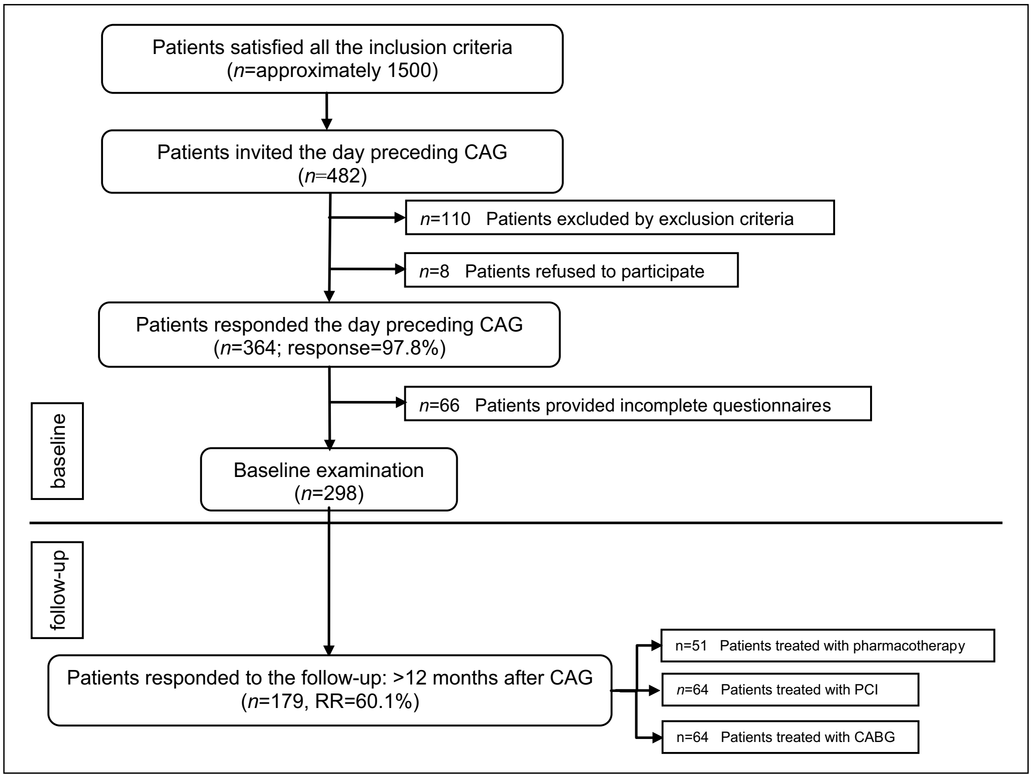

Figure 1. Flowchart diagram of the participants.
CABG: coronary artery bypass grafting; CAG: coronary angiography; PCI: percutaneous coronary intervention; RR: response rate.

Thus, the baseline sample consisted of 298 patients: 227 males (76.2%) and 71 females (23.8%), with ages ranging from 37–74 years (mean range=56.88; standard deviation (SD)=6.85). Out of these, 179 (60.1 %) were measured at follow-up, 145 of whom were males (81.0%). Ages ranged from 39–73 years, with a mean of 58.32 (SD=6.54) at follow-up. There were no statistically significant differences in terms of age, functional status, type of intervention and SOC between those who participated in the follow-up and those who declined. However, there were differences by gender (Cramer's V=0.15, p=0.01), with more men than women (63.4% vs 46.5%) willing to participate at follow-up, but these differences were trivial.

The study was approved by the Ethics Committee of the East Slovakian Institute for Cardiac and Vascular Disease in Kosice, Slovakia, in November 2004. All participants were provided with information about the study and signed an informed consent statement prior to the study. Participation in the study was fully voluntary and anonymous, with no incentives provided for participation, and the investigation conforms to the principles outlined in the Declaration of Helsinki.

Measures

SOC was assessed using the 13-item Orientation to Life Questionnaire (OLQ).[9] The questionnaire consists of three subdimensions: meaningfulness (e.g. Do you have the feeling that you don't really care about what goes on around you?), comprehensibility (e.g. Do you have the feeling that you are in an unfamiliar situation and don't know what to do?) and manageability (e.g. How often do you have feelings that you're not sure you can keep under control?). Each item was rated on a seven-point scale (1=never, 7=always). Negatively-worded items were reverse-coded. The total sum score was calculated, with a higher score indicating a stronger SOC. The OLQ scale has been well tested and has proven to have satisfactory psychometric properties and international comparability, including among cardiac patients.[10,25,31–34] In the present study, the internal consistency was adequate (Cronbach's α=0.76 at baseline).

Health-related behaviours were measured in a structured interview with questions assessing participants' cigarette smoking, diet, physical exercise and alcohol intake. Smoking status was assessed by asking the patient to characterise their current smoking status as never smoked, ex-smoker or currently smoking. The question is consistent with earlier studies.[35,36]

Diet was assessed by asking patients to rate how often they ate fruit, vegetables, food high in sugar or red meat during a week and using a five-point scale (never, hardly ever, once a week, once every 2–3 days, every day) for responses. As a part of the diet assessment patients were also asked if they prefer to eat white bread, whole-wheat bread or both. The total sum score was calculated and divided into three groups defined as poor, medium and good dietary intake using the first and third quartiles as the cut-off points.

Physical exercise was assessed by questions on how often patients engaged in physical exercise each week on a five-point scale, from never to five times or more. The higher the score, the healthier was the exercise behaviour. The same scale was used among first-time myocardial infarction patients by French and colleagues.[37] For the purposes of this study we divided the frequency of physical activity into two categories: exercise less than four times per week; and exercise four times or more per week.

Alcohol consumption was assessed by asking participants to classify themselves as non-drinkers, occasional drinkers (less than three times per week) or regular drinkers. This measure was based on the questionnaire from the European Health and Behaviour Survey.[38] In the follow-up, only non-drinkers and occasional drinkers were identified.

Functional status was assessed by a cardiologist based on two scales: New York Heart Association (NYHA), four categories according to the NYHA classification of dyspnoea symptoms[39] and Canadian Cardiovascular Society (CCS), four categories identifying the severity of chest pain.[40] In this study functional status is calculated using both scales in such a way that the worst score on one of these two scales was used to define the severity of coronary heart disease.

The socioeconomic status of participants was measured by family income in addition to the stratification by educational level. It was evaluated at three levels: 1, low income (lower than the 'minimum wage', i.e. under the poverty line); 2, middle income (at least 'minimum wage' but less than double minimum wage); and 3, high income (twice the 'minimum wage' and higher). 'Minimum wage' is an indicator of the financial situation which is adjusted for the income of all family members according to the Slovak Ministry of Social Affairs, Act No. 252/2009 Governmental Regulation of Minimum Wage.[41]

Statistical analysis

Firstly, we computed baseline statistics (prevalence rates and means) for background characteristics, SOC and health-related behaviours regarding patients with invasive (CABG or PCI) and non-invasive (pharmacotherapy) treatment. We tested the statistical significance of differences between them by calculating χ^2 tests for categorical variables and analysis of variance (ANOVA) and Kruskal-Wallis for continuous variables. Logistic regression analyses were used to explore the association between SOC at baseline and health-related behaviours (smoking, diet, level of physical exercise and alcohol consumption) at follow-up (Model 1), yielding ORs and 95% confidence intervals (CIs). In Model 2, we repeated this analysis with adjustments for gender and age, and in Model 3 we added socioeconomic status. Functional status was added to Model 4 because of the statistical differences between the categories of functional status in SOC scores. To assess whether SOC was associated with improvements (change) in health-related behaviour, we added health-related behaviour at baseline in Model 5. We performed these analyses for the total sample and stratified by the type of treatment (pharmaceutical treatment, PCI or CABG). Two-sided p values are presented, with p values <0.05 regarded as significant. In all regression analyses we used sets of dummy variables for each categorical variable. All analyses were performed using the statistical software IBM SPSS 18.0 for Windows.

Additionally, in line with previous research[42] and for the purpose of this longitudinal study, cross-lagged path analysis based on structural equation modelling was conducted to indicate the predominant direction of effects over time. As was previously done by Apers et al.,[42] four indices were used to assess the model fit (criteria between parentheses): (a) the model chi-square (low possible); (b) the root mean square error of approximation (RMSEA, <0.08); (c) the comparative fit index (CFI, >0.90); and (d) the standardised root mean square residual (SRMR, <0.10). Cross-lagged analyses were performed using Mplus 6.1 (http://www.statmodel.com/).

Results

Characteristics of the sample

The sociodemographic and medical characteristics, SOC scores and health-related behaviours of the sample are shown by type of intervention in Table 1. These subgroups differ significantly in age: patients with CABG were significantly older than patients with pharmacotherapy (mean age 60 vs 57). Furthermore, these subgroups differ significantly in functional status. Patients with CABG had the best functional status, followed by PCI patients and those with pharmacotherapy intervention, who had the worst functional status.

Associations of SOC with health-related behaviours in the total sample

Table 2 shows that a higher SOC was a predictor of non-smoking and quitting smoking among the total sample. According to Model 3 (OR 1.06, 95% CI: 1.00–1.13) and Model 4 (OR 1.11, 95% CI: 1.03–1.19), patients with higher SOC, older age and being female had a higher chance of being non-smokers compared with smokers. Higher SOC was a predictor of quitting smoking when controlled for gender, age, family income (Model 3, OR 1.06, 95% CI: 1.00–1.12) and functional status (Model 4, OR 1.10, 95% CI: 1.02–1.18). This association also remained

Table 1. Background characteristics of the total sample and subsamples according to the type of intervention at follow-up examination and sense of coherence at baseline.

	Total sample	CABG-1	PCI-2	Pharmacotherapy-3	Differences between groups
Total number	179 (100%)	64 (35.8%)	64 (35.8%)	51 (28.5%)	
Age					1–3, $p<0.05$[a]
Mean (±SD)	58.32 (±6.5)	60 (±6.0)	58 (±7.0)	57 (±7.0)	
Range	39–73	48–73	41–72	39–69	
Gender					ns
Males	145 (81%)	54 (84.4%)	50 (78.1%)	41 (80.4%)	
Females	34 (19%)	10 (15.6%)	14 (21.9%)	10 (19.6%)	ns
Family income					ns
Low	4 (2.2%)	0 (0%)	2 (3.1%)	2 (3.9%)	
Middle	112 (62.6%)	44 (68.8%)	37 (57.8%)	31 (60.8 %)	
High	57 (31.8%)	17 (26.6%)	23 (35.9%)	17 (33.3%)	
Functional status					1–2,1–3, $p<0.05$[b]
Class I	51 (28.5%)	24 (37.5%)	14 (21.9%)	13 (25.5%)	
Class II	72 (40.2%)	27 (42.2%)	27 (42.2%)	18 (35.3%)	
Class III	37 (20.7%)	7 (10.9%)	15 (23.4%)	15 (29.4%)	
Cigarette smoking					ns
Non-smoker	57 (31.8%)	22 (34.4%)	19 (29.7%)	16 (31.4%)	
Ex-smoker	99 (55.3%)	37 (57.8%)	34 (53.1%)	28 (54.9%)	
Smoker	16 (8.9%)	5 (7.8%)	7 (10.9%)	4 (7.8%)	
Diet					ns
Poor	57 (31.8%)	19 (29.7%)	23 (35.9%)	15 (29.4%)	
Medium	73 (40.8%)	30 (46.9%)	20 (31.2%)	23 (45.1%)	
Good	42 (23.5%)	14 (21.9%)	16 (25.0%)	12 (23.5%)	
Physical exercise					ns
<4 times/week	64 (35.8%)	23 (35.9%)	22 (34.4%)	19 (37.3%)	
Alcohol intake					ns
Non-drinkers	62 (34.6%)	22 (34.4%)	24 (37.5%)	16 (31.4%)	
Sense of coherence					ns
Mean (±SD)	64.65 (±11.12)	64.78 (±10.64)	64.25 (±10.72)	65 (±12.36)	
Range	38–91	38–88	40–86	38–91	

CABG: coronary-artery bypass grafting; ns: no significant difference between groups;
PCI: percutaneous coronary intervention; SD: standard deviation.
[a]ANOVA with Tukey correction; [b]Kruskal-Wallis test with Mann-Whitney tests.
Note: The missing cases for each variable are as follows: age 0%; gender 0%; education 0%; family income 3.4%; functional status 10.6%, cigarette smoking 3.9%; diet 3.9%; physical exercise 3.9%; alcohol intake 3.4%; sense of coherence 0%.

significant after adjustment for smoking status measured at baseline (Model 5, OR 1.09, 95% CI: 1.01–1.17). The OR for the SOC score indicates that when holding all other variables constant, for each one point increase on the SOC scale (mean 64.65±11.12, range 38–91) it is 1.09 times more likely that the subject will quit smoking when compared with currently smoking patients. Thus, if the patient improves in one item from never (1 point) to very often (7 points), the OR of 1.09 for the likelihood of quitting smoking is 1.09^6; this applies to a range of 53 for the SOC scale. SOC did not appear to be a statistically significant predictor of healthy diet, physical exercise and alcohol consumption among the total sample. None of the cross-lagged analyses yielded significant findings aside from the results already reported (results not shown).

Associations of SOC with health-related behaviours among the CABG, PCI and pharmacotherapy samples

Table 3 shows that SOC was a predictor of quitting smoking among the PCI sample after adjustment for sociodemographic and medical variables (Model 4, OR 1.31, 95% CI: 1.02–1.67). Again, this indicates an exponential increase of the OR of the SOC-score increases (in this case across a range of 16 for SOC as measured). Furthermore, ordinal logistic regression showed that a higher SOC adjusted for gender, age and socioeconomic and functional status had significant effects among PCI patients on healthier nutrition behaviour measured at follow-up (OR 1.08, 95% CI: 1.01–1.15).

Table 2. Associations of sense of coherence with health-related behaviours among the total sample: Odds ratio (OR) crude and after inclusion of additional variables (n=179).

Total sample	Model 1		Model 2		Model 3		Model 4		Model 5	
	OR (95% CI)	smc	OR (95% CI)	smc	OR (95% CI)	smc	OR (95% CI)	smc	OR (95% CI)	smc
Smoking status (non-smoking vs smoking[a])										
Sense of coherence	1.03 (0.98–1.09)	ns	1.05 (0.99–1.11)	***	1.06 (1.00–1.13)*	***	1.11 (1.03–1.19)**	**		
Gender (male vs female[a])			0.09 (0.01–0.75)*		0.08 (0.01–0.73)*		0.07 (0.01–0.69)*			
Age			1.11 (1.01–1.22)*		1.12 (1.02–1.23)*		1.14 (1.03–1.28)*			
Family income[b]										
Low+middle vs high[a]					1.52 (0.40–5.78)		2.98 (0.60–14.73)			
Functional status[a]										
Class I							0.96 (0.14–6.43)			
Class II							0.96 (0.17–5.42)			
Behaviour at baseline[c]										
Smoking status (ex-smoking vs smoking[a])										
Sense of coherence	1.05 (0.995–1.10)	ns	1.05 (0.997–1.10)	***	1.06 (1.00–1.12)*	***	1.10 (1.02–1.18)*	**	1.09 (1.01–1.17)*	***
Gender (male vs female[a])			0.43 (0.05–3.65)		0.45 (0.05–3.97)		0.46 (0.05–4.39)		1.32 (0.11–15.43)	
Age			1.05 (0.96–1.15)		1.05 (0.96–1.15)		1.07 (0.97–1.18)		1.06 (0.94–1.19)	
Family income[b]										
Low+middle vs high[a]					1.74 (0.50–5.99)		3.35 (0.75–14.93)		3.97 (0.72–21.82)	
Functional status[a]										
Class I							0.86 (0.15–5.00)		0.56 (0.09–3.41)	
Class II							1.05 (0.22–5.14)		0.79 (0.14–4.35)	
Behaviour at baseline										
Non-smoking vs smoking[a]									2.84 (2.84–2.84)	
Ex-smoking vs smoking[a]									5.86 (1.43–24.07)*	
Healthy diet										
Sense of coherence	1.01 (0.99–1.03)	ns	1.02 (0.99–1.04)	***	1.01 (0.98–1.04)	***	1.01 (0.98–1.04)	***	1.01 (0.98–1.04)	***
Gender (male vs female[a])			0.22 (0.11–0.48)***		0.21 (0.10–0.46)***		0.20 (0.09–0.45)***		0.24 (0.98–1.08)**	
Age			1.05 (1.01–1.10)*		1.06 (1.01–1.10)*		1.06 (1.01–1.10)*		1.03 (0.10–0.58)	
Family income[b]										
Low+middle vs high[a]					0.71 (0.37–1.36)		0.71 (0.36–1.44)		0.54 (0.40–1.82)	
Functional status[a]										
Class I							0.53 (0.22–1.27)		0.99 (0.21–1.42)	
Class II							0.93 (0.42–2.05)		0.11 (0.43–2.29)	
Behaviour at baseline										
Poor vs good[a]									0.31 (0.02–0.50)**	
Medium vs good[a]									0.31 (0.07–1.41)	

Table 2. (Continued)

Total sample	Model 1		Model 2		Model 3		Model 4		Model 5	
	OR (95% CI)	smc	OR (95% CI)	smc	OR (95% CI)	smc	OR (95% CI)	smc	OR (95% CI)	smc
Physical exercise										
Sense of coherence	0.99 (0.96–1.02)	ns	0.99 (0. 96–1.03)	ns	1.001 (0.97–1.04)	ns	1.004 (0.97–1.04)	ns	1.01 (0.97–1.05)	*
Gender (male vs female[a])			0.41 (0.14–1.21)		0.44 (0.15–1.32)		0.43 (0.14–1.30)		0.36 (0.12–1.11)	
Age			1.06 (1.003–1.13)*		1.06 (1.003–1.13)*		1.06 (1.002–1.13)*		1.06 (1.002–1.13)*	
Family income[b]										
Low+middle vs high[a]					1.7 (0.77–3.75)		1.66 (0.74–3.75)		1.67 (0.73–3.82)	
Functional status[a]										
Class I							0.76 (0.27–2.12)		0.59 (0.20–1.72)	
Class II							1.21 (0.46–3.21)		1.17 (0.43–3.19)	
Behaviour at baseline										
>4 times / week vs <4 times / week[a]									2.87 (1.11–7.46)*	
Alcohol intake										
Sense of coherence	0.98 (0.95–1.01)	ns	1.00 (0.96–1.03)	***	1.00 (0.96–1.04)	***	1.01 (0.97–1.05)	***	0.99 (0.08–0.80)	***
Gender (male vs female[a])			0.14 (0.05–0.35)***		0. 14 (0.05–0.36)***		0.13 (0.05–0.34)***		0.25 (0.99–1.14)*	
Age					1.04 (0.98–1.10)		1.03 (0.98–1.10)		1.06 (0.13–1.74)	
Family income[b]										
Low+middle vs. high[a]					1.20 (0.52–2.77)		1.10 (0.46–2.59)		1.37 (0.45–3.74)	
Functional status[a]										
Class I							0.4 (0.13–1.26)		0.48 (0.13–1.74)	
Class II							1.17 (0.45–3.04)		1.05 (0.35–3.16)	
Behaviour at baseline										
Non-drinkers vs regular drinkers[a]									18.31 (2.92–114.75)**	
Occasional drinkers vs regular drinkers[a]									0.88 (0.21,3.80)	

CI: confidence interval; smc: significance of the model change for the added variable (improvement of fit of the model due to the addition of the variable concerned (χ2-test)).
[a]reference category; Class III and good nutrition behaviour were set as the reference categories; [b]categories have been merged to prevent empty cells; [c]non-smoking status at baseline remained unchanged at follow-up, thus Model 5 was set up as redundant; *p<0.05; **p<0.01; ***p<0.001.
Note: smoking status was analysed using multinomial logistic regression; healthy diet by ordinal logistic regression; physical exercise and alcohol intake by binary logistic regression.

Table 3. Associations of sense of coherence with smoking status and healthy diet among the percutaneous coronary intervention (PCI) sample: odds ratios (OR) crude, and after inclusion of additional variables (n=64).

PCI sample	Model 1		Model 2		Model 3		Model 4		Model 5	
	OR (95% CI)	smc	OR (95% CI)	smc	OR (95% CI)	smc	OR (95% CI)	smc		
Smoking status (non-smoking vs smoking)[a]										
Sense of coherence	1.02 (0.94–1.11)	ns	0.99 (0.88–1.12)	**	0.99 (0.86–1.12)	*	1.17 (0.91–1.53)	*		
Gender (male vs female[a])			1.35 (1.97–9.24)***		1.08 (1.13–1.04)***		1.15 (9.20–1.43)***			
Age			1.27 (0.98–1.64)		1.31 (0.99–1.74)		2.24 (1.13–4.44)*			
Family income[b]										
Low+middle vs high[a]					0.47 (0.03–8.93)		-			
Functional status[a]										
Class I							-			
Class II							0.81 (0.007–91.38)			
Smoking status (ex-smoking vs smoking[a])										
Sense of coherence	1.08 (0.99–1.17)	ns	1.10 (0.99–1.24)	**	1.11 (0.98–1.25)	*	1.31 (1.02–1.67)*	*		
Gender (male vs female)[a]			3.53 (3.53–3.53)		4.38 (4.38–4.38)		5.30 (5.30–5.30)			
Age			1.13 (0.90–1.42)		1.11(0.87–1.42)		1.78 (0.93–3.40)			
Family income[b]										
Low+middle vs high[a]					1.88 (0.17–21.42)		-			
Functional status[a]										
Class I							1.41 (0.011–185.31)			
Class II							1.87 (0.03–102.81)			
Healthy diet										
Sense of coherence	1.04 (0.90–1.08)	ns	1.07 (1.01–1.13)*	**	1.06 (1.01–1.12)*	*	1.08 (1.01–1.15)*	**	1.07 (1.00–1.15)	ns
Gender (male vs female)[a]			1.12 (0.11–1.23)		0.32 (0.09–1.12)		0.17 (0.04–0.69)*		0.19 (0.04–0.85)*	
Age			0.36 (1.03–1.21)**		1.12 (1.02–1.22)*		1.14 (1.03–1.26)*		1.09 (0.98–1.22)	
Family income[b]										
Low+middle vs high[a]					0.71 (0.21–2.40)		0.68 (0.18–2.61)		0.99 (0.21–4.57)	
Functional status[a]										
Class I							0.63 (0.12–3.33)		0.67 (0.10–4.47)	
Class II							1.14 (0.27–4.77)		1.29 (0.28–6.07)	
Behaviour at baseline										
Poor vs good[a]									0.10 (0.01–1.38)	
Medium vs good[a]									2.04 (0.16–26.29)	

CI: confidence interval; smc: significance of the model change for the added variable (improvement of fit of the model due to the addition of the variable concerned (χ2-test) a).
[a]reference category; Class III and good nutrition behaviour were set as the reference category; [b]categories have been merged to prevent empty cells; *p<0.05, **p<0.01, ***p<0.001.
Note: smoking status was analysed using multinomial logistic regression; healthy diet by ordinal logistic regression: because of the small sample it was not possible to control for smoking status at baseline in the analyses.

In addition, cross-lagged analyses indicated that a high level of SOC at baseline was a significant predictor of both lower alcohol consumption and improvement in alcohol consumption (change) at follow-up among patients treated with CABG (standard score result: –0.04; –0.15, respectively; $p<0.05$). The cross-lagged model linking SOC and alcohol consumption had a good fit to the data (df=5, $\chi^2=39.1$, $p<0.001$; RMSEA=0.00; CFI=1.00; SRMR=0.00) as well as the model linking SOC and change in alcohol consumption (df=5, $\chi^2=92.7$, $p<0.0001$; RMSEA=0.00; CFI=1.00; SRMR=0.00).

Discussion

The aim of this study was to explore the association between SOC at baseline and health-related behaviours (smoking, diet, level of physical exercise and alcohol consumption) at 12–28 months follow-up among patients with invasive and non-invasive treatment for CHD. The most interesting finding of this study is that SOC was a predictor of non-smoking and quitting smoking after adjustment for sociodemographic and clinical characteristics. Furthermore, SOC was a predictor of quitting smoking and healthier nutrition behaviour among patients treated with PCI, but not with CABG or pharmacotherapy. Moreover, we found an association between SOC and alcohol consumption among patients treated with CABG. Lastly, we did not find an association between SOC and physical activity during 12–28 months follow-up.

Previous studies have shown that people in general are aware of the risks and harmful effects of tobacco smoking, alcohol consumption, lack of proper nutrition habits and low levels of physical activity.[43] However, a lack of strong motivation and a lack of readiness among CHD patients to modify their behaviour seems to make it difficult for them to make decisions concerning changes in their health-endangering behaviours.[44] Furthermore, previous studies stress that a change in health-endangering behaviours is determined by many factors which need to be continually explored and taken into account when designing successful interventions. Our study thus shows that SOC could contribute to the evidence-based framework for health promotion among CHD patients, at least among the best-established CHD-related risk behaviours, which are smoking together with dietary fat.[45]

Our findings that SOC was a predictor of non-smoking, quitting smoking, healthier nutrition behaviour and lower alcohol consumption are consistent with previous studies[2,3,20] and with Antonovsky's theory.[9] Individuals with a strong SOC may be better able to adopt healthy behaviours and more likely to respond to health-related advice. In addition, individuals with a weak SOC may engage in less healthy behaviours because they are less able to deal with everyday stress.[15]

The lack of the association between SOC and the frequency of physical activity contradicts the results of the study by Bergman et al.[20] The results of their longitudinal study showed that persons with a first myocardial infarction and with high SOC scores were more physically active compared with those with medium or low SOC. An explanation may be that SOC affects the frequency of physical activity more in patients with an acute state of disease, such as first myocardial infarction, than in patients with a stable CHD. Another possible explanation might be that in our study we used a structured interview to obtain information about health behaviours, while in the Bergman et al. study self-administered questionnaires were used. Results of the study by Durant and Carey suggest that both face-to-face interview and self-administered questionnaires obtain equally reliable answers about health-endangering behaviours, but that self-administered questionnaires may elicit more accurate responses, at least for some behaviour.[46] However, the cognitive burden during an interview is low,[47] and thus this was chosen as the best mode of questionnaire administration in hospitalised patients waiting for invasive treatment (CAG).

Strengths and limitations

The strengths of our study are that it was based on a sample covering the full range of CHD patients referred for CAG and had a high response rate at baseline (97.8%). Additionally, we used a longitudinal design, which allowed us to measure whether SOC was a predictor of improvements in health-related behaviours at 12–28 months follow-up by controlling for baseline health-related behaviours. However, in interpreting our data, one has to consider certain limitations. In the present study, the data collection period was long due to the limited capacity for follow-up. As a result, patients were included at random when research capacity was available, i.e. independent of the clinical or mental status of patients. The cardiologists involved in the data collection could collect the follow-up data (e.g. medical information from medical records, measurement of blood pressure and electrocardiography) for only one patient per week. This led to the data collection period lasting a long time, i.e. from 2004–2008.

Another possible limitation may be patients' self-reported health-related behaviours, which could be subject to information bias. To reduce the likelihood of bias, patients were guaranteed that their physician would not see their responses. Next, the overall response rate for the follow-up was 59.6%; however, respondents and non-respondents did not differ regarding SOC ($p=0.81$), which makes selection bias less likely. Another limitation may be the variation in time to follow-up between subjects. However, the time to follow-up did not depend on the clinical or mental status of patients but was merely due to logistical variation, making bias due to this variation less likely. Lastly, women in our sample were underrepresented at baseline.

Implications

We found that SOC was a predictor of non-smoking, quitting smoking, healthy nutrition behaviour and alcohol consumption. Our study thus complements the previous evidence that SOC may be an important target in secondary prevention, not only among CHD patients[48,49] but also among other groups of cardiac patients (e.g. congenital heart disease).[42,50] Special attention should thus be paid in health promotion to those with low SOC in these patient groups. The three-item SOC instrument is a good alternative for use in daily practice compared with the relatively lengthy 13-item OLQ.[25] Health care professionals might be able to use information on patients' SOC to improve these patients' health-related behaviours by concentrating on the three components of SOC: comprehension, manageability and meaningfulness. Psychological interventions,[11] such as talk-therapy groups,[12] social exchanges,[13] mindfulness-based stress reduction programmes[12] and individualised psychoeducational programmes based on dialogue,[14] may be promising interventions to achieve this aim.

Additionally, as it seems that comprehension is the most important component of SOC change,[51] health care professionals should ensure that patients receive sufficient and comprehensible information about their disease, including its prevention (by changes of health-related behaviour) and treatment. In turn, a proper understanding of each aspect of CHD provides a patient with a feeling of control over his or her own life and thus increases meaningfulness.[44]

Moreover, our findings should be replicated, as studies assessing the predictive relationships between SOC and the improvement of health-related behaviours among patients with different treatment of CHD are scarce. Such studies should perform cross-lagged analyses to identify the predominant direction of effects over time. Underlying mechanisms could also be included in such replications. Furthermore, the effectiveness of the interventions mentioned regarding SOC deserves additional study.

Conclusion

The results of this study highlight the importance of SOC as a predictor of health-related behaviours among CHD patients. A new finding is that high SOC promotes non-smoking and stopping smoking among all CHD patients, healthier nutrition behaviour among patients treated with PCI and lower alcohol consumption in patients treated with CABG. This knowledge may help in targeting the education process of patients with CHD.

Implications for practice

- Patients with low SOC are less likely to improve health behaviours
- Health care professionals could try improve low SOC by psychological interventions
- Such interventions are talk-therapy groups, social exchanges and psychoeducational programmes

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Conflicts of interests

The authors declare that there are no conflicts of interest.

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