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Sense of coherence as a mediator between hostility and health-related quality of life among coronary heart disease patients

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ABSTRACT

Objectives: To explore the association between hostility and health-related quality of life (HRQoL) among coronary heart disease (CHD) patients, and whether these associations are mediated by sense of coherence (SOC).
Background: Intervention research has shown that a decrease in levels of hostility leads to an increase of HRQoL among individuals with CHD. However, the mechanisms that link hostility and HRQoL in CHD patients are not clear.
Methods: 509 CHD patients (mean age 58.8 ± 7.3, 29.3% female) were examined.
Results: Hostility was associated with poorer mental HRQoL. Adding SOC to the model weakened the strength of the association between hostility and mental HRQoL. The effect of hostility on mental HRQoL was explained for 61.9% by SOC. Neither hostility nor SOC was associated with physical HRQoL.
Conclusions: Our findings indicate that low SOC may partially explain the adverse effect of hostility on low mental HRQoL in CHD patients.

Introduction

Coronary heart disease (CHD, also called ischaemic heart disease) remains the leading cause of death in Europe with significant differences in mortality rates between countries. Death rates from CHD are generally higher in Central and Eastern Europe than in Northern, Southern and Western Europe.[1] Therefore both clinicians and policy makers need to be aware of these differences between countries. Their decisions concerning prevention and treatment of CHD should rely on the data collected in a specific country or area.

Along with the increased importance of prevention, health-related quality of life (HRQoL) has gained attention and become an important outcome in patients with CHD.[2–4] For example, poor HRQoL has been shown to be independently associated with both onset and progression of CHD.[5–7] HRQoL is at present recognised as a clinically relevant construct useful for assessment of the impact of CHD on patient, the effectiveness of interventions and the risk for future CHD.

Hostility, among many psychosocial factors, has been studied regarding its role in the aetiology and prognosis of CHD.[8,9] In general, hostility may be characterised as a negative orientation toward interpersonal transactions and includes traits such as cynicism, anger, mistrust and aggression.[10] Recent meta-analyses have shown that the combined estimate for anger and hostility was associated with a modest but significant 19% increase in CHD incidence in initially healthy populations (25 studies) and a 24% increase in recurrent CHD events in patients with pre-existing CHD (19 studies).[11] Intervention research has shown that a decrease in levels of hostility leads to an increase of HRQoL after an acute heart attack and after cardiac surgery.[12–14] However, the mechanisms that link hostility and HRQoL in CHD patients are not clear.[15]

One of the mechanisms linking hostility and CHD outcomes including HRQoL may be sense of coherence (SOC) via its impact on coping.[15,16] According to Antonovsky,[17–19] high SOC enables a

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person to react with flexibility to demands and to activate the appropriate resources for specific situations. SOC is postulated to have three components: comprehensibility, manageability and meaningfulness. A link between hostility and HRQoL via SOC is likely, as the levels of SOC stabilise during adulthood and may be shaped by the levels of hostility which usually develop during childhood.[17–19] A study conducted among 841 females[16] showed that hostility predicted low SOC at 3-years follow-up, which in turn predicted sick leave taken by employee (1–3 years later) and self-rated health (4 years later). Another study[15] conducted among 774 hypertensive participants showed that the association between cynicism, the cognitive component of hostility and HRQoL was totally accounted for by SOC.

The number of studies on hostility and SOC among CHD patients is limited, and studies on the mediating role of SOC between hostility and HRQoL are entirely lacking based on data collected in Central or Eastern Europe. Thus, this study aimed to explore the association between hostility and HRQoL among CHD patients, and whether this association is mediated by SOC crude and adjusted for potentially confounding sociodemographic and clinical variables. Potential confounders were age,[20–22] sex[20,23] and functional status.[24]

Methods

Sample and procedure

We recruited participants from the East Slovakian Institute for Cardiac and Vascular Diseases in Kosice, as part of the ongoing, observational study 'Social class and its impact on patients' functional status and recovery process' that investigates health differences between the Roma and non-Roma population. Participants were potentially eligible if they were referred for coronary angiography (CAG) by their cardiologist and aged less than 75 years at the time of enrolment. Additionally, they were excluded if they have a diagnosis of severe cognitive impairments in the medical history (e.g. dementia of the Alzheimer's type, vascular dementia, amnestic disorders), a diagnoses of psychiatric disorders in the medical history (e.g. substance-related disorders, schizophrenia and other psychotic disorders or mood disorders including depressive disorder and bipolar disorder), cardiovascular problems other than CHD (e.g. valve disease), a normal CAG and a serious co-morbidity (such as malignancies and nervous system diseases).[25–27] All data were collected the day before the CAG during participants' hospitalisation. Sociodemographic data were collected via an interview conducted by a psychologist or trained research assistant. Medical data were retrieved from the medical records, and patients also completed self-administered questionnaires on hostility, SOC and HRQoL. For the purpose of this study, we used baseline data collected among non-Roma patients.

Between November 2004 and December 2012 approximately 5000 patients scheduled to undergo CAG, mostly living in eastern Slovakia, satisfied the inclusion criteria for this study. Out of these, we randomly selected 762 potential participants after pre-stratification by socioeconomic status (measured by educational level: low, middle, high) to obtain equal numbers per stratum.

The study was approved by the Ethics Committee of the East Slovakian Institute for Cardiac and Vascular Disease in Kosice in November 2004. All participants were provided with information about the study and all signed an informed consent statement prior to the study. Participation in the study was fully voluntary and anonymous, with no incentives provided for participation. The investigation conforms with the principles outlined in the Declaration of Helsinki.[28]

Measures

We used the 27-item Cook-Medley hostility scale (CMHS)[10] to assess hostility. This scale is a shorter form of the original 50-item Cook-Medley hostility scale.[29] The 27-item CMHS comprises of three subscales: cynicism, hostile affect and aggressive responding reflecting the cognitive, behavioural and mood components of hostility. Barefoot et al[10] showed that the combination of these three subscales was better predicting mortality than any individual subscale of the original CMHS. Each item was rated on a dichotomised scale (1 = "true", 0 = "false"). We calculated the total sum score, with a higher score indicating a higher level of hostility. The validity and internal consistency of the CMHS were high.[10] In the present study, Cronbach's alpha was 0.71.

We assessed SOC using the 13-item Orientation to Life Questionnaire (OLQ).[17] The questionnaire consisted of three sub-dimensions: 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 7-point Likert scale (1 = never, 7 = always). Negatively-worded items were reverse-coded. We calculated the total sum score, with a higher score indicating a stronger SOC. The validity and internal consistency of the OLQ were high.[19,30] In the present study, Cronbach's α was 0.74.

We measured HRQoL with the Short Form Health Survey Questionnaire (SF-36). The SF-36 scale was used internationally as a generic measure of self-reported physical and mental HRQoL.[31] It consists of 36 items covering eight primary dimensions of subjective health perceptions. These included physical functioning, role limitations due to physical problems, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems and mental health. Subscale scores and summary scores (the mental component summary – MCS and the physical component summary – PCS) were calculated using published algorithms[31] in which higher scores indicated better functioning. We used means, standard deviations and weights from the general U.S. population. The SF-36 scale was well tested and had satisfactory psychometric properties and international comparability, also among cardiac patients.[32]

Age was divided in this study into two groups, using median age (59.0 years) as the cut-off: 32–59 and 60–75.

Severity of CHD was defined by functional status. Functional status was assessed by a cardiologist based on 2 scales: the NYHA – 4 classifications according to the New York Heart Association classification of dyspnoea symptoms,[33] and the CCS – 4 classifications identifying the severity of chest pain according to the Canadian Cardiovascular Society.[34] In both scales, a higher score represents a worse functional status. In this study functional status was calculated using both scales in such a way that the worst score on either of these two scales was used to define the severity of CHD.

In the present study, all questionnaires were administered in Slovak language. The process of translation was based on published guidelines for translation and cultural adaptation of self-report measures.[35] As a first step, two people translated questionnaires independently from each other from English into Slovak language (forward translation). Next, the translation resulting from previous step was given to two translators whose mother tongue was English without an access to the original questionnaire. Both translators were asked to translate back the questionnaire from Slovak language to English (backward translation). Final changes in the translated version were then made accordingly.

Statistical analysis

All statistical analyses were performed using the statistical software IBM SPSS 21.0 for Windows. As a first step, we computed baseline statistics (prevalence rates and means) for the background characteristics, MCS-, PCS-, CMHS- and SOC-scores. Next, we performed hierarchical regression analyses and the Sobel test (Aroian version) to test whether the level of SOC mediates the relationship between hostility and MCS, PCS.[36] We assessed three models. Model 1 tested the crude effect of hostility on MCS and PCS, and Model 2 tested the effect of hostility when controlling for gender, age and functional status. In Model 3, SOC was added as a mediator. The association between hostility and SOC was tested using hierarchical regression analyses. Model 1 tested the crude effect of hostility on SOC and Model 2 tested the effect of hostility when controlling for gender, age and functional status. According to Baron and Kenny,[36] the following conditions must be met in order to establish mediation: the independent variable (hostility) must affect the dependent variable (MCS, PCS); secondly, the independent variable must affect the mediator (SOC); and lastly, the mediator must affect the dependent variable.

In the present study only participants with non-missing variables were analysed. The missing data were for the variables of interest as follows: hostility 25.9% and SOC 17.1%. There were no significant differences regarding MCS (Mann–Whitney U test, $p = 0.10$) and PCS (Student's t-test, $p = 0.30$) between those with non-missing information on both hostility and SOC (344 participants, 67.6%) and those with missing information. The potential impact of missing data was explored in sensitivity analyses using a multiple imputations (5) for missing data.

Results

Out of the selected participants, 729 (response rate: 95.7%) agreed to participate in this study. Subsequently, 220 (30.2%) patients were excluded because they had a normal CAG. Thus, the sample consisted of 509 patients: 360 males (70.7%) and 149 females (29.3%), with ages ranging from 32 to 75 years (mean = 58.77; SD = 7.3). 38% of the patients were treated with percutaneous coronary intervention (PCI), 31% with pharmacotherapy and 31% with coronary artery bypass grafting (CABG). 36.7% of participants had a history of diabetes mellitus, 5.7% of stroke and 2.6% of chronic kidney disease. The background characteristics and MCS-, PCS-, CMHS- and SOC-scores are presented in Table 1.

The mediating effect of SOC on the relationship between hostility and PCS/MCS

Table 2 shows that hostility was significantly associated with lower MCS-scores crude (Model 1) and also when adjusted for age, gender and functional status (Model 2). Hostility was significantly associated with lower SOC-scores crude ($B = -1.05$; [−1.34; −0.75]) and adjusted for age, gender and functional status ($B = -1.02$; [−1.32; −0.73]). Additionally, SOC was associated with higher MCS-scores and weakened the relationship between hostility and MCS-scores (Model 3).

Hostility as well as SOC was not significant predictors of PCS (Model 1, Model 2, and Model 3).

The Sobel test (−5.75; $p < 0.001$) confirmed a statistically significant indirect effect of SOC on MCS via hostility (Fig. 1). The proportion mediated method showed that the effect of hostility on MCS was explained for 61.9% by the indirect path hostility – SOC – MCS and for 38.1% by the direct path hostility – MCS.

Table 1
Background characteristics of the sample; sociodemographic and clinical data, hostility, sense of coherence and health-related quality of life components.

Variable	N	%
Gender		
Male	360	70.7%
Female	149	29.3%
Age		
32–59	237	46.6%
60–75	272	53.4%
NYHA classification		
Class I	129	25.3%
Class II	94	18.5%
Class III	104	20.4%
Class IV	11	2.2%
CCS classification		
Class I	77	15.1%
Class II	140	27.5%
Class III	166	32.6%
Class IV	47	9.2%
Type of intervention		
Pharmacotherapy	160	31.4%
PCI	193	37.9%
CABG	156	30.6%
Coronary findings		
Nonsignificant	7	1.4%
One-vessel disease	165	32.4%
Two-vessel disease	161	31.6%
Three-vessel disease	155	30.5%
Normal	4	0.8%
Hostility	377	
Mean (±SD)		14.60 (±3.66)
5th and 95th percentile		8.9–21.0
Sense of coherence	422	
Mean (±SD)		64.96 (±10.99)
5th and 95th percentile HRQoL		47.0–83.0
Health-related quality of life		
Mental Component Summary SF36: mean (range)	443	
Mean (±SD)		47.26 (±9.66)
5th and 95th percentile		31.18–62.06
Physical Component Summary SF36: mean (range)	443	
Mean (±SD)		36.39 (±10.14)
5th and 95th percentile		21.33–54.37

Abbreviations: CCS – the Canadian Cardiovascular Society grading of angina pectoris; NYHA – New York Heart Association Functional Classification; PCI – percutaneous coronary intervention; CABG – coronary artery bypass grafting.
Note: The percentage of missing values for each variable were: gender 0%; age 0%; NYHA 33.6%; CCS 15.5%; type of intervention 0%; coronary findings 3.3%; hostility 25.9%; sense of coherence 17.1%; mental and physical component summary of SF36 13.1%.

Discussion

The main aim of this study was to explore whether hostility was associated with both mental and physical HRQoL among CHD patients, and whether this association was mediated by SOC. We found that high levels of hostility were strongly associated with a worse mental HRQoL and a low SOC in CHD patients, crude and when adjusted for age, gender and functional status. Additionally, a low SOC was associated with a worse mental HRQoL when adjusted for age, gender and functional status but not with physical HRQoL. Lastly, our results indicate that SOC mediated the association between hostility and mental HRQoL.

Our findings on the relation between hostility and HRQoL are in line with a recent critical review by Pragodpol and Ryan[37] which reported that hostility was a negative predictor of HRQoL in newly diagnosed patients with CHD. Interestingly, in our study hostility was not a predictor of worse physical HRQoL. Other psychological variables, such as depression, anxiety, and social isolation,[37] should be taken into account as possible determinants of physical HRQoL in CHD patients. However, it is also possible that physical

Table 2
Associations of hostility and sense of coherence with mental and physical health-related quality of life among 336 coronary heart disease patients.

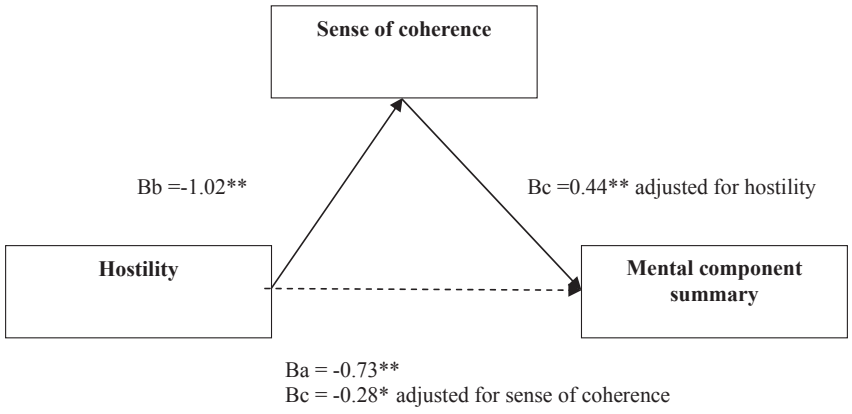
	Model 1		Model 2		Model 3	
	B (95% CI)	smc	B (95% CI)	smc	B (95% CI)	smc
Mental component summary (MCS)						
Hostility	−0.80 (−1.06, −0.53)***	***	−0.73 (−0.99, −0.47)***	***	−0.28 (−0.52, −0.04)*	***
Hostility[a]	−0.75 (−1.00, −0.50)***		−0.72 (−0.97, −0.46)***		−0.26 (−0.51, 0.001)	
Sense of coherence[b]					0.44 (0.36, 0.52)***	
Sense of coherence[a]					0.41 (0.33, 0.50)***	
Physical component summary (PCS)						
Hostility	−0.17 (−0.47, 0.12)		−0.05 (−0.32, 0.21)	***	0.002 (−0.28, 0.29)	
Hostility[a]	−0.11 (−0.38, 0.17)		0.01 (−0.25, 0.26)		0.07 (−0.22, 0.35)	
Sense of coherence					0.05 (−0.05, 0.15)	
Sense of coherence[a]					0.05 (−0.05, 0.15)	

Model 1: crude; Model 2 adjusted for age gender, and functional status; Model 3 adjusted for age, gender, functional status and sense of coherence.
R^2 in MCS: Model 1:0.10; Model 2: 0.16; Model 3: 0.37; R^2 in PCS: Model 1:0.004; Model 2: 0.22; Model 3: 0.22; R^2 change in MCS: Model 1:0.10; Model 2: 0.06; Model 3: 0.21; R^2 change in PCS: Model 1:0.004; Model 2: 0.21; Model 3: 0.003.
smc – Significance of model change for the added variable(s); Improvement of fit of the model due to the addition of the variable concerned the *F* change test.
$^{*}p < 0.05$, $^{***}p < 0.001$.
[a] After multiple imputation of the missing data.
[b] Sobel test: −5.75; $p < 0.001$.

conditions (such as functional status) are more important predictors of physical HRQoL than psychological factors. This study clearly indicates that it is important to distinguish between mental and physical HRQoL, as it seems that the same variable may play different role in these two components of HRQoL. This may have consequences not only for further research but also for developing interventions.

Moreover, we found that higher levels of hostility were strongly associated with a low SOC in CHD patients, which is in line with previous studies.[15,16] Until now, only limited attention was paid to the mechanisms explaining relationship between SOC and hostility. A possible mechanism might be that high SOC is associated with the ability to control the expression of anger and with low levels of suppressed or openly expressed anger.[15] Another explanation of the link between hostility and SOC is discussed by Kivimaki et al,[16] who proposed that the behavioural, psychophysiological and interpersonal models of hostility might reflect individual dimensions of SOC (low manageability, incomprehensibility, and lack of meaningfulness). The results of the present study as well as previous studies indicate that SOC may have an important relationship to other psychological predictors of CHD, such as hostility. The results of the present study as well as previous studies indicate that SOC may have an important relationship to other psychological predictors of CHD, such as hostility. This relationship deserves not only further attention in research, but it also provides an opportunity for developing interventions.

In our study, hostility was inversely associated with SOC, which in turn was associated with poor mental HRQoL. This study shows that most of the adverse effect of hostility on poor mental HRQoL is mediated via SOC (approximately 62%). Evidence indicates that



Model a tested the effect of hostility on mental component summary
Model b tested the association between hostility and sense of coherence
Model c tested the effect of hostility on mental component summary when mediator (sense of coherence) was added into the model
Note: all associations are adjusted for gender, age and functional status
*p<0.01, **p<0.001

Fig. 1. Assessment of the mediating role of sense of coherence in the association between hostility and the mental component summary of the Short Form Health Survey Questionnaire.

possible mechanisms regarding how hostility may influence CHD outcomes include the activation of stress response systems (autonomic dysfunction, inflammation, immunosenescence, thrombogenesis), the continuation of unhealthy behaviours (e.g. smoking, alcohol consumption) (for a review, see Ref. 13) or psychological factors, such as lower social support, more use of maladaptive coping and more severe depressive symptoms.[14] Thus, our finding that most of the adverse effect of hostility on poor mental HRQoL was mediated via SOC provides another possible mechanism regarding the impact of hostility on HRQoL. Longitudinal studies have found similar results; in particular a study by Kivimaki et al[16] confirmed the mediating role of SOC in the association between hostility and health and a study by Julkunen and Ahlstrom[15] the mediation role of SOC between hostility and HRQoL. Despite the cross-sectional character, the present study complements these findings in several important ways. Firstly, in this study we included the whole spectrum (regarding gender, age and severity of disease) of patients with developed CHD, while a study by Kivimaki et al[16] included full-time female municipal workers, and a study by Julkunen and Ahlstrom[15] included a high-risk sample of people with elevated blood pressure. In addition, in our study both HRQoL and hostility were measured using the questionnaires which are used by the majority of researchers. Moreover, according to our knowledge, this is the first study exploring mediating role of SOC between hostility and HRQoL based on the data collected in Central Europe. If causal, our findings have considerable implications for clinicians and policy decisions concerning prevention of CHD. Therefore our results are deserving of additional study to confirm them.

Strengths and limitations

The strengths of this study are its high response rate (95.7%) and the valid and reliable measurement of the relevant variables. However, in interpreting our data one has to consider certain limitations. One of these is a potential information bias regarding self-reported hostility, due to the tendency to provide socially acceptable answers.[38] Next, in the present study we used the 27-item CMHS[10] to assess hostility, i.e. the best version at the moment of starting the study. At present, there are many versions of the CMHS and a recent study among 656 male participants with stable CHD found that a 7-item version of Williams subscale and the 39-item Barefoot composite subscale were most strongly associated with mortality.[39] Standardising the assessment tool for hostility deserves research attention to improve our understanding of the role of hostility in both aetiology and progression of CHD. Thirdly, the cross-sectional nature of this study does not allow conclusions about causality in the relationships between hostility, SOC and HRQoL. Next, 32.4% of participants provided incomplete questionnaire either on SOC or hostility; however there were no significant differences between those with non-missing information and those with missing information regarding MCS ($p = 0.10$) and PCS ($p = 0.30$) which makes selection bias less likely. In addition we repeated the analyses after multiple imputations of the missing data. That led to roughly the same results. Lastly, in the present study, the data collection period was long due to the limited research capacity. As a result, patients were included at random when research capacity was available, i.e., independent of the clinical or mental status of patients, making bias due to the length of data collection less likely.

Implications

The results of our study indicate that most of the adverse effect of hostility on low mental HRQoL runs via SOC. This provides two routes to prevent CHD and to improve its prognosis, i.e. by increasing SOC or decreasing hostility. A significant increase in SOC could be gained by mindfulness-based stress reduction programmes,[40] individualised psychoeducational programmes based on dialogue,[41] talk-therapy groups[42] and social exchanges. In addition, feelings of hostility may be decreased by cognitive behavioural therapy,[43] group-based hostility-control interventions and behavioural modifications.[10] Because studies assessing the predictive relationship between hostility, SOC and HRQoL are scarce, we recommend that our study be replicated with a larger sample from different hospital settings.

Conclusions

Our study indicated that both high levels of hostility and low levels of SOC are associated with poor mental HRQoL. Low SOC may thus be an important factor partially explaining the adverse effect of hostility on low mental HRQoL in CHD patients. However, our findings need to be confirmed. The knowledge gained could help to develop strategies that help patients cope with CHD, and in turn, improve their HRQoL.

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