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ORIGINAL ARTICLE

Sense of coherence and periodontal health outcomes

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ABSTRACT

Objective: Sense of Coherence (SOC) has been associated with perceived oral health measures, but the contribution of SOC to clinical measures is still unclear. The aim of the present cross-sectional study was to evaluate the potential association between periodontal health outcomes, such as periodontal clinical parameters and perceived periodontal health, and SOC. **Materials and methods:** The study sample comprised 276 individuals, aged 18–60 years, from Belo Horizonte, Brazil. Participants answered questionnaires covering sociodemographic variables, self-perceived periodontal health and SOC. Full-mouth periodontal examinations were performed. The sample was divided into three groups according to SOC score: (a) SOC1 = weak (24–46); (b) SOC2 = moderate (47–51); (c) SOC3 = strong (52–65). Multivariate analyses including appropriate logistic or linear regression models were performed to evaluate the association between periodontal health outcomes and biological, sociodemographic and behavioural variables. **Results:** Perceived general oral health was associated with family income bracket ($p = 0.010$), smoking ($p = 0.004$), dental flossing ($p = 0.017$) and SOC (weak SOC: $p = 0.005$). Perceived gum disease and perceived periodontal disease were associated with SOC (weak SOC: $p = 0.001$ and $p = 0.015$, respectively). **Conclusions:** Overall, perceived periodontal health outcomes were associated with SOC. However, no association between clinical periodontal health outcomes and SOC were observed.

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Introduction

The salutogenic theory, proposed more than 30 years ago,[1] is based on the relationship between health, stress and coping. One core concept that is essential in the *salutogenic theory* is the Sense of Coherence (SOC). SOC is a theoretical formulation that provides a central explanation for the role of stress in human functioning and health. It has three major components: comprehensibility (cognitive), manageability (instrumental/behavioural) and meaningfulness (motivational).[1–3]

The theory considers that diseases and stressors are inherent to the human condition and that the stronger the SOC of individuals, the more adequately they cope with those conditions and, therefore, maintain health.[2] Hence, SOC may influence habits and behaviours that directly interfere in health. One potential mechanism linking SOC to health is health-related behaviours.[1,4,5]

Several findings demonstrated that a higher SOC was associated with better health.[6–11] Nevertheless, there is no clear determination of the appropriate cut-off point where SOC loses its protective effect. In general, SOC is divided in weak or strong and there is no value determined to be normal. Individuals with a strong SOC can handle stressful situations and stay better than individuals with a weak SOC.[3]

SOC was positively related to self-reported oral health-related behaviours [7,9,10,12] and perceived oral health measures.[7,13,14] There is some evidence that subjects with strong SOC have a higher number of present teeth, a lower number of teeth with restorations, as well as a better perception of health.[10] The association between SOC and periodontal conditions such as gingivitis [8] and periodontal pockets [10,15] was previously demonstrated. However, SOC was not associated with periodontal pockets in a 4-year follow-up study.[16] Therefore, the contribution of SOC to clinical measures of adult periodontal health is worth more studying.

Consequently, it is important to evaluate the relationship between SOC and periodontal health outcomes in different populations in order to clarify this issue.[10] SOC may have an impact on oral health since it reflects a person's way of acting and living within his/her own life context.[15]

The hypothesis of the present study was that SOC is associated with periodontal health outcomes, that is, individuals with a strong SOC may present better periodontal health when compared to those with a weak SOC. The aim of the present study was to evaluate the potential association between SOC and periodontal health outcomes, such as gingivitis, periodontitis and periodontal clinical parameters in a sample of Brazilians. In addition, the association between SOC and perceived periodontal health was also evaluated.

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Materials and methods

Study design, settings and participants

The present study had a cross-sectional design. the study sample comprised individuals from the city of Belo Horizonte, Minas Gerais, Brazil. Participants were enrolled among employees of a large corporation in five different company units from different demographic regions, during November 2009–April 2010. In total, 2800 individuals were determined eligible for the study and contacted during their annual medical routine examinations. These individuals were also invited to participate in the study by printed and electronic communications, lectures and posters at the company units of the study. A total of 629 individuals met the inclusion criteria: (1) 18–60 years of age; (2) dentate. Sample age range was defined based on the fact that SOC precipitous decline with ageing over the second half of life.[17] From this total, 300 individuals were then randomly chosen by lottery and invited to undergo clinical examination and to complete a questionnaire. Sixteen individuals refused to participate. In addition, eight SOC questionnaires were incompletely answered and were discarded. Therefore, the final convenience sample comprised 276 individuals with complete examinations. Sample size was estimated based on a prevalence of periodontitis ~30% in the Brazilian general population, defined as clinical attachment level >3 mm in > 4 teeth.[18] It was calculated according to the 95% confidence interval and a variation of 5% around this prevalence rate. In this manner, sample size ~300 subjects were determined to be necessary.

Participants were informed of the aims of the study and provided a written informed consent prior to their participation in the study. Subjects' rights were protected at all times. The present study was approved by the Federal University of Minas Gerais Ethics Research Committee (COEP/UFMG protocol #ETIC 0583.0.203.000-09).

Questionnaires and data collection

The SOC questionnaire used in the present study was the short version previously validated.[19] This short version comprises 13 items in three dimensions: comprehensibility (five items), manageability (four items) and meaningfulness (four items). For the use in the Brazilian population, the original 7-point Likert scale [19] was adjusted in a trans-cultural adaptation to the Portuguese language into a 5-point Likert scale.[20] Therefore, the SOC scale ranged from 1–5 and the sum of the scores could vary from 13–65, with the greater values corresponding to a greater ability of adaptation to stressful situations.

Participants also answered a set of periodontal self-reported items,[21] related to general oral health, gum disease and periodontal disease. Questionnaires, including SOC and self-reported items, were applied by a single trained periodontist (R.M.C.), just before the clinical examination.

Moreover, data related to age, gender, educational level, family income bracket, smoking, diabetes and oral hygiene habits were collected.

Clinical examination

Clinical examinations were performed at the medical department of the respective units of the study. Full-mouth periodontal examinations were all performed by a single trained and calibrated periodontist (R.M.C.), using a manual periodontal probe (PCPUNC-15 North Carolina, Hu-Friedy, Chicago, IL) in proper ergonomic, lighting and infection-control conditions. Periodontal parameters including probing depth (PD), clinical attachment level (CAL), bleeding on probing (BOP), plaque index (PI) [22] and gingival index (GI) [23] were recorded. PD and CAL were measured at six sites per tooth and the highest values were recorded for mesial, distal, lingual and buccal sites. For intra-examiner agreement, measurements of PD and CAL were performed and repeated within a 1-week interval for 10 subjects randomly selected from the study sample. Results showed weighted kappa values >0.89 and intra-class correlation coefficient > 0.87. Agreement values were determined to be appropriate (very good).

Statistical analysis

Initially, a sample was described regarding variables of interest. For this purpose, individuals were divided according to SOC score tertiles. Therefore, three groups were formed: (a) SOC1 = weak (24–46); (b) SOC2 = moderate (47–51); and (c) SOC3 = strong (52–65). Univariate analyses were performed to compare the study groups in relation to variable of interest.

Subsequently, multivariate analyses including appropriate logistic or linear regression models were performed to evaluate the association between periodontal health outcomes (dependent variables) and biological, sociodemographic and behavioural variables (independent variables).

In this manner, logistic regression for binary outcomes included as dependent variables for the multivariate models: (1) perceived oral health—(1a) perceived general oral health [good/poor (Overall, how would you rate the health of your teeth and gums?)]; (1b) perceived gum disease [yes/no (People with gum disease might have bleeding in the gums around the teeth, swollen gums or sore or infected gums that last for 2 weeks or more and is not caused by injury or problems with partial or complete dentures. Do you think you might have gum disease?)]; (1c) perceived periodontal disease [yes/no (Have you ever had any teeth that became loose on their own, without any injury, or have you ever noticed that your front teeth have moved forward—toward the lip—or that gaps have developed between your front teeth?)]; (2) gingivitis—(2a) ≥ 10% of sites with BOP; (2b) ≥ 30% of sites with BOP; (2c) ≥ 50% of sites with BOP; (3) periodontitis—(3a) ≥ 4 teeth with at least one site with PD ≥ 4 mm and CAL ≥ 3 mm;[24] (3b) interproximal PD or CAL ≥ 4 mm at ≥ 2 sites not on the same tooth;[25] (3c) proximal CAL ≥ 3 mm in ≥ 2 non-adjacent teeth.[26]

Linear regression for continuous outcomes included as dependent variables for multivariate models: (1) periodontal parameters—(1a) plaque index; (1b) gingival index; (1c) number of teeth; (1d) mean probing depth; (1e) mean clinical attachment level. Mean PD and CAL were calculated across all sites.

Independent variables for each multivariate logistic or linear models included: (a) age (years); (b) gender (male/female); (c) educational level (< 12/≥ 12 years of schooling); (d) family income bracket [< 5/> 5 BMS (Brazilian minimum salary)]; (e) smoking (yes/no); (f) diabetes (yes/no); (g) dental flossing (yes/no); (h) frequency of tooth brushing (1/≥ 2 times daily); (i) last dental check-up (up to 1/≥ 1 year); and (j) SOC [tertiles (weak/moderate/strong)]. All independent variables were selected and included in the initial full models. For the final version models, variables were manually removed or put back, step-by-step in a theory-driven manner and retained if significant. Although smoking and diabetes are well-known risk factors associated with periodontal status, they were retained in the models only if significant; smoking and diabetes were not forced in the models since any significant variation in the coefficients of the retained variables was observed.

Results

The study sample comprised 202 males and 74 females with a mean age of 37.36 ± 12.05 years. Characteristics of the sample and SOC groups regarding variables of interest are presented in Table 1. Differences among the groups were observed in relation to gender and family income bracket.

Multivariate logistic models for perceived oral health are presented in Table 2. Perceived general oral health (poor health) was associated with family income bracket < 5 BMS, smoking, no use of dental floss and weak SOC. Perceived gum disease was associated with weak SOC. Perceived periodontal disease was associated with weak SOC.

Table 3 shows multivariate logistic models for gingivitis. Model 1 (gingivitis: ≥ 10% of sites with BOP) retained age and no use of dental floss. Model 2 (gingivitis: ≥ 30% of sites with BOP) retained family income bracket < 5 BMS. Model 3 (gingivitis: ≥ 50% of sites with BOP) retained last dental check-up ≥ 1 year.

Table 4 shows multivariate logistic models for periodontitis. Model 1 (periodontitis: four teeth with at least one site with PD ≥ 4 mm and CAL ≥ 3 mm) retained age, last dental check-up ≥ 1 year and no use of dental floss ($p < 0.001$). Model 2 (periodontitis: interproximal PD or CAL ≥ 4 mm at ≥ 2 sites not on the same tooth) retained age, last dental check-up ≥ 1 year and no use of dental flossing. Model 3 (periodontitis: proximal CAL ≥ 3 mm in ≥ 2 non-adjacent teeth) retained age and no use of dental flossing ($p = 0.013$).

Multivariate linear models for periodontal clinical parameters are presented in Table 5. Plaque index was associated with age, male gender, family income bracket < 5 BMS and no use of dental flossing. Gingival index was associated with age, family income bracket < 5 BMS and last dental check-up ≥ 1 year. Number of teeth was associated with age, family income bracket < 5 BMS and smoking. Mean probing depth was associated with age and no use of dental flossing. Mean clinical attachment level was associated with age, educational level < 12 years of schooling, family income bracket < 5 BMS and no use of dental floss.

Discussion

Findings from the present study demonstrated that SOC was associated with perceived general oral health, perceived gum disease and perceived periodontal disease. However, it was also demonstrated that SOC was not associated with clinical periodontal health outcomes.

Clinical outcomes such as different definitions of gingivitis and periodontitis, plaque index, gingival index, probing depth and clinical attachment level were not associated with SOC in the present study. In contrast, it was previously demonstrated that SOC was associated with periodontal pockets,[10,15] calculus, dental plaque and filled and decayed surfaces [15].

Table 1. Sample characteristics according to SOC groups.

Variables	Total sample ($n = 276$)	Weak SOC ($n = 111$)	Moderate SOC ($n = 79$)	Strong SOC ($n = 86$)	p
Age	37.4 ± 12.1 (18–60)	37.9 ± 12.0 (18–60)	38.6 ± 11.4 (18–60)	35.6 ± 12.6 (18–60)	0.231
Gender					
Male	202 (73.2%)	69 (62.2%)	63 (79.7%)	70 (81.4%)	0.003
Female	74 (26.8)	42 (37.8%)	16 (20.3%)	16 (18.6%)	
Educational level					
<12 years	81 (29.3%)	37 (33.3%)	22 (27.8%)	22 (25.6%)	0.467
≥12 years	195 (70.7%)	74 (66.7%)	57 (72.2%)	64 (74.4%)	
Family income bracket					
<5 BMS	109 (39.5%)	36 (32.4%)	40 (50.6%)	33 (38.4%)	0.039
≥5 BMS	167 (60.5%)	75 (67.6%)	39 (49.4%)	53 (61.6%)	
Smoking	39 (14.1%)	18 (16.2%)	11 (13.9%)	10 (11.6%)	0.656
Diabetes	8 (2.9%)	2 (1.8%)	3 (3.8%)	3 (3.5%)	0.668
Dental flossing	206 (74.6%)	76 (68.5%)	64 (81.0%)	66 (76.7%)	0.127
Frequency of tooth brushing					
once daily	9 (3.3%)	6 (5.4%)	2 (2.5%)	1 (1.2%)	0.229
≥2 times daily	267 (96.7%)	105 (94.6%)	77 (97.5%)	85 (98.8%)	
Last dental check-up					
up to 1 year	204 (73.9%)	85 (76.6%)	59 (74.7%)	60 (69.8%)	0.555
≥1 year	72 (26.1%)	26 (23.4%)	20 (25.3%)	26 (30.2%)	

BMS, Brazilian minimum salary (~US$330).

Table 2. Multivariate logistic models for perceived oral health (sample $n = 276$).

Variables	Coefficient	OR (95% CI)	p
Model 1: Perceived general oral health (poor health)			
Constant	−3.65	NA	<0.001
Family income bracket	1.50	4.49 (1.42–14.16)	0.010
Smoking	1.33	3.79 (1.53–9.40)	0.004
Dental flossing	−0.98	0.38 (0.17–0.84)	0.017
Weak SOC	1.53	4.63 (1.59–3.51)	0.005
Moderate SOC	0.27	1.31 (0.34–5.04)	0.698
Strong SOC	(reference)	NA	0.004
Model 2: Perceived gum disease			
Constant	−1.40	NA	<0.001
Weak SOC	1.09	2.98 (1.55–5.70)	0.001
Moderate SOC	0.25	1.28 (0.61–2.69)	0.506
Strong SOC	(reference)	NA	0.001
Model 3: Perceived periodontal disease			
Constant	−1.82	NA	<0.001
Weak SOC	0.92	2.50 (1.20–5.21)	0.015
Moderate SOC	0.53	1.69 (0.75–3.81)	0.205
Strong SOC	(reference)	NA	0.048

Model 1: pseudo $R^2 = 0.2001$, area under ROC curve = 0.8060, correctly classified = 89.13%.
Model 2: pseudo $R^2 = 0.0403$, area under ROC curve = 0.6264, correctly classified = 69.93%.
Model 3: pseudo $R^2 = 0.0221$, area under ROC curve = 0.5982, correctly classified = 77.90%.
NA, not applicable.

Table 3. Multivariate logistic models for gingivitis (sample $n = 276$).

Variables	Coefficient	OR (95% CI)	p
Model 1: ≥ 10% of sites with bleeding on probing			
Constant	−0.08	NA	0.863
Age	0.03	1.03 (1.01–1.05)	0.006
Dental flossing	−1.12	0.33 (0.18–0.60)	<0.001
Model 2: ≥ 30% of sites with bleeding on probing			
Constant	−1.92	NA	<0.001
Family income bracket	0.82	2.28 (1.17–4.42)	0.015
Model 3: ≥ 50% of sites with bleeding on probing			
Constant	−3.91	NA	<0.001
Last dental check-up	1.68	5.36 (1.52–18.89)	0.009

Model 1: pseudo $R^2 = 0.0552$, area under ROC curve = 0.6562, correctly classified = 60.58%.
Model 2: pseudo $R^2 = 0.0233$, area under ROC curve = 0.5909, correctly classified = 79.71%.
Model 3: pseudo $R^2 = 0.0769$, area under ROC curve = 0.6951, correctly classified = 96.00%.
NA, not applicable.

Some of these associations were attenuated after adjusting for confounders.[10,15] A weak association between SOC and clinical measures can be explained by the biological factors that are involved in the disease.[15] In the present study, clinical outcomes were associated with factors such as age, gender, family income bracket, dental flossing and last dental check-up. It is also interesting to note that the association between caries experience and SOC was demonstrated, but did not remain significant after controlling for confounders.[27] Moreover, SOC was not associated with caries and filled surfaces.[28] Differently from the present study, the number of teeth was associated with SOC in previous studies.[10,28]

Table 5. Multivariate linear models for periodontal parameters (sample $n = 276$).

Variables	Coefficient	95% CI	p
Model 1: Plaque index			
Constant	11.87	−3.31 to 27.05	0.125
Age	0.43	0.15 to 0.71	0.003
Gender	8.81	1.29 to 16.33	0.022
Family income bracket	13.41	6.25 to 20.56	<0.001
Dental flossing	−8.90	−16.84 to −0.96	0.028
Model 2: Gingival index			
Constant	−0.04	−0.16 to 0.09	0.583
Age	0.01	0.00 to 0.01	0.004
Family income bracket	0.12	0.06 to 0.19	<0.001
Last dental check-up	0.16	0.08 to 0.23	<0.001
Model 4: Number of teeth			
Constant	35.16	32.28 to 37.04	<0.001
Age	−0.21	−0.26 to −0.17	<0.001
Family income bracket	−1.53	−2.57 to −0.49	0.004
Smoking	−1.83	−3.26 to −0.40	0.012
Model 5: Mean probing depth			
Constant	2.06	1.93 to 2.19	<0.001
Age	0.01	0.00 to 0.01	0.001
Dental flossing	−0.16	−0.24 to −0.08	<0.001
Model 6: Mean clinical attachment level			
Constant	1.82	1.55 to 2.09	<0.001
Age	0.01	0.01 to 0.02	<0.001
Educational level	0.17	0.04 to 0.30	0.010
Family income bracket	0.16	0.04 to 0.29	0.012
Dental flossing	−0.31	−0.44 to −0.17	<0.001

Model 1: adjusted $R^2 = 0.1154$. Model 2: adjusted $R^2 = 0.1051$. Model 3: adjusted $R^2 = 0.2824$. Model 4: adjusted $R^2 = 0.0795$. Model 5: adjusted $R^2 = 0.1471$.

Table 4. Multivariate logistic models for periodontitis (sample $n = 276$).

Variables	Coefficient	OR (95% CI)	p
Model 1: 4 teeth with at least 1 site with PD ≥ 4 mm and CAL ≥ 3 mm			
Constant	−2.55	NA	<0.001
Age	0.05	1.05 (1.02–1.08)	<0.001
Last dental check-up	1.04	2.82 (1.44–5.51)	0.002
Dental flossing	−1.28	0.28 (0.15–0.53)	<0.001
Model 2: interproximal PD or CAL ≥ 4 mm at ≥ 2 sites not on the same tooth			
Constant	−3.01	NA	<0.001
Age	0.07	1.07 (1.04–1.10)	<0.001
Last dental check-up	0.97	2.63 (1.39–5.00)	0.003
Dental flossing	−0.91	0.40 (0.22–0.75)	0.004
Model 3: proximal CAL ≥ 3 mm in ≥ 2 non-adjacent teeth			
Constant	−2.21	NA	<0.001
Age	0.05	1.05 (1.03–1.08)	<0.001
Dental flossing	−0.75	0.47 (0.26–0.85)	0.013

Model 1: pseudo $R^2 = 0.1296$, area under ROC curve = 0.7320, correctly classified = 79.27%.
Model 2: pseudo $R^2 = 0.1261$, area under ROC curve = 0.7403, correctly classified = 74.18%.
Model 3: pseudo $R^2 = 0.0753$, area under ROC curve = 0.6854, correctly classified = 72.83%.
NA, not applicable.

Weak SOC was associated with poor oral hygiene and lower frequency of tooth brushing,[15] supporting the idea that weak SOC may be a potential risk factor for poor oral health self-care. However, this association was not observed in a study of adolescents.[27 Findings from the present study also failed to demonstrate an association between plaque index and gingival index and SOC.

In a recent longitudinal study,[16] it was demonstrated that SOC was not a predictor of the incidence of periodontal disease. The authors argued that, since periodontal disease has some intermittent bursts of activity and periodontal parameters may vary along time, time examination probably influenced the association or that SOC is simply not relevant to periodontal disease.

Although the relationship between SOC and clinical and self-reported measures of health is still unclear, SOC may be a modifying factor of an individual's subjective assessment of oral health [7] and may be related to a positive subjective state of health.[3] Self-reported health measures might translate this subjective state of health that not always necessarily coincides with the biomedical state.[6,29] Individuals with strong SOC have a higher adaptability and could perceive their health status according to an optimistic view of themselves and their wellbeing.[14] In the present study, a weak SOC was associated with perceived poor oral health, perceived gum disease and perceived periodontal disease.

A positive association between strong SOC and good self-perception of health was previously demonstrated.[14,30,31] This positive association was also presented for self-perceived oral health,[10,28] corroborating findings from the present study. The stronger the SOC, the better the perceived health in general, regardless of age, gender, ethnicity, nationality and study design.[3] SOC could be a factor of an individuals' subjective assessment of oral health,[7] involving judgement and consideration of multiple experiences.[32]

It is fundamental to note that, as previously reported, there may be some discrepancies between self-reported oral health and more objective clinical measures.[15,32] SOC measures a global view of health, whereas physical health (in the present study represented by periodontal health) reflects only one dimension.[15] Individuals' perception of periodontal status, especially slight-to-moderate conditions, may be potentially different from a professional perception. Most people in society do not experience gingivitis or periodontitis as traumatic or stressful situations.[15] It has been advocated that SOC is more often related to psychological symptoms than to overall physical health and somatic symptoms.[33,34]

Conflicting findings between oral health outcomes and SOC suggest a reflection about the general theory of SOC and the different pathways to promote health.[2,10,14,29] Overall, findings from the present study points toward some influence of SOC on oral health measures, especially those related to the emotional pathway and subjective assessment of health. In modern dental care, in order to understand changes in oral health and the influence of adaptive and health-promoting behaviour, it is important to consider both the professional's objective data together with the patient's total life context.[15] It is important to understand that oral health can be improved by interventions focused in psychosocial determinants of oral health rather than oral health behaviours itself.[35]

Different reports in the literature about the associations between SOC and oral health measures may be related to some methodological issues. The use of different versions of the questionnaire, the use of SOC scale as a continuous or categorized variable, as well as sample characteristics can have a great impact on the results.[15] In the present study, the sample comprised a heterogeneous group and differences were observed in SOC groups regarding family income bracket and gender. Men presented a stronger SOC when compared to women. According to the literature, this difference is slightly small but it exists.[3,17] Differences among social classes, ethnic groups, genders and occupation can influence individual's position in the social structure, life experiences and SOC levels.[2] This unbalanced distribution of gender in the sample of the present study may have influenced the results.

Some restrictions of the present study regarding sample size, specific sample characteristics, SOC scale used and cross-sectional design have to be pointed out. Therefore, generalizability of the results should be exercised with caution. However, some strengths of the present study also have to be pointed out: evaluation of self-reported and clinical periodontal outcomes, different definitions for gingivitis and periodontitis, as well as different clinical periodontal parameters.

It can be concluded that SOC was not associated with clinical periodontal health outcomes, but it was associated with perceived periodontal health. Future studies, especially those with larger samples and prospective designs, should be conducted to better evaluate the influence of SOC on clinical oral health outcomes and periodontal status.

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Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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