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Title Page

The association between sense of coherence and dental caries in low-social status schoolchildren

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Abstract Page

The association between sense of coherence and dental caries in low-social status schoolchildren

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Abstract

The relationship between dental caries and sense of coherence (SOC) has not been substantiated in children and adolescents, mainly among those from low socioeconomic status. The aim of this study was to investigate the association between SOC and dental caries in schoolchildren from low socioeconomic background. A random sample of 356 8-14-year-old schoolchildren enrolled in public schools from the poorest region of Santa Maria, a southern city in Brazil was selected. Dental examinations were performed to assess dental plaque and dental caries (DMF-S and dmf-s indexes). Children's SOC was assessed using a validated Brazilian version of the SOC-13 scale. Socioeconomic, demographic and behavioural data were collected from parents using a questionnaire. Multilevel Poisson regression analysis was used following a hierarchical approach to investigate the association between SOC and DMF-T+dmf-t mean. Children whose mothers had studied 8 years or less (RR 1.30; 95% CI 1.08-1.57) and children with dental plaque (RR 1.29; 95% CI 1.06-1.58) presented higher DMF-T scores than their counterparts (p<0.05). Higher household income (RR 0.66; 95 % CI 0.51-0.84) and greater SOC scores (RR 0.71, 95 % CI 0.56-0.90) were associated with lower DMF-T in children (p<0.05). Children's SOC seems to be a relevant protective psychosocial factor for dental caries experience in socially vulnerable children.

Introduction

Dental caries in children and adolescents is considered a public health problem due to its high prevalence and impact at the individual and community levels [Marcenes et al., 2013]. Understanding the determinants of dental caries is crucial to plan and develop effective preventive and intervention strategies [Peres et al., 2009]. Previous studies have identified unhealthy behaviours and poor socioeconomic conditions as relevant factors on the aetiology of dental caries in children, including foods and beverages consumption with a high content of refined carbohydrates, poor oral hygiene, and living in socially underprivileged families and isolated groups [Engelmann et al., 2016; Joshi et al., 2013; Masood et al., 2012].

More recently, the interest on psychosocial determinants of general and oral health has increased [Scheerman et al., 2016; Silva et al., 2008]. The salutogenic theory is a prominent approach to understand the role of psychosocial factors on health outcomes that challenge the pathogenic model [Antonovsky, 1996]. Salutogenesis represents a shift from the traditional risk factor approach in understanding the nature of diseases to a person-centred one that focuses on people's resources and capacity to promote health [Antonovsky, 1996]. Sense of coherence (SOC) is the central construct of Salutogenesis, which express the personal capacity to react positively to general and specific stressors toward health promotion [Antonovsky, 1997]. The higher the SOC the greater the individual's ability to define life events as less stressful (comprehensibility), to use the available resources more effectively to deal the stressors (manageability), and to perceive one's life as meaningful to cope with the enviroment (meaningfulness) [Eriksson and Lindstrom, 2006].

There is evidence that SOC is a useful resource to promote health, to strengthen resilience, and to develop an optimistic subjective state of health [Eriksson and Lindstrom, 2006]. It has been associated with quality of life [Nasermoaddeli et al., 2003], well-being [Smits et al., 1995], health-related risk behaviours, and social support [Antonovsky, 1993]. SOC seems to have different effects on the various dimensions of health. Although several longitudinal studies clearly support the strong association between SOC and perceived good health, especially the mental dimension, the relationship between SOC and physical health is more complex. Previous review papers suggest the influence of SOC on mental health is more robust and consistent than on physical health [Eriksson and Lindstrom, 2006; Länsimies et al., 2017].

SOC has also been associated with oral health. In elderly and adult populations, SOC was identified as a psychosocial determinant of oral health-related quality of life (OHRQoL) [Machado et al., 2017; Boman et al., 2012; Savolainen et al., 2005a], oral health-related behaviours, attitudes towards oral health and knowledge of dental caries [Elyasi et al., 2015; Lindmark et al., 2011; Bernabe et al., 2009; Savolainen et al., 2005b], and dental clinical status [Possebon et al., 2017; Davoglio et al., 2016; Gupta et al., 2015; Bernabe et al., 2013; Bernabe et al., 2010]. Other studies have shown a positive prospective relationship between strong SOC and better oral health-related quality of life among adolescents [Pakpour et al., 2017; Baker et al., 2010]. The relationship between SOC and oral health behaviours has also been studied. Children and adolescents with higher SOC scores presented greater frequency of tooth brushing [Ayo-Yusuf et al., 2009] and a lower likelihood of visiting the dentist mainly when in trouble [Freire et al., 2001]. Furthermore, inverse associations of mothers' SOC with children's dental caries and children's gingival status were reported [Kramer et al., 2015; Bonanato et al., 2009; Freire et al., 2002]. Children's utilization of dental care was predicted by high levels of mother's SOC [Perazzo et al., 2016; da Silva et al., 2011].

There are variations in the occurrence of dental caries and its determinants between and within populations. Socially underprivileged children are more likely to have poorer oral health than privileged ones [Carvalho et al., 2009]. However, evidence on the relationship between dental caries and SOC in children and adolescents remains inconclusive, mainly among those from low socioeconomic status and living in deprived areas. The understanding of such relationship would lead to effective programs aiming at reducing oral health inequalities in this population.

The aim of the present study was to investigate the relationship between SOC and dental caries in a population of socially vulnerable children from Southern Brazil. It was hypothesized that children with higher levels of SOC have less dental caries experience than those with lower levels of SOC.

Materials and Methods

Study Settings and Population

A baseline survey was performed to assess the oral health status of 8-14-year-old schoolchildren in primary schools from Santa Maria, Brazil, participating in a cluster-randomized controlled trial. Santa Maria is located in the south of Brazil and has five administrative regions with 261,031 inhabitants in the year 2010, with 26,477 children

aged between 8 and 14 years old. Children enrolled in the 4th and 5th years of the five public schools from the West region of the city were invited to participate in this study. West region is the poorest one in Santa Maria, where there are a higher prevalence of people living below poverty line [IBGE, 2010]. Parents/guardians received information about the aims of the study and the participation of their children was requested using an informed consent form. Only children whose parents/guardians authorized their participation were included.

In this cross-sectional study, the sample size was calculated considering the following parameters: 95% confidence level (CI), 80% power, a 57.9% prevalence of subjects with low SOC scores in the exposed group (with caries), a 42.1% prevalence of subjects with low SOC scores in the unexposed group (without caries), 1:1 ratio of unexposed to exposed [Bonanato et al., 2009]. Considering possible losses, 10% was added to the sample size, resulting in a minimum number of 361 required children.

Data Collection

Data were collected through dental clinical examination and questionnaires. Two examiners and three interviewers previously trained and calibrated collected the data.

The dental examination was performed using international criteria standardized by the World Health Organization for oral health surveys [WHO, 2013]: in a room with natural light, using CPI probes and plane dental mirrors. The clinical examination recorded dental caries experience, assessed according to the decayed, missing, filled teeth index for both deciduous and permanent dentitions (DMF-T and dmf-t). Dental plaque was registered in all dental surfaces using the Visible Plaque Index (VPI). The participants were grouped as with presence ($\geq$ 15% of dental surfaces) or absence (< 15% of dental surfaces) of dental plaque.

Children's SOC was assessed using the validated Brazilian version of the SOC scale (SOC-13), which contains 13 items, each scored using a five-point Likert scale [Bonanato, 2009]. The total SOC-13 score can range from 13 to 65 points and the higher the score the stronger the SOC. The SOC scale was developed to assess the three components of SOC: comprehensibility, manageability, and meaningfulness. For this study, the tertiles of SOC distribution were used to categorize children's SOC as low, moderate and high [Bernabé et al., 2010].

The mothers of the participants answered a structured questionnaire to provide information about demographic, socioeconomic characteristics and oral health-related behaviours. Demographic variables included child's sex (male/female) and age (8-10

years-old/11-14 years-old). The socioeconomic variables assessed were mother's level of education and household income. Maternal education was evaluated according to the number of approved years of schooling, categorized as < 8 and ≥ 8 years. Monthly household income was converted to Brazilian minimum wages (BMW nearly U$ 280) and then categorized as < 1 BMW, 1-1.5 BMW and >1.5 BMW per month. The oral health-related behaviours were whether the child had visited any dental care service in the previous 6 months and children's tooth brushing frequency. In the latter, children were categorized as < 3 and ≥ 3 times per day.

Data Analysis

Data analysis was performed using Stata 14.0 (Stata Corp, College Station, TX, USA). The DMF-T and dmf-t indexes was the outcome of this study (mixed dentition) [Yang et al., 2015]. Descriptive statistics were used to describe the socioeconomic, demographic, psychosocial, behavioural, and clinical characteristics of the sample. Unadjusted and adjusted rate ratio of dental caries were estimated in Poisson regression multilevel analysis, considering a fixed effect/random intercept (Median Incidence Rate Ratio = 1.33). In the multilevel model, children were the first-level unit and schools the second-level unit. Rate ratios and 95% confidence intervals (95% CI) of each variable were estimated in the unadjusted analysis. Later, multivariable analysis following a hierarchical approach was carried out to determine the predictors of dental caries. We followed the criteria suggested by Victora et al. [Victora et al., 1997], which is suitable to study different child's health outcomes. Thus, the variables were grouped in four groups that represent distal, mediating, and proximate determinants of dental caries (Fig. 1): Demographics and socioeconomic factors are the distal determinants influencing, directly or indirectly, all other predictors. The second group of determinants included the psychosocial variables, which may affect behavioural variables. These variables, in turn, affect clinical variables, including presence of dental plaque. Finally, all these above factors may affect child's dental caries. We performed multivariable modeling including only explanatory variables presenting a P value ≤ 0.20 in the unadjusted analysis, except for sex and age, which remained in the models irrespective of the statistical significance. Therefore, the final model estimated rate ratios for the selected variables after adjusting for the variables of the same level or upper selected in the final model. Only predictors presenting a P value ≤ 0.05 after adjustment were considered statistically significant.

Ethical Aspects

This study was approved by the Ethical Committee of Federal University of Santa Maria. Written informed positive consent and assent were obtained from the parents and children, respectively.

Results

A total of 404 children were invited to participate in the survey; 356 (88%) agreed to participate. Non-participation was mainly due to the lack of the signed form. Inter- and intra-examiner agreement for the DMF-T/dmf-t scores ranged from 0.87 to 0.93 and from 0.85 to 0.90, respectively. Sample's DMF-T total (DMF-T + dmf-t) and SOC mean were 1.45 (SD = 3.04) and 50.68 (DP = 6.22), respectively.

Participants' sociodemographic, psychosocial, behavioural and clinical characteristics are presented in Table 1. Among the 356 assessed children, 187 (53.3%) were boys and 250 (70.22%) were 8-10 years-old. Children were predominately from families with < 1 BMW or 1-1.5 BMW monthly household income, and 59.30% of the mothers had at least eight years of schooling. The prevalence of children who visited the dentist in the last 6 months and dental plaque was 35.26% and 74.71%, respectively.

Unadjusted analyses demonstrated that mother's education, family income, SOC, having visited the dentist and presence of dental plaque were significantly associated with dental caries (Table 2). Child's total DMF-T was not associated with the demographic variables, as well as with the frequency of tooth brushing.

After the adjustments, the variables that remained significantly associated with the outcome were mother's education, family income, SOC and dental plaque (Table 3). Children whose mothers had studied less than 8 years (RR 1.30; 95 % CI 1.08-1.57) and children with dental plaque (RR 1.29; 95 % CI 1.06-1.58) presented higher DMF-T scores than their counterparts. Higher household income (RR 0.66; 95 % CI 0.51-0.84) and higher SOC scores (RR 0.71, 95 % CI 0.56-0.90) were identified as determinants of lower DMF-T means in children.

Discussion

This study investigated the relationship between SOC and dental caries in Brazilian children from low socioeconomic status and living in deprived areas. The hypothesis that higher children's SOC was inversely associated with dental caries experience was confirmed. SOC was a psychosocial determinant of dental caries in this population.

In order to identify the relationship between SOC and dental caries, the hierarchical approach was applied for modelling the variables in the adjusted analysis. With this method, it was possible to prevent the underestimation or dismissal of the effect of a distal determinant on the outcome [Newton and Bower, 2005]. In the present study, the likelihood of having caries was mediated, besides the socioeconomic, behavioural and clinical determinants, by a psychosocial variable. Children with higher SOC means had lower mean DMF-T scores when compared to those with lower SOC.

The literature has shown that oral and general health status are related to social and psychological issues [Viswanath and Krishna, 2015; Lyra et al., 2015; Coutinho and Heimer, 2014; Bonanato et al., 2009; Freire et al., 2001]. An integrative review of the literature reported that several studies have shown that a strong SOC was associated with different health behaviors, such as improved oral hygiene, conscious use of medicines, not taking up smoking, lower consumption of alcohol and the more frequent practice of physical activities [Coutinho and Heimer, 2014]. Authors also observed that other studies highlight the protective role of SOC by reducing the impact caused by adverse situations, such as illness or even war. Regarding to oral health, few studies have assessed the relation between SOC and dental caries in infant population, and the findings are in line with the present study [Viswanath and Krishna, 2015; Lyra et al., 2015; Bonanato et al., 2009]. One of them demonstrated that adolescents whose mothers had higher levels of SOC score had lower levels of dental caries and gingival bleeding, and were less likely to visit the dentist mainly when in urgent need than those whose mothers had lower levels of SOC [Freire et al., 2001]. Other study conducted with 5-years-old children reported that mothers with a lower SOC were more likely to have children with decayed, dental pulp exposure or filled teeth [Bonanato et al., 2009]. Moreover, one study evaluated the relationship between SOC and dental caries in 12-16-years-old school children from Bangalore North, and observed that low SOC predicted high dental caries index [Viswanath and Krishna, 2015].

According to the salutogenic theory, one possible explanation by which SOC might lead to better oral health outcomes is promoting healthy behaviors [Bernabe et al., 2009]. In support of this pathway, namely, SOC acting as "protector" of dental caries, the present analysis demonstrated that the protective effects of SOC might work by influencing child dental visit (higher SOC → dental visit → lower caries levels), or other behavioural variables that were not assessed in this study (eg. sugar intake). Thus, dental attendance might be a mediator through which SOC impacts oral health. It is conceivable that individuals with greater SOC may perceive themselves to have more control and

confidence in their ability to achieve goal. Moreover, people with stronger SOC are more likely to prevent damage and have preventive direction. Evidence on the association between dental care use and SOC was demonstrated in a previous Brazilian study, in which SOC was identified as a psychosocial determinant of their oral health-related behaviour, particularly affecting their pattern of dental attendance [Freire et al., 2001]. Another Brazilian study showed that children whose mothers had higher levels of SOC were more likely to use dental care services and visit a dentist, mainly for check-ups, than those whose mothers had lower levels of SOC [da Silva et al., 2011].

This study has some limitations. First, it is possible that important variables might have been omitted and alternative models that fit the data might exist. Thus, information regarding other key variables (ex. dietary habits, reason for dental visit) in the literature, should be included in future studies. Second, the age range of the studied sampled is broad. Parental knowledge about frequency of tooth brushing of participants aged 12-14 may not be as accurate as if the information was provided by the adolescent. However, we believe that parents were able to provide valid answers about children's use of dental services. Moreover, most of the participants were between 8 and 10 years-old. Third, the cross-sectional design limits the causal inference between the predictors and the outcome. Thus, the present model and alternative models should be tested prospectively, as well as in other settings with differing disease levels. However, this is the first study exploring the relationship between dental caries and SOC in a population of socially vulnerable children. In addition, the study sample was composed of children from 1 geographical region of the city, the poorest one, and thus, the results of the study are not generalizable to other populations. However, the aim was to study the associations among socially vulnerable children, who are more likely to have poorer oral health than privileged ones.

Based on the results of this study and previous evidence, psychosocial factors need further investigation as possible determinants of dental caries. This study demonstrates the association between higher SOC and lower dental caries experience in socially vulnerable children. In this way, interventions aiming to enhance SOC may help to tackle social inequalities of dental caries by improving the understanding of what maintain oral health in stressful and adverse conditions. Finally, these findings are important to guide strategies that promote resilience and other psychological resources, which may contribute to disease reduction and prevention.

Conclusion

Children's SOC seems to be a relevant protective psychosocial factor for dental caries experience in socially vulnerable children.

Acknowledgements

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Table 1 – Sociodemographic, psychosocial, behavioral, and clinical characteristics of the sampled children

Variables	N	(%)
Sex		
Boys	189	53.09
Girls	167	46.91
Age		
8-10 years-old	250	70.22
11-14 years-old	106	29.78
Mother's schooling*		
≥ 8 years	204	59.30
< 8 years	140	40.70
Family monthly income*		
< 1 BMW	128	37.21
1-1.5 BMW	128	37.21
>1.5 BMW	88	25.58
SOC		
Low	119	33.43
Middle	134	37.64
High	103	28.93
Dental Visit*		
Yes	122	35.26
No	224	64.74
Frequency of tooth brushing*		
≥ 3 times a day	139	39.94
< 3 times a day or never	209	60.06
Dental Plaque		
No	266	74.72
Yes	90	25.28

BMW: Brazilian minimum wage (approximately U$ 280 during the data gathering).
*Variables with missing data.

Table 2 – Unadjusted assessment of socioeconomic, demographics, psychosocial, behavioral, and clinical variables associating with the DMF-T score (Poisson multilevel regression analysis).

Variables	DMF-T+dmf-t mean (SD)	RR	(95% CI)	P
Demographic and socioeconomic characteristics				
Sex				0.248
Girls	1,57 (3.22)	1	-	-
Boys	1.35 (2.85)	0.90	(0.75-1.07)	-
Age				0.470
8-10 years-old	1.45 (2.91)	1	-	-
11-14 years-old	1.46 (3.33)	1.01	(0.89-1.30)	-
Mother's schooling				0.001
≥ 8 years	1.27 (2.87)	1	-	-
< 8 years	1.83 (3.34)	1.34	(1.12-1.60)	-
Family monthly income				
< 1 BMW	1.74 (3.50)	1	-	-
1-1.5 BMW	1.5 (3.03)	0.84	(0.69-1.02)	0.081
>1.5 BMW	1.10 (2.44)	0.64	(0.50-0.82)	0.000
Psychological variables				
SOC				
Low	1.78 (3.33)	1	-	-
Middle	1.40 (2.83)	0.83	(0.68-1.01)	0.070
High	1.13 (2.94)	0.70	(0.56-0.88)	0.003
Behavioural variables				
Dental Visit				
Yes	1.34 (2.73)	1	-	-
No	1.58 (3.24)	1.27	(1.06-1.54)	0.011
Frequency of tooth brushing				
≥ 3 times a day	1.37 (3.06)	1	-	-
< 3 times a day or never	1.54 (3.07)	1.09	(0.91-1.30)	0.348
Clinical variables				
Dental Plaque				
No	1.35 (2.78)	1	-	-
Yes	1.75 (3.70)	1.35	(1.12-1.64)	0.002

RR, rate ratio; 95% CI, 95% confidence intervals.
BMW, Brazilian minimum wage (approximately U$ 280 during the data gathering).

Table 3 – Multilevel Poisson regression on the association between socioeconomic, demographics, psychosocial, behavioral, clinical variables and the DMF-T score.

Variables	Model 1 RR* (95%CI)	Model 2 RR* (95%CI)	Model 3 RR* (95%CI)	Model 4 RR* (95%CI)
Demographic and socioeconomic characteristics				
Sex				
Girls	1	1	1	1
Boys	0.87 (0.73-1.05)	0.89 (0.74-1.06)	0.90 (0.75-1.08)	0.86 (0.71-1.03)
Age				
8-10 years-old	1	1	1	1
11-14 years-old	1.02 (0.84-1,24)	1.02 (0.84-1.24)	1.04 (0.86-1.27)	1.01 (0.83-1.23)
Mother's schooling				
≥ 8 years	1	1	1	1
< 8 years	1.30 (1.08-1.57)*	1.29 (1.07-1.55)*	1.27 (1.05-1.53)*	1.23 (1.01-1.49)*
Family monthly income				
< 1 BMW	1	1	1	1
1-1.5 BMW	0.90 (0.74-1.10)	0.93 (0.76-1.14)	0.95 (0.77-1.16)	0.94 (0.77-1.15)
>1.5 BMW	0.66 (0.51-0.84)*	0.67 (0.53-0.86)*	0.69 (0.54-0.89)*	0.69 (0.54-0.88)*
Psychological variables				
SOC				
Low		1	1	1
Middle		0.84 (0.69-1.03)	0.85 (0.69-1.04)	0.85 (0.69-1.04)
High		0.71 (0.56-0.90)*	0.70 (0.55-0.89)*	0.70 (0.55-0.90)*
Behavioural variables				
Dental Visit				
Yes			1	#
No			1.20 (0.99-1.46)	
Clinical variables				
Dental Plaque				
No				1
Yes				1.29 (1.06-1.58)*
MIRR	1.29	1.27	1.27	1.28

RR, rate ratio; 95% CI, 95% confidence intervals.
BMW: Brazilian minimum wage (approximately U$ 280 during the data gathering).
MIRR, median incidence rate ratio.
*P<0.05

Figure 1 - Hierarchical conceptual model for Dental Caries among children.