Associations between the Sense of Coherence and the Motivation to Start and Stop Smoking among Adolescents: findings from a school-based survey

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Abstract

Background

The science of behaviour change has advanced considerably in understanding the psychological dimensions that make up individuals' motivation to change their smoking behaviour. However, there is a lack of studies on the factors associated with the motivational system that prompts smoking initiation and cessation among adolescents. An important psychosocial factor related with smoking in adolescence, which has not yet been investigated in relation to their motivational system, is the Sense of Coherence (SOC). The present study aimed to estimate the extent to which the SOC is associated with the motivation to start and stop smoking among a population of adolescent students.

Methods

A cross-sectional school-based survey was carried out in Midwest Brazil. Participants were high-school students aged between 13 and 19 years who completed self-administered questionnaires. Explanatory variable was the SOC score, measured with Antonovsky's Orientation to Life Questionnaire (13-item version). Motivation to start and stop smoking were measured with questions based on the Prime Theory of Motivation to address desire to smoke, belief on smoking benefit and intention to future smoking. Logistic regression was used in the statistical analysis, and a Directed Acyclic Graph was used to identify potential confounders.

Results

Participants ($n = 2189$) were 2073 never-smokers (94.7%) and 116 smokers (5.3%). The mean SOC score was 50.1 (95% CI = 49.6–50.7). About a quarter of the never-smokers were motivated to start smoking, and 14.7% of the smokers were not motivated to quit the habit. For each one-unit increase in the SOC score of never-smokers, the odds of desiring to smoke, believing on smoking benefit, and intending to smoke in the future decreased by 3%, 3% and 5%, respectively. Among smokers, the findings were inconclusive as to whether an association between SOC and motivation to stop smoking was present.

Conclusion

Increasing SOC was associated with decreasing motivation to start smoking among never-smokers. The findings indicate that SOC may play a protective role in the process of smoking initiation among adolescents, offering a potential adjuvant resource of theory-based interventions to prevent adolescent smoking.

Background

The harmful consequences of tobacco on health are ubiquitous, and tobacco use remains one of the leading causes of preventable diseases and premature deaths worldwide [1]. While a substantial decline in tobacco consumption in several countries over the last decades was observed, it is still a serious public health concern [2]. To decrease the burden of tobacco-related disease, strategies that facilitate cessation and prevent smoking uptake early in life are fundamental [2].

Smoked products, specially industrialized combustible cigarettes, are the most common forms of tobacco consumption, which usually begins during the second decade of life [3]. Adolescence is a critical phase that demands special attention to prevent the development of addictive behaviours such as smoking [3]. Adolescent smoking onset is a complex phenomenon involving individual, social, and situational influences [4].

Age, lower socioeconomic status, and having smokers among family members and friends have been closely related to the onset of adolescent smoking [4–6]. Another robust predictor of smoking initiation during adolescence is future intention to smoke [4], which is in turn a fundamental aspect related to the motivation to change smoking behaviours [7, 8].

Motivation to change refers to reflective and automatic processes that energise and direct smoking behaviours [7, 8]. It is one of the key-domains of the Capability, Opportunity, and Motivation – Behaviour (COM-B) System, a theoretical framework for understanding behaviours and designing behaviour change interventions [8, 9]. The COM-B model proposes that behaviour change requires motivation, as well as capability and opportunity to change. Capability encompasses psychological and physical capacity to engage in the behaviour change, and opportunity refers to social and physical external factors that prompt the behaviour [8].

Based on the interrelatedness of the three domains in the COM-B model, both capability and opportunity could influence motivation, such as if individuals understand the severe negative health consequences of smoking (knowledge), they will be less motivated to start smoking. However, knowledge is only one aspect related to adolescents' psychological capabilities [8].

Another important psychosocial factor that has been associated with smoking among adolescents is their Sense of Coherence (SOC) [10, 11]. SOC expresses the capability of individuals to deal with stimuli deriving from their internal and external environments in the course of living [12]. Being the core construct of the salutogenic model of health, the SOC is a global measure of the positioning of individuals or groups in the health-disease dynamic process [12].

High levels of SOC indicate improved ability to comprehend, find meaning and manage life issues [12]. That is, it reflects the feeling that stressful stimuli are reasonably structured, the demands they pose are worthy of engagement and likely to be overcome through physical and psychological resources that might be available, the so-called generalized resistance resources [12].

By making optimum use of the resources at their disposal, individuals with a high SOC have better health prospects [12]. Such influence can be achieved through behaviours that favour health, in addition to other decisions that strengthen the structural support of health, such as seeking the company of peers who are adept at constructive and healthy activities [12]. In comparison with those with low SOC, people with high SOC feel more in control of their lives, get better social support and live life with more enjoyment. Also, they face life with more positivity and optimism, have greater self-esteem and deal more effectively with stressors [12].

SOC is associated with a decreased risk of all-cause mortality in the general population [13]. Among adolescents, besides its effect on smoking [10, 11], high SOC is connected to improved health-related quality of life, health behaviours, mental health, and family relationships [10].

There is previous evidence of the relationship between motivation and other psychosocial aspects (e.g., self-efficacy in avoiding smoking in various high-risk situations, and decisional balance regarding the pros and cons of smoking) [14]. However, we are unaware of any studies examining the association between adolescents' SOC and their motivation to change smoking behaviour, that is, their motivation to start and to stop smoking. Studying this relationship may favour the design and implementation of anti-smoking interventions for this population that are theory-based. Knowledge about the factors that can influence interventions' outcomes is essential to clinicians and working to improve their SOC could benefit interventions as an additional strategy to improve their motivation to prevent smoking initiation or quit the habit.

Guided by the COM-B model, we hypothesized that adolescents' SOC, as part of their psychological capability, may be related to their motivation to change smoking behaviours, so that those with high levels of SOC are less motivated to start smoking, or more motivated to quit if they are smokers. The objective of this study was to estimate the extent to which SOC is associated with motivation to start (MStart) and stop smoking (MStop) among adolescent students.

Methods

Study design, participants, and setting

We conducted a cross-sectional school-based survey with high-school students aged 13 to 19 years. Adolescents from all 14 public high schools of the Federal Institute of Education Science and Technology of Goiás, from 13 municipalities in the Midwest region of Brazil, including one of the Brazilian capital cities, Goiânia, were selected as a convenience sample to be part of this survey. The study's response rate was 99.7%. Detailed descriptions about the setting and sample size calculations were reported in a previous publication [15].

Data collection, instrument, and procedures

Data were collected at the beginning or end of the students' regular classes. The research instrument, a self-administered printed questionnaire specifically designed for this survey, consisted of 67 closed questions concerning an array of sociodemographic, psychosocial, smoking behaviours and other health-related factors. The methodological steps of the questionnaire design and testing were previously described [15]. It included original questions and others compiled from previous studies, among which is the SOC questionnaire [12].

Students took approximately 20 minutes to complete the questionnaire. To improve response rate, minimize missing data and prevent information bias, the researcher who collected the data provided information about the study and gave prior instructions to the adolescents, using printed banners, on how to fill out the questionnaire. For example, the banners were used to explain which questions were aimed at smokers and should be left blank by non-smokers, and vice-versa.

Smoking status

The adolescents answered the following yes-or-no questions: (i) 'Have you ever tried smoking cigarettes, even one or two puffs?', (ii) 'Currently, do you smoke cigarettes? (Select yes if you smoked at least one cigarette in the past 30 days)'.

Based on the responses, adolescents were classified as (i) never-smokers (negative answers to the two questions), (ii) former smokers (answered yes to the first but not to the second question), (iii) and smokers (two positive answers). Former smokers were not eligible for the present analysis, therefore a status of a non-smoker in this study refers to adolescents who had never tried smoking.

Motivation to changing the smoking behaviour

We relied on the Prime Theory of Motivation [7] to conceptualize and measure the motivation of adolescents to change their smoking behaviours. This comprehensive theory of motivation poses that the main elements of motivation to change a behaviour include, in addition to beliefs about what to do and what is good or bad, the feelings of desire and the self-conscious intentions to act in a specific way [7].

Concepts are at the psychological level, and the theory was designed to perform as a pegboard into which other theories can be plugged [7]. The pictorial representation of the Prime Theory was adapted to illustrate our assumption of an association between the adolescents' SOC and their motivational system (Fig. 1).

Outcome 1: Smokers' motivation to stop smoking

We assessed MStop using the Motivation to Stop Scale (MTSS), a one-item instrument based on Prime Theory that was validated in English [16] and Dutch [17]. For the present study, we have translated and adapted the instrument to the Brazilian Portuguese language [15]. The MTSS scale consists of the following question: 'Which of the following describes you?' Response options are: (i) 'I don't want to stop smoking', (ii) 'I think I should stop smoking but don't really want to', (iii) 'I want to stop smoking but

haven't thought about when', (iv) 'I REALLY want to stop smoking but I don't know when I will', (v) 'I want to stop smoking and hope to soon', (vi) 'I REALLY want to stop smoking and intend to in the next 3 months' and (vii) 'I REALLY want to stop smoking and intend to in the next month'. The ordering of the categories indicates an ascending level of MStop: (i) absence of any belief, desire or intention, (ii) belief only, (iii) moderate desire but no intention, (iv) strong desire but no intention, (v) moderate desire and intention, (vi) strong desire and medium-term intention and (vii) strong desire and short-term intention [16, 17].

Outcome 2: Non-smokers' motivation to start smoking

The measurement of MStart was based on a three-item questionnaire proposed by one of the senior authors of Prime Theory [7] to assess desire, beliefs, and intentions to start smoking: 1) Does the idea of smoking feel good to you? (desire); 2) Do you think the benefits of smoking for you would make up for the risks? (belief); and 3) Do you plan to try smoking in the next year? (intention). Each question has five response categories, where 1 indicates strong agreement (Definitely yes) and 5 strong disagreement (Definitely not).

To construct the outcome variable MStart, we first evaluated the internal consistency of the questions, and it was satisfactory (Cronbach's $\alpha = 0.72$; 95% CI = 0.70–0.74). Then, we dichotomized the response categories into (0) Definitely not (a strong and firm absence of desire, belief, or intention to smoke) and (1) Probably not + Not sure + Probably + Definitely yes. Subsequently, we computed the combination of the responses to the three questions and created an eight-category level MSS ordinal variable which was ordered from (1) absence of any belief, desire and intention (no MStart) to (8) simultaneous presence of any level of belief, desire, and intention (highest level of MStart) (Table 1). The categories were ordered according to previous studies that assessed motivation to change smoking behaviours and were based on Prime Theory (7,8,16,17). In addition, we analysed each of the three dimensions of motivation investigated (desire, belief, and intention) as a single ordinal outcome.

Table 1
Levels of motivation to start smoking identified through the combination of responses to the Prime Theory-based questionnaire.

Levels of Motivation		Combination of responses		
		Desire	Belief	Intention
1	No motivation	0	0	0
2	Belief, only	0	1	0
3	Desire, only	1	0	0
4	Desire and belief, no intention	1	1	0
5	Intention, only	0	0	1
6	Belief and intention	0	1	1
7	Desire and intention	1	0	1
8	Desire, belief, and intention	1	1	1
0 = Absence; 1 = Presence				

Sense of Coherence

The adolescent's SOC was measured with the short version of the SOC Orientation to Life Questionnaire [12], which was adapted to the Brazilian context [18]. The scale consists of 13 items on a 7-point Likert-type scale with descriptive endpoints. The total SOC score is obtained by the sum of the 13 items single scores, ranging from 13 to 91, with the higher scores indicating stronger SOC [12]. Before computing the SOC score, some of the items (1, 2, 3, 7 and 10) are recoded in reverse to provide an ascendant measurement to the scale. The scale's Cronbach's Alpha in the present study was 0.79 (95% CI = 0.77–0.80) indicating a good internal consistency.

Background variables

The potential confounders were: 1) Self-reported race/skin colour (official categories in Brazil [19]: white, black, brown, yellow (Asian descendants) or indigenous; 2) Sex: (i) male and (ii) female; 3) Age: 13 to 19 years; 4) Socioeconomic status, based on the level of education of the adolescents' mother, with categories ascending from no study (illiterate) to university degree (Table 1); 5) Exposure to smoking parents: (i) yes (at least one of their parents was a smoker) and (ii) no; 6) Exposure to smoking friends: (i) yes (at least one of their friends was a smoker) and (ii) no.

Statistical analysis

We describe our data using absolute and relative frequencies (n; %), mean values and standard deviations (SD). Ordinal Logistic Regression was used to estimate the odds ratio (OR) and 95%

confidence intervals (CI) for the associations between SOC and adolescents' motivation to start and stop smoking. We used a Direct Acyclic Graph (DAG) [20, 21] (Fig. 2) to guide the selection of variables to be adjusted for in the multivariable models, which were age, sex, mothers' educational level, parents' smoking status, and friends' smoking status. The IBM SPSS (v. 24) software was used in the statistical analyses and the DAG was structured using the DAGitty tool [22].

Results

The study flowchart is in Fig. 3, and the sample characteristics are in Table 2. Participants were 2189 adolescent students, of whom 2073 (94.7%) were non-smokers and 116 (5.3%) were smokers. Their mean age was 15.9 years (SD = 1.1), most of them were female (54.8%), non-whites (66.7%), and had mothers with a low level of education (66.2%). Smoking parents were observed in 16.7% of cases and more than half of the participants reported having smoking friends.

Table 2
Participants' sociodemographic characteristics (n = 2189).

Characteristics	n	%
Race/skin colour		
Black	286	13.1
Brown	1086	49.6
White	721	32.9
Yellow	81	3.7
Indigenous	6	0.3
Not reported	9	0.4
Sex		
Male	986	45.0
Female	1200	54.8
Not reported	3	0.1
Mothers' level of education		
Illiterate (no study)	15	0.7
Incomplete elementary school	276	12.6
Elementary school	112	5.1
Incomplete High-school	192	8.8
High school	694	31.7
Incomplete higher education	160	7.3
Higher education	656	30.0
Not known / not reported	84	3.8
Exposure to smoking parents		
Yes	366	16.7
No	1795	82.0
Not known / not reported	28	1.3
Exposure to smoking friends		
Yes	1139	52.0

Characteristics	n	%
No	1044	47.7
Not reported	6	0.3

The mean score of adolescents' SOC was 50.1 (95% CI = 49.6–50.7; SD = 12.2). Most non-smokers were not motivated to start smoking (74.0%), while the majority of adolescents who smoked had only belief (42.2%) or desire, but no intention (24.1%) to stop smoking (Table 3).

Table 3
Adolescents' levels of motivation to changing their smoking behaviour according to Prime Theory (n = 2189).

Levels of Motivation	n	%
Motivation to start smoking among never-smokers (n = 2073)		
No motivation	1533	74,0
Belief, only	155	7,5
Desire, only	71	3,4
Desire and belief, no intention	81	3,9
Intention, only	32	1,5
Belief and intention, no desire	56	2,7
Desire and intention, no belief	22	1,1
Desire, belief, and intention	123	5,9
Motivation to stop smoking among smokers (n = 116)		
No motivation	17	14.7
Belief, only	49	42.2
Moderate desire, but no intention	25	21.6
Strong desire, but no intention	3	2.6
Moderate desire and intention	15	12.9
Strong desire and medium-term intention	2	1.7
Strong desire and short-term intention	5	4.3

Table 3 shows odds ratio and 95% CI for the association between SOC and motivation to start smoking (MStart). The results showed that, both in the unadjusted and adjusted analyses, the SOC of non-smokers was inversely associated with increasing levels of motivation to start smoking (MStart), the adjusted odds ratio being 0.97 (95%CI = 0.96–0.98). Similarly, in the analyses of the three dimensions of MStart as

separate outcomes, the adjusted odds ratio indicated a small inverse association between the non-smokers' SOC and desire (OR = 0.97; 95%CI = 0.96–0.98), belief (OR = 0.97; 95%CI = 0.96–0.98), and intention (OR = 0.96; 95%CI = 0.95–0.97). Regarding the association between the smokers' SOC and their MStop, the adjusted odds ratio was 0.99 (95%CI = 0.96–1.03) (Table 4).

Table 4
Logistic regression of associations between adolescents' SOC and motivation to start and stop smoking (n = 2189).

Unadjusted OR (95%CI)	Adjusted* OR (95%CI)
Model 1: Outcome = Motivation to start smoking	
0.96 (0.95–0.97)	0.97 (0.96–0.98)
Model 2: Outcome = Desire to start smoking	
0.96 (0.95–0.97)	0.97 (0.96–0.98)
Model 3: Outcome = Belief on smoking benefits	
0.97 (0.96–0.98)	0.97 (0.96–0.98)
Model 4: Outcome = Intention to start smoking	
0.95 (0.94–0.96)	0.95 (0.94–0.97)
Model 5: Outcome = Motivation to stop smoking	
0.99 (0.96–1.02)	0.99 (0.96–1.03)
* Adjusted by age, sex, mothers' level of education, exposure to smoking parents, and exposure to smoking friends. SOC: Sense of Coherence. OR: Odds ratio. CI: Confidence interval.	

Discussion

This study innovates by examining adolescents' motivation to changing their smoking behaviour and its association with SOC, using a theoretical framework of evidence-based behaviour change theories, namely the COM-B System [8] and the Prime Theory of Motivation [7]. SOC was conceptually assessed as part of the psychological capability of adolescents to change their smoking behaviours, and in relation to their motivation to change both in terms of smoking acquisition and cessation.

We found evidence of an association between low levels of SOC among adolescents and their motivation to start smoking, as well as with each of the dimensions of motivation investigated, that is, their desire to smoke, belief about smoking benefits, and intentions to start smoking. This result is in agreement with previous evidence of the association between SOC and smoking among adolescents [10, 11, 23].

Although the magnitude of the associations was small, the two variables were associated even when adjusted for factors such as the presence of smoking friends, which has been considered a salient social influence on a child's susceptibility to smoke [6], especially until middle adolescence [24]. Even through

adulthood, having friends who smoke as a social activity persists a major trigger for smoking initiation, and a barrier to cessation [25].

SOC seems to be an important psychosocial factor against motivation to start smoking, along with other external factors that influence smoking in this age group. It has been suggested that adolescents with high SOC deal better with peer pressure to smoke [26].

Our study corroborates the Global Youth Tobacco Survey, which showed that at least one in three adolescent smokers in all the countries surveyed had desire to quit smoking, in the period between 2012 and 2015 [27]. Likewise, the percentage of adolescents who did not wish to quit smoking in the present study was comparable to those found in adults of other countries [16, 17]. Since measures of motivation to change smoking behaviour are especially effective in predicting who initiates the change [28], our findings point to the need for increasing adolescent students' motivation, to stimulate cessation attempts.

Most of our sample of smokers were not motivated to stop smoking or only believed they should but did not desire or had any intention to quit. Similarly, a previous systematic review [14] based on the Transtheoretical Model [29], which is another theory of behaviour change that has been extensively applied in anti-smoking interventions, showed that most adolescent smokers from middle-to-high income countries had no intention to quit smoking [14]. In the present study based on the Prime Theory, intention to start smoking as a single outcome was inversely associated with SOC, as well as desire and belief as single outcomes.

These findings suggest that improving adolescents' SOC could be used as an intervention with the function of enabling them to prevent smoking initiation. However, longitudinal or experimental evidence is needed before such conclusion can be drawn. The most important limitation is typical for all cross-sectional studies, which is to say that causal inferences are beyond this study design, therefore the associations should be further investigated with a prospective study design. Furthermore, the measurement of the outcome variables was based on the adolescents' self-reports, who could have hidden facts trying to avoid exposures since smoking is a behaviour that their parents and teachers would disapprove of. To mitigate this, anonymity and confidentiality were expressly guaranteed to the students during the recruitment process, and the instrument was anonymous.

The study relied on a large sample of adolescent students, consisting of many non-smokers but few smokers. Among the latter, no association between SOC and MStop was observed. However, given the sample size limitation, this study does not provide evidence for lack of an effect between these two variables. All the IFG high-school adolescents were invited to participate and the survey had a high response rate, therefore, our findings could be considered as having a good validity and refer to high-school students in public schools of a single Brazilian State.

Conclusion

In this study, SOC was inversely associated with the motivation of non-smoking adolescent students to start smoking, indicating that high SOC may play a protective role in the process of smoking initiation. Thus, our findings could offer a potentially adjuvant resource of theory-based interventions. Among smokers, the findings were inconclusive as to whether an association between SOC and motivation to stop smoking was present or not. Future longitudinal research is required to allow the assessment of the interaction effects between SOC and adolescents' motivation to start and stop smoking on their smoking behaviour over time.

Abbreviations

CI: Confidence Interval; COM-B: Capability, Opportunity, Motivation – Behaviour System; MStart: Motivation to Start Smoking; MStop: Motivation to Stop Smoking; MTSS: Motivation To Stop Scale; OR: Odds Ratio; SD: Standard Deviation; SOC: Sense of Coherence.

Declarations

Ethics approval and consent to participate

The survey protocol was approved by the Research Ethics Committee (REC) of the Federal University of Goiás, Brazil (sponsor institution) (Approval No. 2142027). Subsequently, it was approved by the REC of the Federal Institute of Education Science and Technology of Goiás (co-participant institution where data were collected) (Approval No. 2556510). All the participants signed informed consents. The exemption from obtaining consent from parents or guardians of underage adolescents was approved by the REC.

Consent for publication

Not applicable.

Availability of data and materials

The dataset generated and analysed for the current study is available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no known competing interests.

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Authors' contributions

LER conceived the study, collected, and analysed the data, and drafted the initial manuscript. MCMF participated in the study design, analysis and interpretation of data, and critical revisions of the manuscript. BN and SAM contributed to the analysis and interpretation of the data, and critical revisions of the manuscript. All authors read and approved the final manuscript.

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References

1. World Health Organization. WHO report on the global tobacco epidemic, 2017: monitoring tobacco use and prevention policies. World Health Organization. 2017. <https://apps.who.int/iris/bitstream/handle/10665/255874/9789241512824-eng.pdf>. Accessed October 15, 2020.
2. World Health Organization. WHO report on the global tobacco epidemic, 2019: Offer help to quit tobacco use. World Health Organization. 2019. https://www.who.int/tobacco/global_report/en/. Accessed October 15, 2020.
3. World Health Organization. Adolescents: health risks and solutions. World Health Organization. 2018. <http://www.who.int/en/news-room/fact-sheets/detail/adolescents-health-risks-and-solutions>. Accessed October 15, 2020.
4. Wellman RJ, Dugas EN, Dutczak H, O'Loughlin EK, Datta GD, Lauzon B, et al. Predictors of the onset of cigarette smoking: a systematic review of longitudinal population-based studies in youth. *Am J Prev Med*. 2016; 51(5): 767-778. DOI: 10.1016/j.amepre.2016.04.003
5. Liu J, Zhao S, Chen X, Falk M, Albarracín D. The influence of peer behavior as a function of social and cultural closeness: A meta-analysis of normative influence on adolescent smoking initiation and continuation. *Psychol Bull*. 2017; 143(10): 1082-1115. DOI : 10.1037/bul0000113
6. Duncan LR, Pearson ES, Maddison R. Smoking prevention in children and adolescents: A systematic review of individualized interventions. *Patient Educ Couns*. 2018; 101(3): 375-388. DOI: 10.1016/j.pec.2017.09.011
7. Brown J, West R. *Theory of addiction*. 2nd ed. United Kingdom: John Wiley & Sons; 2012.
8. Michie S, Atkins L, West R. *The behaviour change wheel: a guide to designing interventions*. United Kingdom: Silverback Publishing; 2014.
9. Michie S, Van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Sci*. 2011; 6(1): 42. DOI: 10.1186/1748-5908-6-42

10. Länsimies H, Pietilä AM, Hietasola-Husu S, Kangasniemi M. A systematic review of adolescents' sense of coherence and health. *Scand J Caring Sci.* 2017; 31(4): 651-61. DOI: 10.1111/scs.12402
11. Mattila ML, Rautava P, Honkinen PL, Ojanlatva A, Jaakkola S, Aromaa M, et al. Sense of coherence and health behaviour in adolescence. *Acta Paediatr.* 2011; 100(12): 1590-95. DOI: 10.1111/j.1651-2227.2011.02376.x
12. Antonovsky A. *Unraveling the mystery of health: How people manage stress and stay well.* San Francisco: Jossey-Bass; 1987.
13. Piironen I, Tuomainen T, Tolmunen T, Kauhanen J, Kurl S, Nilsen C, et al. Sense of coherence and mortality: A systematic review and meta-analysis. *Psychosom Med.* 2020; 82(6): 561-67. DOI: 10.1097/PSY.0000000000000812
14. Rios LE, Herval AM, Ferreira RC, Freire MCM. Prevalences of Stages of Change for Smoking Cessation in Adolescents and Associated Factors: Systematic Review and Meta-Analysis. *J Adolesc Health.* 2019; 64(2): 149-57. DOI: 10.1016/j.jadohealth.2018.09.005
15. Rios LE, Freire MCM. Opinion of adolescent school smokers about smoking cessation counselling and treatment in health services: a cross-sectional study, Goiás, Brazil, 2018. *Epidemiol Serv Saude.* 2020; 29(4): DOI: 10.5123/s1679-49742020000400001
16. Kotz D, Brown J, West R. Predictive validity of the Motivation To Stop Scale (MTSS): a single-item measure of motivation to stop smoking. *Drug and Alc Depend.* 2013; 128 (1-2): 15-9. DOI: 10.1016/j.drugalcdep.2012.07.012
17. Hummel K, Brown J, Willemsen MC, West R, Kotz D. External validation of the Motivation To Stop Scale (MTSS): findings from the International Tobacco Control (ITC) Netherlands Survey. *Eur J Public Health.* 2017; 27(1): 129-34. DOI: 10.1093/eurpub/ckw105
18. Freire MCM, Sheiham A, Hardy R. Adolescents' sense of coherence, oral health status, and oral health-related behaviours. *Community Dent Oral Epidemiol.* 2001; 29(3): 204-212. DOI: 10.1034/j.1600-0528.2001.290306.x
19. Instituto Brasileiro de Geografia e Estatística. Pesquisa nacional por amostra de domicílios: síntese de indicadores 2015. Instituto Brasileiro de Geografia e Estatística. 2016. <https://biblioteca.ibge.gov.br/visualizacao/livros/liv98887.pdf>. Accessed October 15, 2020.
20. Pearl J. Causal diagrams for empirical research, *Biometrika.* 1995; 82 (4): 669–688. DOI: 10.1093/biomet/82.4.669.
21. Hernán MA, Robins JM. *Causal Inference: What If.* Boca Raton: Chapman & Hall/CRC; 2020.
22. Textor J, Zander B, Gilthorpe MK et al. Robust causal inference using directed acyclic graphs: The R package 'dagitty'. *Int J Epidemiol.* 2016; 45(6):1887-94. DOI: 10.1093/ije/dyw341
23. García-Moya I, Jiménez-Iglesias A, Moreno C. Sense of coherence and substance use in Spanish adolescents. Does the effect of SOC depend on patterns of substance use in their peer group? *Adicciones.* 2013; 25(2): 109-17. DOI: 10.20882/adicciones.58
24. O'Loughlin J, O'Loughlin EK, Wellman RJ, Sylvestre MP, Dugas EN, Chagnon M, et al. Predictors of cigarette smoking initiation in early, middle, and late adolescence. *J Adolesc Health.* 2017; 61(3):

363-370. DOI: 10.1016/j.jadohealth.2016.12.026

25. Poureslami I, Shum J, Aran N, Tregobov N. Chinese- and English-speaking adult current smokers' perspectives on smoking and culturally and linguistically appropriate cessation: a qualitative analysis. *Addict Sci Clin Pract.* 2020; 15, 23. DOI: 10.1186/s13722-020-00197-4
26. Glanz K, Maskarinec G, Carlin L. Ethnicity, sense of coherence, and tobacco use among adolescents. *Ann. Behav Med.* 2005; 29(3): 192–199 (2005). DOI: 10.1207/s15324796abm2903_5
27. Arrazola RA, Ahluwalia IB, Pun E, Quevedo IG, Babb S, Armour BS. Current tobacco smoking and desire to quit smoking among students aged 13–15 years—global youth tobacco survey, 61 countries, 2012–2015. *MMWR Morb Mortal Wkly Rep.* 2017; 66(20), 533-37. DOI: 10.15585/mmwr.mm6620a3
28. Boudreaux ED, Sullivan A, Abar B, Bernstein SL, Ginde AA, Camargo CA Jr. Motivation rulers for smoking cessation: a prospective observational examination of construct and predictive validity. *Addict Sci Clin Pract.* 2012; 7, 8. DOI: 10.1186/1940-0640-7-8
29. Velicer WF, Rossi JS, Prochaska JO, Diclemente CC. A criterion measurement model for health behavior change. *Addict Behav.* 1996, 21(5): 555-84. DOI: 10.1016/0306-4603(95)00083-6

Figures

Figure 1

Theoretical framework of the study: Sense of Coherence (SOC) and the Prime Theory motivational system. Source: Adapted [7], with permission.

Figure 2

Directed Acyclic Graph used in the study.

Figure 3

Study flowchart.

Supplementary Files

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