DOI: 10.1590/1413-81232015205.13542014

Tobacco use and friendship networks: a cross-sectional study among Brazilian adolescents

Uso do tabaco e rede de amigos entre adolescentes brasileiros: um estudo transversal

Kelly Oliva Jorge [1]
Luís Otavio Cota [2]
Efigênia Ferreira e Ferreira [3]
Miriam Pimenta do Vale [1]
Ichiro Kawachi [4]
Patrícia Maria Zarzar [1]

Abstract *Aim: To determine the prevalence of tobacco use and its association with types of friendship networks, socioeconomic status and gender among Brazilian adolescents. Methods: A cross-sectional study was carried out with a representative sample of 905 students aged 15 to 19 years. Information on social networks and tobacco use was collected by the self-administered questionnaire 'Alcohol, Smoking and Substance Involvement Screening Test" and the question "What is your most important group of close friends?'. Socioeconomic status was assessed using an area-based social vulnerability index and type of school. Multinomial logistic regression analysis was employed to test associations between tobacco use and the independent variables. Results: The overall prevalence of tobacco use was 18.9%. Female adolescents had 3.80-fold greater odds of reporting weekly to daily tobacco use compared to male adolescents. Participants who reported that their most important groups of close friends were from church had a lower risk of reporting weekly to daily tobacco use in comparison to those who reported that their best friends were from school. Conclusions: The prevalence of tobacco use was high and was associated with school-based (as compared to church-based) friendship networks, female gender and higher area-level socioeconomic status.*

Keywords *Tobacco, Friendship, Adolescent, Epidemiology*

Resumo *Objetivo: Determinar a prevalência do uso do tabaco e sua associação com tipos de amigos, condições socioeconômicas e gênero entre adolescentes brasileiros. Métodos: Um estudo transversal foi conduzido com uma amostra representativa de 905 estudantes de 15 a 19 anos. Informações sobre as redes sociais e o uso do tabaco foram coletadas através do "Questionário para triagem do uso de álcool, tabaco e outras substâncias", e a questão "Qual é o seu grupo de amigos mais importante?". As condições socioeconômicas foram avaliadas através do Índice de vulnerabilidade social e do tipo de escola. Regressão logística multinomial foi utilizada para testar as associações entre o uso do tabaco e as variáveis independentes. Resultados: A prevalência do uso do tabaco foi de 18.9%. Meninas apresentaram 3.80 vezes mais chances de usarem tabaco na frequência semanalmente a diariamente comparado aos meninos. Os participantes que responderam ser o grupo de amigos da igreja o mais importante tiveram um risco menor de usarem tabaco com maior frequência em comparação aos adolescentes que consideraram o grupo de amigos da escola. Conclusões: A prevalência do uso de tabaco foi alta na amostra estudada e foi associada a rede de amigos da escola (em comparação aos amigos da igreja), gênero feminino e melhores condições socioeconômicas.*

Palavras-chave *Tabaco, Amizade, Adolescente, Epidemiologia*

[1] Departamento de Odontopediatria e Ortodontia, Faculdade de Odontologia, Universidade Federal de Minas Gerais (UFMG). Av. Antônio Carlos 6627, Pampulha. 31270-901 Belo Horizonte MG Brasil. kellyoliva@ig.com.br
[2] Departamento de Clínica Patológica e Cirurgia Odontológica, Faculdade de Odontologia, UFMG.
[3] Departamento de Odontologia Social e Preventiva, Faculdade de Odontologia, UFMG.
[4] Department of Society, Human Development, and Health, Harvard School of Public Health.

Introduction

Cigarette smoking continues to be one of the major preventable causes of premature death in the world[1] and often starts in adolescence before 18 years of age[2]. Ninety percent of Brazilian smokers start smoking before 19 years of age and adolescents between 17 and 19 years are identified as the group with the highest proportion of daily smokers (31.9%)[3]. Moreover, the prevalence of smoking is increasing substantially between the ages of 12 to 16 years[4]. Hence, adolescents remain an important focus of studies on smoking.

Health behaviors have been studied with respect to socio-demographic factors (age and gender) and socioeconomic status, but few investigations have focused on the characteristics of social networks[5]. A large number of studies have analyzed the influence of friendship networks on behavioral problems among adolescents and have demonstrated a significant positive correlation between exposure to the behavior of close friends and the use or probability of the use of psychoactive substances, indicating that friendships have a direct influence on individual behavior[5-8]. Most studies have addressed friendship networks in the school environment and the findings contribute to the understanding of the structure and size of friendship networks and associations with the use of tobacco. However, many surveys carried out at schools neither include nor compare different contexts in the same sample, such as participation in religious groups, sports and community activities[9].

Tobacco use in adolescence is reported to vary depending on socioeconomic status[10,11], but such findings have not been consistent across studies. Some studies report an association between high socioeconomic status and tobacco use[12,13], whereas others found that adolescents with a low socioeconomic status smoke more[5,11,14].

Despite being predominantly and historically linked to males, the prevalence of tobacco use among females has been on the rise[15,16]. Some Brazilian investigations have found no statistically significant association between gender and tobacco use[17,18]. However, gender may be associated with social networks and the use of substances. Studies have found an increase in substance use by girls in the presence of problems regarding social relationships[19,20]. It has been suggested that the female gender is more affected by interpersonal difficulties and girls may experience emotional imbalance when close friendships are threatened[9]. A better understanding of the smoking behavior among Brazilian adolescents is needed. Such information can contribute toward the establishment of more effective prevention programs and public policies directed at reducing access to tobacco, as the growth in the Brazilian economy could possibly lead to an increase in the use of this substance by adolescents.

The aim of the present study was to investigate both individual aspects (gender and socioeconomic status) and social relationships among the different types of friendship networks (friends from school, sports, theater, dance and music activities) in different social contexts to characterize inequalities regarding tobacco consumption among adolescents in Brazil.

Methods

Ethical considerations

This study received approval from the Human Research Ethics Committee of the *Universidade Federal de Minas Gerais* (Brazil). Authorization was obtained from the schools to undertake the study and all participants and their parents/guardians signed a statement of informed consent.

Study design and participants

A cross-sectional study was carried out addressing social/friendship networks and tobacco use among 936 adolescents aged 15 to 19 years attending public (n = 717; 81.0%) and private (n = 174; 19.0%) schools in the city of Belo Horizonte between August 2009 and February 2010. Belo Horizonte is the state capital of Minas Gerais, Brazil, with an approximate population of 2.4 million inhabitants, and is geographically divided into nine administrative districts[21]. A random sample of 936 adolescents was selected using two-stage stratified cluster sampling. To ensure the representativeness of the sample, the percentage distribution of students from 15 to 19 years was proportional to the actual distribution of students in the nine administrative districts of the city (1 public and 1 private school was selected from each district). The sample size was calculated to yield a standard error of 4.0%. An assumed prevalence rate of 50.0% was used to calculate the required sample size. The minimum sample size needed to satisfy the requirements was estimated to be 600 individuals, to which 20.0% was added to compensate for possible

Ciência & Saúde Coletiva, 20(5):1415-1424, 2015

losses during the data collection (n = 720) and a 1.3 design effect was applied to increase the precision, as multistage sampling was adopted rather than random sampling[22]. Thus, the final sample consisted of 936 adolescents. The proportion of refusals and losses resulting from incomplete questionnaires was 4.8% (45 adolescents) and the final sample comprised 891 adolescents.

Administration of questionnaires

A pilot study was first conducted with 101 adolescents. The self-report questionnaire Alcohol, Smoking and Substance Involvement Screening Test and the question "What is your most important group of close friends?" were tested and the need for possible changes was suggested by the adolescents. Previous studies have used similar questions to investigate social capital/friendship networks[23,24]. Both questionnaires were distributed in the classroom by a researcher and an assistant and collected immediately after being filled out. The students were told that the questionnaire would be anonymous and the responses would be treated confidentially. Students could refuse to participate and return incomplete questionnaires in the envelopes.

Assessment of tobacco use

The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) is a brief screening tool addressing the use of psychoactive substances. ASSIST has been validated for use in Brazil by Henrique et al.[25] and has eight questions on nine different kinds of drugs (tobacco, alcohol, marijuana, cocaine, stimulants, sedatives, inhalants, hallucinogens and opiates). The risk of tobacco consumption was categorized based on the recommendations of the Brazilian version of ASSIST[25], in which a risk score ranging from 0 to 4 is provided for each substance. The total score (sum of the scores for each class of drug) ranges from 0 to 20. Scores are grouped into the following categories: 0 to 3 points, indicating low risk (individuals at low risk of health and other problems from their current pattern of substance use); 4 to 15 points, indicating moderate risk or abuse (individuals at moderate risk of health and other problems from their current pattern of substance use); and ≥ 16 points, indicating high risk or dependence (individuals at high risk of experiencing severe health, social, financial, legal and/or relationship problems as a result of their current pattern of substance use and likely dependence).

Only items related to tobacco use were analyzed in the present study. The dependent variable was the item on tobacco use in the previous three months. For the calculation of the score for specific involvement with tobacco, Question 5 (During the past three months, how often have you failed to do what was normally expected of you because of your use of tobacco?), Question 1 (In your life, which of the following substances have you ever used?) and Question 8 (Have you ever used any drug by injection?) were not included in the final score, as advocated by the original and validated Brazilian questionnaire.

Assessment of social and friendship networks

To assess social behavior related to membership in adolescent peer networks, the following question was posed: "What is your most important group of close friends?" Answers were categorized based on the most frequent responses: friends from school, family, church and others (friends from sports, theater, dance and music activities).

Covariates

The Social Vulnerability Index (SVI) measures social exclusion in the city of Belo Horizonte and was used to assess socioeconomic status based on place of residence. The city hall database of SVI scores for each district was used in the present study based on the address of each family (derived from the survey)[26]. This index has 20 variables grouped into five "dimensions of citizenship": access to housing and basic infrastructure; access to education; access to income and employment; access to legal assistance; and access to health, food security and welfare[27]. Residential areas are categorized into five classes (I to V); class I families have the highest degree of social vulnerability and class V families have the lowest degree of social vulnerability[27]. The final score ranges from zero to one. Each student's address was collected individually and categorized into one of the five SVI classes. For the bivariate analysis, the SVI was dichotomized as greater vulnerability (social classes I and II, scores ≥ 0.5) and lesser vulnerability (social classes III, IV and V, scores < 0.5). For the multinomial logistic regression analysis, the five classes were maintained independent to determine the curvilinear (U-shaped) relationship between socioeconomic status and tobacco use in the previous three months.

As wealthy adolescents in Brazil are generally enrolled in private schools, since most Brazilian public schools have fewer educational resources, type of school was also used as a socioeconomic indicator. Private school was coded 0 and public school was coded 1 for the statistical analysis.

Statistical analysis

Data analysis was performed using the Statistical Package for Social Sciences (SPSS for Windows, version 17.0, SPSS Inc, Chicago, IL, USA). Descriptive and bivariate analyses were carried out using the chi-square test ($p < 0.05$). Multinomial logistic regression was used to evaluate tobacco use in the previous three months and associated variables, comparing "never smoked" to "weekly to daily" and "less than monthly to monthly" tobacco use. "Never smoked" was used as the reference group and separate odds ratios (OR) were calculated, with the exception of the comparison categories.

Results

The final sample comprised 891 adolescents with a mean age of 16.3 years (± 1 year). The prevalence of lifetime tobacco use was 18.9% (n = 168). A total of 6.2% (n = 55) of the adolescents indicated that they felt a strong craving and a sense of urgency to consume tobacco. Regarding the scores for tobacco use, 94.4% of the total sample (n = 841) were in the low risk range (0 to 3 points), 5.4% (n = 48) were in the moderate risk range (4 to 15 points) and 0.2% (n = 1) were in the high risk range (≥ 16 points).

Table 1 displays the distribution of the respondents according to the prevalence of lifetime tobacco use and background characteristics. Lifetime tobacco use was not statistically associated with gender, age, type of school or SVI.

Table 2 displays the distribution of the sample according to the prevalence of friendship networks and background characteristics.

Table 3 displays the results of the multinomial logistic regression analysis of tobacco use in the previous three months (weekly to daily/less than monthly to monthly) according to the independent variables. Female adolescents had a 3.80-fold greater chance (OR: 3.804; 95% CI: 1.28 to 11.2) of using tobacco weekly to daily in comparison to male adolescents. Participants who reported that their most important friends were from church had a lesser chance of using tobacco weekly to daily (OR: 0.121; 95% CI: 0.027 to 0.551) in comparison to those who reported that their most important groups of close friends were from school. Adolescents residing in areas of greater vulnerability (SVI classes II and III – worse socioeconomic conditions) reported less tobacco use on a monthly or less than monthly basis in comparison to adolescents from more privileged areas.

Discussion

The prevalence of lifetime tobacco use in the present study was 18.9%, which is somewhat lower than the rate reported in the Fifth National Survey on the Consumption of Psychotropic Drugs among students in 27 large cities in Brazil (24.9%)[28]. However, a recent survey involving the same 27 large cities found a reduction in the number of students who reported tobacco use between 2004 and 2010 in terms of both lifetime use (16.9%) and use in the previous 12 months (9.6%)[29], with similar prevalence rates to those found in the present study. Madruga et al.[30] suggest that the reduction in tobacco use is the result of the government practices, as Brazil has been actively restricting tobacco advertising in the media since 2001 and tobacco product manu-

Table 1. Distribution of sample according to prevalence of lifetime tobacco use and background characteristics; Belo Horizonte, Minas Gerais, Brazil, 2010.

Independent Variables	Tobacco use		p-value*
	Yes n (%)	No n (%)	
School			0.861
Public	136 (19.0)	581 (81.0)	
Private	32 (18.4)	142 (81.6)	
Age			0.061
15 to 16	89 (16.8)	440 (83.2)	
17 to 19	79 (21.8)	283 (78.2)	
Gender			0.948
Male	66 (18.7)	286 (81.3)	
Female	102 (18.9)	437 (81.1)	
Social Vulnerability Index (SVI			0.061
More Vulnerable	79 (16.6)	398 (83.4)	
Less Vulnerable	89 (21.5)	325 (78.5)	

* chi-square test.

Table 2. Distribution of sample according to prevalence of friendship networks and background characteristics; Belo Horizonte, Minas Gerais, Brazil, 2010.

Independent Variables	Most important group of friends/close friends				p-value*
	School n (%)	Family n (%)	Others** n (%)	Church n (%)	
School					0.001
Public	153 (31.2)	84 (17.1)	79 (16.1)	175 (35.6)	
Private	48 (32.2)	65 (43.6)	22 (14.8)	14 (9.4)	0.029
Age					
15 to 16	109 (27.6)	104 (26.3)	63 (15.9)	119 (30.1)	
17 to 19	92 (37.6)	45 (18.4)	38 (15.5)	70 (28.6)	0.022
Gender					
Male	71 (31.8)	46 (20.6)	48 (21.5)	58 (26.0)	
Female	130 (31.2)	103 (24.7)	53 (12.7)	131 (31.4)	
Social Vulnerability Index (SVI)					0.001
More Vulnerable	90 (29.3)	38 (12.4)	57 (18.6)	122 (39.7)	
Less Vulnerable	111 (33.3)	111 (33.3)	44 (13.2)	67 (20.1)	

* chi-square test. ** Others (friends from sports, theater, dance, sect and music activities).

facturers are currently required by law to include pictorial health warnings on cigarette packages.

While 94.4% of the present sample was classified as at low risk for tobacco use, exposure to tobacco in adolescence is known to have important health consequences, as nicotine dependence is not limited to the daily use of tobacco[17].

Tobacco use by adolescents varies with socioeconomic status[10]. However, due to differences in the methodology, sample selection, type of study, age group, cultural factors, geographic characteristics and socioeconomic indicators employed, there is no consensus among studies, which hinders the comparison of findings. In the generalized estimating multinomial logistic regression used in the present study regarding tobacco use in the previous three months (less than monthly to monthly), adolescents from more vulnerable socioeconomic classes (classes II and III) had a lesser chance of tobacco use in comparison to those from class V (least socioeconomically vulnerable). It is possible that youths from families with a lower income may be more price sensitive than their better-off peers[31]. However, no significant association was found between the SVI and weekly to daily tobacco use, which is consistent with findings reported in previous studies[32,33]. It is possible that adolescents who use tobacco weekly to daily have a greater craving for tobacco in comparison to those who use it monthly or less than monthly. Thus, having a higher or lower socioeconomic status would not be a determinant of such use, as adolescents can gain access to tobacco through means other than money, such as their network of friends[34,35]. On the other hand, adolescents with a low socioeconomic status are more likely to grow up in a family environment in which smoking is more prevalent and may therefore more easily pick up the smoking habit[5]. It has been suggested that lower class youths could have greater access to tobacco from family and friends as well as access to cheaper cigarettes from illegal sources. This may explain the curvilinear (U-shaped) relationship found between socioeconomic status and tobacco use, in which the extremes represent high and low socioeconomic status.

Female adolescents had a nearly fourfold greater chance of engaging in weekly to daily tobacco use in comparison to male adolescents. Data from 2004 on the prevalence of tobacco use in the city of Belo Horizonte also reveal a higher rate of smoking among female adolescents (25.9%) in comparison to males (24.0%)[28]. While a reduction in lifetime tobacco use among adolescents of both genders occurred between 2004 and 2010, the prevalence remains higher among females (18.6%) in comparison to males (17.1%), although there is not statistical significance[29]. A number of authors have reported no gender differences in smoking habits[8,36], whereas the majority of researchers report greater tobacco consumption among males[3,29,37]. The lack of consensus in the findings suggests that tobacco use may vary by gender even within the same city,

Table 3. Generalized estimating multinomial logistic regression for tobacco use in previous three months and independent variables comparing "never smoked" (reference) to "weekly to daily" and "less than monthly to monthly" tobacco use among adolescents in Belo Horizonte, Minas Gerais, Brazil (n = 891), 2010.

Independent variables	Tobacco use in previous 3 months (weekly to daily)			
	Coefficient	**OR**	**95% CI**	**p-value**
Constant	-3.622	-	-	<0.001
Private School	(reference)	-	-	-
Public School	0.340	1.404	0.524 – 3.763	0.500
Age (15 to 16 years old)	(reference)	-	-	-
Age (17 to 19 years old)	0.013	1.013	0.446 – 2.303	0.975
Male	(reference)	-	-	-
Female	1.336	3.804	1.285 – 11.261	0.016
SVI class V	(reference)	-	-	-
SVI class I	-0.118	0.888	0.167 – 4.723	0.889
SVI class II	-0.321	0.726	0.182 – 2.896	0.650
SVI class III	0.000	1.000	0.260 – 3.841	1.000
SVI class IV	0.325	1.384	0.360 – 5.320	0.636
Type of group of best friends/close friends				
School	(reference)	-	-	-
Church	-2.108	0.121	0.027 – 0.551	0.006
Family	-0.581	0.559	0.214 – 1.461	0.236
Others (e.g., sports, music activity, dance group, sects)	-0.308	0.735	0.253 – 2.135	0.571
	Tobacco use in previous 3 months (less than monthly to monthly)			
Constant	-1.793	-	-	<0.001
Private School	(reference)	-	-	-
Public School	0.555	1.743	0.818 – 3.713	0.150
Age (15 to 16 years old)	(reference)	-	-	-
Age(17 to 19 years old)	0.552	1.737	0.962 – 3.138	0.067
Male	(reference)	-	-	-
Female	0.002	1.002	0.562 – 1.785	0.995
SVI class V	(reference)	-	-	-
SVI class I	-1.074	0.341	0.111 – 1.054	0.062
SVI class II	-1.147	0.318	0.129 – 0.781	0.013
SVI class III	-1.124	0.345	0.129 – 0.818	0.017
SVI class IV	-0.802	0.448	0.173 – 1.165	0.100
Type of group of best friends/close friends				
School	(reference)	-	-	-
Church	-0.610	0.543	0.256 – 1.154	0.112
Family	0.005	1.005	0.496 – 2.033	0.990
Others (e.g., sports, music activity, dance group, sects)	-0.608	0.545	0.221 – 1.341	0.186

depending on the socio-cultural context[8]. In the group that reported less than monthly to monthly use of tobacco, no significant association was found with gender. According to Horta et al.[15], the establishment of smoking behavior is a complex phenomenon that cannot be explained by its association with a single variable or a single phenomenon. It is possible that girls have their first contact with tobacco earlier than boys or there may be the occurrence of the establishment of more frequent smoking among females than males in future generations.

The present study sought to identify the role of friendship networks in tobacco use among students. Adolescents who reported that the majority of their groups of close friends were from

Ciência & Saúde Coletiva, 20(5):1415-1424, 2015

church had a lower risk of smoking on a weekly to daily basis in comparison to those whose main groups of close friends were from school. The level of social capital to which an individual may gain access through social networks depends on the structural characteristics of these networks as well as the amount of social capital that other individuals in the network possess. Despite the potential for the diffusion of health-promoting behaviors, the present findings suggest that some types of friendship networks can also exert adverse influences on health behavior, depending on the behavior endorsed by the peer group[38]. In the group that reported less than monthly to monthly use of tobacco, no significant association was found with type of groups of close friends. Barreto et al.[39] found that the chances of both experimenting with tobacco and currently using tobacco increase with the weekly exposure of adolescents to other smokers and with the perception of family acceptance of the habit. Thus, individuals who smoke less often are less exposed to friends who smoke frequently.

The literature has shown homophily or similarity in substance use among adolescent peers. This similarity has been attributed to the socialization process, wherein the peer group influences the substance use behavior of the individual, and to the selection process, wherein individuals associate with peers that are similar to them in their substance use behavior[40]. Social network analysis may offer an explanation for the role of friends in smoking behavior[7]. Participation in religious groups has been associated with a reduced proneness to risky health-related behavior among adolescents, such as alcohol consumption, smoking and the use of illicit drugs. Religious participation may deter risky behavior by helping adolescents develop social networks that provide social support and reinforce widely accepted social norms[41]. In line with the present results, Mellor and Freeborn[41] found that adolescents who participated in religious groups with greater frequency were less likely to smoke, participate in binge drinking and use marijuana. However, the non-use of drugs may be more due to the greater exposure to the values and norms of church-going peers who disapprove of drug use rather than religious beliefs *per se*.

The present study has important limitations that may affect the interpretation of the findings. Although some part of the association between different types of friendship networks and smoking can be ascribed to peer influence, one cannot exclude the possibility of homophily or social selection based upon shared behaviors. Selection can be divided into two conceptually different mechanisms: adolescents may acquire new friends with similar characteristics, attitudes and behaviors or may avoid contact with new friends or even break off friendships because of differences in opinions and behavior[6]. Therefore, the associations found in the present study may have been driven by the tendency of individuals to influence or select their groups of friends based partly on behavioral preferences rather than the network characteristics *per se* (e.g., social norms that influence and regulate behavior within certain types of social networks). Secondly, the present findings may reflect the influence of unmeasured confounding factors that affect both patterns of friendship ties as well as tobacco use. For instance, the strictness of school policies against smoking among students may influence both the formation of different friendship connections and the prevalence of smoking. Moreover, no information was acquired on the profile of parents, who are known to exert considerable influence over the type of friends their children select as well as the practice of smoking. Another issue that was not investigated is the influence of religiosity on tobacco use. It is possible that faith in a religion that prohibits smoking and the frequency of participation in religious activities have an independent effect on the prevalence of tobacco use, with lower prevalence among adolescents who report that friends from church constitute their most important group of friends. Moreover, the present investigation was a cross-sectional study and causal relationships can therefore not be determined. Information bias may have occurred due to a lack of attention, memory errors, social desirability and a suspicion that school authorities could demand access to the questionnaires. Public health promotion and smoking prevention policies aimed at the community, schools and families and targeting adolescents in particular should involve joint actions of the government, educational organizations and society as a whole. Actions on the primary care level regarding education and smoking should be prioritized. Publicizing the chemical content of cigarettes and sharply increasing prices for tobacco products may be areas of policy action that hold the greatest promise for altering smoking behavior[42]. The prevalence of tobacco use by adolescents is lower in places where laws regarding its use are strictly enforced.

Conclusions

The prevalence of tobacco use was high in this sample of Brazilian adolescents studied and was associated with school-based friendship networks, the female gender and higher area-level socioeconomic status. Future studies are needed to investigate the selection processes that determine the formation of adolescent peer networks and how these networks may influence tobacco use behavior. Longitudinal studies are also needed to clarify the persistence of smoking habits in these groups over time.

Collaborations

KO Jorge, EF Ferreira, MP Vale and PM Zarzar conceived of the study. KO Jorge collected data and wrote the first version. LO Cota conducted the analysis. LO Cota and I Kawachi contributed substantially to the interpretation of the results. KO Jorge, LO Cota, EF Ferreira, MP Vale, I Kawachi and PM Zarzar revised the manuscript for important intellectual content. All authors read and approved the final version of the manuscript.

Acknowledgments

The authors wish to thank the Brazilian fostering agency Fundação de Amparo à Pesquisa de Minas Gerais (FAPEMIG) for its support.

References

1. Warren CW, Jones NR, Eriksen M, Asma S. Patterns of global tobacco use in young people and implications for future chronic disease burden in adults. *Lancet* 2006; 367(9512):749-753.
2. Cai L, Wu X, Goyal A, Han Y, Cui W, Xiao X, He J, Zhao K, Song Y, Jiao F. Patterns and socioeconomic influences of tobacco exposure in tobacco cultivating rural areas of Yunnan Province, China. *BMC Public Health* 2012; 12:842.
3. Brazilian Institute of Geography and Statistics (IBGE). National Survey by Household Sample Survey 2008. *Smoking*. Rio de Janeiro: IBGE; 2008.
4. Gielkens-Sijstermans CM, Mommers MA, Hoogenveen RT, Feenstra TL, de Vreede J, Bovens FM, van Schayck OC. Reduction of smoking in Dutch adolescents over the past decade and its health gains: a repeated cross-sectional study. *Eur J Public Health* 2010; 20(2):146-150.
5. Huisman C, Bruggeman J. The social network, socioeconomic background, and school type of adolescent smokers. *Int J Behav Dev* 2012; 36(5):329-337.
6. Engels RC, Vitaro F, Bloklandc ED, Kemp R, Scholte Ron HJ. Influence and selection processes in friendships and adolescent smoking behaviour: the role of parental smoking. *J Adolesc* 2004; 27(5):531-544.
7. Hall JA, Valente TW. Adolescent smoking networks: the effects of influence and selection on future smoking. *Addict Behav* 2007; 32(12):3054-3059.
8. Sanchez ZM, Opaleye E, Martins S, Ahluwalia JS, Noto AR. Adolescent gender differences in the determinants of tobacco smoking: a cross sectional survey among high school students in São Paulo. *BMC Public Health* 2010; 10:748.
9. Mason MJ, Mennis J, Schmidt CD. A social operational model of urban adolescents' tobacco and substance use: A mediational analysis. *J Adolesc* 2011; 34(5):1055-1063.
10. Richter M, Leppin A. Trends in socio-economic differences in tobacco smoking among German schoolchildren, 1994-2002. *Eur J Public Health* 2007; 17(6):565-571.
11. Bortoluzzi MC, Kehrig RT, Loguercio AD, Traebert JL. Prevalence and tobacco user profile in adult population in the South of Brazil (Joaçaba, SC). *Cien Saude Colet* 2011; 16(3):1953-1959.
12. Zanini RR, de Moraes AB, Trindade AC, Riboldi J, de Medeiros LR. Smoking prevalence and associated factors among public high school students in Santa Maria, Rio Grande do Sul, Brazil, 2002. *Cad Saude Publica* 2006; 22(8):1619-1627.
13. Pinto DS, Ribeiro SA. Variables related to smoking initiation among students in public and private high schools in the city of Belém, Brazil. *J Bras Pneumol* 2007; 33(5):558-564.
14. Doku D, Koivusilta L, Raisamo S, Rimpelä A. Do socioeconomic differences in tobacco use exist also in developing countries? A study of Ghanaian adolescents. *BMC Public Health* 2010; 10:758.
15. Horta RL, Horta BL, Pinheiro RT, Morales B, Strey MN. Tobacco, alcohol, and drug use by teenagers in Pelotas, Rio Grande do Sul State, Brazil: a gender approach. *Cad Saude Publica* 2007; 23(4):775-783.
16. Kyaing NN, Islam MA, Sinha DN. Social, economic and legal dimensions of tobacco and its control in South-East Asia region. *Indian J Public Health* 2011; 55(3):161-168.
17. Barreto SM, Giatti L, Casado L, Moura, L, Crespo C, Malta DC. Smoking children in Brazil. *Cien Saude Colet* 2010; 15(Supl. 2):3027-3034.
18. Moreno RS, Ventura RN, Brêtas JR. The use of alcohol and tobacco by adolescents in the municipality of Embu, São Paulo, Brazil. *Rev Esc Enferm USP* 2010; 44(4):966-973.
19. Wills TA, Sandy JM, Yaeger AM. Stress and smoking in adolescence: a test of directional hypotheses. *Health Psychol* 2002; 21(2):122-130.
20. Zahn-Waxler C, Crick N, Shirtcliff E, Woods K. The origins and development of psychopathology in females and males. In: Cicchetti D, Cohen DJ, editors. *Developmental Psychopathology. Theory & Method*. Hoboken: Wiley & Sons; 2006. p. 76-138.
21. Brazilian Institute of Geography and Statistics (IBGE). *2010 population census*. [accessed 2013 Jul 20]. Available from: http://www.ibge.gov.br/home/estatistica/populacao/contagem
22. Kirkwood BR, Stern J. *Essentials of medical statistics*. London: Blackwell; 2003.
23. Lindström M. Social capital, the miniaturization of community and high alcohol consumption: a population-based study. *Alcohol Alcohol* 2005; 40(6):556-562.
24. Giordano GN, Lindström M. The impact of changes in different aspects of social capital and material conditions on self-rated health over time: A longitudinal cohort study. *Soc Sci Med* 2010; 70(5):700-710.
25. Henrique IF, Micheli D, Lacerda RB, Lacerda LA, Formigoni ML. Validation of the Brazilian version of Alcohol, Smoking and Substance Involvement Screening Test (ASSIST). *Rev Assoc Med Bras* 2004; 50(2):199-206.
26. Belo Horizonte. *The Social Vulnerability Index (SVI)*. [accessed 2013 Aug 23]. Available from: http://www.portal2.pbh.gov.br/pbh/index.html
27. Nahas M, Ribeiro C, Esteves O, Moscovitch S, Martins VL. O mapa da exclusão social de Belo Horizonte: metodologia de construção de um instrumento de gestão urbana. *Cad Cienc Soc* 2000; 7:75-88.
28. Galduróz JC, Fonseca AM, Noto AR, Carlini EA. Decrease in tobacco use among Brazilian students: A possible consequence of the ban on cigarette advertising? *Addict Behav* 2007; 32(6):1309-1313.
29. Carlini EA, Noto AR, Sanchez S, Carlini CMA, Locatelli DP, Abeid LR, Amato TC, Opaleye ES, Tondowski CS, Moura YG. *VI Levantamento Nacional sobre o Consumo de Drogas Psicotrópicas entre Estudantes do Ensino Fundamental e Médio das Redes Pública e Privada de Ensino nas 27 Capitais Brasileiras – 2010*. São Paulo, Brasília: Centro Brasileiro de Informações sobre Drogas Psicotrópicas, Universidade Federal de São Paulo, Secretaria Nacional de Políticas sobre Drogas; 2010.
30. Madruga CS, Laranjeira R, Caetano R, Pinsky I, Zaleski M, Ferri CP. Use of licit and illicit substances among adolescents in Brazil-a national survey. *Addict Behav* 2012; 37(10):1171-1175.

31. West P, Sweeting H, Young R. Smoking in Scottish youths: personal income, parental social class and the cost of smoking. *Tobacco Control* 2007; 16(5):329-335.
32. Birmpili E, Katsiki N, Malhotra A, Dimopoulou E, Dimitri P, Mikhailidis DP, Tsiligiroglou-Fachantidou A. Gender and socio-economic differences in daily smoking and smoking cessation among adult residents in a Greek rural area. *Open Cardiovasc Med J* 2012; 6:15-21.
33. Filippidis FT, Vardavas CI, Loukopoulou A, Behrakis P, Connolly GN, Tountas Y. Prevalence and determinants of tobacco use among adults in Greece: 4 year trends. *Eur J Public Health* 2012; 23(5):772-776.
34. Ramírez-Ortiz G, Caballero-Hoyos R, Ramírez-López G, Valente TW. The effects of social networks on tobacco use among high-school adolescents in Mexico. *Salud Publica Mex* 2012; 54(4):433-441.
35. Fujimoto K, Valente TW. Decomposing the components of friendship and friends' influence on adolescent drinking and smoking. *J Adolesc Health* 2012; 51(2):136-143.
36. Tavares BF, Béria JU, Lima MS. Drug use prevalence and school performance among teenagers. *Rev Saude Publica* 2001; 35(2):150-158.
37. Barros AJD, Cascaes AM, Wehrmeister FC, Martínez-Mesa J, Menezes AMB. Tobacco smoking in Brazil; regional inequalities and prevalence according to occupational characteristics. *Cien Saude Colet* 2011; 16(9):3707-3716.
38. Rosenquist J, Murabito J, Fowler J, Christakis N. The spread of alcohol consumption behavior in a large social network. *Ann Intern Med* 2010; 152(7):426-433.
39. Barreto SM, Giatti L, Oliveira-Campos M, Andreazzi MA, Malta DC. Experimentation and use of cigarette and other tobacco products among adolescents in the Brazilian state capitals (PeNSE 2012). *Rev Bras Epidemiol* 2014; 17(Supl. 1):62-76.
40. Andrews JA, Tildesley E, Hops H, Li F. The influence of peers on young adult substance use. *Health Psychol* 2002; 21(4):349-357.
41. Mellor JM, Freeborn BA. Religious participation and risky health behaviors among adolescents. *Health Econ* 2011; 20(10):1226-1240.
42. Crawford MA, Balch GI, Mermelstein R. Responses to tobacco control policies among youth. *Tob Control* 2002; 11(1):14-19.

Artigo apresentado em 08/09/2014
Aprovado em 14/09/2014
Versão final apresentada em 16/09/2014