Smoking, alcohol consumption and mental health: Data from the Brazilian study of Cardiovascular Risks in Adolescents (ERICA)

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ABSTRACT

Introduction: Previous researches have indicated a strong association of alcohol and tobacco use with psychiatric disorders, but the relationship with depression and anxiety symptoms is still uncertain. We investigated the association of psychological distress and alcohol consumption, tobacco use and exposure to secondhand smoke (SHS) among adolescents in a developing country.

Methods: The authors evaluated 73,399 individuals (12–17 years) who participated in the Cardiovascular Risks Study in Adolescents (ERICA), a cross-sectional, national and school-based study, carried out in 124 Brazilian municipalities. The variables considered were alcoholic beverages (experimentation, consumption in the previous month and frequency of use) and smoking (experimentation, current smoking habits, frequent smoking and SHS exposure). Psychological distress was defined as a score ≥ 3 points in GHQ-12. Analyses included multiple logistic regression modeling.

Results: The frequency of individuals with psychological distress was higher in the group who smoked for at least 7 consecutive days (53.3% vs 31.2%; OR: 2.17; 95%CI: 1.65–2.86), were exposed to SHS indoors (37.8% vs 29.8%; OR:1.30; 95%CI: 1.14–1.48), and outdoors (37.7% vs 26.6%; OR: 1.49; 95%CI: 1.28–1.74), and among young people who consumed at least 1 drink of alcohol in the previous 30 days (42.4% vs 28.6%; OR: 1.70; 95%CI: 1.46–1.97), when compared to adolescents not exposed.

Conclusions: Smoking (passively and actively) and the consumption of alcoholic beverages are associated to psychological distress in the adolescent population. Avoiding smoking and the use of alcohol may have beneficial effects on the mental health. Our data reinforce the urgent necessity to prevent effectively underage access to legal drugs in Brazil.

1. Introduction

Adolescence is a period in which remarkable changes in physical, physiological and social aspects take place and these changes can be very stressful for this segment of the population. On becoming an adolescent, the individual bridges familial aspects while searching for a new identity in one's social sphere, and independence to make personal choices. This personality-building period promotes conflicts and favors risky and dangerous behaviors, such as buying and using illegal drugs, alcohol and tobacco (Keyes et al., 2015).

Studies with Brazilian adolescents estimate a high prevalence of alcohol consumption (21.2%) (Coutinho, França-Santos, & Magliano, 2016) and tobacco experimentation (18.6%) (Figueiredo, Szklo, Costa, et al., 2016). These results raise a great deal of concern, since tobacco usage is the most important cause of preventable death worldwide and one of the most important risk factors for chronic conditions, particularly cardiovascular and respiratory diseases and many types of cancer (Health USDO & Human S., 2006). Alcohol consumption, especially binge drinking, in addition to increasing the risk of cardiovascular disease, predisposes the adolescent to become a victim of traffic accidents, violent or criminal behavior, risky sexual activities, experimentation of other drugs. Such habits can also cause poor academic performance, and financial problems (Rose, Winter, Viken, & Kaprio, 2014).

In addition to the physical health risk factors mentioned above, scientific evidence has linked smoking and alcohol consumption to

mental disorders in adolescent populations (Balogun, Koyanagi, Stickley, Gilmour, & Shibuya, 2014; Mason, Kosterman, Haggerty, et al., 2008; Skogen et al., 2014). Studies have shown that alcohol addiction (Marmorstein, Iacono, & Malone, 2010) and tobacco use (Chaiton, Cohen, O'Loughlin, & Rehm, 2009) during the last phase of adolescence can increase the risk of depression in adulthood. Worthy of note is the prevalence of smoking and alcohol consumption among adolescents with psychiatric disorders, when compared to the general population in that age bracket (Mangerud, Bjerkeset, Holmen, Lydersen, & Indredavik, 2014).

Despite the fact that numerous studies throughout the world have already established that there is a relationship between active smoking and mental morbidities, the negative effects of second-hand smoke on mental health have only recently been considered (Bandiera, 2011). Researchers suggests that there is a positive dose-response relationship between length of exposure to the smoke exhaled by smokers and psychological distress, expressed as anxiety and depression symptoms, among non-smoking adolescents (Hamer, Ford, Stamatakis, Dockray, & Batty, 2011; Lee, 2014).

Mental disorders among the youth population have become a public health problem, not only because they hinder academic performance, but most importantly, because of the high possibility that they will persist throughout adulthood (Marmorstein et al., 2010). Public health professionals and researchers have focused on common mental disorders (CMD), usually called psychological distress, since they represent the mental disorders with the highest prevalence in both the general population (20%–30%) (Goldberg & Huxley, 1992) and Brazilian adolescents (30%) (Lopes, Abreu, Santos, et al., 2016). CMD are characterized primarily by the presence of depression and anxiety-like symptoms, as well as psychosomatic complaints. These events, however, may present as early and minor signs of more severe and specific psychiatric disorders, that can ultimately impact negatively the family and social relationships of the affected population (Goldberg, 1972; Goldberg & Huxley, 1992).

Previous researches have indicated a strong association of alcohol and tobacco use with non-psychotic psychiatric disorders, but the relationship with anxiety and depression symptoms is still uncertain. Most studies were conducted in adult populations of developed countries. In addition, there are few studies evaluating whether the frequency of consumption (number of days) and exposure to SHS are related to poor mental health. In the present study we aim to assess the association of psychological distress with alcohol consumption, tobacco use and exposure to secondhand smoke among school adolescents in a developing country.

2. Materials and methods

The study of cardiovascular risks among adolescents (ERICA) is a multicenter cross-sectional national school-based study conducted in Brazilian cities with > 100,000 inhabitants. Adolescents aged between 12 and 17 years, enrolled in public and private schools, in the morning and evening period were enrolled. Data were collected between March and December of 2013/2014. The ERICA Protocol has been previously described (Bloch, Szklo, Kuschnir, et al., 2015).

The study population was stratified in 32 geographical strata, consisting of 27 capitals and five sets of municipalities with > 100,000 inhabitants, in each of the five geographical macro-regions of the country. After that probability sampling of schools was performed in two steps. The first schools were selected for each geographic stratum, with probability proportional to size and inversely proportional to the distance from the capital. In the second stage, three classes in each school were chosen as having the same probability during the field-work, using the class year as informational age variable. The sample is representative for medium and large municipalities (> 100,000 inhabitants) at national, regional levels, regarding Brazilian capitals. More details about the sampling design can be found in a previous

publication (Vasconcellos, Silva, Szklo, et al., 2015).

In the selected classes, all the students who signed and brought the informed consent form signed by their guardians (when required by the local research Ethics Committee) were interviewed and examined. Adolescents outside the age range established for the study, pregnant girls, and those with a temporary or permanent physical or mental disability were exclusion criteria. A total of 114,162 students participated in the survey, from 1247 schools, in 124 Brazilian cities. From that total, 11,835 (10.4%) were excluded from the analysis, because they were outside the eligible age range (11,256), pregnant (215 girls) or with a physical disability that did not allow the measurement of anthropometric measures (364). Of the 102,327 adolescents considered eligible, 73,399 were included in the present study (71.7% of eligible) since they answered the adolescent's questionnaire and had the anthropometric and blood pressure measurements performed. Among the eligible non-participants, the majority were absent on the day of data collection, 5272 were present and refused to participate, 109 were logistic losses and 1154 were partial losses (did not answer the questionnaire or only had anthropometric and blood pressure measurements performed).

The mean age in the present study was 14.7 years (SD = 1.59). The majority of the population was from public schools (78.7%) and had brown or black skin (58.6%). The most common referred morbidity was asthma (10.0%), followed by dyslipidemia (9.1%), as shown in Table 1.

The data collection instrument was a self-filled questionnaire, applied in the classroom under the supervision of the study team, using a single portable electronic data collector PDA (personal digital assistant, LG® model GM750Q). The independent variables assessed were sexual maturity (self-classification using Tanner's pictures)(Tanner, 1962), morbidity (hypertension, diabetes, hypercholesterolemia and asthma) and the following social and demographic characteristics: sex, age in full years and subsequently categorized (12–14 and 15–17 years), skin

Table 1
Characterization of the sample of adolescents, according to social and demographic variables, sexual maturity and morbidity. ERICA, Brazil, 2013–2014 (n = 73,399).

Variables	(%)
Sex	
Boys	44.6
Girls	55.4
Age group (years)	
12–14	45.9
15–17	54.1
Skin color[a]	
Black or Brown	60.2
White	36.4
Others	3.4
School type	
Public	78.7
Private	21.3
Macroregion	
North	20.4
Northeast	31.0
Midwest	13.0
Southeast	22.9
South	12.7
Sexual maturity stage[*][,b]	
Prepubescent	0.5
Pubescent	62.9
Post-pubescent	36.6
Referred morbidity[c]	
Hypertension	3.6
Diabetes mellitus	3.7
Dyslipidemia	9.1
Asthma	10.0

Without information: [a]2,7%;[b]0,1%;[c]8,8%.

[*] Prepubescent (tanner stages 1 e 2), pubescent (tanner stage 3) e post-pubescent (tanner stage 4 e 5).

Table 2
Prevalence of adolescents with psychological distress (GHQ score ≥ 3) and the corresponding Odds Ratios (OR), according to alcohol consumption. ERICA, Brazil, 2013–2014.

Variables	All (n)	With psychological distress (%)	Gross OR (95% CI)	p value	Adjusted OR[1] (95% CI)	p value
All	73,399	31.8	–	–	–	–
Experimentation[a]						
Never	37,723	25.0	1		1	
09–11 years	5764	40.3	2.00 (1.84–2.18)	< 0.001	2.01 (1.65–2.44)	< 0.001
12–17 years	25,924	39.5	1.97 (1.71–2.28)	< 0.001	1.76 (1.56–1.97)	< 0.001
Consumption previous month[b]						
No	55,520	28.6	1			
Yes	15,293	42.4	1.96 (1.76–2.19)	< 0.001	1.70 (1.46–1.97)	< 0.001
Frequency of consumption month[c]						
1–2 days	9808	41.5	1		1	
3–5 days	2830	43.0	1.20 (0.51–2.87)	0.674	1.07 (0.30–3.80)	0.919
6 or more days	2655	45.0	1.21 (0.50–2.92)	0.670	1.21 (0.34–4.24)	0.769

Without information: [a]5.4%; [b]3.5%; [c]3.5%.

[1] Odds ratios (and 95% confidence intervals) derived from multiple logistic regression models adjusted for sex, age, school type (public/private), stage of sexual maturity, body mass index-BMI, morbidity and smoking.

[a] Experimentation: age in which the individual had at least a drink/dose of alcoholic beverage for the first time.

[b] Consumption previous month: at least 1 drink/dose of alcohol in the last 30 days.

[c] Frequency of consumption month: consumption days of at least one drink/dose of alcohol within the past 30 days.

color (white, black, brown, yellow or indigenous), school type (public or private) and geographical macro-region (North, Northeast, Midwest, Southeast and South).

Regarding alcohol usage, teenagers were classified into consumers or non-consumers of alcoholic drinks (having consumed at least 01 drink/dose of alcohol in the last 30 days). Drink or dose means any quantity of alcohol. Experimentation and frequency of use in the month were also evaluated by means of the following questions: age in which the person had at least a drink (or dose) of alcoholic beverage for the first time; consumption days of at least one drink (dose) of alcohol within the past 30 days.

To evaluate active smoking, the variables current smoking habits, experimentation and frequent smoking were considered. Experimentation was defined whether the teenager had ever tried smoking cigarettes or not, and if the answer was positive at what age ("have you ever tried or experimented smoking cigarettes, even one or two puffs?" and "how old were you?"). Current smoking was defined as the use of cigarettes for at least a day during the past 30 days (in the past 30 days (one month), "how many days did you smoke cigarettes?"). Both variables followed the definitions adopted by the WHO and the US Centre for Disease Prevention and Control (Centers for Disease Control and Prevention-CDC) in the Global Youth Tobacco Surveillance (GYTS) (Warren, Jones, Peruga, et al., 2008). To determine how frequent tobacco was used, the indicator was having smoked cigarettes at least seven days in a row ("have you ever smoked cigarettes at least 7 days in a row, meaning, during a whole week?") (Figueiredo et al., 2016).

Passive smoking has also been estimated. It is defined as exposure to environmental tobacco smoke inside and outside the home ("are you exposed to the smoke of cigarettes or cigars, cigarillos, pipe used by other people in the house where you live? And away from home, to the point of smelling it?"). About second-hand smoke indoors, the frequency of exposure to smoke (number of days per week) and the number of people who smoke indoors ("how many people in your family or who live with you smoke in the house where you live, without telling you?") were also determined.

Psychological distress was evaluated by the General Health Questionnaire, 12 item- version (GHQ-12), a mental trace instrument (Goldberg, 1972). Individual items scores were coded as "absent" (0) or "present" (Keyes et al., 2015) and the results were then added. Adolescents with scores of three or more were classified as CMD (Goldberg & Williams, 1988) cases. The GHQ-12 has been validated for the Brazilian population, using a structured psychiatric interview as gold

standard and the same score ≥ 3 criteria for CMD cases. The results showed 85.0% sensitivity and 79.0% specificity (Mari & Williams, 1985).

We computed the prevalence (%) of a GHQ score ≥ 3 according to alcohol consumption and smoking (active and passive). Considering the sampling design, the Odds Ratios (OR) with their respective 95% confidence intervals (CI) were estimated using multiple logistic regression models (stepwise backward analysis), adjusted for sex, age, school type (public/private), stage of sexual maturity, body mass index-BMI, morbidity and smoking or alcohol consumption (potential confounders). The survey module of the Stata program (STATA Corp. 12.0 version Stata: statistical software for professionals. College Station, Texas, USA; 2015) was used for data analysis of complex samples, since it applies stratification and conglomeration in their selection stages (Skinner, 1989).

ERICA was conducted according to Declaration of Helsinki. The study was approved by the ethics committees of the Federal University of Rio de Janeiro (registration number 45/2008) and by each State.

3. Results

Regarding alcohol and tobacco consumption in the previous 30 days, 4% of adolescents had smoked for at least a day and 22% had at least 1 drink or dose of alcohol. The percentage of adolescents who had never experienced or tried smoking cigarettes (82%) was higher than the percentage of those that had never had at least a drink or dose of alcohol (54%). One quarter of the adolescents had been exposed to environmental tobacco smoke at home and less than half, outside their home.

Tables 2, 3 and 4 show the association of the independent variables assessed related to smoking (active and passive) and alcohol consumption, with psychological distress. As shown in Table 2, the frequency of individuals with scores ≥3 in the GHQ-12 (psychological distress) was higher in the group of adolescents who drank at least 1 dose of alcohol in the previous 30 days, compared to those who did not drink (OR: 1.70; 95%CI: 1.46–1.97; p < 0.001). There was no significant association of psychological distress with frequency of consumption of alcohol (number of days) in a month (p = 0.919; p = 0.769).

Regarding experimentation age, the earlier the adolescents had contact with these substances, the higher the odds ratio for mental disorders. The chance of psychological distress was two times higher among adolescents who had at least one dose of alcohol for the first

Table 3
Prevalence of adolescents with psychological distress (GHQ score ≥ 3) and the corresponding Odds Ratios (OR), according to active smoking. ERICA, Brazil, 2013–2014.

Variables	All (n)	With psychological distress (%)	Gross OR (95% CI)	p value	Adjusted OR[1] (95% CI)	p value
All	73,399	31.8	–	–	–	–
Experimentation[a]						
Never	59,186	28.8	1		1	
9–11 years	3048	44.1	2.13 (1.78–2.54)	< 0.001	1.99 (1.45–2.72)	< 0.001
12–17 years	10,199	45.0	2.02 (1.83–2.23)	< 0.001	1.65 (1.44–1.89)	< 0.001
Current smoking[b]						
No	69,638	30.9	1		1	
Yes	3201	49.1	1.97 (1.71–2.28)	< 0.001	1.46 (1.15–1.84)	< 0.005
Frequent smoking[c]						
No	71,134	31.2	1		1	
Yes	1607	53.3	2.76 (2.33–3.27)	< 0.001	2.17 (1.65–2.86)	< 0.001

Without information: [a]1,3%; [b]0,8%; [c]0,9%.

[1] Odds ratios (and 95% confidence intervals) derived from multiple logistic regression models adjusted for sex, age, school type (public/private), stage of sexual maturity, body mass index-BMI, morbidity and alcohol consumption.

[a] Experimentation: age in which the adolescent tried or experimented with smoking cigarettes for the first time.

[b] Current smoking: use of cigarettes for at least a day during the previous 30 days.

[c] Frequent smoking: having smoked cigarettes at least 7 days in a row.

time before the age of 12 (p < 0.001), relative to those who had never experienced alcohol (Table 2).

A higher prevalence of psychological distress was also found among those who had smoked for 7 consecutive days (OR: 2.17; 95%CI: 1.65–2.86; p < 0.001), when compared to non-smokers (Table 3). The same result was found among those exposed to environmental tobacco smoke indoors (37.8% versus 29.8%) and outdoors, for example at school, parties, bars, restaurants, work (37.7% versus 26.6%), comparing to adolescents who had not been exposed (p < 0.001) (Table 4).

4. Discussion

This is the first epidemiological study conducted in Brazil, nationally representative, which assessed the relationship between psychological distress and risk behavior in the adolescent population. Other strengths of this work include the high rate of participation, the validity of the GHQ-12, allowing for comparisons with national and international studies and the analyses adjusted for confounding factors (sex, age, school type, stage of sexual maturity, body mass index-BMI, morbidity and the use of alcohol or tobacco). In sum, we found that exposure to cigarette smoke, smoking and alcohol consumption were associated to the presence of common mental disorders in the Brazilian adolescent population, even after adjusting for potential confounding variables.

Several studies have shown the negative impact of alcohol consumption on the mental health of the youth (Balogun et al., 2014; Makela, Raitasalo, & Wahlbeck, 2015; Rose et al., 2014; Skogen et al., 2014). Using longitudinal data of Finnish twins, Rose et al. (2014) concluded that alcohol abuse at 18 years of age predicts mental disorders (high scores in the GHQ-12) in adulthood. In developing countries, alcohol consumption in the previous 30 days, by adolescents from 13 to 15 years, was associated to psychological stress. In 12 developing countries, 44.4% of young people who were consuming alcohol reported depression symptoms, while 82.1% described insomnia induced

Table 4
Prevalence of adolescents with psychological distress (GHQ score ≥ 3) and the corresponding Odds Ratios (OR), according to passive smoking. ERICA, Brazil, 2013–2014.

Variables	All (n)	With psychological distress (%)	Gross OR (95% CI)	p value	Adjusted OR[1] (95% CI)	p value
All	73,399	31.8	–	–	–	–
SHS outdoors[a]						
No	38,898	26.6	1		1	
Yes	34,501	37.7	1.78 (1.65–1.93)	< 0.001	1.49 (1.28–1.74)*	< 0.001
SHS indoors[b]						
No	54,799	29.8	1		1	
Yes	18,600	37.8	1.43 (1.29–1.58)	< 0.001	1.30 (1.14–1.48)*	< 0.001
Frequency of SHS indoors[c]						
< 1 day	4860	33.9	1		1	
1–6 days	6478	37.5	1.19 (0.60–2.38)	0.618	1.18 (0.46–3.08)	0.728
7 days	6836	43.2	1.57 (0.89–2.77)	0.118	1.30 (0.57–2.94)	0.531
N.° of smokers indoors[d]						
1 person	15,494	35.2	1		1	
2–3 persons	5428	37.4	1.01 (0.62–1.66)	0.968	1.00 (0.53–1.87)	0.993
4 or more persons	914	43.1	1.84 (0.86–3.93)	0.117	1.93 (0.58–6.46)	0.286

Without information: [c]4,2%.

[1] Odds ratios (and 95% confidence intervals) derived from multiple logistic regression models adjusted for sex, age, school type (public/private), stage of sexual maturation, body mass index-BMI, morbidity, alcohol consumption and active smoking.

[a] SHS outdoors: secondhand smoke exposure to environmental tobacco smoke outside the home.

[b] SHS indoors: secondhand smoke exposure to environmental tobacco smoke inside the home.

[c] Frequency of secondhand smoke (SHS) indoors: frequency of exposure to smoke (number of days per week) at home.

[d] N° of smokers at home: the number of people who smoke in the home.

by anxiety (Balogun et al., 2014).

Another aspect to be highlighted is the significant adolescent involvement with alcohol, measured by frequency of use, episodes of heavy use and binge use, which can cause different types of interference on mental health (Mason et al., 2008). The study performed by Makela et al. (2015) indicated that binge use of alcohol was the consumer dimension more strongly associated with psychological stress (GHQ-12 ≥ 4), while the frequency and volume of consumption did not show a consistent relationship with mental disorders. There was no significant association in ERICA of psychological distress with alcohol consumption frequency a month, considering number of days.

The relationship between psychological distress and active smoking (tobacco experimentation, current smoking and frequent smoking) found on ERICA's is concordant to evidence currently available on this subject (Emre, Topal, Bozkurt, & Topaktas, 2014; Lee, 2014; Pinheiro et al., 2007). Lee, (2014) also reported an association of current tobacco use (smoking at least 1 cigarette in the previous 30 days) with a depressive mood, in a nationally representative sample of students (primary and secondary) from South Korea. A similar effect was observed among smokers aged between 18 and 65 years, seeking treatment, who showed higher scores on the GHQ-12, compared to non-smokers. Another result emphasized by the authors was the increase in anxiety and depression scores with increasing degrees of nicotine addiction (Emre et al., 2014).

A study of adolescents (15–18 years) living in Pelotas, in the southern region of Brazil, found a direct relation between the presence of common mental disorders measured by the Self Reporting Questionnaire 20 (SRQ-20), and the number of cigarettes smoked per day. The prevalence of psychological distress among adolescents who smoke > 15 cigarettes/day was 1.66 times higher (95%CI: 1.05–2.64) in than non-smokers. In this Brazilian adolescent population, alcohol intake was not associated to psychological distress (Pinheiro et al., 2007). Other population-based cross-sectional studies, conducted in the city of Pelotas, with young people 18 to 24 years, found a higher CMD prevalence, from SRQ-20, among individuals who consumed alcohol and used tobacco at least once a week prior to the survey (Jansen, Mondin, Ores, et al., 2011).

Most recent evidence suggests that health risk behaviors, represented by alcohol and tobacco and symptoms of depression tend to coexist (Marmorstein et al., 2010; Mason et al., 2008). However, some studies have found inconsistent associations (Bell & Britton, 2015; Fischer, Najman, Williams, & Clavarino, 2012; Gea, Beunza, Estruch, et al., 2013; Lam, Kvaavik, Hamer, & Batty, 2013) and there is not a consensus on the relationship of causality. It is possible that the abuse of alcohol and tobacco in during adolescent years change the hypothalamic-pituitary-adrenal system, the secretion of cortisol, dopamine receptor availability and how these young people relate to school, career, friends and family life (Fehr, Yakushev, Hohmann, et al., 2008). These adverse effects can interfere with natural mechanisms for dealing with stress, inducing depression in adulthood (Marmorstein et al., 2010; Mason et al., 2008; Rose et al., 2014).

On the other hand, adolescents with depressive symptoms may use alcohol and nicotine as outlet, in an attempt to relieve symptoms of emotional disorders, or as a support to handle multiple stressors (Audrain-McGovern, Rodriguez, & Kassel, 2009). In this case, abusing of those substances would be, in a way, a form self-medicate, to deal with distress or mental illness (Khantzian, 1997). An alternative explanation would be the bidirectional association, in that the two conditions influence each other (Audrain-McGovern et al., 2009; Chaiton et al., 2009).

The positive association between psychological distress and passive smoking found on ERICA is consistent with findings on population ≥15 years in Spain, where the prevalence of individuals exposed to secondhand smoke with a score ≥3 in the GHQ-12 (22.7%) was higher than that of non-exposed individuals (18.9%; OR: 1.39; CI: 1.19–1.62) (Ballbe, Martinez-Sanchez, Gual, et al., 2015). Data from the Scottish

Health Survey (2008–2011) also showed an association between secondhand smoke and mental health. It was observed that exposure to tobacco smoke increased the cumulative risk for cardiovascular and mental morbidities (GHQ ≥ 12) in adults, including negative effects on sleep, auto learn function, decision-making, self-esteem, self-confidence and feelings of happiness or sadness (Shiue, 2014). Findings from a study with British children suggests that participants in the highest quartile (> 0.70 ng/mL) of salivary cotinine, a biomarker of exposure to tobacco smoke, experienced more psychological stress, as evaluated by the Strengths and Difficulties Questionnaire (SDQ), compared to the lowest quartile participants (Hamer et al., 2011).

It must be pointed out, as a challenge for the health sector, the significant percentage of ERICA participants still exposed to secondhand smoke indoors (25.3%) and outdoors (47.0%), even with a ban on smoking in collective environments (Law n°. 12,546/2011). The scientific literature shows that nonsmokers exposed to tobacco smoke indoors inhale more toxic elements (e.g., nicotine and CO) and an amount of up to 10 times greater of nitrosamine NPYR (carcinogenic substance), relative to smokers, and that there is no safe level of exposure (Health USDO & Human S., 2006). Considering that smoking and alcohol consumption are already prohibited by law in the age group covered by this study, our data also reinforces the need for effective government response to reduce the access of young people to these substances.

Limitations of this study need to be recognized. The data were based on self-reports. However, the account of the adolescents about alcohol use, smoking and exposure to secondhand smoke has shown to have an acceptable correlation with biomarkers of exposure (Brener, Billy, & Grady, 2003; Johnson-Kozlow, Wahlgren, Hovell, et al., 2010). Another limitation relates to the cross-sectional nature of the study, which does not allow for the assessment of causality among the phenomena observed. It is worth mentioning that the use of the Odds Ratio can overestimate the strength of the association in cross-sectional studies, when the outcome has a high prevalence in the population, what possibly occurred in this study (Reichenheim & Coutinho, 2010). The GHQ-12, is a screening instrument and, therefore, it has not been possible to establish any formal diagnosis of psychopathologies. This study was restricted to adolescents who were attending schools, but they represent the great majority of adolescents in Brazil. Finally, other variables not studied may have been acting as confusion factors, such as, for example, a family history of mental illness, familial socioeconomic status, parental psychopathology, or the use of tobacco, alcohol and drugs in the family.

In conclusion, it was observed that passive and active smoking and the consumption of alcoholic beverages are associated to the presence of psychological distress in the adolescent population. According to these findings, health professionals can inform the population about common mental disorders in adolescents exposed to environmental tobacco smoke or involved in the use of tobacco and alcohol. Our results also emphasize the importance of strategies for restricting adolescents' access to alcohol and tobacco. Those strategies should include: prohibit the unit sale of cigarettes, fund certified training courses for educators and educational campaigns in schools, provide treatment to smokers and alcohol addicts, increase taxes/prices, establish minimum age for purchase (with adequate supervision), ban totally or partially the advertising of these products, extend restrictions on indirect marketing (apology in novels and movies), restrict location, days/h of operation and density of points of sale, establishment of licensing system for the sale of tobacco and alcoholic beverages, promotion of alternative leisure activities (e.g. sports) and vehicular advertising impacting impact on cigarette packaging.

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design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication.

Contributors

VRF and PCVJ conducted literature searches and provided summaries of previous research studies. VRF, TVJ, and ALLS conducted the statistical analysis. VRF and BMC wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

Conflict of interest

All authors declare no conflict of interests.

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