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Socioeconomic inequalities in youth smoking in Brazil

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Abstract

Objective: The contribution of smoking to socioeconomic inequalities in health is increasing worldwide, including in Brazil. Youth smoking may play important role in the increasing social inequalities related to smoking. This study investigates social determinants of smoking among 15- to 19 year-old individuals.

Design: Cross-sectional study

Setting: Study uses data of 3,464 participants aged 15-19 years participants of the Global Tobacco Survey (GATS) and the National Household Sample Survey (PNAD) obtained from household interviews. Smoking was defined as currently smoking tobacco products, regardless of frequency. Household socioeconomic indicators included per capita income, the educational level and sex of the head of the household, the presence of smoking restrictions and the number of smokers (excluding adolescents). Adolescent social factors included years of delaying school and social status (full-time student, working, and neither working nor studying). The hierarchical logistic regression analysis considered the effect of the complex sampling design.

Results: From 3,464 participants, 5.4% were smokers (95%CI: 5.1-5.7). More males than females smoked (6.4%; 6.0-6.8 *vs* 3.4%; 3.1-3.8). The likelihood of smoking was significantly greater for male teens and older teens. There was an upward trend in the OR of smoking according to the number of smokers in the house. Adolescents living in households with no smoking restrictions had a greater likelihood of being smokers. OR of smoking rose as the number of years of delaying school increased being about three times greater among adolescents who working and five times greater among those who were neither studying nor working.

Conclusions: Results demonstrate that socioeconomic inequality in smoking is established at younger ages and that school retention and dropping out might perpetuate and increase smoking-related inequalities. Smoking restrictions at home were protective against adolescents becoming smokers. Living with other smokers was a strong predictor of adolescents becoming smokers.

Article Summary

Article Focus: We investigated the social determinants of current smoking among 15- to 19-year-old Brazilian participants in the Global Tobacco Survey (GATS) Brazil. In particular, we tested whether delaying of school and dropping out of school, which are regarded as early markers of future socioeconomic disadvantage, were associated with youth smoking.

Key messages:

- Youth smoking is associated with delaying of school and dropping out of school, as well as with early entry into the work force.

- Adolescents exposed to smokers at home have a much greater chance of being a smoker than adolescents who are not.

- Smoking restrictions at home were protective against youth smoking.

Strengths and limitations of this study:

- The main strength of this study is its analysis of the social determinants, both at the household and individual levels, of teenage smoking using a nationwide household sample in a large middle-income country.

- The main limitation is the lack of information about the relationship between adolescents and other smokers in the household.

INTRODUCTION

Cigarette smoking has fallen sharply in Brazil; in approximately two decades, the smoking prevalence among individuals aged 18 years and older decreased 48%, from 34.8% in 1989 to 18.2% in 2008 [1], preventing almost 420,000 (260,000-715,000) deaths.[2] Such achievements have been attributed largely to Brazil's strong upstream anti-tobacco policies, combined with increased access to tobacco cessation treatments.[2, 3]

However, the contribution of smoking to socioeconomic inequalities in health is increasing in Brazil. According to data from the World Health Survey, 2002-04, smoking rates were higher among poor men and women (74% and 59%, respectively), even after controlling for age, marital status, education, employment and urban/rural residence. [4] The results of the Global Tobacco Survey (GATS) Brazil showed that there were almost twice as many tobacco users with no or less than a year of schooling, compared to tobacco users with 11 or more years of education. [5]

Early initiation of tobacco use could be a key component in the increasing social inequalities of smoking and its related morbidity and mortality. [6] Analyses of three birth cohorts in Italy showed that the increase in smoking inequalities among both men and women was mainly due to growing inequalities in smoking initiation rates. Studies have shown that most regular adult smokers become addicted in their teens. [7-9] In addition, early smoking has been associated with higher levels of tobacco dependence, increased difficulty in smoking cessation and more negative health outcomes in adulthood.[10-13]

In 2004, approximately 70% of adult smokers residing in large Brazilian cities had begun to smoke before the age of 20 years.[14] However, youth smoking seems far

more frequent among socially disadvantaged groups.[15,16] In Brazil, among daily or former daily smokers, the proportion of individuals who started smoking before 15 years of age was two-fold greater among those with no or less than one year of schooling than among those with eight years of schooling or more. [5]

Few studies have specifically addressed the social determinants of teenage smoking in Brazil, [17, 18, 19] and none have been undertaken in a nationwide household sample. This study investigated the social determinants of current smoking among participants 15 to 19 years of age in the Global Tobacco Survey (GATS) Brazil. In particular, we investigated whether delaying of school and dropping out of school, which are regarded as early markers of future socioeconomic disadvantage, were independently associated with smoking among teenagers.

METHODS

Participants

This study used data from the Global Tobacco Survey (GATS), the National Health Survey (NHS) and the National Household Sample Survey (PNAD); surveys were conducted jointly in 2008 by the Brazilian Institute of Geography and Statistics (IBGE) and the Ministry of Health. GATS Brazil used a four-stage complex probabilistic household sample (municipality, census tract, household and individual) and was representative of the national and regional levels. Further details on the sampling design can be found at http://www.who.int/tobacco/surveillance/en_tfi_gats_2010_brazil.pdf.

Together, the questionnaires of these surveys provided socioeconomic information about households and selected individual characteristics, including detailed information on tobacco use and exposure. GATS Brazil aimed to include 40,000 individuals aged 15 years and older with a response rate of 95.2%. Out of 39,425

interviews, 33,680 were conducted in urban areas and 5,745 in rural areas. Bearing in

mind our objectives, we studied all adolescents aged 15 to 19 years who participated in

GATS Brazil, totalling 3,464 individuals.

Variables

The response variable of the study was current smoking, defined as being a current

smoker regardless of frequency, and it was grouped into two categories (yes, no). The

proportion of daily smokers, age at initiation and the number of cigarettes smoked per

day among daily smokers were used to describe smoking behaviour.

The explanatory variables were grouped into three sets of co-variables in this

analysis. Household socioeconomic factors included location (urban, rural), household

per capita income grouped in quintiles, highest education level attained by the head of

the household in number of years completed (0-8, 9-11, 12-14, 15 and more) and female

head of household (no, yes).

The second set of co-variables consisted of household smoking characteristics,

which included the number of smokers in the household, excluding the participating

adolescent (zero, one, two, three or more), and smoking restrictions at home (not

allowed, generally not allowed, allowed). The category "allowed" also included an

absence of smoking restrictions.

The last set of co-variables included the adolescents' characteristics: sex; age

(15, 16, 17, 18, 19 years old); self-declared race/skin colour (white, black, brown, Asian

descent and indigenous); social status (full-time student, only working, working and

studying and neither studying/neither working); and school delay, defined as the

difference in years of schooling between the individual's current school grade and the

school grade in which he/she was expected to be given his/her age (none, one, two,

three years or more). A negative difference in school delay was treated as no difference. Asian descent and indigenous were combined as "other" because the number of individuals was very small.

Statistical analysis

First, we described the prevalence of smoking, the proportion (with 95% confidence intervals) of daily smokers, age at initiation and the mean and median numbers of cigarettes smoked per day by sex. Next, we performed a descriptive analysis of the distribution of adolescents according to individual and household socioeconomic indicators (Table 1).

Associations between each explanatory variable and current smoking were measured by Pearson's chi-square test with a p-value <0.05. Variables with p<0.20 were included in the multivariable analysis. The magnitude of the associations was measured using odds ratios (ORs), and 95% CIs were obtained by multiple logistic regression. The "svy" procedure, available in Stata, version 11.0, was used to account for the effect of the GATS complex survey design. Multicollinearity among household co-variables was assessed using a variance inflation factor and the condition number. Multicollinearity was not found among the variables (Tables 2-3).

To account for the hierarchical levels of the determination of youth smoking, multivariable analysis was performed, assuming that the socioeconomic household factors were the most distal factors, household smoking indicators were intermediate factors, and individual socioeconomic factors were the most proximal factors.[20] Thus, after considering the sex and age of the adolescents, we began hierarchical modelling by simultaneously introducing the distal variables (educational level of the head of the household, sex and household per capita income), keeping the factors related to

smoking that remained statistically significant (p<0.05) (Model 1). Then, we entered

household smoking factors (number of smokers and smoking restrictions) and kept the

statistically significant factors (Model 2). Finally, we added the youth level of education

and social status factors, retaining only the proximal factors that were statistically

significant (Model 3). The analysis was controlled for potential confounders — in this

case, the variables maintained from the previous stages. The proximal variables were

adjusted for the distal and intermediate variables (Table 3).

RESULTS

Among the participants, 5.4% were current smokers (95% CI: 5.1-5.7), and 5.0% (95%

CI: 4.7-5.2) reported being daily smokers, with a statistically significant difference

between male and female subjects (male: 6.4%; 95% CI 6.0-6.8; female: 3.4%; 95% CI

3.1-3.8; p<0.001). All of the current smokers had smoked at least 100 cigarettes in their

lifetimes. Among daily smokers, the mean (and median) numbers of cigarettes smoked

per day were 10.7 (10.0), which were approximately the same in male (10.8 and [10.0])

and female subjects (10.5 and [10.0]).

The distributions of participants according to socioeconomic and household

characteristics are presented in Table 1. Almost 60% of the adolescents were between

17 and 19 years of age, a great majority lived in urban dwellings, half were male, and

54% (95% CI: 52.3-55.7) matched the level of schooling expected for their ages (Table

1). Most of the participants were full-time students at the time of the interview. In total,

61% of adolescents lived in households concentrated between the first (lowest) and

third quintiles of income distribution, and the majority lived in houses headed by men

with up to eight years of schooling and in households with smoking restrictions.

In the univariable analysis (Table 2), male sex, older age and black skin colour were all significantly associated with a greater likelihood of being a regular smoker. The following factors in the household context were significantly associated with an increased chance of an adolescent being a current smoker: being in the fourth quintile of per capita income distribution and the head of the household having a lower level of education. The odds ratio of smoking increased with the number of smokers in the same household, and it was greater in homes in which smoking was allowed. The chance of smoking rose as the number of delayed years of education increased, and it was greater among adolescents who were studying and working, only working or neither studying nor working, compared to full-time students at the time of data collection.

In the hierarchical analysis (Table 3), exposure to tobacco smoking remained significantly lower among female subjects, although it increased with age. In the household context, the association between smoking and the educational level of the head of the household was no longer significant (p=0.847, p=0.082 and p=0.077 for 9-11, 12-14 and 15 or more years of schooling, respectively). Additionally, in the household context, the OR, regarding the number of smokers in the household, for being exposed to three or more smokers was as high as 7.22 (95% CI: 3.16-16.46), demonstrating a significant upward trend (p<0.001) Additionally, exposure to tobacco smoking remained significantly higher among adolescents living in households with smoking restrictions. After considering the effects of household socioeconomic and smoking factors, the chances of smoking remained significantly associated with the number of years of delaying of school, showing a significant upward trend (p<0.001). Compared to adolescents who were full-time students, those who were only working or who were working and studying had an approximately three times greater chance of

being a smoker, while those who were neither studying nor working had a roughly five times greater chance of being a smoker.

DISCUSSION

Our results confirm that slow progress at school, as well as dropping out of school, and early entrance into the work force are associated with a greater likelihood of tobacco smoking among teenagers. In general, our results support the hypothesis that socioeconomic inequality in smoking is established at younger ages. In addition, our results confirm the importance of household smoking exposure in teenage smoking, reinforcing the evidence that smoking behaviour can be contagious.[21, 22] The findings are particularly relevant as socioeconomic disparities in smoking behaviour among youth are predictive of future disparities in smoking, as well as in morbidity and mortality from chronic diseases.[23]

We found important and strong associations between school engagement and smoking. The chances of smoking were substantially greater among adolescents who were no longer attending school, regardless of what they were currently doing. Moreover, we also found that the chances of smoking increased as the number of years of school delay increased. School delay and dropping out are important markers of both current and future lower socioeconomic status, independent of youth health, parental education and sex.[24] A recently published analysis of US survey data showed that at the population level, education gaps among adult smokers are produced mostly by educational inequalities in initiation rather than in quitting smoking.[25]

Likely explanations for the association between school delay and dropping out and smoking include less information on the health consequences of smoking and differences in access to and effectiveness of cessation treatments. Lower reading skills were associated with becoming a regular smoker, as well as the current amount smoked,

in a cohort analysis. [26] Several studies have indicated that failure to complete high school is associated with substance use, including the use of tobacco.[27]

Educational underachievement and dropping out of school remain serious problems in Brazilian society: only 50% of adolescents who enter high school will graduate. In 2009, 15% of adolescents 15 to 17 years of age were not in high school. Among those who were enrolled, one-third were not in the correct school grade for their ages.[28] Researchers in the area have cited dismay, poverty, early parenthood and criminal involvement among the main reasons for this finding. [28]

The household environment is the most important source of cultural and social values for children and adolescents, and it is the most proximal context for them. Adolescents from non-smoking homes are less likely to start or develop smoking habits. [29] Our results showed a very sharp, positive relationship between the number of smokers in the household and the likelihood that a youth would smoke. There is compelling evidence that children of smoking parents are more likely to initiate smoking in adolescence than children of non-smoking parents, thus transmitting the single greatest cause of preventable death from generation to generation. [29] Beyond promoting smoking, exposure to other smokers at home also seemed to hamper quitting attempts and smoking cessation among adolescent Chinese smokers. [30]

Additionally, our results corroborate the growing and consistent evidence that home smoking restrictions protect non-smokers from second-hand smoke and influence the smoking behaviour of adult smokers. These results also suggest that parental smoking might interact with home smoking restrictions to impact youth smoking behaviour, further reinforcing the anti-smoking values of non-smoking parents. In addition, a completely smoke-free home appears to send a stronger anti-smoking message than partial restrictions, and a smoke-free home might be more influential in

earlier, rather than later, stages of the smoking continuum.[29-33] Late adolescence is a period characterised by increasing role instability and major life options, such as whether to start working, go to college, leave home and so on. As adolescents approach adulthood, unhealthy behaviours initiated earlier might be abandoned or could develop into more consolidated attitudes. Thus, it is a crucial period to approach the promotion of health. Our results support the evidence that socioeconomic inequalities in smoking begin in adolescence and are likely to endure and even increase because smoking is linked to school delay and dropping out, which reduce the likelihood of having a better job and better life conditions in the future.

Comments and limitations

Unfortunately, our work lacked information about parent and adolescent peer behaviours, which are known to be important risk factors for smoking. In addition, we had no data on the relationship between the respondents and other smokers in the household. For this reason, we cannot estimate whether smoking parents, compared to other smokers, had a different impact on adolescent smoking. Despite being a cross-sectional study, it is quite unlikely that youth smoking produces disadvantages at the household level. It is possible, however, that youth smoking is involved in youth school performance in a vicious cycle: the same problems that result in poor performance at school (or dropping out) also influence smoking, and these two behaviours reinforce each other. We believe that low socioeconomic status, with all that it implies (in terms of culture and access to information), is the primary factor behind these behaviours.

The major associations observed in this study indicate that keeping teenagers in school could help to prevent smoking and to reduce the health inequalities associated with this habit. It is undeniable that adolescents must be in school. However, because

smoking seems to be a transmissible habit, reducing delays in education and dropping out of school must accompany reductions in smoking exposure in the home.

Data Sharing: No similar data from this study have been previously published.

Tables

Table 1 Distribution of participants according to socioeconomic and household characteristics. Brazil - 2008.

Characteristics	%	95%CI
Sex		
Male	50.4	48.6-52.3
Female	49.6	47.7-51.4
Age (years)		
15-16	40.9	39.1-42.7
17-19	59.1	57.0-60.8
Self declared race/skin colour		
White	44.7	43.1-46.4
Black	6.5	5.6-7.4
Brown	48.1	46.4-49.8
Other	0.7	0.3-0.8
School delay		
None	54.0	52.3-55.7
One	12.5	11.3-13.7
Two	10.5	9.3-11.5
Three or more	23.0	21.5-24.4
Social Status		
Full student	46.3	44.4-48.1
Only working or working and studying	40.2	38.4-42.0
Neither studying/Neither working	13.5	12.2-14.7
Household per capita income		
1^0 quintile (lowest)	20.8	19.3-22.3
2^0 quintile	20.7	19.2-22.2
3^0 quintile	19.9	18.3-21.3
4^0 quintile	18.9	17.5-20.3
5^0 quintile (highest)	19.7	18.2-20.9

Education of household head (years)		
0-8	55.9	54.2-57.7
9-11	16.8	15.4-18.1
12-14	21.6	20.1-23.1
15+	5.7	4.7-6.4
Female-headed household		
No	62.2	64.4-63.9
Yes	37.8	36.0-39.5
Urban/rural dwelling		
Urban	82.9	81.6-84.2
Rural	17.1	15.7-18.3
Number of smokers in the household		
Zero	65.5	63.7-67.2
One	25.3	23.6-26.8
Two	8.1	7.1-9.1
Three or more	1.1	0.7-1.5
Smoking restrictions rules at home		
Not allowed	46.4	44.5-48.1
Generally not allowed	13.3	12.0-14.5
Allowed	40.3	38.5-42.1

Source: Brazilian National Household Sample Survey (PNAD, 2008) and Global Tobacco Survey (GATS-2008)
* Included Asian descendent and Indigenous

Table 2 Odds Ratio (OR) of regular smoking* according to adolescents' socio demographic features and household socioeconomic and smoking characteristics. Brazil - 2008.

Characteristics	OR (95% CI)	p Value
Adolescents' characteristics		
Sex		
Male	1.00	<0.01
Female	0.47 (0.33 - 0.64)	
Age (years)		
15-16	1.00	<0.01
17-19	3.77 (2.63 - 5.39)	
Self declared race/skin colour		
White	1.00	
Black	1.70 (1.05 - 2.75)	0.030
Brown	1.02 (0.77 - 1.36)	0.854
Other**	0.65 (0.08 - 4.84)	0.672
Social Status		
Full student	1.00	
Only working or working and studying	4.73 (3.22 - 6.92)	<0.001
Neither studying/Neither working	6.99 (4.56 - 10.70)	<0.001
School delay		
None	1.00	
One	2.33 (1.41- 3.84)	<0.001
Two	3.40 (2.11 - 5.48)	<0.001
Three or more	6.56 (4.62 - 9.33)	<0.001
Household characteristics		
Urban/rural dwelling		
Urban	1.00	
Rural	0.80 (0.54 - 1.19)	0.287
Household per capita income		
5^0 quintile (lowest)	1.00	

4^0 quintile	1.63 (1.05 - 2.51)	0.028
3^0 quintile	1.03 (0.64 - 1.67)	0.314
2^0 quintile	1.23 (0.78 – 1.96)	0.361
1^0 quintile (highest)	1.46 (0.93 – 2.28)	0.093
Head of the household schooling (years)		
0-8	1.00	
9-11	0.57 (0.37 - 0.88)	0.011
12-14	0.59 (0.40 - 0.85)	0.005
15+	0.58 (0.29 - 1.16)	0.128
Female-headed household		
No	1.00	
Yes	1.02 (0.77 - 1.35)	0.855
Number of smokers		
Zero	1.00	
One	1.93 (1.42 - 2.63)	<0.001
Two	3.00 (1.98 - 4.53)	<0.001
Three or more	9.01 (4.45 - 18.19)	<0.001
Smoking restrictions rules		
Not allowed	1.00	
Generally not allowed	1.47 (0.93 - 2.30)	0.092
Allowed	2.18 (1.61 - 2.94)	<0.001

Source: Brazilian National Household Sample Survey (PNAD, 2008) and Global Tobacco Survey (GATS-2008)

*Report of having smoked 100 cigarettes in lifetime and currently smoking every day or not every day.

** Included Asian descendent and Indigenous

Table 3 Results of the hierarchical regression analyses in adolescents examined the association between individual and household characteristics and smoking*. Brazil - 2008

Variables	Model 1	Model 2	Model 3
Household socioeconomic factors			
Head of the household schooling (years)			
0-8	1.00	1.00	1.00
9-11	0.58 (0.38 – 0.90)	0.67 (0.43 – 0.91)	0.95 (0.60 – 1.51)
12-14	0.57 (0.39 – 0.83)	0.72 (0.48 – 1.05)	1.45 (0.95 – 2.22)
15+	0.59 (0.29 – 1.20)	0.75 (0.36 – 1.65)	1.97 (0.93 – 4.17)
Household smoking characteristics			
Number of smokers	—	1.00	1.00
One		1.68 (1.21 – 2.35)	1.59 (1.13 – 2.23)
Two		2.60 (1.67 – 4.06)	2.29 (1.44 – 3.64)
Three or more		7.96 (3.70 – 17.11)	7.22 (3.16 – 16.46)
Smoking restrictions rules	—		
Not allowed		1.00	1.00
Generally not allowed		1.21 (0.76 – 1.94)	1.32 (0.82 – 2.15)
Allowed		1.53 (1.10 – 2.13)	1.49 (1.06 – 2.09)
Adolescents' characteristics			
Sex			
Male	1.00	1.00	1.00
Female	0.45 (0.34 - 0.61)	0.43 (0.33 - 0.59)	0.45 (0.32 – 0.62)
Age (years)			
15-16	1.00	1.00	1.00
17-19	3.89 (2.71 - 5.58)	3.95 (2.74 - 5.69)	2.38 (1.62 – 3.49)
Social Status	—	—	
Full student			1.00
Only working or working and studying			2.81 (1.86 – 4.25)
Neither studying/Neither working			4.56 (2.85 – 7.30)
School delay	—	—	
None			1.00
One			2.34 (1.37 – 3.96)

Two	2.81 (1.69 – 4.69)
Four or more	4.27 (2.87 – 6.35)

Source: Brazilian National Household Sample Survey (PNAD, 2008) and Global Tobacco Survey (GATS-2008)
*Report of having smoked 100 cigarettes in lifetime and currently smoking every day or not every day.
All models adjusted for age, sex.

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STROBE Checklist of items that should be included in reports of *cross-sectional studies*

Title: Socioeconomic inequalities among youth smoking in Brazil

Authors: Barreto SM, Figueiredo RC, Giatti L

	Item No	Recommendation	
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	ok
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	ok
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	ok
Objectives	3	State specific objectives, including any prespecified hypotheses	ok
Methods			
Study design	4	Present key elements of study design early in the paper	ok
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	ok
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	ok
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	ok
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	ok
Bias	9	Describe any efforts to address potential sources of bias	ok
Study size	10	Explain how the study size was arrived at	ok
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	ok
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	ok
		(*b*) Describe any methods used to examine subgroups and interactions	ok
		(*c*) Explain how missing data were addressed	ok
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	ok
		(*e*) Describe any sensitivity analyses	ok
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	ok
		(b) Give reasons for non-participation at each stage	ok
		(c) Consider use of a flow diagram	ok
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	ok
		(b) Indicate number of participants with missing data for each variable of interest	ok
Outcome data	15*	Report numbers of outcome events or summary measures	ok

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	ok
		(*b*) Report category boundaries when continuous variables were categorized	ok
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	ok
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	ok
Discussion			
Key results	18	Summarise key results with reference to study objectives	Ok
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Ok
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Ok
Generalisability	21	Discuss the generalisability (external validity) of the study results	ok
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	ok

*Give information separately for exposed and unexposed groups.

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Socioeconomic inequalities in youth smoking in Brazil

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Research article

Socioeconomic inequalities in youth smoking in Brazil

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Running title: Smoking among Brazilian adolescents

Keywords: Smoking, Adolescence, Social determinants of health, Health behaviour

Word   count: 2542

Abstract

Objective: The contribution of smoking to socioeconomic inequalities in health is increasing worldwide, including in Brazil. Youth smoking may play important role in the increasing social inequalities related to smoking. This study investigates social determinants of smoking among 15- to 19 year-old individuals.

Design: Cross-sectional study.

Setting: Study uses data of 3,536 participants aged 15-19 years of age of the Global Tobacco Survey (GATS) and the National Household Sample Survey (PNAD) obtained from household interviews. Smoking was defined as currently smoking tobacco products, regardless of frequency. Household socioeconomic indicators included per capita income, the educational level and sex of the head of the household, the presence of smoking restrictions and the number of smokers (excluding adolescents). Adolescent social factors included years of delaying school and social status (full-time student, working, and neither working nor studying). The hierarchical logistic regression analysis considered the effect of the complex sampling design.

Results: From 3,536 participants, 6.2% were smokers (95%CI: 5.4-7.1). More males than females smoked (7.2%; 5.9-8.6 *vs* 3.6%; 2.7-4.6). The likelihood of smoking was significantly greater for male and older teens. There was an upward trend in the OR of smoking according to the number of smokers in the house. Adolescents living in households with no smoking restrictions had a greater likelihood of being smokers. OR of smoking rose as the number of years of delaying school increased being about three times greater among adolescents who working and five times greater among those who were neither studying nor working.

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Conclusions: Results demonstrate that socioeconomic inequality in smoking is established at younger ages and that school delay well as school abandonment may contribute to increase smoking-related inequalities. Smoking restrictions at home were protective against adolescents becoming smokers. Living with other smokers was a strong predictor of adolescents becoming smokers.

Article Summary

Article Focus: We investigated the social determinants of current smoking among 15- to 19-year-old Brazilian participants in the Global Tobacco Survey (GATS) Brazil. In particular, we tested whether school delay and abandonment, as well as early entry to work, which are regarded as early markers of future socioeconomic disadvantage, were associated with youth smoking.

Key messages:

- Youth smoking is associated with delaying of school and leaving school, as well as with early entry into the work force.

- Adolescents exposed to smokers at home have a much greater chance of being a smoker than adolescents who are not.

- Smoking restrictions at home were protective against youth smoking.

Strengths and limitations of this study:

- The main strength of this study is its analysis of the social determinants, both at the household and individual levels, of teenage smoking using a nationwide household sample in a large middle-income country.

- The main limitation is the lack of information about the relationship between adolescents and other smokers in the household.

INTRODUCTION

Cigarette smoking has fallen sharply in Brazil; in approximately two decades, the smoking prevalence among individuals aged 18 years and older decreased 48%, from 34.8% in 1989 to 18.2% in 2008 [1], preventing almost 420,000 (260,000-715,000) deaths.[2] Such achievements have been attributed largely to Brazil's strong upstream anti-tobacco policies, combined with increased access to tobacco cessation treatments.[2, 3]

However, the contribution of smoking to socioeconomic inequalities in health is increasing in Brazil. According to data from the World Health Survey, 2002-04, smoking rates were higher among poor men and women (74% and 59%, respectively), even after controlling for age, marital status, education, employment and urban/rural residence. [4] The results of the Global Tobacco Survey (GATS) Brazil showed that there were almost twice as many tobacco users with no or less than a year of schooling, compared to tobacco users with 11 or more years of education. [5]

Early initiation of tobacco use could be a key component in the increasing social inequalities of smoking and its related morbidity and mortality. [6] Analyses of three birth cohorts in Italy showed that the increase in smoking inequalities among both men and women was mainly due to growing inequalities in smoking initiation rates. Studies have shown that most regular adult smokers become addicted in their teens. [7-9] In addition, early smoking has been associated with higher levels of tobacco dependence, increased difficulty in smoking cessation and more negative health outcomes in adulthood.[10-13]

In 2004, approximately 70% of adult smokers residing in large Brazilian cities had begun to smoke before the age of 20 years.[14] However, youth smoking seems far

more frequent among socially disadvantaged groups.[15,16] In Brazil, among daily or former daily smokers, the proportion of individuals who started smoking before 15 years of age was two-fold greater among those with no or less than one year of schooling than among those with eight years of schooling or more. [5]

Few studies have specifically addressed the social determinants of teenage smoking in Brazil, [17, 18, 19] and none has been undertaken in a nationwide household sample. This study investigated the social determinants of current smoking among participants 15 to 19 years of age in the Global Tobacco Survey (GATS) Brazil. In particular, we investigated whether school delay and abandonment, as well as early entry to work, which are regarded as early markers of future socioeconomic disadvantage, were independently associated with smoking among teenagers.

METHODS

Participants

This study used data from the Global Tobacco Survey (GATS), which was carried out in a random subsample of the National Household Sample Survey (PNAD). PNAD was conducted in 2008 by the Brazilian Institute of Geography and Statistics (IBGE) and the Ministry of Health. PNAD and GATS Brazil used a four-stage complex probabilistic household sample (municipality, census tract, household and individual) and was representative of the national and regional levels. Further details on the sampling design can be found at http://www.who.int/tobacco/surveillance/en_tfi_gats_2010_brazil.pdf.

PNAD questionnaires provided socioeconomic information about households and selected individual characteristics and health related factors, and the GATS questionnaire provided detailed information on tobacco use and exposure. GATS Brazil aimed to include 40,000 individuals aged 15 years and older with a response rate of

95.2%. Out of 39,425 interviews, 33,680 were conducted in urban areas and 5,745 in

rural areas. Bearing in mind our objectives, we studied all adolescents aged 15 to 19

years who participated in GATS Brazil, totalling 3,536 individuals.

Variables

The response variable of the study was current smoking, defined as being a current

smoker regardless of frequency, and it was grouped into two categories (yes, no). The

proportion of daily smokers, age at initiation and the number of cigarettes smoked per

day among daily smokers were used to describe smoking behaviour.

The explanatory variables were grouped into three sets of co-variables in this

analysis. Household socioeconomic factors included location (urban, rural), household

per capita income grouped in quintiles, highest education level attained by the head of

the household in number of years completed (0-8, 9-11, 12-14, 15 and more) and female

head of household (no, yes).

The second set of co-variables consisted of household smoking characteristics,

which included the number of smokers in the household, excluding the participating

adolescent (zero, one, two, three or more), and smoking restrictions at home (not

allowed, generally not allowed, allowed). The category "allowed" also included an

absence of smoking restrictions.

The last set of co-variables included the adolescents' characteristics: sex; age

(15, 16, 17, 18, 19 years old); self-declared race/skin colour (white, black, brown, Asian

descent and indigenous); social status (full-time student, only working, working and

studying and neither studying/neither working); school delay, defined as the difference

in years of schooling between the individual's current school grade and the school grade

in which he/she was expected to be given his/her age (none, one, two, three years or

more). A negative difference in school delay was treated as no difference. Asian descent and indigenous were combined as "other" because the number of individuals was very small.

Statistical analysis

First, we described the prevalence of smoking, the proportion (with 95% confidence intervals) of daily smokers, age at initiation and the mean and median numbers of cigarettes smoked per day by sex. Next, we performed a descriptive analysis of the distribution of adolescents according to individual and household socioeconomic indicators (Table 1).

Associations between each explanatory variable and current smoking were measured by Pearson's chi-square test with a p-value <0.05. Variables with p<0.20 were included in the multivariable analysis. The magnitude of the associations was measured using odds ratios (ORs), and 95% CIs were obtained by multiple logistic regression. The "svy" procedure, available in Stata, version 11.0, was used to account for the effect of the GATS complex survey design. Multicollinearity among household co-variables was assessed using a variance inflation factor and the condition number. Multicollinearity was not found among the variables (Tables 2-3).

To account for the hierarchical levels of the determination of youth smoking, multivariable analysis was performed, assuming that the socioeconomic household factors were the most distal factors, household smoking indicators were intermediate factors, and individual socioeconomic factors were the most proximal factors.[20] Thus, after considering the sex and age of the adolescents, we began hierarchical modelling by simultaneously introducing the distal variables (educational level and sex of the head of the household and household per capita income), keeping the factors related to smoking

that remained statistically significant (p<0.05) (Model 1). Then, we entered household smoking factors (number of smokers and smoking restrictions) and kept the statistically significant factors (Model 2). Finally, we added the youth level of education and social status factors, retaining only the proximal factors that were statistically significant (Model 3). The analysis were controlled for potential confounders — in this case, the variables maintained from the previous stages. The proximal variables were adjusted for the distal and intermediate variables (Table 3).

RESULTS

Among the participants, 6.2% were current smokers (95% CI: 5.4-7.1), and 5.4% (95% CI: 4.6-6.3) reported being daily smokers, with a statistically significant difference between male and female subjects (male: 7.2%; 95% CI 5.9-8.6; female: 3.6%; 95% CI 2.7-4.6; p<0.001). All of the current smokers had smoked at least 100 cigarettes in their lifetimes. Among daily smokers, the mean (and median) numbers of cigarettes smoked per day were 11.8 (10.0), which were approximately the same in male (12.3 and [10.0]) and female subjects (10.8 and [10.0]).

The distributions of participants according to socioeconomic and household characteristics are presented in Table 1. Almost 60% of the adolescents were between 17 and 19 years of age, a great majority lived in urban dwellings, half were male, and 54% (95% CI: 52.3-55.7) matched the level of schooling expected for their ages (Table 1). Most of the participants were full-time students at the time of the interview. In total, almost 60% of adolescents lived in households concentrated between the first (lowest) and third quintiles of income distribution, and the majority lived in houses headed by men with up to eight years of schooling and in households with smoking restrictions.

In the univariable analysis (Table 2), male sex, older age and black skin colour were all significantly associated with a greater likelihood of being a regular smoker. The following factors in the household context were significantly associated with an increased chance of an adolescent being a current smoker: being in the fourth quintile of *per capita* income distribution and the head of the household having a lower level of education. The odds ratio of smoking increased with the number of smokers in the same household, and it was greater in homes in which smoking was allowed. The chance of smoking rose as the number of delayed years of education increased, and it was greater among adolescents who were studying and working, only working or neither studying nor working, compared to full-time students at the time of data collection.

In the hierarchical analysis (Table 3), exposure to tobacco smoking remained significantly lower among female subjects, although it increased with age. In the household context, the association between smoking and the educational level of the head of the household was no longer significant (p=0.847, p=0.082 and p=0.077 for 9-11, 12-14 and 15 or more years of schooling, respectively). Additionally, in the household context, the OR, regarding the number of smokers in the household, for being exposed to three or more smokers was as high as 7.22 (95% CI: 3.16-16.46), demonstrating a significant upward trend (p<0.001). Exposure to tobacco smoking remained significantly higher among adolescents living in households without smoking restrictions. After considering the effects of household socioeconomic and smoking factors, the chances of smoking remained significantly associated with the number of years of delaying of school, showing a significant upward trend (p<0.001). The chances of smoking were about three times greater among individuals who were only working or who were working and studying, and five times higher among those who were neither studying nor working when compared to adolescents who were full-time student.

DISCUSSION

Our results confirm that school delay, as well as not attending school, and early entrance into the work force are associated with a greater likelihood of tobacco smoking among teenagers. In general, our results support the hypothesis that socioeconomic inequality in smoking is established at younger ages. In addition, our results confirm the importance of household smoking exposure in teenage smoking, reinforcing the evidence that smoking behaviour can be contagious.[21, 22] The findings are particularly relevant as socioeconomic disparities in smoking behaviour among youth are predictive of future disparities in smoking, as well as in morbidity and mortality from chronic diseases.[23]

We found important and strong associations between school engagement and smoking. The chances of smoking were substantially greater among adolescents who were no longer attending school, regardless of what they were or not working. Moreover, we also found that the chances of smoking increased as the number of years of school delay increased. School delay and leaving school are important markers of both current and future lower socioeconomic status, independent of youth health, parental education and sex.[24] Recently published analysis of US survey data showed that at the population level, education gaps among adult smokers are produced mostly by educational inequalities in initiation rather than in quitting smoking.[25]

Likely explanations for the association between school delay and school abandonment and smoking include less information on the health consequences of smoking and differences in access to and effectiveness of cessation treatments. Lower reading skills were associated with becoming a regular smoker, as well as the current

amount smoked, in a cohort analysis. [26] Several studies have indicated that failure to complete high school is associated with substance use, including the use of tobacco.[27]

Educational underachievement and dropping out of school remain serious problems in Brazilian society: only 50% of adolescents who enter high school will graduate. In 2009, 15% of adolescents 15 to 17 years of age were not in high school. Among those who were enrolled, one-third were not in the correct school grade for their ages.[28] Researchers in the area have cited disillusion, poverty, early parenthood and criminal involvement among the main reasons for this finding. [28]

The household environment is the most important source of cultural and social values for children and adolescents, and it is the most proximal context for them. Adolescents from non-smoking homes are less likely to start or develop smoking habits. [29] Our results showed a very sharp, positive relationship between the number of smokers in the household and the likelihood that a youth would smoke. There is compelling evidence that children of smoking parents are more likely to initiate smoking in adolescence than children of non-smoking parents, thus transmitting the single greatest cause of preventable death from generation to generation.[29] Beyond promoting smoking, exposure to other smokers at home also seemed to hamper quitting attempts and smoking cessation among adolescent Chinese smokers. [30]

Additionally, our results corroborate the growing and consistent evidence that home smoking restrictions protect non-smokers from second-hand smoke as it reduces smoking exposure at the household level. These results also suggest that home smoking restrictions contribute to reduce youth smoking behaviour. Moreover, a completely smoke-free home appears to send a stronger anti-smoking message than partial restrictions, and a smoke-free home might be more influential in earlier, rather than later, stages of the smoking continuum.[29-33] Late adolescence is a period characterised

by increasing role instability and major life options, such as whether to start working, go to college, leave home and so on. As adolescents approach adulthood, unhealthy behaviours initiated earlier might be abandoned or could develop into more consolidated attitudes. Thus, it is a crucial period to approach the promotion of health. Our results support the evidence that socioeconomic inequalities in smoking begin in adolescence and are likely to endure and even increase because smoking is linked to school delay and abandonment, which reduce the likelihood of having a better job and better life conditions in the future.

Comments and limitations

Unfortunately, our work lacked information about parent and adolescent peer behaviours, which are known to be important risk factors for smoking. In addition, we had no data on the relationship between the respondents and other smokers in the household. For this reason, we cannot estimate whether smoking parents, compared to other smokers, had a different impact on adolescent smoking. Despite being a cross-sectional study, it is quite unlikely that youth smoking produces disadvantages at the household level. It is possible however, that youth smoking is involved in youth school performance in a vicious cycle: the same problems that result in school delay (or abandonment) also influence smoking, and these two behaviours reinforce each other. We believe that low socioeconomic status, with all that it implies (in terms of culture and access to information), is the primary factor behind these behaviours.

The major associations observed in this study indicate that keeping teenagers at school could help to prevent smoking and to reduce the health inequalities associated with this habit. It is undeniable that all adolescents must be in school. However, because smoking seems to be a transmissible behaviour, reducing delays in education and school

abandonment must be accompanied by reductions in smoking exposure in the home. This information is important as it identifies groups where current tobacco control measures are not having the desired effect.

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Table 1 Distribution of participants according to socioeconomic and household characteristics. Brazil - 2008.

Characteristics	%	95%CI
Sex		
Male	50.4	48.6-52.3
Female	49.6	47.7-51.4
Age (years)		
15-16	40.9	39.1-42.7
17-19	59.1	57.0-60.8
Self declared race/skin colour		
White	44.7	43.1-46.4
Black	6.5	5.6-7.4
Brown	48.1	46.4-49.8
Other	0.7	0.3-0.8
School delay (years)		
None	54.0	52.3-55.7
One	12.5	11.3-13.7
Two	10.5	9.3-11.5
Three or more	23.0	21.5-24.4
Social Status		
Full student	46.3	44.4-48.1
Only working or working and studying	40.2	38.4-42.0
Neither studying/Neither working	13.5	12.2-14.7
Household per capita income		
5^0 quintile (highest)	20.8	19.3-22.3
4^0 quintile	20.7	19.2-22.2
3^0 quintile	19.9	18.3-21.3
2^0 quintile	18.9	17.5-20.3
1^0 quintile (lowest)	19.7	18.2-20.9
Head of the household schooling (years)		
0-8	55.9	54.2-57.7
9-11	16.8	15.4-18.1
12-14	21.6	20.1-23.1

15+	5.7	4.7-6.4
Female-headed household		
No	62.2	64.4-63.9
Yes	37.8	36.0-39.5
Urban/rural dwelling		
Urban	82.9	81.6-84.2
Rural	17.1	15.7-18.3
Number of smokers		
Zero	65.5	63.7-67.2
One	25.3	23.6-26.8
Two	8.1	7.1-9.1
Three or more	1.1	0.7-1.5
Household smoking rule		
Not allowed	46.4	44.5-48.1
Generally not allowed	13.3	12.0-14.5
Allowed	40.3	38.5-42.1

Source: Brazilian National Household Sample Survey (PNAD, 2008) and Global Tobacco Survey (GATS-2008)
* Included Asian descendent and Indigenous

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Table 2 Odds Ratio (OR) of regular smoking* according to adolescents' socio demographic features and household socioeconomic and smoking characteristics. Brazil - 2008.

Characteristics	OR (95% CI)	p Value
Adolescents' characteristics		
Sex		
Male	1.00	<0.01
Female	0.47 (0.33 - 0.64)	
Age (years)		
15-16	1.00	<0.01
17-19	3.77 (2.63 - 5.39)	
Self declared race/skin colour		
White	1.00	
Black	1.70 (1.05 - 2.75)	0.030
Brown	1.02 (0.77 - 1.36)	0.854
Other**	0.65 (0.08 - 4.84)	0.672
Social Status		
Full student	1.00	
Only working or working and studying	4.73 (3.22 - 6.92)	<0.001
Neither studying/Neither working	6.99 (4.56 - 10.70)	<0.001
School delay (years)		
None	1.00	
One	2.33 (1.41- 3.84)	<0.001
Two	3.40 (2.11 - 5.48)	<0.001
Three or more	6.56 (4.62 - 9.33)	<0.001
Household characteristics		
Urban/rural dwelling		
Urban	1.00	
Rural	0.80 (0.54 - 1.19)	0.287
Household per capita income		
5^0 quintile (highest)	1.00	
4^0 quintile	1.63 (1.05 - 2.51)	0.028
3^0 quintile	1.03 (0.64 - 1.67)	0.314

2^0 quintile	1.23 (0.78 – 1.96)	0.361
1^0 quintile (lowest)	1.46 (0.93 – 2.28)	0.093
Head of the household schooling (years)		
0-8	1.00	
9-11	0.57 (0.37 - 0.88)	0.011
12-14	0.59 (0.40 - 0.85)	0.005
15+	0.58 (0.29 - 1.16)	0.128
Female-headed household		
No	1.00	
Yes	1.02 (0.77 - 1.35)	0.855
Number of smokers		
Zero	1.00	
One	1.93 (1.42 - 2.63)	<0.001
Two	3.00 (1.98 - 4.53)	<0.001
Three or more	9.01 (4.45 - 18.19)	<0.001
Household smoking rule		
Not allowed	1.00	
Generally not allowed	1.47 (0.93 - 2.30)	0.092
Allowed	2.18 (1.61 - 2.94)	<0.001

Source: Brazilian National Household Sample Survey (PNAD, 2008) and Global Tobacco Survey (GATS-2008)

*Report of having smoked 100 cigarettes in lifetime and currently smoking every day or not every day.

** Included Asian descendent and Indigenous

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Table 3 Results of the hierarchical regression analyses in adolescents examined the association between individual and household characteristics and smoking*. Brazil - 2008

Variables	Model 1	Model 2	Model 3
Household socioeconomic factors			
Head of the household schooling (years)			
0-8	1.00	1.00	1.00
9-11	0.58 (0.38 – 0.90)	0.67 (0.43 – 0.91)	0.95 (0.60 – 1.51)
12-14	0.57 (0.39 – 0.83)	0.72 (0.48 – 1.05)	1.45 (0.95 – 2.22)
15+	0.59 (0.29 – 1.20)	0.75 (0.36 – 1.65)	1.97 (0.93 – 4.17)
Household smoking characteristics			
Number of smokers	—	1.00	1.00
One		1.68 (1.21 – 2.35)	1.59 (1.13 – 2.23)
Two		2.60 (1.67 – 4.06)	2.29 (1.44 – 3.64)
Three or more		7.96 (3.70 – 17.11)	7.22 (3.16 – 16.46)
Household smoking rule	—		
Not allowed		1.00	1.00
Generally not allowed		1.21 (0.76 – 1.94)	1.32 (0.82 – 2.15)
Allowed		1.53 (1.10 – 2.13)	1.49 (1.06 – 2.09)
Adolescents' characteristics			
Sex			
Male	1.00	1.00	1.00
Female	0.45 (0.34 - 0.61)	0.43 (0.33 - 0.59)	0.45 (0.32 – 0.62)
Age (years)			
15-16	1.00	1.00	1.00
17-19	3.89 (2.71 - 5.58)	3.95 (2.74 - 5.69)	2.38 (1.62 – 3.49)
Social Status	—	—	
Full student			1.00
Only working or working and studying			2.81 (1.86 – 4.25)
Neither studying/Neither working			4.56 (2.85 – 7.30)
School delay (years)	—	—	
None			1.00
One			2.34 (1.37 – 3.96)
Two			2.81 (1.69 – 4.69)

Four or more	4.27 (2.87 – 6.35)

Source: Brazilian National Household Sample Survey (PNAD, 2008) and Global Tobacco Survey (GATS-2008)
*Report of having smoked 100 cigarettes in lifetime and currently smoking every day or not every day.
All models adjusted for age, sex.

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Title Page

Research article

Socioeconomic inequalities in youth smoking in Brazil

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Abstract

Objective: The contribution of smoking to socioeconomic inequalities in health is increasing worldwide, including in Brazil. Youth smoking may play important role in the increasing social inequalities related to smoking. This study investigates social determinants of smoking among 15- to 19 year-old individuals.

Design: Cross-sectional study.

Setting: Study uses data of 3,536 participants aged 15-19 years of age of the Global Tobacco Survey (GATS) and the National Household Sample Survey (PNAD) obtained from household interviews. Smoking was defined as currently smoking tobacco products, regardless of frequency. Household socioeconomic indicators included per capita income, the educational level and sex of the head of the household, the presence of smoking restrictions and the number of smokers (excluding adolescents). Adolescent social factors included years of delaying school and social status (full-time student, working, and neither working nor studying). The hierarchical logistic regression analysis considered the effect of the complex sampling design.

Results: From 3,536 participants, 6.2% were smokers (95%CI: 5.4-7.1). More males than females smoked (7.2%; 5.9-8.6 *vs* 3.6%; 2.7-4.6). The likelihood of smoking was significantly greater for male and older teens. There was an upward trend in the OR of smoking according to the number of smokers in the house. Adolescents living in households with no smoking restrictions had a greater likelihood of being smokers. OR of smoking rose as the number of years of delaying school increased being about three times greater among adolescents who working and five times greater among those who were neither studying nor working.

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Conclusions: Results demonstrate that socioeconomic inequality in smoking is established at younger ages and that school delay well as school abandonment may contribute to increase smoking-related inequalities. Smoking restrictions at home were protective against adolescents becoming smokers. Living with other smokers was a strong predictor of adolescents becoming smokers.

Article Summary

Article Focus: We investigated the social determinants of current smoking among 15- to 19-year-old Brazilian participants in the Global Tobacco Survey (GATS) Brazil. In particular, we tested whether school delay and abandonment, as well as early entry to work, which are regarded as early markers of future socioeconomic disadvantage, were associated with youth smoking.

Key messages:

- Youth smoking is associated with delaying of school and leaving school, as well as with early entry into the work force.

- Adolescents exposed to smokers at home have a much greater chance of being a smoker than adolescents who are not.

- Smoking restrictions at home were protective against youth smoking.

Strengths and limitations of this study:

- The main strength of this study is its analysis of the social determinants, both at the household and individual levels, of teenage smoking using a nationwide household sample in a large middle-income country.

- The main limitation is the lack of information about the relationship between adolescents and other smokers in the household.

INTRODUCTION

Cigarette smoking has fallen sharply in Brazil; in approximately two decades, the smoking prevalence among individuals aged 18 years and older decreased 48%, from 34.8% in 1989 to 18.2% in 2008 [1], preventing almost 420,000 (260,000-715,000) deaths.[2] Such achievements have been attributed largely to Brazil's strong upstream anti-tobacco policies, combined with increased access to tobacco cessation treatments.[2,3]

However, the contribution of smoking to socioeconomic inequalities in health is increasing in Brazil. According to data from the World Health Survey, 2002-04, smoking rates were higher among poor men and women (74% and 59%, respectively), even after controlling for age, marital status, education, employment and urban/rural residence. [4] The results of the Global Tobacco Survey (GATS) Brazil showed that there were almost twice as many tobacco users with no or less than a year of schooling, compared to tobacco users with 11 or more years of education. [5]

Early initiation of tobacco use could be a key component in the increasing social inequalities of smoking and its related morbidity and mortality. [6] Analyses of three birth cohorts in Italy showed that the increase in smoking inequalities among both men and women was mainly due to growing inequalities in smoking initiation rates. Studies have shown that most regular adult smokers become addicted in their teens. [7-9] In addition, early smoking has been associated with higher levels of tobacco dependence, increased difficulty in smoking cessation and more negative health outcomes in adulthood.[10-13]

In 2004, approximately 70% of adult smokers residing in large Brazilian cities had begun to smoke before the age of 20 years.[14] However, youth smoking seems far

more frequent among socially disadvantaged groups.[15,16] In Brazil, among daily or former daily smokers, the proportion of individuals who started smoking before 15 years of age was two-fold greater among those with no or less than one year of schooling than among those with eight years of schooling or more. [5]

Few studies have specifically addressed the social determinants of teenage smoking in Brazil, [17, 18, 19] and none has been undertaken in a nationwide household sample. This study investigated the social determinants of current smoking among participants 15 to 19 years of age in the Global Tobacco Survey (GATS) Brazil. In particular, we investigated whether school delay and abandonment, as well as early entry to work, which are regarded as early markers of future socioeconomic disadvantage, were independently associated with smoking among teenagers.

METHODS

Participants

This study used data from the Global Tobacco Survey (GATS), which was carried out in a random subsample of the National Household Sample Survey (PNAD). PNAD was conducted in 2008 by the Brazilian Institute of Geography and Statistics (IBGE) and the Ministry of Health. PNAD and GATS Brazil used a four-stage complex probabilistic household sample (municipality, census tract, household and individual) and was representative of the national and regional levels. Further details on the sampling design can be found at http://www.who.int/tobacco/surveillance/en_tfi_gats_2010_brazil.pdf.

PNAD questionnaires provided socioeconomic information about households and selected individual characteristics and health related factors, and the GATS questionnaire provided detailed information on tobacco use and exposure. GATS Brazil aimed to include 40,000 individuals aged 15 years and older with a response rate of

95.2%. Out of 39,425 interviews, 33,680 were conducted in urban areas and 5,745 in

rural areas. Bearing in mind our objectives, we studied all adolescents aged 15 to 19

years who participated in GATS Brazil, totalling 3,536 individuals.

Variables

The response variable of the study was current smoking, defined as being a current

smoker regardless of frequency, and it was grouped into two categories (yes, no). The

proportion of daily smokers, age at initiation and the number of cigarettes smoked per

day among daily smokers were used to describe smoking behaviour.

The explanatory variables were grouped into three sets of co-variables in this

analysis. Household socioeconomic factors included location (urban, rural), household

per capita income grouped in quintiles, highest education level attained by the head of

the household in number of years completed (0-8, 9-11, 12-14, 15 and more) and female

head of household (no, yes).

The second set of co-variables consisted of household smoking characteristics,

which included the number of smokers in the household, excluding the participating

adolescent (zero, one, two, three or more), and smoking restrictions at home (not

allowed, generally not allowed, allowed). The category "allowed" also included an

absence of smoking restrictions.

The last set of co-variables included the adolescents' characteristics: sex; age

(15, 16, 17, 18, 19 years old); self-declared race/skin colour (white, black, brown, Asian

descent and indigenous); social status (full-time student, only working, working and

studying and neither studying/neither working); school delay, defined as the difference

in years of schooling between the individual's current school grade and the school grade

in which he/she was expected to be given his/her age (none, one, two, three years or

more). A negative difference in school delay was treated as no difference. Asian descent

and indigenous were combined as "other" because the number of individuals was very

small.

Statistical analysis

First, we described the prevalence of smoking, the proportion (with 95% confidence

intervals) of daily smokers, age at initiation and the mean and median numbers of

cigarettes smoked per day by sex. Next, we performed a descriptive analysis of the

distribution of adolescents according to individual and household socioeconomic

indicators (Table 1).

    Associations between each explanatory variable and current smoking were

measured by Pearson's chi-square test with a p-value <0.05. Variables with p<0.20 were

included in the multivariable analysis. The magnitude of the associations was measured

using odds ratios (ORs), and 95% CIs were obtained by multiple logistic regression.

The "svy" procedure, available in Stata, version 11.0, was used to account for the effect

of the GATS complex survey design. Multicollinearity among household co-variables

was assessed using a variance inflation factor and the condition number.

Multicollinearity was not found among the variables (Tables 2-3).

    To account for the hierarchical levels of the determination of youth smoking,

multivariable analysis was performed, assuming that the socioeconomic household

factors were the most distal factors, household smoking indicators were intermediate

factors, and individual socioeconomic factors were the most proximal factors.[20] Thus,

after considering the sex and age of the adolescents, we began hierarchical modelling by

simultaneously introducing the distal variables (educational level and sex of the head of

the household and household per capita income), keeping the factors related to smoking

that remained statistically significant (p<0.05) (Model 1). Then, we entered household smoking factors (number of smokers and smoking restrictions) and kept the statistically significant factors (Model 2). Finally, we added the youth level of education and social status factors, retaining only the proximal factors that were statistically significant (Model 3). The analysis were controlled for potential confounders — in this case, the variables maintained from the previous stages. The proximal variables were adjusted for the distal and intermediate variables (Table 3).

RESULTS

Among the participants, 6.2% were current smokers (95% CI: 5.4-7.1), and 5.4% (95% CI: 4.6-6.3) reported being daily smokers, with a statistically significant difference between male and female subjects (male: 7.2%; 95% CI 5.9-8.6; female: 3.6%; 95% CI 2.7-4.6; p<0.001). All of the current smokers had smoked at least 100 cigarettes in their lifetimes. Among daily smokers, the mean (and median) numbers of cigarettes smoked per day were 11.8 (10.0), which were approximately the same in male (12.3 and [10.0]) and female subjects (10.8 and [10.0]).

The distributions of participants according to socioeconomic and household characteristics are presented in Table 1. Almost 60% of the adolescents were between 17 and 19 years of age, a great majority lived in urban dwellings, half were male, and 54% (95% CI: 52.3-55.7) matched the level of schooling expected for their ages (Table 1). Most of the participants were full-time students at the time of the interview. In total, almost 60% of adolescents lived in households concentrated between the first (lowest) and third quintiles of income distribution, and the majority lived in houses headed by men with up to eight years of schooling and in households with smoking restrictions.

In the univariable analysis (Table 2), male sex, older age and black skin colour were all significantly associated with a greater likelihood of being a regular smoker. The following factors in the household context were significantly associated with an increased chance of an adolescent being a current smoker: being in the fourth quintile of *per capita* income distribution and the head of the household having a lower level of education. The odds ratio of smoking increased with the number of smokers in the same household, and it was greater in homes in which smoking was allowed. The chance of smoking rose as the number of delayed years of education increased, and it was greater among adolescents who were studying and working, only working or neither studying nor working, compared to full-time students at the time of data collection.

In the hierarchical analysis (Table 3), exposure to tobacco smoking remained significantly lower among female subjects, although it increased with age. In the household context, the association between smoking and the educational level of the head of the household was no longer significant (p=0.847, p=0.082 and p=0.077 for 9-11, 12-14 and 15 or more years of schooling, respectively). Additionally, in the household context, the OR, regarding the number of smokers in the household, for being exposed to three or more smokers was as high as 7.22 (95% CI: 3.16-16.46), demonstrating a significant upward trend (p<0.001). Exposure to tobacco smoking remained significantly higher among adolescents living in households without smoking restrictions. After considering the effects of household socioeconomic and smoking factors, the chances of smoking remained significantly associated with the number of years of delaying of school, showing a significant upward trend (p<0.001). The chances of smoking were about three times greater among individuals who were only working or who were working and studying, and five times higher among those who were neither studying nor working when compared to adolescents who were full-time student.

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DISCUSSION

Our results confirm that school delay, as well as not attending school, and early entrance into the work force are associated with a greater likelihood of tobacco smoking among teenagers. In general, our results support the hypothesis that socioeconomic inequality in smoking is established at younger ages. In addition, our results confirm the importance of household smoking exposure in teenage smoking, reinforcing the evidence that smoking behaviour can be contagious.[21, 22] The findings are particularly relevant as socioeconomic disparities in smoking behaviour among youth are predictive of future disparities in smoking, as well as in morbidity and mortality from chronic diseases.[23]

We found important and strong associations between school engagement and smoking. The chances of smoking were substantially greater among adolescents who were no longer attending school, regardless of what they were or not working. Moreover, we also found that the chances of smoking increased as the number of years of school delay increased. School delay and leaving school are important markers of both current and future lower socioeconomic status, independent of youth health, parental education and sex.[24] Recently published analysis of US survey data showed that at the population level, education gaps among adult smokers are produced mostly by educational inequalities in initiation rather than in quitting smoking.[25]

Likely explanations for the association between school delay and school abandonment and smoking include less information on the health consequences of smoking and differences in access to and effectiveness of cessation treatments. Lower reading skills were associated with becoming a regular smoker, as well as the current

amount smoked, in a cohort analysis.[26] Several studies have indicated that failure to complete high school is associated with substance use, including the use of tobacco.[27]

Educational underachievement and dropping out of school remain serious problems in Brazilian society: only 50% of adolescents who enter high school will graduate. In 2009, 15% of adolescents 15 to 17 years of age were not in high school. Among those who were enrolled, one-third were not in the correct school grade for their ages.[28] Researchers in the area have cited disillusion, poverty, early parenthood and criminal involvement among the main reasons for this finding.[28]

The household environment is the most important source of cultural and social values for children and adolescents, and it is the most proximal context for them. Adolescents from non-smoking homes are less likely to start or develop smoking habits.[29] Our results showed a very sharp, positive relationship between the number of smokers in the household and the likelihood that a youth would smoke. There is compelling evidence that children of smoking parents are more likely to initiate smoking in adolescence than children of non-smoking parents, thus transmitting the single greatest cause of preventable death from generation to generation.[29] Beyond promoting smoking, exposure to other smokers at home also seemed to hamper quitting attempts and smoking cessation among adolescent Chinese smokers.[30]

Additionally, our results corroborate the growing and consistent evidence that home smoking restrictions protect non-smokers from second-hand smoke as it reduces smoking exposure at the household level. These results also suggest that home smoking restrictions contribute to reduce youth smoking behaviour. Moreover, a completely smoke-free home appears to send a stronger anti-smoking message than partial restrictions, and a smoke-free home might be more influential in earlier, rather than later, stages of the smoking continuum.[29-33] Late adolescence is a period characterised

by increasing role instability and major life options, such as whether to start working, go to college, leave home and so on. As adolescents approach adulthood, unhealthy behaviours initiated earlier might be abandoned or could develop into more consolidated attitudes. Thus, it is a crucial period to approach the promotion of health. Our results support the evidence that socioeconomic inequalities in smoking begin in adolescence and are likely to endure and even increase because smoking is linked to school delay and abandonment, which reduce the likelihood of having a better job and better life conditions in the future.

Comments and limitations

Unfortunately, our work lacked information about parent and adolescent peer behaviours, which are known to be important risk factors for smoking. In addition, we had no data on the relationship between the respondents and other smokers in the household. For this reason, we cannot estimate whether smoking parents, compared to other smokers, had a different impact on adolescent smoking. Despite being a cross-sectional study, it is quite unlikely that youth smoking produces disadvantages at the household level. It is possible however, that youth smoking is involved in youth school performance in a vicious cycle: the same problems that result in school delay (or abandonment) also influence smoking, and these two behaviours reinforce each other. We believe that low socioeconomic status, with all that it implies (in terms of culture and access to information), is the primary factor behind these behaviours.

The major associations observed in this study indicate that keeping teenagers at school could help to prevent smoking and to reduce the health inequalities associated with this habit. It is undeniable that all adolescents must be in school. However, because smoking seems to be a transmissible behaviour, reducing delays in education and school

abandonment must be accompanied by reductions in smoking exposure in the home. This information is important as it identifies groups where current tobacco control measures are not having the desired effect.

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Table 1 Distribution of participants according to socioeconomic and household characteristics. Brazil - 2008.

Characteristics	%	95%CI
Sex		
Male	50.4	48.6-52.3
Female	49.6	47.7-51.4
Age (years)		
15-16	40.9	39.1-42.7
17-19	59.1	57.0-60.8
Self declared race/skin colour		
White	44.7	43.1-46.4
Black	6.5	5.6-7.4
Brown	48.1	46.4-49.8
Other	0.7	0.3-0.8
School delay (years)		
None	54.0	52.3-55.7
One	12.5	11.3-13.7
Two	10.5	9.3-11.5
Three or more	23.0	21.5-24.4
Social Status		
Full student	46.3	44.4-48.1
Only working or working and studying	40.2	38.4-42.0
Neither studying/Neither working	13.5	12.2-14.7
Household per capita income		
5^0 quintile (highest)	20.8	19.3-22.3
4^0 quintile	20.7	19.2-22.2
3^0 quintile	19.9	18.3-21.3
2^0 quintile	18.9	17.5-20.3
1^0 quintile (lowest)	19.7	18.2-20.9
Head of the household schooling (years)		
0-8	55.9	54.2-57.7
9-11	16.8	15.4-18.1
12-14	21.6	20.1-23.1

15+	5.7	4.7-6.4
Female-headed household		
No	62.2	64.4-63.9
Yes	37.8	36.0-39.5
Urban/rural dwelling		
Urban	82.9	81.6-84.2
Rural	17.1	15.7-18.3
Number of smokers		
Zero	65.5	63.7-67.2
One	25.3	23.6-26.8
Two	8.1	7.1-9.1
Three or more	1.1	0.7-1.5
Household smoking rule		
Not allowed	46.4	44.5-48.1
Generally not allowed	13.3	12.0-14.5
Allowed	40.3	38.5-42.1

Source: Brazilian National Household Sample Survey (PNAD, 2008) and Global Tobacco Survey (GATS-2008)

* Included Asian descendent and Indigenous

Table 2 Odds Ratio (OR) of regular smoking* according to adolescents' socio demographic features and household socioeconomic and smoking characteristics. Brazil - 2008.

Characteristics	OR (95% CI)	p Value
Adolescents' characteristics		
Sex		
Male	1.00	<0.01
Female	0.47 (0.33 - 0.64)	
Age (years)		
15-16	1.00	<0.01
17-19	3.77 (2.63 - 5.39)	
Self declared race/skin colour		
White	1.00	
Black	1.70 (1.05 - 2.75)	0.030
Brown	1.02 (0.77 - 1.36)	0.854
Other**	0.65 (0.08 - 4.84)	0.672
Social Status		
Full student	1.00	
Only working or working and studying	4.73 (3.22 - 6.92)	<0.001
Neither studying/Neither working	6.99 (4.56 - 10.70)	<0.001
School delay (years)		
None	1.00	
One	2.33 (1.41- 3.84)	<0.001
Two	3.40 (2.11 - 5.48)	<0.001
Three or more	6.56 (4.62 - 9.33)	<0.001
Household characteristics		
Urban/rural dwelling		
Urban	1.00	
Rural	0.80 (0.54 - 1.19)	0.287
Household per capita income		
5^0 quintile (highest)	1.00	
4^0 quintile	1.63 (1.05 - 2.51)	0.028
3^0 quintile	1.03 (0.64 - 1.67)	0.314

2^0 quintile	1.23 (0.78 – 1.96)	0.361
1^0 quintile (lowest)	1.46 (0.93 – 2.28)	0.093
Head of the household schooling (years)		
0-8	1.00	
9-11	0.57 (0.37 - 0.88)	0.011
12-14	0.59 (0.40 - 0.85)	0.005
15+	0.58 (0.29 - 1.16)	0.128
Female-headed household		
No	1.00	
Yes	1.02 (0.77 - 1.35)	0.855
Number of smokers		
Zero	1.00	
One	1.93 (1.42 - 2.63)	<0.001
Two	3.00 (1.98 - 4.53)	<0.001
Three or more	9.01 (4.45 - 18.19)	<0.001
Household smoking rule		
Not allowed	1.00	
Generally not allowed	1.47 (0.93 - 2.30)	0.092
Allowed	2.18 (1.61 - 2.94)	<0.001

Source: Brazilian National Household Sample Survey (PNAD, 2008) and Global Tobacco Survey (GATS-2008)

*Report of having smoked 100 cigarettes in lifetime and currently smoking every day or not every day.

** Included Asian descendent and Indigenous

Table 3 Results of the hierarchical regression analyses in adolescents examined the association between individual and household characteristics and smoking*. Brazil - 2008

Variables	Model 1	Model 2	Model 3
Household socioeconomic factors			
Head of the household schooling (years)			
0-8	1.00	1.00	1.00
9-11	0.58 (0.38 – 0.90)	0.67 (0.43 – 0.91)	0.95 (0.60 – 1.51)
12-14	0.57 (0.39 – 0.83)	0.72 (0.48 – 1.05)	1.45 (0.95 – 2.22)
15+	0.59 (0.29 – 1.20)	0.75 (0.36 – 1.65)	1.97 (0.93 – 4.17)
Household smoking characteristics			
Number of smokers	—	1.00	1.00
One		1.68 (1.21 – 2.35)	1.59 (1.13 – 2.23)
Two		2.60 (1.67 – 4.06)	2.29 (1.44 – 3.64)
Three or more		7.96 (3.70 – 17.11)	7.22 (3.16 – 16.46)
Household smoking rule	—		
Not allowed		1.00	1.00
Generally not allowed		1.21 (0.76 – 1.94)	1.32 (0.82 – 2.15)
Allowed		1.53 (1.10 – 2.13)	1.49 (1.06 – 2.09)
Adolescents' characteristics			
Sex			
Male	1.00	1.00	1.00
Female	0.45 (0.34 - 0.61)	0.43 (0.33 - 0.59)	0.45 (0.32 – 0.62)
Age (years)			
15-16	1.00	1.00	1.00
17-19	3.89 (2.71 - 5.58)	3.95 (2.74 - 5.69)	2.38 (1.62 – 3.49)
Social Status	—	—	
Full student			1.00
Only working or working and studying			2.81 (1.86 – 4.25)
Neither studying/Neither working			4.56 (2.85 – 7.30)
School delay (years)	—	—	
None			1.00
One			2.34 (1.37 – 3.96)
Two			2.81 (1.69 – 4.69)

Four or more	4.27 (2.87 – 6.35)

Source: Brazilian National Household Sample Survey (PNAD, 2008) and Global Tobacco Survey (GATS-2008)
*Report of having smoked 100 cigarettes in lifetime and currently smoking every day or not every day.
All models adjusted for age, sex.

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STROBE Checklist of items that should be included in reports of *cross-sectional studies*

Title: Socioeconomic inequalities among youth smoking in Brazil
Authors: Barreto SM, Figueiredo RC, Giatti L

	Item No	Recommendation	
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	ok
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	ok
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	ok
Objectives	3	State specific objectives, including any prespecified hypotheses	ok
Methods			
Study design	4	Present key elements of study design early in the paper	ok
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	ok
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	ok
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	ok
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	ok
Bias	9	Describe any efforts to address potential sources of bias	ok
Study size	10	Explain how the study size was arrived at	ok
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	ok
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	ok
		(*b*) Describe any methods used to examine subgroups and interactions	ok
		(*c*) Explain how missing data were addressed	ok
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	ok
		(*e*) Describe any sensitivity analyses	ok
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	ok
		(b) Give reasons for non-participation at each stage	ok
		(c) Consider use of a flow diagram	ok
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	ok
		(b) Indicate number of participants with missing data for each variable of interest	ok
Outcome data	15*	Report numbers of outcome events or summary measures	ok

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	ok
		(*b*) Report category boundaries when continuous variables were categorized	ok
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	ok
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	ok
Discussion			
Key results	18	Summarise key results with reference to study objectives	Ok
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Ok
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Ok
Generalisability	21	Discuss the generalisability (external validity) of the study results	ok
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	ok

*Give information separately for exposed and unexposed groups.