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Susceptibility to Smoking among Non-smoking East-Asian Youth: A Multilevel Analysis

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COMPETING INTERESTS

GE Guindon is a former employee of the World Health Organization – Tobacco Free Initiative whose objective is to reduce the global burden of disease and death caused by tobacco.

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ABSTRACT

Objective: Among non-smoking youth in east-Asia, to estimate the extent to which susceptibility to smoking is associated with between-context differences (schools and classes) and to identify factors at school, class and individual levels that influence individual susceptibility to smoking.

Methods: Cross-sectional data from the Global Youth Tobacco Survey conducted in Cambodia (2002), Laos (2003) and Vietnam (2003) are used to conduct multilevel analyses that account for the nesting of students in classes and classes in schools. The outcome variable is smoking susceptibility, defined as the absence of a firm decision not to smoke and measured using a validated algorithm. Explanatory variables include school and class level influences (current tobacco use prevalence in school, exposure to anti-smoking media messages, exposure to tobacco billboard advertising and school prevention) and individual level influences (parent and friends smoking behaviour, knowledge of the harmful effects of and exposure to secondhand smoke at home, age, sex and pocket income).

Results: Multilevel analyses indicate that about 10 percent of the variation in smoking susceptibility is associated with school and class differences. Teens who have parents or friends who smoke, who are exposed to secondhand smoke at home and those who have access to pocket income are found to be more susceptible while better knowledge of the harmful effects of secondhand smoke appears to diminish susceptibility to smoking. For girls only, billboard tobacco advertising increases the risk for susceptibility and school prevention decreases risk while for boys only, attendance to schools with higher prevalence of tobacco use increases risk for susceptibility and anti-smoking media messages decreases risk.

Conclusions: This study highlights a number of modifiable factors associated with smoking susceptibility and identifies interactions between teen sex and several factors associated with the susceptibility to smoking. This finding provides support to the call to move beyond gender-blind tobacco control policies.

BACKGROUND & OBJECTIVES

Globally, it is estimated that about 5 million deaths per year are caused by tobacco use and that approximately half of these deaths occur in low- and middle-income countries (Ezzati and Lopez, 2003). In the past few decades many high-income countries have experienced steady but slow decreases in tobacco use. During the same period, however, many low- and middle-income countries, including several in Asia, have experienced dramatic increases, especially among males. For example, in Vietnam more than half of the male population consumes tobacco (General Statistics Office and Ministry of Health of Vietnam, 2003). The importance of preventing tobacco use initiation, therefore, cannot be over-stated.

Susceptibility to smoking – defined as the absence of a firm decision not to smoke – has been shown to be a good predictor of smoking onset. Pierce et al. (1996) assessed the predictive validity of smoking susceptibility and found baseline susceptibility to smoking was a strong independent predictor of experimentation (the next step in the smoking onset process). Similarly, Unger et al. (1997) found susceptible teens to be two to three times more likely to experiment with cigarette smoking during the subsequent 2 years than were non-susceptible teens. Choi et al. (2001) using data from a national and state (California) longitudinal survey of teens showed that susceptibility to smoking increased the risk of future established smoking at all levels of previous smoking behaviour.¹ In a survey of teens in three east-Asian countries (Cambodia, Laos and Vietnam) nearly 7 percent of girls and more than 20 percent of boys were found to be susceptible to smoking. Susceptibility has the advantage of being measured well before youth begin to smoke. This feature combined with the reality that smoking initiation occurs at a later age in east-Asia, offer important opportunities not captured by the more traditional use of smoking experimentation or participation.

School and class level influences

Existing studies have identified a number of school-level characteristics associated with increased susceptibility to smoking. In particular, one factor that influences positively the susceptibility to smoking is the exposure to tobacco advertising (Borzekowski et al., 1999, Evans et al., 1995, Feighery et al., 1998, Gritz et al., 2003, Kaufman et al., 2002, Straub et al., 2003). Evidence of the effectiveness of school-based smoking prevention programmes is mixed. It suggests that exposure to and perceived usefulness of school prevention programs and perceived information helpfulness is associated with decreased susceptibility (Huang et al.,

¹ The smoking continuum was defined as: never smoker; puffer; non-recent experimenter; recent experimenter; former established; current established.

2000). However, it does not appear that school-based smoking prevention programs have had much long-term success at keeping youth from starting to smoke.(Wiehe et al., 2005) Attendance to a school with a relatively high smoking rate among older students has been associated with increased susceptibility to smoking (Leatherdale et al., 2006).

Individual level influences

At the student level, there is considerable evidence that youth smoking susceptibility is influenced by whether friends and/or family members smoke (Evans et al., 1995, Feighery et al., 1998, Gritz et al., 2003, Kaufman et al., 2002, Straub et al., 2003). Additionally, the extent to which restrictions are placed on smoking at home (Wakefield et al., 2000) and attitudes about the social consequences of smoking have been linked to susceptibility to smoking (Filice et al., 2003, Unger et al., 2001). The effect of sex on susceptibility to smoking is unclear. Some studies find that boys are at increased risk (Evans et al., 1995, Gritz et al., 2003), some that it is girls who are at increased risk (Feighery et al., 1998, Kaufman et al., 2002, Leatherdale et al., 2005) while others find no significant differences (Huang et al., 2000, Straub et al., 2003).

Objectives

The objectives of this study are twofold. The first objective is to examine the extent to which variability in smoking susceptibility is associated with between- versus within-class differences and between- versus within-school differences. That is, to what extent between-context (as opposed to between-individual heterogeneity) explains individual differences in susceptibility to smoking. Disaggregating these effects provides a basis for estimating the potential of contexts to influence behaviour. Given that contexts have the potential to influence susceptibility, the next objective is to identify and quantify specific influences, particularly those that might be susceptible to modification through national tobacco control policies such as strict advertising bans or school-based prevention programmes. Our second objective is thus to determine the factors that influence susceptibility to smoking among non-smoking youth in east-Asia with special attention given to school and class level determinants (current tobacco use prevalence in school, exposure to anti-smoking media messages, exposure to tobacco billboard advertising and school prevention). In doing so, we allow the association between smoking susceptibility and sex to vary across schools and explore cross-level interactions to assess whether the magnitude of school and class influences on susceptibility may be modified by sex.

To our knowledge, this is the first study to examine factors associated with susceptibility to smoking in low-income countries as all the evidence thus far is based on studies conducted in

the United-States and Canada.

METHODS

Data

The World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) developed the Global Youth Tobacco Survey (GYTS) to track tobacco use among young people across countries using a common methodology and core questionnaire. The GYTS is school-based and employs a two-stage sample design to collect representative data on smoking among students aged 11 to 17. The first stage is a probabilistic selection of schools. The second stage is a random selection of classes from participating schools.

In this study, data are taken from 5 province-based surveys (Ha Noi, Hai Phong, Tuyen Quang, Da Nang, Ho Chi Minh) conducted in Vietnam, four surveys in Laos (Luang Prabang, Vientiane Municipality, Vientiane Province, and Savannakhet) and a national survey conducted in Cambodia. The surveys were conducted in 2003 in Vietnam and Laos, and in 2002 in Cambodia; they included 9507 students from grades 8-10 in Vietnam; 9720 students from grades 2-4 in Laos and 2011 students from grades 8-10 in Cambodia. School response rates were 100 percent for all surveys with the exception of Cambodia (98 percent) and Ho Chi Minh City (88 percent). Student and overall response rates were high with average response rates across surveys of 91 percent and 90 percent respectively.

Concepts and measures

Dependent variable

Smoking susceptibility among east-Asian never smokers (i.e., never tried or experimented with cigarette smoking, even one or two puffs), was derived using the validated algorithm of Pierce et al. (1996). In particular, susceptibility is measured by asking students the following questions (using a 4-point ordinal scale):

- Do you think you will be smoking cigarettes 5 years from now?
- If one of your best friends offered you a cigarette, would you smoke it?
- At any time during the next 12 months do you think you will smoke a cigarette?

Students who answered 'definitely not' to all three questions were considered non-susceptible; all other students were considered susceptible.

School and class level variables

The following school-level variables were constructed: prevalence of smoking, anti-smoking

media exposure and exposure to billboard advertising. First, current tobacco use prevalence – school average – was the percent of students using any form of tobacco product (e.g. cigarettes, water pipe, etc.) on one or more days in the 30 days preceding the survey. Second, anti-smoking media exposure was the percent of students who reported having seen ‘a lot’ of anti-smoking media messages during the past 30 days. Third, billboard tobacco advertising was the percent of students who reported having seen ‘a lot’ of billboard advertisements for cigarettes during the past 30 days. Estimated at the class level, prevention was the percent of students who had been taught about the danger of smoking in any of their classes during the current school year. The entire sample (n=21238), including teens who had experimented with smoking and those who were currently smoking, was used to construct the school and class level variables.

Individual level variables

A number of individual level variables were incorporated into the model. Parents and peer smoking behaviour were defined separately. First, a binary measure of mother and father smoking behaviour as reported by students is used while friends smoking behaviour is measured using a 4-point ordinal scale.² The knowledge of the harmful effects of secondhand smoke is measured using a 4-point ordinal scale³ while a 5-point ordinal scale is used to measure exposure to secondhand smoke at home.⁴ A continuous variable representing the following categories of age is included (11 years old or younger, 12 years old, 13 years old, 14 years old, 15 years old, 16 years old, 17 years old or older).⁵ A variable for income – monthly pocket income - is also included. Because of differing response scales utilized across countries, we include a binary measure of pocket income.⁶

Analysis

Multilevel modelling is employed to conduct analyses that account for the nesting of students in classes and classes in schools. Multilevel modelling explicitly accounts for between-context and between-individual heterogeneity. In addition to assessing the relative contribution of individual

² 1=none; 2=some; 3=most; 4=all

³ 1=definitely not harmful; 2=probably not harmful; 3=probably harmful; 4=definitely harmful

⁴ 1=0 days per week; 2=1-2 days per week; 3=3-4 days per week; 4=5-6 days per week; 5=7 days per week.

⁵ Note that the category 11 years includes persons under the age of 11 and the category 17 years includes person older than 17 years. Given that so few observations fall into these categories, we are confident the outcome will not be affected in a meaningful way.

⁶ 1=some pocket income; 0=no pocket income

and contextual effects, multilevel techniques allows for an examination of cross-level effects (Duncan et al., 1998).

First, we specify a *null* or *empty* model to estimate the percent of total variability in susceptibility that is due to grouping (i.e., differences between classes and differences between schools). Second, we include all explanatory variables as *fixed* effects. Third, we estimate a random slope model where the association between susceptibility and sex is allowed to vary across school (sex is specified as a *random* effect). Fourth, we determine if the strength of association between our school/class level variables and susceptibility vary as a function of student sex (i.e., test for cross-level interactions) and whether the slope of school/class level variables differs from zero for teenage boys and girls (i.e., test for simple slopes).

To facilitate the interpretation of interaction effects, the following variables are centred at their mean: income, friends smoking, school prevalence of any tobacco use, prevention, exposure to billboard tobacco advertising and exposure to anti-smoking media message; all school and class variables are expressed in increments of 10 percent (i.e., the variables are coded so that a difference of one unit represents a 10 percent change in magnitude). All models are estimated using MLwiN 2.02 and re-estimated using Stata/SE 9.2 for Macintosh (results not reported) to prevent against programming coding errors.

RESULTS

Table 1 presents sample characteristics of non-smoking east-Asian youth. About 13.2 percent of students are susceptible to smoking, from 14.1 percent in Cambodia to 12.4 percent in Laos. There are relatively few teens less than 14 years old. More than 50 percent of teens have a father who smokes but less than 5 percent have a mother who smokes. Most teens (67.6 percent) have non-smoking friends. About half of teens report being exposed to secondhand smoke at home, including 16.1 percent who report being exposed every day of the week. Most students (89.5 percent) believe that second-hand smoke is harmful.

Table 2 presents class and school characteristics. The sample is taken from teens nested in 516 classes nested in 260 schools (49 in Cambodia, 100 in Laos and 111 in Vietnam). On average, about 82 students are sampled from each school. School average prevalence of any tobacco use (e.g., cigarette, tobacco smoking such as water pipe) is 8.6 percent. 25.4 percent of students report having seen 'a lot' of billboard tobacco advertising and about 2/3 report having seen 'a lot' of anti-smoking media messages. Finally, 64 percent of teens report having been taught in classes about the dangers of smoking.

Table 3 presents the results of multilevel logistic regressions. In model 1, the school and class intercept variances, at 0.159 and 0.155, are both statistically significant. Expressed as intra-class correlation coefficients, these variances indicate that 0.049 and 0.046 percent of the variability in susceptibility to smoking is associated with between school (level 3) and between class (level 2) differences. As is usually the case, within-school differences are far more important (Sellstrom and Bremberg, 2006, Snijders and Bosker, 1999).⁷ Model 2 incorporates all explanatory variables into the null model. Smoking prevalence among students of the same school has a positive and significant impact on students' susceptibility to smoking. A 10 percent increase in prevalence increases the odds of being susceptible by about 16 percent. Exposure to anti-smoking messages has a protective effect, as it significantly reduces the odds of being susceptible. The associations between smoking susceptibility, exposure to billboard tobacco advertising and school prevention (i.e., having been taught in classes about the dangers of smoking) are not significant. Not surprisingly, smoking susceptibility is associated with the smoking behaviour of parents and friends. Parental smoking increases the likelihood of smoking susceptibility by nearly 20 percent if the father smokes and by more than 200 percent if the mother smokes. Boys are found to be more than 3 times more likely to be susceptible to smoking than girls while age is not associated with smoking susceptibility. Exposure to secondhand smoke at home increases the odds of being susceptible while knowledge about the harmful effects of secondhand smoke has a protective effect. Students who have pocket income are more than 60 percent more likely to be susceptible than students who have no access to pocket income. Lastly, levels of susceptibility are not associated with country.

In model 3, the regression of susceptibility on student sex is allowed to vary across schools. The slope variance at 0.416 is significant: in about 68 percent of schools (\pm one standard deviation), the regression of susceptibility on student sex will go from 0.63 to 1.92 ($1.275 \pm \sqrt{0.416}$). This indicates that the effect of being a boy is clearly positive in all schools but high effects are more than three times larger than low effects.⁸ Model 4 builds on model 3 and incorporates cross-level interactions. The relevant values of the asymptotic variance/covariance matrix of fixed effects necessary to probe the significance of interactions are reported in Appendix 2 (Bauer and Curran, 2005, Brambor et al., 2006). For girls only, billboard tobacco advertising increases the risk for susceptibility and school prevention decreases risk. For boys only, school prevalence increases the risk for susceptibility and anti-smoking media decreases

⁷ This is primarily due to the fact that there are substantially more teens than schools and there is more heterogeneity between teens than between schools.

⁸ 'High' and 'low' refer to values occurring in schools with, respectively, the top 15 percent, and the bottom 15 percent, of the school-dependent effect.

risk. The influences of billboard tobacco advertising and school prevention are not significantly different from zero for boys while the influences of school prevalence and anti-smoking media are not significantly different from zero for girls.

DISCUSSION

Principal findings

Interrupting or slowing down the process along the smoking uptake continuum can help prevent teen addiction to tobacco products. In this respect, we find susceptibility to smoking is associated with a number of school and individual level influences.

We find the association between sex and susceptibility varies significantly across schools. More specifically, for girls only, the association between advertising and susceptibility is positive and significant while the association between school prevention and susceptibility is negative and significant. For boys only, the association between school prevalence and susceptibility is positive and significant while the association between anti-smoking media messages and susceptibility is negative and significant.

We provide additional evidence that teens who attend schools with higher prevalence of tobacco use are more likely to be susceptible to smoking (Leatherdale et al., 2006). Consistent with the findings of other studies, we find teens who have parents or friends who smoke are more susceptible to smoking. Additionally we find teens who are exposed to secondhand smoke at home and those who have access to pocket income to be more susceptible while better knowledge of the harmful effects of secondhand smoke appears to diminish susceptibility to smoking. Individual level influences are robust across specifications.

Strengths and weaknesses of the study

The study presented is sound and innovative in several respects. First, to our knowledge, it is the first that examines the factors associated with the susceptibility to smoking in low-income countries. In this context, it takes advantage of a relatively untapped and rich dataset of more than 20 000 youth in three east-Asian countries. Second, the methodological approach is sound in that its utilization of multilevel modelling permits for the examination of both individual level determinants and variation between classes and schools.

There are, however, some weaknesses that merit discussion. First, the measure of susceptibility developed by Pierce et al. (1996) has not been validated in low-income countries. Although we do not expect Asian youth to differ markedly from North-American youth in their progression through the smoking uptake continuum, there is no empirical evidence to support it.

Second, exposure to billboard tobacco advertising and anti-smoking media messages may be endogenous (i.e., not independent of teens' susceptibility). For example, the differences in reported exposure to advertising by students may be explained by differences in susceptibility (more susceptible teens being more aware of tobacco advertising). That said, our measures of exposure to billboard tobacco advertising and anti-smoking media messages represent school averages and thus, may alleviate the problem of endogeneity because differences in exposure may reflect regional differences (especially across regions from different countries). An additional concern with respect to our measure of tobacco advertising is that nearly 20 percent of Vietnamese respondents report having seen 'a lot' of billboard advertisements for cigarettes during the past 30 days when, in theory, such advertisements are banned in Vietnam. It may be the case that point-of-purchase promotion, which is often substantial in Vietnam, was perceived as being equivalent to billboard advertisements. Third, GYTS is a school-based survey and cannot capture teens no longer in school. Secondary school enrolment is high in Vietnam (72 percent in girls and 75 percent in boys) but relatively low in Cambodia (24 percent in girls and 35 percent in boys) and Laos (39 percent in girls and 52 percent in boys) (Asian Development Bank, 2006). Additionally, the surveys conducted in Laos and Vietnam are not nationally representative. More specifically, four out of five provinces where the survey was conducted in Vietnam are principally urban areas whereas the urban population as a percentage of total population is only about 25 percent in Vietnam (Asian Development Bank, 2006).

Meaning of the study: possible mechanisms and implications for policymakers

Cambodia, Laos and Vietnam have all recently ratified the Framework Convention on Tobacco Control which demonstrates a commitment from policymakers to curb the tobacco epidemic. Findings from this study provide insight to policymakers in addressing tobacco use initiation among young boys and girls.

First, this study's most important contribution is the finding that sex can modify factors associated with the susceptibility to smoking. This finding provides support to the call to move beyond gender-blind tobacco control policies. (Morrow and Barraclough, 2003, Morrow et al., 2002)

Second, our results indicate the potential benefits to banning billboard tobacco advertising in regions where it is not already banned and further existing bans to include point-of-purchase promotion. Tobacco industry documents have revealed tobacco companies have used such promotion in response to advertising restrictions (Lavack and Toth, 2006).

Third, the positive association between exposure to secondhand smoke at home and the

negative association between knowledge of the harmful effects of secondhand smoke with susceptibility to smoking suggest potential benefits to be gained from the provision of information about the harmful effects of secondhand smoke. In particular, it may improve teen knowledge and reduce their exposure to secondhand smoke at home.

Fourth, our results underscore the important influence that parents and friends have on the susceptibility to smoking among youth. As such, interventions proven to be effective at reducing tobacco use overall, such as price increases, can be expected to have an additional benefit in reducing teen susceptibility to smoking.

Unanswered questions and future research

The results of this study illustrate the advantages of using multilevel modelling with GYTS data from multiple countries. GYTS data are a rich source of information. In addition to studying smoking susceptibility, these data can be used to examine factors associated with smoking initiation – a particular void in the current literature – and to explore exposure to tobacco advertising among east-Asian teens, especially in the presence of comprehensive advertising bans. Using multilevel approaches, further exploitation of the GYTS – for which over 100 datasets now exist - will shed additional light on the benefits of the GYTS data for understanding the determinants of tobacco initiation and use among adolescents in surveyed countries.

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Table 1

Sample characteristics: non-smoking east Asian youth

	All		Cambodia		Laos		Vietnam	
	(n)	%	(n)	%	(n)	%	(n)	%
Susceptibility to smoking	2,144	13.2	236	14.1	963	12.4	945	13.8
Boys	1,544	21.17	177	20.18	727	19.60	640	23.63
Girls	600	6.66	59	7.42	236	5.78	305	7.38
Sex								
Female	9,011	55.3	795	47.55	4,083	52.4	4,133	60.4
Male	7,294	44.7	877	52.45	3,709	47.6	2,708	39.6
Age								
<11	463	2.8	64	3.83	247	3.2	152	2.2
12	768	4.7	74	4.43	598	7.7	96	1.4
13	1,881	11.5	152	9.09	1,569	20.1	160	2.3
14	3,880	23.8	201	12.02	2,237	28.7	1,442	21.1
15	4,213	25.8	339	20.28	1,785	22.9	2,089	30.5
16	3,658	22.4	425	25.42	995	12.8	2,238	32.7
>17	1,442	8.8	417	24.94	361	4.6	664	9.7
Smoking behaviour								
Mother smokes	509	3.1	62	3.71	294	3.8	153	2.2
Father smokes	8,078	49.5	767	45.87	3,568	47.8	3,743	54.7
Friends smoke								
None	11,019	67.6	1,288	77.03	5,855	75.1	3,876	56.7
Some	4,883	30.0	343	20.51	1,794	23.0	2,746	40.1
Most	275	1.7	16	0.96	95	1.2	164	2.4
All	128	0.8	25	1.50	48	0.6	55	0.8
Secondhand smoke (shs)								
Exposure at home (days per week)								
0	8,424	51.7	871	52.09	4,708	60.4	2,845	41.6
1-2	3,391	20.8	387	23.15	1,157	14.9	1,847	27.0
3-4	1,415	8.7	185	11.06	364	4.7	866	12.7
5-6	448	2.8	72	4.31	121	1.6	255	3.7
7	2,627	16.1	157	9.39	1,442	18.5	1,028	15.0
Knowledge about harmful effect of shs								
Definitely not harmful	774	4.8	36	2.15	365	4.7	373	5.5
Probably not harmful	852	5.2	57	3.41	623	8.0	172	2.5
Probably harmful	3,525	21.6	403	24.10	1,929	24.8	1,193	17.4
Definitely harmful	11,154	68.4	1,176	70.33	4,875	62.6	5,103	74.6
Pocket income	9,116	55.9	1,548	92.58	3,355	43.1	4,213	61.6

Susceptibility to Smoking Among Non-smoking East-Asian Youth: A Multilevel Analysis

Table 2

School and class characteristics -full sample

	All		Cambodia		Laos		Vietnam	
School (n)	260		49		100		111	
Class (n)	516		50		226		240	
	mean	sd	mean	sd	mean	sd	mean	sd
<i>School characteristics</i>								
Students sampled (per school)	81.68	35.52	41.04	10.43	97.20	38.86	85.65	24.38
School smoking prevalence								
Ever smoking	0.135	0.097	0.067	0.072	0.125	0.096	0.175	0.088
Current cigarette smoking	0.061	0.067	0.050	0.057	0.076	0.080	0.052	0.054
Current tobacco smoking	0.040	0.038	0.043	0.035	0.061	0.038	0.021	0.026
Current cigarette/tobacco smoking	0.086	0.070	0.084	0.061	0.116	0.077	0.060	0.055
Exposure to anti-smoking media messages	0.627	0.142	0.751	0.111	0.671	0.089	0.533	0.133
Exposure to tobacco advertising -billboard	0.254	0.155	0.518	0.101	0.198	0.083	0.189	0.089
<i>Class characteristics</i>								
Students per class	41.16	10.94	40.22	9.06	43.01	13.78	39.61	7.52
Prevention	0.639	0.171	0.669	0.169	0.625	0.173	0.646	0.168

Table 3
Multilevel logistic regressions

<i>Fixed effect</i>	<u>Model 1</u>		<u>Model 2</u>		<u>Model 3</u>		<u>Model 4</u>	
	b	SE	b	SE	b	SE	b	SE
Intercept	-2.00	0.040 ***	-2.391	0.351 ***	-2.437	0.358 ***	-2.391	0.357 ***
<i>Level 3 (school)</i>								
Prevalence			0.148	0.058 ***	0.142	0.059 **	0.036	0.090
Anti-smoking media			-0.077	0.035 **	-0.079	0.039 **	-0.056	-0.051
Tobacco advertising			0.049	0.042	0.054	0.043 *	0.138	0.056 **
<i>Level 2 (class)</i>								
Prevention			-0.018	0.022	-0.021	0.022	-0.079	0.035 **
<i>Level 1 (student)</i>								
Sex (male=1)			1.251	0.056 ***	1.275	0.071 ***	1.248	0.070 ***
<i>Smoking behaviour</i>								
Father smokes			0.187	0.056 ***	0.187	0.057 ***	0.188	0.057 ***
Mother smokes			0.754	0.117 ***	0.757	0.119 ***	0.757	0.119 ***
Friends smoke			0.790	0.041 ***	0.793	0.042 ***	0.793	0.042 ***
<i>Secondhand smoke</i>								
Knowledge of harmful effects			-0.309	0.029 ***	-0.313	0.029 ***	-0.314	0.029 ***
Exposure			0.079	0.018 ***	0.080	0.019 ***	0.079	0.019 ***
Age			0.018	0.020	0.019	0.020	0.018	0.020
Pocket income			0.499	0.058 ***	0.503	0.059 ***	0.501	0.059 ***
<i>Country^a</i>								
Laos			0.095	0.182	0.103	0.187	0.088	0.186
Vietnam			0.112	0.186	0.108	0.191	0.096	0.190
<i>Contextual interaction</i>								
Prevalence x sex							0.162	0.102
Anti-smoking media x sex							-0.034	0.056
Advertising x sex							-0.127	0.054 **
Prevention x sex							0.090	0.041 **
<i>Random effects</i>								
	Var. comp.	SE	Var. comp.	SE	Var. comp.	SE	Var. comp.	SE
<i>Level 3 (school)</i>								
<i>Random intercept</i>								
Intercept variance	0.159	0.041 ***	0.085	0.034 **	0.229	0.076 ***	0.203	0.073 ***
<i>Random slope</i>								
Slope variance					0.416	0.108 ***	0.366	0.102 ***
Intercept-slope covariance					-0.246	0.080 ***	-0.210	0.076 ***
<i>Level 2 (class)</i>								
<i>Random intercept</i>								
Intercept variance	0.155	0.041 ***	0.123	0.04 ***	0.132	0.042 ***	0.129	0.041 ***

* significant at 10%; ** significant at 5%; *** significant at 1%

a. Cambodia is the reference country
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Appendix 1. Response rates**Table A1.**

Response rates

Survey	School response rate (%)	Student response rate (%)	Overall response rate (%)	Total N
<i>Cambodia</i>	98	89.2	87.4	2011
<i>Laos</i>				
Luang Prabang	100	91.9	91.9	2558
Savannakhet	100	90.7	90.7	2458
Vientiane Municipality	100	93.6	93.6	2300
Vientiane Province	100	94.9	94.9	2404
<i>Vietnam</i>				
Denang	100	94.7	94.7	2163
Haiphong	100	94	94	2006
Hanoi	100	96.4	96.4	2112
Ho Chi Minh City	88	90.1	79.3	1791
Tuenquang	100	82.9	82.9	1435

Appendix 2. Interactions

Table A2

Interactions: variances and covariances

Sex		x prevalence	x advertising	x anti-smoking media	x prevention
Intercept	γ_{00}	0.1272124	0.1272124	0.12721240	0.127212
Level 1	γ_{10}	0.0049460	0.0049460	0.00494603	0.004946
Level 2	γ_{01}	0.0080349	0.0030873	0.00259765	0.001229
Interaction	γ_{11}	0.0104713	0.0029001	0.00318533	0.001684
cov	$\gamma_{00,01}$	0.0011020	-0.005016	-0.0008563	-0.0008563
cov	$\gamma_{10,11}$	0.0000203	-0.001891	0.0002895	0.0000975
cov	$\gamma_{00,10}$	-0.0031783	-0.003178	-0.0031783	-0.0031783
cov	$\gamma_{01,11}$	-0.0068766	-0.001891	-0.0020660	-0.0011062