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Predictors of Cigarette Smoking Initiation in Early, Middle, and Late Adolescence

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Abstract

Purpose—Little is known about age-related differences in risk factors for cigarette smoking initiation. We identified predictors of initiation in early, middle, and late adolescence from among sociodemographic factors, indicators of smoking in the social environment, psychological characteristics, lifestyle indicators, and perceived need for cigarettes.

Methods—Data were drawn from a longitudinal study of 1,801 children recruited at age 10–11 years from 29 elementary schools in Montreal, Canada. Multivariable logistic regression within a generalized estimating equations framework was used to identify predictors among never smokers across three 2-year windows: age 11–13 years ($n = 1,221$); age 13–15 years ($n = 737$); and age 15–17 years ($n = 690$).

Results—Among the 18 risk factors investigated, two differed across age. Friends' smoking, a strong risk factor in early adolescence (odds ratio [95% confidence interval] = 5.78 [3.90–8.58]), lost potency in late adolescence (1.83 [1.31–2.57]). Depressive symptoms, a risk factor in early and middle adolescence (1.60 [1.26–2.02] and 1.92 [1.45–2.54], respectively), were inversely associated in late adolescence (.76 [.58–1.00]). Sex, TV viewing, and weight-related goals were

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Supplementary Data

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not associated with initiation at any age. All other factors were significant in two or three age groups.

Conclusions—Most risk factors for smoking initiation were stable across age. Tobacco control interventions may be robust for risk factors across age groups and may not need adjustment. At all ages, interventions should focus on eliminating smoking in the social environment and on reducing the availability of tobacco products.

Keywords

Longitudinal; Adolescent; Children; Cigarette smoking initiation; Tobacco; Nicotine

Most smokers begin smoking during childhood or early adolescence [1,2], with initiation at younger ages conferring a higher risk of continued smoking, nicotine dependence [3,4], and long-term sustained smoking into adulthood [5]. However, few longitudinal studies differentiate risk factors for cigarette smoking initiation across age during adolescence, although such studies could provide critical information for the development of tobacco control interventions for adolescents. In a recent systematic review of 53 longitudinal studies of smoking initiation in adolescents, which identified 98 conceptually distinct predictors of initiation [6], only two studies investigated risk factors by age. Mahabee-Gittens et al. [7] studied the influence of peer smoking and family factors on initiation in seven cohorts of never smokers, aged 10–16 years at baseline. Peer smoking was positively associated with initiation at every age from age 12 to 17 years, but the protective influence of parent-youth connectedness, parental monitoring, and punishment differed at different ages. In the second study, Harakeh et al. [8] followed 11-year-old never smokers for 4 years and found that two aspects of neurocognitive functioning differentially predicted smoking initiation at age 13 and 15 years.

Animal models have also provided evidence of age differences in vulnerability to smoking, and more specifically that exposure to nicotine may be more influential in early adolescence. Compared with mice exposed in middle or late adolescence, those exposed in early adolescence developed a strong preference for nicotine solution over tap water, self-administered more nicotine, and increased consumption to compensate when the nicotine concentration was reduced. In addition, the mice exposed early developed greater nicotine-induced arousal than those exposed later [9].

In humans, differences in risk factors for cigarette smoking initiation across age during adolescence are highly plausible for several reasons. The physical and hormonal transformations experienced during puberty could constitute risk factors in and of themselves or alternatively, heighten sensitivity to other risk factors in the social environment (e.g., [10,11]). In addition, the transition from elementary to high school, which usually occurs around age 12–13 years, entails changes in school cultures, increased academic demands, and shifts in peer groups [12]. This transition can be difficult to negotiate for some students, with declines in academic achievement and self-esteem, and increased social anxiety [13]. These challenges are exacerbated among youth at risk because of social, economic, familial, or neighborhood challenges [13]. As with puberty, these issues

could constitute risk factors in and of themselves or they could increase sensitivity to other risk factors.

If the risk factors for smoking initiation do indeed differ by age, then the design of smoking prevention interventions that target such risk factors may need to be tailored to different age groups. This issue could be one underpinning of the modest effects observed in randomized controlled trials of smoking prevention programs, which generally adopt a “one size fits all” approach. For example, a meta-analysis of 49 randomized controlled trials of school-based smoking prevention programs, including youths aged 5–18 years in 19 countries, reported an overall significant effect with an average 12% reduction in smoking initiation compared with controls at longest follow-up but no effect for all trials pooled at 1 year [14]. If risk factors for initiation do differ across age during adolescence, the effects of an intervention focused on these risk factors could be attenuated or even adverse at ages when the risk factors are differentially influential [15].

Because little is known about age-related differences in risk factors for cigarette smoking initiation, our objective in this study was to determine whether a range of established predictors of initiation differ between early (by age 13 years), middle (by age 15 years), and late (by age 17 years) adolescence. These age groupings have distinct psychological and cognitive needs and capacities which could necessitate differing approaches to substance use prevention interventions [15].

Methods

The AdoQuest I study

Data were available in AdoQuest I (2005–2011), a prospective study of fifth grade students ($n = 1,801$; age 10–11 years at inception), which investigated the natural course of the co-occurrence of health-compromising behaviors in children [16]. A random sample of 40 schools with more than 90 students enrolled in fifth grade was identified from among all French language schools in greater Montreal. To assure equal representation of students of high, middle, and low socioeconomic status (SES), schools were stratified into groupings defined by tertiles of an indicator [17] based on maternal education, parental employment, and a measure of low family income that accounts for family size and area of residence [18,19]. An equal number of schools were selected into each grouping, and 29 schools (72.5% of those invited), including 10 in the first, 10 in the second and nine in the third groupings, agreed to participate. Students were recruited from all fifth grade classes in the 29 schools. Participants provided assent and their parents/guardians provided informed consent. The study received approval from the ethics and protection review boards of Concordia University and the Centre de Recherche du Centre Hospitalier de l'Université de Montréal.

Using data collection methods adapted from the Canadian Youth Smoking Survey [20], we collected baseline data in cycle 1 from fifth grade students ($n = 1,801$) in Spring 2005 using classroom-administered, self-report questionnaires. Data on cigarette smoking initiation were collected in five follow-up cycles spanning 7 years. Cycles 2 and 3 were conducted in Fall 2005 ($n = 1,543$; 86% of baseline) and Spring 2006 ($n = 1,837$, 99% of 1,859

participants, 58 of whom joined in sixth grade) when students were in sixth grade, using the same data collection methods as cycle 1. Students then transitioned to more than 100 high schools. Cycle 4 was conducted in seventh grade in 2006–2007 ($n = 1,026$). Cycle 5 was conducted in ninth grade in 2008–2009 ($n = 1,233$). Finally, cycle 6 was conducted in 11th grade (the last year in high school) in 2010–2011 ($n = 1,249$). In the high school cycles, self-report questionnaires were mailed to participants' homes with stamped, addressed return envelopes. The mean age of participants in cycle 1 was 10.7 years (standard deviation [SD] = .60) and 16.8 years (SD = .50) in cycle 6. Participants completed a mean of 4.6 years of the six possible cycles (SD = 1.4); those who missed a cycle were retained in subsequent cycles. Parents also completed mailed self-report questionnaires in 2006–2007 and again in 2008–2009.

Present study

To attain the objectives for the present study, we conducted three sets of analyses, stratified by age, ensuring that the time span between measurement of exposures and the outcome was no longer than 2 years. Initiation was modeled among never smokers in (1) early adolescence (fifth grade; mean[M] age = 11.2 years [SD = .39]) with the outcome measured in sixth and seventh grades (cycles 2–4); (2) middle adolescence (seventh grade; M age = 12.8 years [SD = .39]) with the outcome measured in ninth grade (cycle 5); and (3) late adolescence (ninth grade; M age = 15.1 years [SD = .46]) with the outcome measured in 11th grade (cycle 6, M age = 16.8 years [SD = .50]). As indicated in Figure 1, each of the three analytic samples was created by identifying never smokers from among participants who provided complete smoking data in the relevant cycles. Never smokers in earlier samples were retained in subsequent samples if complete outcome data were available.

Study variables

In each cycle, participants were asked: “Have you ever tried cigarette smoking, even just a few puffs?” (yes or no). To ensure consistency in classifying never smokers to retain in the analytic samples, responses to several smoking-related items (e.g., number of cigarettes consumed in the previous week or 3 months) were also examined. If smoking was reported on any item, the participant was classified as having smoked and was eliminated from the analytic sample. Cigarette smoking initiation was defined as a never smoker reporting yes for the first time. Self-report of cigarette smoking by youth is valid and reliable [21].

We selected potential predictor variables based on our recent review [6], their possible utility in prevention [2,22], and availability of data on the variable at different ages in the AdoQuest data set. Variables included sociodemographic factors (sex, age, and maternal education [which served as a proxy for SES]); indicators of smoking in the social environment (father's, mother's, siblings', and friends' smoking; home smoking rules, number of smokers at home, number of days in the last week exposed to smoking in cars, and school smoking rules); psychological characteristics (depressive symptoms and school connectedness); lifestyle indicators (hours of TV daily, weight-related goals, and use of other tobacco products); and perceived need for cigarettes (really need a cigarette and have strong cravings). Adolescent never smokers have reported needing and craving cigarettes, which may be related to secondhand smoke exposure [23,24].

Table A1 outlines each variable, its source if taken from another study, the survey cycles in which it was assessed, its measurement item(s) and response choices, how response choices were recoded for analysis, and Cronbach's alpha for continuous scales.

Data analysis

After descriptive analyses, the univariate associations between each potential predictor variable measured in fifth, seventh, or ninth grade and each outcome (i.e., early, middle, or late cigarette smoking initiation) were examined. Before conducting multivariable analyses we examined the distribution of missing data across potential predictor variables (Table A2). The median (interquartile range; minimum-maximum) percentage of missing values across potential predictors was 3.2% (2.2–7.6; 0–19.9) in fifth grade, 1.9% (1.3–3.1; 0–5.3) in seventh grade, and 1.3% (.7–2.3; 0–5.9) in ninth grade. Missing values on all potential predictor variables were imputed using an iterative Markov chain Monte Carlo method [25] to create 10 separate data sets.

We conducted three sets of multivariable logistic regression analyses on the imputed data sets (one set each for early, middle, and late adolescence). Across the five categories of exposures, each potential predictor variable was tested separately in its own model (in each of the three sets of analyses) adjusting for sex, age, and maternal education. We took this approach rather than testing potential predictors in an omnibus model because omnibus models are atheoretical and may well be incorrect. Specifically, inclusion of highly correlated covariates (e.g., parental smoking and number of smokers in the household) can be problematic because of multicollinearity. Moreover, if a covariate is on the causal pathway between the exposure of interest and the outcome, then the estimate may be attenuated. Clustering attributable to participants attending the same elementary school was accounted for using generalized estimating equations with an exchangeable correlation matrix and robust (sandwich) estimators of standard errors [26]. Parameter estimates and 95% confidence intervals (CIs) were pooled across the 10 data sets and *p* values were determined using Rubin's rule [27]. Multiple imputation and all analyses were undertaken using IBM SPSS version 24 (released in 2016, SPSS Statistics for Windows; IBM Corp., Armonk, NY).

Results

Of 2,946 fifth grade students enrolled in schools eligible for AdoQuest I, 1,801 (61%) participated at baseline. No data were collected on eligible students who did not participate. Table 1 presents a comparison of selected characteristics of the 1,801 participants with those of two provincially representative samples of similarly aged children [20,28]. The characteristics were similar, with the exception that AdoQuest participants had a higher SES (likely attributable to equal sampling in family deprivation groupings) and a higher proportion had tried smoking (13% vs. 11% and 10%). Among the 1,801 participants, 16 (1%) had missing data on smoking in fifth grade and an additional 232 participants (13%) who had already initiated smoking at baseline, were excluded from further analyses (Figure 1).

To assess attrition we compared selected characteristics of the 1,553 never smokers in fifth grade who did ($n = 1,071$; 69%) and did not ($n = 482$; 31%) provide data in 11th grade (see Table 2). Participants lost to follow-up by 11th grade were more likely than those retained to be male, have parents who smoked, be frequently exposed to smoking in cars, perceive their academic performance as above average, feel connected to school, watch TV 3 or more hours per day, and report that they felt like they really needed a cigarette.

The analytic sample for early adolescence included 1,221 fifth grade never smokers, of whom 133 (10.9%) initiated smoking by seventh grade (Figure 1). The analytic sample for middle adolescence included 737 seventh grade never smokers, of whom 207 (28.1%) initiated smoking. Finally, 690 ninth grade never smokers comprised the analytic sample for late adolescence, of whom 157 (22.8%) initiated smoking. Table 3 presents the proportion of participants at each age who initiated smoking according to the categories of exposures.

Table 4 presents the results of the multivariable analyses across age. Among the 18 risk factors investigated, 12 were stable and only two differed across age. Friends' smoking was a strong risk factor in early adolescence (odds ratio [95% CI] = 5.78 [3.90–8.58]) but lost potency in late adolescence (1.83 [1.31–2.57]). While depressive symptoms were a risk factor in early and middle adolescence (1.60 [1.26–2.02] and 1.92 [1.45–2.54], respectively), they were inversely associated with initiation in late adolescence (.76 [.58, 1.00]). Sex, TV viewing, and weight-related goals were not associated with initiation at any age. The following paragraphs provide more detail about the findings in each grouping of risk factors investigated.

Among sociodemographic factors, even within the three analytic samples that were stratified by age, age was statistically significantly associated with an increased odds of initiating smoking in early and middle adolescence. Each 1-month increase in age was associated with a 4%–5% increase in the odds of initiation. Having a university-educated mother was inversely related to initiation across adolescence, although statistically significant only in middle and late adolescence.

Most exposures related to smoking in the social environment were consistently associated with initiation. Father's smoking, a greater number of smokers in home, and more frequent exposure to smoking in cars were significant risk factors in all three age groups, while siblings' and friends' smoking were risk factors in early and late adolescence (they were not measured in middle adolescence). It is notable that the estimate for friends' smoking decreased significantly (i.e., the CIs do not overlap) between early and late adolescence. Mother's smoking and having no smoking ban at home were risk factors in early and middle adolescence but were not significant in late adolescence. Finally, smoking allowed at school was a risk factor in middle adolescence.

Both psychological characteristics were significantly associated with initiation. In early and middle adolescence depressive symptoms were a risk factor, but in late adolescence they were inversely related. School connectedness was protective at all three ages, although significant only in early and middle adolescence.

Of the three lifestyle indicators investigated, only the use of other tobacco products was statistically significantly and strongly related to an increased odds of initiation in all three age groups. Finally, both feeling like one really needs a cigarette and having strong cravings were risk factors for initiation in both early and late adolescence. Feeling like one really needs a cigarette was not assessed, and having strong cravings was not significant, in middle adolescence.

Discussion

Our study is unique in examining the importance of a wide range of established risk and protective factors for smoking initiation in early, middle, and late adolescence. Most factors were consistently related to initiation across the three age groups (i.e., the ORs were in the same direction and the CIs overlapped). The lack of differences in risk factors, if replicated in other samples, should reassure public health practitioners that prevention efforts targeting multiple risk factors should be robust throughout adolescence and may not need adjustment for the age of recipients.

That the potency of friends' smoking diminished notably by late adolescence might reflect several phenomena. First, younger adolescents in general are more vulnerable to influence from friends, and therefore from friends' smoking, than older adolescents [29].

Alternatively, because friends' smoking tends to become more prevalent over time during adolescence, it likely becomes less noteworthy and its influence may diminish. Finally, declining potency may also reflect "depletion of susceptibles" [30,31] whereby children most at risk drop out of the never smoker pool because they initiate cigarette use early on, leaving a subgroup of never smokers less vulnerable to friends' smoking. Whatever the explanation, these data align with most reports [6] that friends' smoking is a strong and consistent risk factor for initiation throughout adolescence but in addition demonstrate that the risk is inordinately high at younger ages.

The differential influence of depressive symptoms in early and middle adolescence compared with late adolescence might also reflect depletion of susceptibles. There may be two subgroups of children with early depressive symptoms. One subgroup turns to cigarettes in an attempt to cope with these symptoms, and most of these children may have already initiated smoking by late adolescence. The other subgroup includes children with depressive symptoms who do not use cigarettes to cope, thus resulting in the appearance of depressive symptoms being protective in later adolescence. Alternatively, the influence of depressive symptoms might depend on their frequency and intensity. The mean score for depressive symptoms increased substantially from 1.90 (SD = .66) in early and 1.80 (SD = .65) in middle adolescence to 4.06 (SD = .77) in late adolescence. It is conceivable that older adolescents who experience levels of depressive symptoms higher than their peers are also different in other ways that might impact their behaviors. More research is needed to define which of the possible underpinnings may be operative. Regardless of their relationship to smoking initiation, subclinical and diagnosable depressive symptoms among young people present risks for poorer outcomes during adolescence and adulthood [32–34] and should, therefore, prompt concern and intervention.

Despite being identified as risk factors for initiation in previous research [6,35], sex, TV viewing, and weight-related goals were not associated with initiation in AdoQuest. This may relate to methodological differences across these studies, although it is possible that risk factors do vary across populations or time. As increasingly widespread intense tobacco control legislation and intervention change social norms and access to tobacco products, monitoring will be needed to detect changes in the profile and strength of risk factors in different populations.

Our findings substantiate that a key focus of tobacco control interventions must be to eliminate smoking in the social environment. Likely because of its role in modeling smoking behavior and in exposing youth to secondhand smoke, smoking in the social environment is a strong and consistent risk factor for initiation across adolescence. It is critical that parents and future parents who smoke understand the effects that their smoking may have on their offspring to make informed decisions about their own smoking. It is also notable that the use of other tobacco products is a strong risk factor for cigarette smoking initiation across adolescence. In this study, we asked about the use of cigars, pipe tobacco, bidis, chewing tobacco, and snuff. Given the increasing popularity of other newer products, such as electronic cigarettes and hookah [36,37], public health practitioners and researchers need to reflect on whether these developments could result in a resurgence of cigarette smoking initiation.

Limitations

Limitations of this study include restriction of the study population to Francophones, which may limit generalizability of the findings. Data collection at school in fifth and sixth grade versus mailed questionnaires in high school, in addition to the use of self-report data, may have contributed to misclassification. Also, because we measured smoking initiation biannually in high school, we may not have captured the first few puffs, but rather identified initiators who had attained later milestones in the natural course of smoking onset. However, any misclassification in this study is likely to have been nondifferential because exposures were measured before the outcome [38] and because self-reports of smoking are typically reliable and valid [21]. We did not measure several risk factors in seventh grade and therefore could not assess the continuity of their influence across age groups. Finally, loss to follow-up may have resulted in selection bias.

Risk factors for cigarette smoking initiation were relatively stable across age during adolescence, so that youth tobacco control interventions may be robust for risk factors across age groups and may not need adjustment. The results strongly support that tobacco control interventions targeting youth at any age should focus on eliminating smoking in the social environment and reducing the availability of tobacco products.

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IMPLICATIONS AND CONTRIBUTION

Risk factors for smoking initiation were relatively stable across age throughout adolescence, obviating the need to tailor the risk factors targeted in tobacco control interventions for specific age groups. Interventions should focus on eliminating smoking in the social environment and reducing access to tobacco products.

Figure 1. Derivation of the analytic samples for initiation in early, middle, and late adolescence. Each sample was created by identifying never smokers from among participants who provided complete smoking data in the relevant cycles. Never smokers in earlier samples were retained in subsequent samples if complete outcome data were available.

Table 1

Comparison of baseline characteristics of AdoQuest participants with those of two provincially representative samples of similarly aged Quebec youths

	AdoQuest 2005 (n = 1,801)	Quebec Child and Adolescent Health and Social Survey 1999 ^a (n = 1,267)	Youth smoking survey 2004–2005 ^b (n = 851)
Age, mean (SD)	10.7 (.5)	9.4 (.3)	^c
Male, %	45.6	49.5	49.8
French speaking only, % yes	88.5	–	76.1
Two-parent family, %	73.8	72.6	–
Household income \$49,999	25.1	57.0	–
At least one parent with university degree, %	41.8	32.6	–
Hours of TV/day, mean (SD)	3.3 (.9)	2.7 (2.7)	2.5 (1.7)
Tried smoking cigarettes, %	12.9	10.7	9.9
Father smokes, % yes	26.3	–	23.0
Mother smokes, % yes	23.5	–	21.0

Percentages exclude missing data.

SD = standard deviation.

^aParadis G, Lambert M, O'Loughlin J, Lavallée C, Aubin J, Berthiaume P, et al. The Québec Child and Adolescent Health and Social Survey: Design and methods of a cardiovascular risk factor survey for youth. *Can J Cardiol* 2003;19(5):523–31.

^bElton-Marshall T, Leatherdale S, Manske S, Wong K, Ahmed R, Burkhalter R. Research methods of the youth smoking survey (YSS). *Health Promot Chronic Dis Prev Can* 2011;32(1):47–54.

^cGrade 5 (age 10–11 years).

Table 2

Comparison of selected characteristics of fifth grade never smokers who did/did not provide data in 11th grade, AdoQuest 2005–2011 (n = 1,553)

	Provided data in 11th grade		
	Yes, (n = 1,071)	No (n = 482)	p
Sociodemographic			
Male, %	42.0	48.6	.014
Age at baseline, mean (SD)	10.7	10.8	.020
Mother university educated, %	33.9	27.6	.153
French speaking, %	89.3	88.7	.979
Smoking in the social environment			
Father smokes, %	21.1	29.0	.001
Mother smokes, %	18.1	24.9	.002
Sibling(s) smoke, %	6.8	9.1	.114
Friends smoke, %	9.5	12.7	.063
Smoking allowed anywhere at home, %	57.7	53.9	.162
Two persons smoke at home, %	10.3	12.8	.092
3 days exposed to smoking in car in last week, %	12.3	19.6	.000
Psychological			
Perceived academic performance, % average	45.0	34.8	.000
Depressive symptoms, mean (SD)	1.9 (.68)	1.9 (.67)	.064
School connectedness, mean (SD)	1.7 (.54)	1.8 (.61)	.030
Lifestyle indicators			
Use other tobacco products, %	10.9	12.2	.461
TV 3 hours per day, % yes	36.5	42.0	.040
Weight goals (taking action), % yes	39.1	42.9	.190
Perceived need for cigarettes			
Really need a cigarette, % yes	1.2	3.2	.009
Crave cigarette, % yes	3.1	4.4	.232

SD = standard deviation.

Table 3

Proportion of participants who initiated smoking by early (seventh grade), middle (ninth grade), and late (11th grade) adolescence according to categories of exposures, AdoQuest 2005–2011

	<u>Early adolescence, n = 1,221</u>		<u>Middle adolescence, n = 737</u>		<u>Late adolescence, n = 690</u>	
	Total n ^a	% Initiated	Total n ^a	% Initiated	Total n ^a	% Initiated
Sociodemographic factors						
Sex						
Female	695	11.4	418	30.9	368	22.8
Male	526	10.3	319	24.5	322	22.7
Age, months						
1st tertile	90	7.7	221	25.3	214	28.5
2nd tertile	410	11.7	253	25.3	263	20.5
3rd tertile	396	11.9	249	32.9	201	19.4
Maternal education						
No university	679	12.1	452	31.4	406	26.1
University	299	7.0	254	21.3	249	18.1
Indicators of smoking in the social environment						
Father smokes ^b						
No	896	8.9	551	24.5	527	20.9
Yes	288	17.4	142	40.8	122	30.3
Mother smokes ^b						
No	946	8.5	582	24.9	544	21.3
Yes	246	20.7	116	43.1	106	30.2
Siblings smoke						
No	1,122	10.2	(not measured)		598	20.4
Yes	83	20.5			81	39.5
Friends smoke						
No	1,084	8.2	(not measured)		491	19.6
Yes	119	35.3			199	30.7
Home smoking rules						
Full ban	518	7.3	413	23.7	446	21.1
Partial ban	423	10.2	231	30.7	182	26.4
No ban	194	21.6	77	42.9	58	24.1
Number of smokers in the home						
0	796	7.3	564	24.1	558	21.9
1	234	16.2	102	33.3	82	19.5
2	168	19.6	64	53.1	46	41.3
Number of days in the past week exposed to smoking in cars						
0	914	8.1	607	25.9	548	20.4
1–2	142	13.4	84	28.6	91	28.6
3–4	59	25.4	27	55.6	34	41.2

	<u>Early adolescence, n = 1,221</u>		<u>Middle adolescence, n = 737</u>		<u>Late adolescence, n = 690</u>	
	Total n ^a	% Initiated	Total n ^a	% Initiated	Total n ^a	% Initiated
5–7	72	29.2	15	66.7	11	36.4
School smoking rules						
Ban	789	10.3	506	25.3	464	21.6
No ban	134	10.4	139	38.8	191	28.8
Do not know	243	14.4	82	23.2	30	6.7
Psychological characteristics						
Depressive symptoms						
1st tertile	439	8.2	243	19.8	243	26.7
2nd tertile	319	9.7	199	23.6	170	21.2
3rd tertile	422	14.5	275	38.5	259	19.7
School connectedness ^c						
1st	246	16.3	274	34.7	130	23.1
2nd	328	10.4	168	22.6	238	22.3
3rd	324	7.4	263	23.6	308	22.4
4th	268	10.8				
Lifestyle indicators						
Hours of TV per day						
<1	193	8.3	(not measured)		465	22.8
1–2	532	11.5			181	24.3
3–4	346	10.7			35	14.3
5	119	11.8			2	0.0
Use other tobacco products						
No	1,080	10.5	702	26.6	627	20.3
Yes	22	36.4	32	53.1	63	47.6
Weight-related goals						
No change	647	10.2	(not measured)		422	21.8
Lose	369	11.7			193	24.9
Gain	47	10.6			51	29.4
Perceived need for cigarettes						
Really need a cigarette						
No	1,099	10.0	(not measured)		669	22.1
Yes	23	43.5			12	58.3
Have strong cravings						
No	1,024	9.5	708	27.5	675	22.2
Yes	37	37.8	9	55.6	7	71.4

^aDenominators differ because of missing data.

^bMeasured in fifth and ninth grades.

^cSchool connectedness reported in quartiles in fifth grade and tertiles in seventh and ninth grades.

Table 4

Results of multivariate logistic regression analyses of predictors of initiation by early (grade 7), middle (grade 9), and late (grade 11) adolescence, AdoQuest 2005–2011

Predictor	Early adolescence, n = 1,221, AOR (95% CI) ^a	Middle adolescence, n = 737, AOR (95% CI) ^a	Late adolescence, n = 690, AOR (95% CI) ^a
Sociodemographic factors			
Sex			
Female	Ref	Ref	Ref
Male	.86 (.60–1.23)	.73 (.49–1.08)	1.02 (.71–1.44)
Age ^b	1.04 (1.00–1.08)	1.05 (1.01–1.09)	.98 (.96–1.01)
Maternal education			
No university	Ref	Ref	Ref
University	.61 (.37–1.03)	.65 (.48–.88)	.65 (.44–.96)
Indicators of smoking in the social environment			
Father smokes			
No	Ref	Ref	Ref
Yes	2.09 (1.38–3.15)	2.00 (1.49–2.75)	1.67 (1.22–2.29)
Mother smokes			
No	Ref	Ref	Ref
Yes	2.72 (1.96–3.77)	2.27 (1.56–3.31)	1.64 (.98–2.75)
Sibling(s) smoke			
No	Ref	(not measured)	Ref
Yes	2.22 (1.36–3.61)		2.62 (1.64–4.19)
Friends smoke			
No	Ref	(not measured)	Ref
Yes	5.78 (3.90–8.58)		1.83 (1.31–2.57)
Home smoking rules			
Full ban	Ref	Ref	Ref
Partial ban	1.51 (.90–2.52)	1.39 (.99–1.94)	1.37 (.84–2.24)
No ban	3.37 (2.05–5.52)	2.35 (1.44–3.86)	1.27 (.69–2.31)
Number of smokers in home ^c	1.75 (1.38–2.23)	1.76 (1.37–2.26)	1.39 (1.08–1.78)
Number of days in past week exposed to smoking in cars ^c	1.68 (1.39–2.04)	1.60 (1.30–1.97)	1.52 (1.15–1.99)
School smoking rules			
Banned	Ref	Ref	Ref
Allowed	.97 (.58–1.61)	1.96 (1.25–3.10)	1.45 (.96–2.18)
Do not know	.73 (.76–1.37)	.87 (.55–1.37)	.23 (.07–.81)
Psychosocial characteristics			
Depressive symptoms ^b	1.60 (1.26–2.02)	1.92 (1.45–2.54)	.76 (.58–1.00)
School connectedness ^b	.59 (.45–.78)	.64 (.48–.86)	.93 (.66–1.31)
Lifestyle indicators			
Hours of TV per week ^c	1.09 (.86–1.39)	(not measured)	.90 (.63–1.28)

Predictor	Early adolescence, n = 1,221, AOR (95% CI) ^a	Middle adolescence, n = 737, AOR (95% CI) ^a	Late adolescence, n = 690, AOR (95% CI) ^a
Use other tobacco products			
No	Ref	Ref	Ref
Yes	3.61 (1.37–9.49)	3.00 (1.47–6.09)	3.56 (2.24–5.67)
Weight-related goals			
No change	Ref	(not measured)	Ref
Lose	1.20 (.85–1.70)		1.19 (.81–1.77)
Gain	1.32 (.40–4.35)		1.43 (.62–3.30)
Perceived need for cigarettes			
Really need a cigarette			
No	No	(not measured)	Ref
Yes	5.66 (2.65–12.11)		5.03 (1.35–18.77)
Have strong cravings			
No	Ref	Ref	Ref
Yes	4.54 (2.12–9.76)	2.99 (.99–9.04)	5.56 (1.23–25.15)

ORs and 95% CIs in bold are statistically significant at $p < 0.05$.

AOR = adjusted odds ratio; CI = confidence interval.

^aAll multivariate analyses performed after imputing missing values. All models were adjusted for sex, age, and mother's education.

^bEntered as a continuous variable.

^cEntered as an ordinal variable.