
# Social Contexts of Regular Smoking in Adolescence:
## Towards a Multidimensional Ecological Model

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## Abstract

Using data from the Longitudinal Study of Adolescent Health (Add Health), this study investigates factors at the individual, family, peer, school, neighborhood, and state levels that are important for subsequent adolescent cigarette regular smoking after controlling for the baseline smoking behavior and individual characteristics. Our analysis shows that time spent with peers and smoking of significant others (i.e., peers and families) are associated with higher risk of an adolescent becoming a regular smoker. Protective factors that may mitigate or prevent adolescents from becoming regular smokers were closeness with parents, attending a private school, attending a school with strong concentration of Hispanic students, self-perceived fitting at school, and living in a neighborhood where neighbors watch out for one another. Because we controlled for the baseline smoking behavior and a wealth of individual factors, these associations may represent causal effects of social contexts on adolescent smoking as a risky behavior that can have a lifelong harmful impact. A take home message from this study is that social contexts are important for understanding individual smoking behavior in adolescence. An ecological model that incorporates overlapping and interacting social systems is more helpful than single-system models to reveal etiology of adolescent smoking. More studies are needed to implement these ecological models to study human behavior.

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## BACKGROUND

Adolescent smoking is an important health issue. Not only is nicotine one of the most addictive substances (Kandel and Merrick 2003) but approximately 80% of adults who use tobacco initiated cigarette smoking before age 18 years in the United States (Center of Disease Control and Prevention 2000). Although tobacco use may not be immediately life-threatening to adolescent smokers, cigarette smoking is a serious risk factor for poorer perceived health, mental problems, and a variety of physiological symptoms in later adulthood (Bjarnason et al. 2003). With more than one-third of high school students reporting smoking at least once a month and 17% reporting smoking a cigarette almost every day (U.S. Department of Health and Human Services 1996; U.S. Department of Health and Human Services 1998), regular teen cigarette smoking is a significant public health concern in our society (Center of Disease Control and Prevention 2000).

### Theoretical Perspectives

An extensive amount of research has theorized and tested numerous pathways linking social context to adolescent smoking behavior. The *social learning theories* emphasize the importance of learning process which includes social interactions with influential others such as parents, peers, schoolmates, and neighbors. As a result, adolescents are typically protected from smoking if the socializing agents discourage smoking and cigarettes are less accessible (Crawford 2001; Eisenberg and Forster 2003; Foshee and Bauman 1992; Kirby 2002; Ma et al. 2003).

The *socialization and social development theories* argue that in addition to the direct influence of influential agents' behavior, influential agents also affect the quality and content of the adolescent's socializing process. In this pathway, parental control, parent-child closeness, parent-child communication, and parental involvement in the child's daily life are all important factors exerting daily influences on child development; and indeed, these factors have been frequently linked to adolescent risk behavior including cigarette smoking (Barnes and Farrell 1992; Johnson and Hoffmann 2000; Kandel et al. 2004; Kirby 2002; Shakib et al. 2003).

Complementarily, the *socioeconomic resources perspectives* argue that low parental socioeconomic status (SES) puts adolescents at risk (Soteriades and DiFranza 2003; Thomson, Hanson and McLanahan 1994) while increased household income is protective, perhaps due to its linkage with parental education, positive parenting styles, and other advantaged life circumstances. Parental education is a protective factor against children's deviant behaviors because parental education is positively linked to parental expectations on children's academic achievement and it probably contributes to more constructive and efficient parenting styles.

In addition, the *social strain theories* maintain that exposure to stressors should be linked to increased smoking (An et al. 1999; Johnson and Hoffmann 2000). In this pathway, stressors including parental conflict and separation, as an additional feature of family processes and not necessarily related to family SES, can act as a stressor (Vandewater and Lansford 1998). These stressors have been positively linked to adolescent smoking likely through raising depressive symptoms and rebelliousness in adolescents (Kirby 2002). Another identified stressor is attending an academically

competitive school. The competitive school environment which maintains high school-level academic expectations is a marker of the school's competitiveness and can result in a stressful school environment (Johnson and Hoffmann 2000).

Clearly, these theories are not mutually exclusive and can be applied to more than one life domain. An individual's learning and socializing activities are not confined to family settings but routinely operationalized in all forms of social relationships. Resources available to the adolescent are not necessarily

**Significant Life Domains of Adolescents**

For a typical adolescent, family, peer, school, and neighborhood constitute the key life domains whereby they learn, socialize, and conduct daily activities. Each of these domains may exert unique impacts on adolescent behavior. Peer influence on adolescent well-being has been well documented (Adam and Chase-Lansdale 2002; Brook et al. 2003; Duncan, Duncan and Strycker 2002; Duncan et al. 1995; Gerard and Buehler 1999; Harris, Duncan and Boisjoly 2002; Kobus 2003). For example, research on the role of social influences found that teenagers who perceived high prevalence rates of smoking were at an increased risk of initiating this behavior (Botvin et al. 1992; Chassin et al. 1984; Sussman et al. 1994). And non-smokers are at greater risk for transitioning to tobacco use if they have smoking friends (Kobus 2003).

School environment is another important domain for adolescents. They spend so much time in school, and most of their social contacts and peer groups are established, connected, and maintained in school settings (Feld 1981). School climate may structure norms, views, beliefs, and values which inevitably impact individuals' exposure to deviant or positive behaviors and internalize normative standards by which teenagers gauge what

is common, socially acceptable, and of little or great consequence for their future (Harris, Duncan and Boisjoly 2002). For example, "school climate," reflected in aggregate academic expectations and smoking prevalence, exerts contextual effects on adolescent smoking, after controlling for individual-level confounders (Ellickson et al. 2003; Johnson and Hoffmann 2000).

Neighborhood environment is also a highly relevant social domain for adolescents who spend much of their after-school time in their local communities. Neighborhood quality is typically predictive of school cultural climate and academic performance. Poor neighborhoods deficient in social and economic resources lack capacity to maintain quality schools. Conversely, poor school quality may worsen neighborhood conditions when relatively better off residents who may have sufficient individual resources decide to move to better neighborhoods with better schools. Neighborhood environment may affect youth behaviors through other pathways as well. There is a rapidly expanding literature that addresses the relationship between place of residence and health and well-being (Kawachi and Berkman 2003). A small portion of this work is focused on youth development. Existing evidence generally points to the importance of neighborhood on youth development. For example, neighborhood contexts have been linked to youth alcohol and drug problems (Duncan, Duncan and Strycker 2002), propensity toward problem behaviors, including aggressive behavior (Kowaleski-Jones 2000), lower intelligence scores and problem behaviors (Brooks-Gunn et al. 1993), psychological problems (Aneshensel and Sucoff 1996), and crime and violence (Sampson, Morenoff and Raudenbush 2005). However, there is little evidence on the effects of neighborhood environment on adolescent smoking. As smoking (compared to diet for example) is a

visible behavior in the neighborhood particularly among adolescents, neighborhood context would have a real chance to have an impact (Ross 2000).

Moreover, policies related to tobacco consumption may also play a role in individual smoking behavior. For example, if a school has stringent rules against teacher and student smoking and has the means and determination to implement these rules, then students of that school may feel it less tempting to try smoking because of the consequential punishment. Similarly, if a state has resources to disseminate the health impact of smoking or has policies against cigarette vending machines accessible to minors, teenagers in that state may feel more discouraged to give smoking a try. How these policies, compared to more proximate factors such as individual and family characteristics, play a role in adolescent smoking is not well known. Nevertheless, it is possible that more proximate factors matter more for individual behaviors and outcomes, as shown in the vast literature of neighborhood contextual effects on health (Kawachi and Berkman 2003).

Indeed, other than the contextual factors, many individual factors have been found to be strong predictors of adolescent smoking (Kandel et al. 2004). For instance, poor school performance, low self-esteem, work for pay, and perceived physical maturity are positively associated with smoking (An et al. 1999; Carvajal et al. 2000; Resnick et al. 1997). In contrast, immigrant status has been shown to be strongly protective for both adults and adolescents against poor health practices including smoking.

**Multidimensional Ecological Model**

Although published studies regarding pathways and factors of adolescent smoking are numerous, few studies have simultaneously examined the impact of a wide range of risk or protective factors at multiple levels to adjudicate among different theories of the

causes of adolescent smoking. The reasons an adolescent chooses to engage in smoking are multifactorial. As has been argued previously (Bronfenbrenner 1979; Kawachi and Berkman 2003; Susser 1994; Susser 1994; Wilcox 2003), we need to recognize and analyze the contributions of overlapping and interacting contexts and explore a multidimensional ecological model of health and behavior while taking various social settings into account. A central premise of this ecological model, readily accepted in developmental psychology, is that individuals can not be studied without a consideration of the multiple ecological systems in which they operate (Brooks-Gunn et al. 1993).

Using a nationally representative longitudinal sample of adolescents, this study aims to investigate factors at the individual, family, peer, school, neighborhood, and state levels that are important for adolescent cigarette smoking. In essence, we attempt to identify a fuller model of adolescent regular smoking that incorporates factors across all key life domains of a typical adolescent.

## METHOD

### Data

We used data from waves 1 and 2 of the National Longitudinal Study of Adolescent Health (Add Health). More detailed information on the Add Health has been published elsewhere (Harris et al. 2003; Resnick et al. 1997; Udry 2003). Briefly, the sampling frame consists of all high schools in the United States with an enrollment of over 30 students and the junior high and middle schools that sent their graduates to those high schools in the 1994-1995 school year. From this frame, 134 schools (80 high schools and 54 middle or junior high schools) were selected to be in the Add Health sample. Using appropriate sample weights, 18,924 students from these schools make up a representative

sample of adolescents enrolled in the seventh through twelfth grades in the United States. Approximately one year after the first interview, members of the original sample who had not yet graduated were reinterviewed. Students completed 14,738 surveys, and sample weights could be constructed for 13,570. This study uses data for adolescents who completed both waves of the survey. After imputing missing values for explanatory variables (see the imputation method below), we have 13,552 cases for our analysis.

**Dependent variable**

The dependent variable was measured at wave II in 1996. We used a dichotomous measure of regular smoking. Responses were coded 1 if they ever smoked at least 1 cigarette every day for 30 days by wave II.

**Independent variable**

All independent variables were measured at wave I in 1994. We studied a variety of social context variables at the individual, peer, parental, family, school, neighborhood, and state levels as described below. The Appendix provides detailed description of all the measures used in this study. Table 1 illustrates sample statistics of a selected set of variables.

*Individual level*

Individual demographic and baseline measures controlled in the analyses include age, sex, ethnic/racial background, immigrant status, self-perceived physical maturity, average grade in math and English, self-perceived intelligence, self-esteem, work hours per week, earnings per week during the school year, and weekly allowance. Additionally, we controlled for reported smoking behavior at wave I (ever smoked at least 1 cigarette

every day for 30 days by wave I) to adjust for its relationship to smoking behavior at wave II.

*Peer level*

Measures of peer influence factors include how frequently the adolescent spends time with their three best friends during the week, and how many of their three best friends smoke[1].

*Parent or family level*

Corresponding to the guiding theories of adolescent behavior, we include measures of family SES (i.e., household income, parent's education), family structure (intact vs. nonintact), household members' smoking, the mother's expectations for the adolescent regarding educational attainment, parental conflicts, parental control, parent-child closeness, parent-child communication, and an item indicating how many days per week the parent has dinner with the adolescent as a proxy for parental involvement in the adolescent's life.

*School Level*

Measures related to the school context are reported by the school administrator, by the adolescent, and collected by Add Health investigators from public sources. These measures include urbanicity of the school (urban, suburban, or rural), whether the school is private or public, percent of Hispanic, black, and Asian students attending the school, percent of students who expect to go to college (as a proxy for average school academic aspiration), a school average student smoking rate, an average score of students' rating on how well they get along with teachers and other students at their school, an average score of students' rating on how well the adolescent feels that they fit in at school, percent of

students smoking, percent of teachers that smoke at school, whether or not the school has a no smoking policy for the teachers, whether or not the school has a no smoking policy for the students, and severity of punishment for a violation of the no smoking policy.

*Neighborhood Level*

Neighborhood variables include both Census-based measures of neighborhood SES and self-perceived neighborhood environment. We include neighborhood median household income and percent of residents age 25 or above with college degree as measures of neighborhood SES. Perceived measures tap neighborhood social capital (i.e., neighbors watch out for each other), attachment (i.e., happy to live in the neighborhood), and use of a recreation center in the neighborhood as a proxy for neighborhood physical condition.

*State Level*

State level variables include the percent of people who smoke in the state, state restrictions on cigarette vending machines accessible to minors, whether the state has marketing restrictions for tobacco, and whether the state has a program for the dissemination of information about tobacco.

**Imputation for missing values**

To prevent the false loss of data, missing independent variable values were imputed using IVEware (Raghunathan et al. 2001). Rather than falsely cause a reduction in standard error estimates using mean substitution, IVEware uses regression imputation where imputed values are sampled from their appropriate sampling distributions. For example, binary variables are sampled from the binomial distribution, and count variables

are sampled from the Poisson distribution. The complete code of imputation is available upon request[2]. Cases missing the dependent variable were dropped.

**Statistical modeling**

Weighted logistic regression models were fit to test the risk or protective factors related to adolescent regular smoking. The modeling method has taken the complex survey design into account, generating findings that are nationally representative of adolescents in the US between 1994 and 1996. Because the primary sampling unit is the school, we used robust standard errors to control for intra-school correlations.

**RESULTS**

Table 1 selectively presents sample statistics of several variables. About 18% and 20% of students smoked at least 1 cigarette every day for 30 days in wave I (1994) and wave II (1996) respectively. These figures are close to other national estimates of adolescent regular smoking (U.S. Department of Health and Human Services 1996; U.S. Department of Health and Human Services 1998). We have a roughly balanced sample of males and females. In addition, about half of the sample is white, 27% of respondents are foreign-born, 23% of students have parents who graduated from college, and 40% of respondents have at least one household member smoking.

Table 2 tests how individual, peer, and parent or family characteristics contribute to the likelihood of adolescent regular smoking, after controlling for the baseline smoking behavior which has been routinely reported as the most powerful predictor of subsequent smoking behavior (Ellickson et al. 2003). Model 2.1 (Table 2, Model 1) includes demographics and individual-level variables that have been previously reported as salient predictors of adolescent risky behavior. Except for length of living in current residence,

all of these variables are significant in this model. We find that girls are more likely than boys to smoke; white adolescents are more likely to smoke than black, Asians/Pacific Islander, and Hispanic adolescents; and US born adolescents are more likely than the foreign born to smoke. Self-perceived physical maturity, earnings and allowance increase smoking, whereas higher grade-point-average (GPA) and self worth protects against smoking. Model 2.2 adds peer characteristics to the model. Adolescents who spend time with peers more frequently and who have close friends who smoke are more likely to take up the smoking habit and become regular smokers. Model 2.3 adds family structure and SES variables. Unexpectedly, neither the family structure nor the SES variables exert prospective effect on regular smoking. Model 2.4 adds additional measures of parent or family characteristics, testing family-level models of adolescent smoking. Family members' smoking is significantly associated with higher likelihood of adolescent smoking, and parent-child closeness is highly protective against adolescent regular smoking, after controlling for individual-level key predictors. Model 2.5 thus provides the model that includes the significant predictors at the individual, peer, parent or family levels.

The first model in Table 3, Model 3.1, adds school demographics to Model 2.5. School urbanicity has no effect on adolescents' regular smoking. However, attending a private school and having a higher percentage of Hispanic students at school is significantly protective. Model 3.2 tests the additional effect of school academic climate. Neither percent of students who expected to go to college nor school attendance rate exhibits significant effects on adolescent smoking behavior. Model 3.3 tests the effects of school social capital and smoking prevalence and shows that self-perceived fitting at

school (e.g. feel comfortable at school, get along well with other students and teachers at school, etc.) has a protective effect on smoking, but percent of students who smoke or teachers' smoking at school does not affect adolescent smoking in the presence of other variables. Model 3.4 shows that school policies related to cigarette consumption do not offer additional help to curb adolescent smoking. Model 3.5, the last model in Table 3, thus presents the final model that includes all significant predictors from the individual level to the school level.

Table 4 examines the additional effects of neighborhood characteristics. Perceived neighborhood social capital, measured by neighbors' watching out for one another is a protective factor over and above risk or protective factors of other life domains. None of the other three neighborhood variables is a salient predictor of regular smoking in adolescence.

Lastly, Table 5 presents results of examining the effects of state-level factors in addition to the impacts of more proximate factors. These higher level contextual factors are not significant after controlling for previously found significant predictors of smoking. Thus, the series of modeling, aimed to identify a fuller model of adolescent smoking, results in Model 4.3 (Model 3, Table 4) as the most parsimonious and effective model including key predictors of adolescent regular smoking across individual-, peer-, family-, school-, and neighborhood-levels.

In summary, according to Model 4.3, girls are 21% more likely than boys to smoke; blacks are 125% less likely than whites to be regular smokers; every $100 more earnings per week is associated with 11% higher risk of smoking[3]; one level higher in frequency of hanging out with friends corresponds to 24% higher risk; one more close friend smoking

leads to 74% higher risk; having a household member smoking increases risk by 48%; a level higher in parent-child closeness corresponds to 1% lower risk of smoking; attending a private school makes it 34% less likely to smoke; 20% higher in Hispanic population is associated with 28% lower risk[4]; one unit higher in the level of self-perceived fitting at school are associated with 2% reduction in the risk of smoking; and lastly, one level higher in neighborhood social capital decreases 17% of the subsequent smoking in adolescence.

## DISCUSSION

A large body of published studies on the factors of adolescent risk behaviors including smoking are available, however there is a paucity of research that has simultaneously examined the impact of a wide range of risk or protective factors at multiple life domains to adjudicate among different theories about the causes and pathways of adolescent risk behaviors. A unique contribution of this study is to implement a multidimensional ecological model, testing the relative contributions of overlapping social contexts of adolescent smoking, and identifying a fuller model explaining the etiology of adolescent regular smoking.

Setting out from this ecological perspective, guided by previously developed theoretical frameworks, we tested an unusually large number of covariates as potential risk or protective factors of adolescent regular smoking. As expected, we found peer, family, school, and neighborhood are all important life domains exerting significant impacts on subsequent regular smoking after controlling for the baseline smoking behavior. This result points to the need of continued expansion of the explanatory

variables measured in empirical works to advance our understanding of how social contexts contribute to adolescent development (Brooks-Gunn et al. 1995).

Among the four aforementioned theoretical frameworks of adolescent behavior, this research strongly supports the social learning perspectives. Our study found that both peer and household members' smoking were significant predictors of adolescent regular smoking, and their effects were independent of each other. By contrast, school-level and state-level prevalence of smoking were not significant factors. It is plausible that only the most influential social agents' behaviors matter for adolescents' behavior. Close friends and household members typically constitute the most accessible behavioral models of an adolescent and weaker ties may play less a role in influencing youth behavior. In this vein, because the less direct effects of more remote socializing agents, such as loosely connected neighbors or schoolmates, objective prevalence of smoking of broader social contexts may be less effective in shaping behaviors than perceived prevalence of smoking. In fact, one study recently showed that actual school-level prevalence of smoking did not predict individuals' subsequent smoking whereas perceived prevalence of smoking was associated with increased risk of smoking (Ellickson et al. 2003). The authors argued that their findings supported the significance of the selected environment (peer cigarette use) and the constructed environment (perceived school prevalence of smoking) but pointed to a weaker effect of the imposed environment (school-level actual prevalence of smoking). Our research did not distinguish the actual environment from the perceived, but we did touch the distinction between the selected environment versus the imposed environment. While we found that peer (selective environment) smoking was more important than school-level actual prevalence of smoking (imposed environment), a result consistent with

the Ellickson and colleagues' study (2000), we also found that family member (imposed environment) smoking was one of the strongest predictors of adolescent smoking. So perhaps it matters less whether the environment is selected or imposed than whether the ties are close enough to exert a real influence on the adolescent's behavior. In addition, cigarette smoking of close friends and family members also makes it immediately easier for adolescents to access cigarettes.

The measure of frequency of hanging out with friends taps the extent to which the adolescent is attached to his/her peer groups. Although higher frequency may signal the popularity of the adolescent and abundant social support he or she may receive from the peers of the same age, our data showed that this peer behavior proved a risk factor of regular smoking in adolescence. This finding may speak to the potential downside of social capital. Although the evidence of protective effect of social capital is mounting (Kawachi and Berkman 2000; Putnam 2000), it is becoming widely accepted that social capital is neither an unqualified social good nor a panacea and at times it can be harmful (Kawachi and Berkman 2000; Kawachi and Berkman 2001; Portes 1998; Portes and Landolt 1996; Woolcock 1998). In fact, it is not difficult to imagine the downside of social capital, including its coercive aspects, the inhibition of individual expression and freedom, and the situations where social capital of the group (e.g., criminal gangs) may provide resources for its members but meanwhile be disruptive of social cohesion of the larger community. How exactly these processes unfold in real settings of peer interaction that matters to adolescent behavior and development is largely unknown and warrants further investigation.

Also related to the social capital theory, the socialization and social development theories, often applied to family settings, were tested and supported as well. We found that parent-child closeness was strongly protective against adolescent regular smoking. By contrast, other parenting styles and parental academic expectations do not make a difference in subsequent adolescent regular smoking. From a family perspective, therefore, it seems that to reduce adolescent smoking the most effective way would be to eliminate or reduce adult smoking in the family and boost parent-child bonding. A neighborhood-level social capital measure, neighborly watching out for one another, also exhibited strong protective impact, net of the effects of all other proven predictors of smoking in adolescence. The conflicting effects of social capital, lodged in different life settings (i.e., peer, family, neighborhood), suggest the need to investigate relative contribution of social capital of different yet overlapping life domains to adolescent risk behavior. To our knowledge, few published articles have addressed this question.

The other two theories that motivated this study are the socioeconomic resource perspectives and the social strain theories. Despite intuitively appealing, these theories failed to predict adolescent subsequent smoking after controlling for sociodemographic factors, peer and family smoking, and baseline smoking behavior. Neither parental education nor household or neighborhood income showed any effect. In fact, weekly earnings are positively related to smoking behavior, a finding consistent with previous evidence that adolescent disposable income is a risk factor of smoking (Soteriades and DiFranza 2003) but contradictory to what the socioeconomic resource perspectives would predict. That is, it seems that adolescents smoke not because they lack money but because, in part, their disposable income allows them to afford cigarettes.

We tested the social strain theory by examining the effects of parental conflicts, school competitiveness, and neighborhood poverty. Contrary to what have been previously reported (Chuang et al. 2005; Johnson and Hoffmann 2000; Vandewater and Lansford 1998), we did not find evidence that adolescents smoke out of stress due to, say, parental conflicts, attending a school that is academically too competitive, or living in a neighborhood that is highly deprived. One possible reason why these factors did not show effects in this study compared to previous studies is that we have simultaneously examined a wider spectrum of explanatory factors some of which are either stronger predictors of smoking or mediators of effects of social stressors. On the other hand, the social strain variables we used can at best indirectly tap stress exposure among adolescents. Given that stress has been consistently linked to a wide range of health-related outcomes (Thoits 1995), more studies are needed to better capture stress exposure and vulnerability and their impacts on smoking among adolescents to further explore the social strain theory.

The last and most broad context we tested is state-level policies regarding cigarette consumption. These policies do not seem to affect individual smoking behavior. However, we only examined a limited number of policies and other policies may have stronger effects. For example, as earlier ecological data from Canada showed, the relationship between alcohol price and consumption was very close, and as price fell consumption rose (Seeley 1960). Similar trends may be observed for cigarette consumption. On the other hand, findings from a recent study suggested that state-level higher cigarette excise taxes did not seem effective in checking the initiation of smoking among adolescents (DeCicca, Kenkel and Mathios 2002). Perhaps the effects of more

macro-level policies—by nature an ecological concept—are more readily manifested in aggregate patterns, making ecological design a sensible choice for analyzing policy impacts.

The research found several patterns that are not easily explainable. Racial difference in adolescent regular smoking needs to be investigated. Obviously, it is not because whites are more deprived than blacks that they are more likely to smoke. The traditional models that explain racial/ethnic disparities in health-related health outcomes do not seem to apply in this case considering that white adolescents on average are more resourceful than black adolescents at least in terms of economic resources. The protective effect of the concentration of Hispanic students is also intriguing, especially given that this effect is independent of school prevalence of smoking and individual immigrant status. Future investigations are needed to explore these issues.

This work is not without limitation. Despite the longitudinal design of this study, it is still possible that peers are formed based on common interests and habits, so it may well be the tendency to smoke that forms peer groups not the other way around. Perhaps both pathways are operating, however; that is, peers are formed based on traits and traits of peers are also affecting other peers. Future work is needed to sort out these dual directional pathways.

Our neighborhood measures may not be as rich as used in some studies focusing on neighborhood effects, as neighborhood measures are limited in the Add Health. We used one item, neighborly watching out for one another, to tap neighborhood social capital, and we found significant effect of this measure on adolescent smoking. All other neighborhood variables were not significant (we have tested all the available data on

neighborhood contexts). Alternative neighborhood measures, such as those tapping subcultural orientation (Wen and Christakis 2006), may exhibit stronger neighborhood effects. None the less, it is also possible that neighborhood effects are just weaker for adolescent smoking, although they may be salient to other individual health and behavioral outcomes (Cagney, Browning and Wen 2005; Haan, Kaplan and Camacho 1987; Ross 2000; Sampson, Morenoff and Gannon-Rowley 2002; Wen, Browning and Cagney 2003; Wen, Cagney and Christakis 2005). How neighborhood contexts affect adolescent behavior including smoking has not been thoroughly examined (Ross 2000), a question that warrants more attention in the future.

That being said, our findings provide longitudinal and nationally representative evidence of the importance of a host of social factors and pathways to adolescent smoking. As far as we know, this is the first attempt of fitting a fuller comprehensive ecological model of adolescent regular smoking in a longitudinal setting, using large-scale national data. The incredibly rich information on adolescent well-being and social settings provided by the Add Health affords an excellent opportunity of testing such a model. Controlling for individual characteristics, our study shows that frequent hanging out with peers and smoking of significant others (i.e., peers and families) are closely associated with higher risk of smoking. Meanwhile, closeness with parents, attending a private school, attending a school with strong concentration of Hispanic students, a sense of fitting in and belonging at school, and living in a neighborhood where neighborhood watch out for one another are all factors preventing adolescents from becoming regular smokers. Because we have controlled for the baseline smoking behavior along with a wealth of individual factors, these associations may possibly represent causal effects of

social contexts on adolescent smoking as a risky behavior that can have a lifelong harmful impact. Nevertheless, the causality issue can never be settled without an appropriate experimental design.

A take home message from this study is that social contexts at the peer-, family-, school-, and neighborhood-levels are important for understanding individual smoking behavior in adolescence. A multidimensional ecological model that incorporates overlapping and interacting social systems is more helpful than single-system models to reveal etiology of adolescent smoking. More studies are needed to implement these ecological models to study human behavior. For now, the most significant contextual factors seem to be the behaviors of significant or admired others (peer or family member smoking) and the relational assets or deficits in the family (closeness with parents), among peers (frequency of hanging out with friends), at school (perceived fitting well at school), or in the neighborhood (neighborly watching out for one another). Different forms of social capital could thus be possible entry points of fruitful interventions tackling adolescent smoking.

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**Table 1: Sample Statistics of Selected Variables**

| | | Frequency | Percent |
|---|---|---|---|
| **Regular smoker at wave I** | | | |
| | No | 11055 | 81.6 |
| | Yes | 2497 | 18.4 |
| **Regular smoker at wave II** | | | |
| | No | 10825 | 79.9 |
| | Yes | 2727 | 20.1 |
| **Sex** | | | |
| | Male | 6961 | 51.4 |
| | Female | 6591 | 48.6 |
| **Race/Ethnicity** | | | |
| | White | 7283 | 53.7 |
| | Black | 2866 | 21.2 |
| | Am. Indian | 136 | 1.0 |
| | Asian/Islander | 916 | 6.8 |
| | Hispanic | 2183 | 16.1 |
| | Other | 168 | 1.2 |
| **US born** | | | |
| | No | 3614 | 26.7 |
| | Yes | 9938 | 73.3 |
| **Number of best friends that smoke** | | | |
| | 0 | 7669 | 56.6 |
| | 1 | 2775 | 20.5 |
| | 2 | 1539 | 11.4 |
| | 3 | 1569 | 11.6 |
| **At least one household member smokes** | | | |
| | No | 8197 | 60.5 |
| | Yes | 5355 | 39.5 |
| **Parent education** | | | |
| | Less than High School | 2252 | 16.6 |
| | High School or equivalent | 4306 | 31.8 |
| | Some college | 3896 | 28.8 |
| | College graduate | 1856 | 13.7 |
| | Post graduate | 1242 | 9.2 |
| | **Median** | **Min** | **Max** |
| **Age** | 15 | 11 | 21 |

N=13,552

**Table 2: Logistic Regression of Individual, Peer, and Parent or Family Characteristics on Adolescent Regular Smoking**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Regular smoking at | 17.012*** | 9.972*** | 9.983*** | 9.594*** | 9.766*** |
| Wave I | (14.535 - 19.912) | (8.476 - 11.732) | (8.481 - 11.751) | (8.144 - 11.303) | (8.324 - 11.458) |
| Age | 1.047** | 1.019 | 1.021 | 1.011 | 1.011 |
| | (1.003 - 1.093) | (0.975 - 1.066) | (0.977 - 1.067) | (0.965 - 1.060) | (0.967 - 1.057) |
| Sex | 0.862* | 0.831** | 0.822** | 0.839** | 0.825** |
| | (0.741 - 1.002) | (0.710 - 0.972) | (0.705 - 0.960) | (0.717 - 0.983) | (0.704 - 0.966) |
| Black | 0.387*** | 0.438*** | 0.423*** | 0.458*** | 0.432*** |
| | (0.301 - 0.498) | (0.339 - 0.565) | (0.328 - 0.546) | (0.356 - 0.588) | (0.335 - 0.556) |
| American Indian | 0.983 | 0.932 | 0.926 | 1.012 | 0.948 |
| | (0.556 - 1.740) | (0.496 - 1.753) | (0.499 - 1.720) | (0.538 - 1.906) | (0.504 - 1.785) |
| Asian/Pacific Islander | 0.614*** | 0.686** | 0.708** | 0.788 | 0.704** |
| | (0.445 - 0.846) | (0.502 - 0.936) | (0.518 - 0.969) | (0.588 - 1.057) | (0.533 - 0.931) |
| Other | 0.729** | 0.790* | 0.781* | 0.844 | 0.814 |
| | (0.565 - 0.941) | (0.614 - 1.018) | (0.606 - 1.008) | (0.657 - 1.086) | (0.632 - 1.049) |
| Hispanic | 0.932 | 1.020 | 1.009 | 1.065 | 0.996 |
| | (0.402 - 2.161) | (0.430 - 2.420) | (0.423 - 2.403) | (0.442 - 2.564) | (0.414 - 2.395) |
| US_born | 1.285** | 1.222* | 1.192* | 1.179 | |
| | (1.035 - 1.596) | (0.998 - 1.497) | (0.974 - 1.460) | (0.968 - 1.437) | |
| Residential tenure | 1.000 | | | | |
| | (0.982 - 1.018) | | | | |
| Physical maturity | 1.152*** | 1.130*** | 1.130*** | 1.123*** | |
| | (1.077 - 1.232) | (1.058 - 1.207) | (1.058 - 1.206) | (1.051 - 1.200) | |
| Average grade of math | 0.752*** | 0.811*** | 0.816*** | 0.829*** | 0.805*** |
| and English | (0.684 - 0.828) | (0.736 - 0.893) | (0.741 - 0.898) | (0.752 - 0.913) | (0.737 - 0.880) |
| Self-perceived | 0.893*** | 0.913** | 0.911** | 0.918** | |
| intelligence | (0.828 - 0.963) | (0.846 - 0.984) | (0.842 - 0.985) | (0.849 - 0.992) | |
| Self-esteem | 0.857** | 0.909 | | | |
| | (0.754 - 0.974) | (0.806 - 1.025) | | | |
| Hours worked per week | 1.006 | | | | |
| | (0.997 - 1.015) | | | | |
| Earnings per week | 1.001* | 1.002** | 1.001** | 1.001** | 1.001** |
| | (1.000 - 1.003) | (1.000 - 1.003) | (1.000 - 1.003) | (1.000 - 1.002) | (1.000 - 1.003) |
| Allowances per week | 1.008** | 1.006 | | | |
| | (1.000 - 1.016) | (0.998 - 1.014) | | | |
| Frequency of hanging out | | 1.237*** | 1.238*** | 1.237*** | 1.242*** |
| with friends | | (1.133 - 1.350) | (1.136 - 1.350) | (1.133 - 1.350) | (1.139 - 1.355) |
| Peer smoking | | 1.797*** | 1.795*** | 1.762*** | 1.777*** |
| | | (1.677 - 1.925) | (1.673 - 1.925) | (1.644 - 1.888) | (1.656 - 1.907) |
| Family structure | | | 0.898 | | |
| (intact vs. non-intact) | | | (0.770 - 1.046) | | |
| Household income | | | 0.999 | | |
| | | | (0.998 - 1.001) | | |
| Parental education | | | 0.938 | | |
| | | | (0.814 - 1.081) | | |
| Family members' smoking | | | | 1.502*** | 1.537*** |
| | | | | (1.290 - 1.749) | (1.323 - 1.786) |
| Mother's educational | | | | 0.977 | |
| expectations | | | | (0.920 - 1.038) | |
| Parental conflicts | | | | 1.058 | |
| | | | | (0.967 - 1.158) | |

| | | | | | |
|---|---|---|---|---|---|
| Parental control | | | | 1.027 | |
| | | | | (0.981 - 1.076) | |
| Parent-child closeness | | | | 0.985** | 0.983*** |
| | | | | (0.971 - 0.998) | (0.973 - 0.993) |
| Frequency of parent-child | | | | 1.022 | |
| having dinner together | | | | (0.869 - 1.202) | |
| Parent-child communication | | | | 0.979 | |
| | | | | (0.914 - 1.049) | |

N=13,552
Odds rations are presented with 95% confidence intervals in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

**Table 3: Logistic Regression of Additional School Characteristics on Adolescent Regular Smoking**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Regular smoking at wave I | 9.767*** | 9.763*** | 9.484*** | 9.543*** | 9.527*** |
| | (8.324 - 11.459) | (8.316 - 11.460) | (8.086 - 11.122) | (8.134 - 11.195) | (8.124 - 11.173) |
| Age | 1.006 | 1.007 | 1.000 | 1.012 | 1.009 |
| | (0.961 - 1.052) | (0.962 - 1.054) | (0.950 - 1.052) | (0.966 - 1.059) | (0.965 - 1.055) |
| Sex | 0.831** | 0.829** | 0.824** | 0.823** | 0.825** |
| | (0.709 - 0.973) | (0.708 - 0.971) | (0.702 - 0.968) | (0.701 - 0.966) | (0.704 - 0.967) |
| Black | 0.484*** | 0.459*** | 0.451*** | 0.442*** | 0.445*** |
| | (0.347 - 0.677) | (0.358 - 0.590) | (0.350 - 0.581) | (0.346 - 0.566) | (0.346 - 0.572) |
| American Indian | 1.178 | 1.180 | 1.142 | 1.131 | 1.145 |
| | (0.541 - 2.566) | (0.531 - 2.624) | (0.518 - 2.517) | (0.514 - 2.485) | (0.513 - 2.558) |
| Asian/Pacific Islander | 0.861 | 0.878 | 0.906 | 0.892 | 0.891 |
| | (0.586 - 1.264) | (0.642 - 1.201) | (0.668 - 1.228) | (0.653 - 1.218) | (0.656 - 1.212) |
| Other | 1.196 | 1.187 | 1.216 | 1.214 | 1.207 |
| | (0.862 - 1.659) | (0.856 - 1.646) | (0.881 - 1.677) | (0.880 - 1.675) | (0.874 - 1.666) |
| Hispanic | 1.170 | 1.176 | 1.155 | 1.144 | 1.142 |
| | (0.464 - 2.951) | (0.472 - 2.931) | (0.457 - 2.917) | (0.452 - 2.896) | (0.453 - 2.879) |
| Average grade of math and English | 0.808*** | 0.808*** | 0.825*** | 0.823*** | 0.824*** |
| | (0.740 - 0.882) | (0.739 - 0.882) | (0.753 - 0.903) | (0.752 - 0.901) | (0.754 - 0.902) |
| Earnings per week | 1.001** | 1.001** | 1.001** | 1.001** | 1.001** |
| | (1.000 - 1.003) | (1.000 - 1.003) | (1.000 - 1.003) | (1.000 - 1.003) | (1.000 - 1.003) |
| Frequency of hanging out | 1.239*** | 1.239*** | 1.239*** | 1.240*** | 1.240*** |
| with friends | (1.135 - 1.352) | (1.135 - 1.352) | (1.136 - 1.352) | (1.137 - 1.353) | (1.136 - 1.352) |
| Peer smoking | 1.771*** | 1.773*** | 1.740*** | 1.743*** | 1.746*** |
| | (1.651 - 1.899) | (1.651 - 1.903) | (1.623 - 1.865) | (1.625 - 1.870) | (1.627 - 1.872) |
| Family members' smoking | 1.510*** | 1.517*** | 1.506*** | 1.502*** | 1.506*** |
| | (1.298 - 1.757) | (1.306 - 1.762) | (1.294 - 1.753) | (1.290 - 1.750) | (1.295 - 1.751) |
| Parent-child closeness | 0.982*** | 0.982*** | 0.985*** | 0.985*** | 0.986*** |
| | (0.972 - 0.993) | (0.972 - 0.992) | (0.975 - 0.996) | (0.975 - 0.996) | (0.975 - 0.996) |
| Suburban[a] | 1.050 | | | | |
| | (0.850 - 1.297) | | | | |
| Rural[a] | 1.001 | | | | |
| | (0.782 - 1.282) | | | | |
| Private school[b] | 0.729** | 0.689** | 0.763* | 0.756* | 0.746* |
| | (0.534 - 0.995) | (0.501 - 0.948) | (0.560 - 1.039) | (0.558 - 1.024) | (0.545 - 1.022) |
| Percent of Hispanic students | 0.305*** | 0.317*** | 0.304*** | 0.294*** | 0.283*** |
| | (0.167 - 0.557) | (0.177 - 0.569) | (0.175 - 0.529) | (0.170 - 0.506) | (0.163 - 0.491) |
| Percent of Black students | 0.842 | | | | |
| | (0.546 - 1.298) | | | | |
| Percent of Asian students | 1.088 | | | | |
| | (0.466 - 2.536) | | | | |
| Percent of students who expect to go to college | | 1.459 | | | |
| | | (0.506 - 4.208) | | | |
| School attendance rate | | 1.009 | | | |
| | | (0.923 - 1.103) | | | |
| People get along in school[c] | | | 0.987 | | |
| | | | (0.936 - 1.041) | | |
| Self-perceived fitting at school[d] | | | 0.978*** | 0.977*** | 0.978*** |
| | | | (0.963 - 0.993) | (0.962 - 0.993) | (0.962 - 0.993) |
| Percent of students smoking | | | 1.398 | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | (0.640 - 3.051) | | |
| Percent of teachers smoking | | | 1.003 | | |
| | | | (0.992 - 1.014) | | |
| Policy against teacher smoking | | | | 0.932 | |
| | | | | (0.794 - 1.094) | |
| Policy against student smoking | | | | 1.017 | |
| | | | | (0.632 - 1.639) | |
| Severe punishment for smoking | | | | 1.035 | |
| | | | | (0.958 - 1.118) | |

N=13,552
Odds ratios are presented with 95% confidence intervals in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
a. urban=reference group
b. public school=reference group
c. An average score for each school on how well students at the school feel they get along with their teachers and other students at school.
d. An average score for each school on the extent to which students feel they fit in at school.

## Table 4: Logistic Regression of Additional Neighborhood Characteristics on Adolescent Regular Smoking

| | (1) | (2) | (3) |
|---|---|---|---|
| Regular smoking at Wave I | 9.509*** | 9.577*** | **9.577*** ** |
| | (8.108 - 11.152) | (8.177 - 11.217) | **(8.180 - 11.214)** |
| Age | 1.008 | 1.009 | **1.009** |
| | (0.964 - 1.055) | (0.965 - 1.055) | **(0.965 - 1.056)** |
| Sex | 0.825** | 0.833** | **0.829** ** |
| | (0.704 - 0.967) | (0.709 - 0.978) | **(0.706 - 0.973)** |
| Black | 0.458*** | 0.452*** | **0.445*** ** |
| | (0.357 - 0.589) | (0.351 - 0.582) | **(0.346 - 0.573)** |
| American Indian | 1.162 | 1.150 | **1.148** |
| | (0.513 - 2.633) | (0.515 - 2.566) | **(0.513 - 2.571)** |
| Asian/Pacific Islander | 0.875 | 0.887 | **0.881** |
| | (0.640 - 1.196) | (0.654 - 1.202) | **(0.648 - 1.198)** |
| Other | 1.214 | 1.205 | **1.202** |
| | (0.882 - 1.671) | (0.872 - 1.664) | **(0.871 - 1.659)** |
| Hispanic | 1.142 | 1.154 | **1.137** |
| | (0.453 - 2.881) | (0.470 - 2.837) | **(0.455 - 2.845)** |
| Average grade of math and English | 0.823*** | 0.827*** | **0.826*** ** |
| | (0.753 - 0.900) | (0.756 - 0.904) | **(0.755 - 0.904)** |
| Earnings per week | 1.001** | 1.002** | **1.001** ** |
| | (1.000 - 1.003) | (1.000 - 1.003) | **(1.000 - 1.003)** |
| Frequency of hanging out with friends | 1.238*** | 1.244*** | **1.242*** ** |
| | (1.135 - 1.350) | (1.140 - 1.356) | **(1.138 - 1.354)** |
| Peer smoking | 1.750*** | 1.746*** | **1.744*** ** |
| | (1.631 - 1.878) | (1.628 - 1.872) | **(1.626 - 1.870)** |
| Family members' smoking | 1.520*** | 1.506*** | **1.503*** ** |
| | (1.303 - 1.774) | (1.296 - 1.751) | **(1.293 - 1.747)** |
| Parent-child closeness | 0.986*** | 0.985*** | **0.986** ** |
| | (0.975 - 0.996) | (0.975 - 0.996) | **(0.976 - 0.997)** |
| Private school[a] | 0.732** | 0.746* | **0.746*** |
| | (0.538 - 0.995) | (0.544 - 1.024) | **(0.545 - 1.022)** |
| Percent of Hispanic students | 0.284*** | 0.284*** | **0.280*** ** |
| | (0.164 - 0.490) | (0.163 - 0.496) | **(0.161 - 0.490)** |
| Self-perceived fitting at school[b] | 0.977*** | 0.978*** | **0.980** ** |
| | (0.962 - 0.993) | (0.962 - 0.994) | **(0.965 - 0.996)** |
| Neighborhood median household income[c] | 1.000 | | |
| | (1.000 - 1.000) | | |
| Percent of residents age 25 or above with college degree[c] | 0.888 | | |
| | (0.332 - 2.379) | | |
| Neighbors watch out for each other[d] | | 0.832* | **0.854*** |
| | | (0.685 - 1.010) | **(0.709 - 1.028)** |
| Happy to live in the neighborhood[d] | | 1.051 | |
| | | (0.981 - 1.126) | |
| Neighborhood recreational facility[e] | | 0.889 | |
| | | (0.751 - 1.052) | |

N=13,552
Odds ratios are presented with 95% confidence intervals in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
a. public school=reference group
b. An average score for each school on the extent to which students feel they fit in at school.
c. Measures of neighborhood socioeconomic status
d. Measures of neighborhood social capital
e. A measure of neighborhood recreational facility as a proxy of neighborhood physical condition

## Table 5: Logistic Regression of Additional State Characteristics on Adolescent Regular Smoking

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Percent of smokers in the state | 1.003 | | | |
| | (0.976 - 1.030) | | | |
| Policy against cigarette vending | | 0.992 | | |
| machines accessible to minors | | (0.870 - 1.132) | | |
| No marketing restrictions for tobacco | | | | 0.981 |
| | | | | (0.851 - 1.130) |
| State program for dissemination of | | | 1.033 | |
| information about tobacco | | | (0.893 - 1.194) | |

N=13,552
Odds ratios are presented with 95% confidence intervals in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
a. All the models controlled for individual, peer, family, school, and neighborhood variables that are included in Model 4.3 (Table 4, Model 3). Model 4.3 is used as the baseline model for models that include variables at the state level and are presented in Table 5.

## Appendix: Description of Measures

### Individual-level variables:

*Regular smoking at Wave I & II*: "Have you ever smoked cigarettes regularly, that is, at least 1 cigarette every day for 30 days?" (yes/no)

*Race/Ethnicity* was captured by five racial/ethnic groups: Non-Hispanic whites, Non-Hispanic blacks, Hispanics, American Indian, Asian/Pacific Islander, and Others

*Physical Maturity*: "How advanced is your physical development compared to other boys or girls your age?" (5 levels)

*Self-Perceived Intelligence*: "Compared with other people your age, how intelligent are you?" (6 levels)

*Self-Esteem* was evaluated by the individual's agreement to the statement "You have a lot of good qualities." (5 levels)

*Frequency of hanging out with friends*: "During the past week, how many times did you just hang out with friends?" (0 to 3)

*Peer smoking*: "Of your 3 best friends, how many smoke at least 1 cigarette a day?" (0-3)

### Parent- or family-level variables:

*Family member smoking*: "Are there any cigarette smokers in your household?" (yes/no)

*Mother's expectation for adolescent of college graduation*: "On a scale of 1 to 5, where 1 is low and 5 is high, how disappointed would your mom be if you did not graduate from college?" (5 levels)

*Parent's level of education*, as reported by parent on the parent questionnaire, is regrouped into five categories: "Less than high school," "High school or equivalent," "Some college," "College graduate," and "Post graduate."

*Parental conflict*: "How much do you fight or argue with your current (spouse/partner)?" (4 levels)

*Parental control*: "Do your parents let you make your own decisions about the time you must be home on weekend nights, the people you hang around with, what you wear, how much television you watch, which television programs you watch, what time you go to bed on week nights, and what you eat?" This variable is a sum of the number of decisions the adolescent's parents let them make about their daily lives. A higher score indicates more decisions being made by the adolescent. The coefficient of alpha was 0.60

*Parent-child closeness* is a summed score combining the adolescent's perception of how close they are to their parents, as well as how much they perceive their parents care about them. The coefficient of alpha was 0.85.

*Parental involvement in the adolescent's life* was captured by an item capturing how many times per week the adolescent eats dinner with parents. "On how many of the past 7 days was at least one of your parents in the room with you while you ate your evening meal?" (0-7) We then constructed a dichotomized variable to indicate if the adolescent eats dinner with the parents for 5 days or more as a proxy for parental involvement in the adolescent's life. Other parental involvement variables are not reliable as they have too many missing values.

*Parent-child communication* is measured by a sum score of responses to several items asking whether the adolescent talked with the mother or the father about someone s/he is dating, or a party s/he went to, about a personal problem you were having, about other things s/he was doing in school. The coefficient alpha was 0.61.

*Household income*: "About how much total income, before taxes did your family receive in 1994? Include your own income, the income of everyone else in your household, and income from welfare benefits, dividends, and all other sources."

*Family Structure* was captured by a dichotomized indicator of intact family structure versus non-intact family structure.

**School-level variables (perceived or actual):**

*School average academic aspiration* was measured by percent of students who expect to go to college.

*Perceived school conflict* was measured by the mean score of students' responses to the item "Since school started this year, how often have you had trouble getting along with other students?"

*Self-perceived fitting* at school was captured by a scale that comprises 7 items. The items ask the adolescent whether she or he gets along with the teachers, gets along with other students, feel close to people at school, feel like she or he is part of school, is happy to be at school, believes that the teachers at school treat students fairly, and feel safe at school. The coefficient of alpha was 0.77.

*Percent of students smoking* was measured by the mean score of students' responses to the item "During the past twelve months, how often did you smoke cigarettes?"

*Percent of teachers smoking* was measured by the school administrator's estimate of the percentage of the full-time classroom teachers smoking at school.

*Policy against teacher smoking* (yes/no)

*Policy against student smoking* (yes/no)

*Severe punishment for smoking* was indicated by discipline policy for student smoking at school on 1st offense that range from verbal warning to expulsion.

**Neighborhood-level variables (perceived or actual):**

*Neighborhood social capital* was captured by the item "People in this neighborhood look out for each other" (yes/no) and the item "On the whole, how happy are you with living in your neighborhood?" (5 levels).

*Neighborhood physical condition* was tapped by the item "Do you use a physical fitness or recreation center in your neighborhood?" (yes/no)

**State-level variables:**

*Policy against cigarette vending machines where minors may access them* (yes/no)

*Policy against marketing for tobacco* (yes/no)

*State has a program for dissemination of information about tobacco* (yes/no)

[1] Based on data from the in-school social network file, we also constructed prevalence rates of smoking among all friends who either nominated the adolescent as a friend or are nominated by the adolescent. We then tested this variable to examine the effect of peer smoking. The results are similar to those using the number of smokers among three best friends. We chose not to use this variable in our final analysis because more than 30 percent of the values needed to be imputed.
[2] Totally there were four variables that have 10% or higher missing values for which we had to impute. They are people's getting along at school (28%), parental conflict (14%), parental education (13%), and household income (23%).
[3] The coefficient of earnings per week in Model 4.3 (Table 4, Model 3) is ln (1.001) equal 0.001 for $1. For $100, the coefficient would be 0.1. The odds ratio is thus e(0.1)=1.11. So every $100 more earnings per week are associated with 11% higher risk of smoking.
[4] The coefficient of percent of Hispanic students in Model 4.3 (Table 4, Model 3) is ln (0.28) equal -1.27 for 100 percent. For 20 percent, the coefficient would be a fifth of -1.27 equal -0.25. The odds ratio is thus 1/e(-0.25)=1/0.78=1.28. So 20% higher in Hispanic population is associated with 28% lower risk.