



High school cigarette smoking and post-secondary education enrollment: Longitudinal findings from the NEXT Generation Health Study



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ARTICLE INFO

Keywords:

Post-secondary education
Adolescent
High school
Smoking
Tobacco prevention

ABSTRACT

The inverse association between smoking and educational attainment has been reported in cross-sectional studies. Temporality between smoking and education remains unclear. Our study examines the prospective association between high school cigarette and smoking post-secondary education enrollment. Data were collected from a nationally representative cohort of 10th graders who participated in the Next Generation Health Study (2010 – 2013). Ethnicity/race, urbanicity, parental education, depression symptoms, and family affluence were assessed at baseline. Self-reported 30-day smoking was assessed annually from 2010 to 2012. Post-secondary education enrollment was measured in 2013 and categorized as either not enrolled or enrolled in technical school, community college, or 4-year college/university. Multinomial logistic regression was used to evaluate the association between cigarette smoking duration and post-secondary education enrollment (N = 1681). Participants who smoked 1, 2, or 3 years during high school had lower odds of attending a 4-year college (relative to a no enrollment) than non-smokers (adjusted OR: smoking 1 year = 0.30, 2 years = 0.28, 3 years = 0.14). Similarly, participants who smoked for 2 or 3 years were less likely than non-smokers to enroll in community college (adjusted OR: 2 years = 0.31, 3 years = 0.40). These associations were independent of demographic and socioeconomic factors. There was a prospective association between high school smoking and the unlikelihood of enrollment in post-secondary education. If this represents a causal association, strategies to prevent/delay smoking onset and promote early cessation in adolescents may provide further health benefits by promoting higher educational attainment.

1. Introduction

Educational attainment is a social determinant of health, which is comprised of social factors proposed as “causes of the causes” for health condition (Marmot, 2005; Braveman & Gottlieb, 2014). Higher educational attainment is associated with better health-related behaviors, more social support, positive mental health, and ultimately, longer life expectancy (Braveman & Gottlieb, 2014; Gilman et al., 2006; Loucks et al., 2015; Braveman et al., 2011). National surveillance data show that educational attainment is inversely associated with cigarette smoking among US adults. For example, data from the 2014 National Health Interview Survey revealed the prevalence of smoking among adults was 22.9% for less than high school education, 21.7% for high school diploma, 19.7% for some college education, 17.1% for associate

degree, 7.9% for with undergraduate degree, and 5.4% for graduate degree (Jamal et al., 2015). Similarly, previous young adult studies also found that those enrolled in 4-year colleges had the lowest prevalence of current smoking, followed by those enrolled in 2-year colleges, while those who only completed high school had the highest prevalence of current smoking (Berg et al., 2012; Solberg et al., 2007). These studies suggest that low educational attainment is a risk factor for health-related behaviors, specifically smoking (Braveman & Gottlieb, 2014; Braveman et al., 2011).

Temporality between educational attainment and smoking is not clearly established, but there is evidence to suggest a bi-directional relationship. The association of smoking with post-secondary education enrollment may have long-term implications for educational attainment, such as health and social outcomes. For example, smoking may

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<http://dx.doi.org/10.1016/j.ypmed.2017.09.025>

Received 4 May 2017; Received in revised form 15 September 2017; Accepted 24 September 2017

Available online 28 September 2017

0091-7435/ © 2017 Published by Elsevier Inc.

be adopted by adolescents as a maladaptive coping strategy for stress generated by poor academic performance, negative affect, or familial/social neglect (Suhrcke & de Paz Nieves, 2011; McGee et al., 2013). This suggests that academic failure precedes tobacco use. On the other hand, there is limited relevant evidence that smoking is a strong predictor of educational underperformance (Rose et al., 1983; Latvala et al., 2014; Ellickson et al., 2001; Bradley & Greene, 2013).

Adolescent nicotine dependence may influence adolescents' ability to concentrate when abstaining from smoking for a few hours, such as during standardized tests. Cross-sectional studies show that adolescents who smoke cigarettes performed significantly worse on standardized tests when compared with their non-smoking peers (Cox et al., 2007; Jeynes, 2002; Diego et al., 2003). Moreover, smoking negatively affects other risky health behaviors, such as dietary habits (Dallongeville et al., 1998; Baer Wilson & Nietert, 2002; Wilson et al., 2005), physical activity (Wilson et al., 2005; Paavola et al., 2004), alcohol use (Jeynes, 2002; Paavola et al., 2004), and sleep (Bellatorre et al., 2016; Shochat et al., 2014) among smokers; these complex factors, solely or together as a cluster, may reduce adolescents' ability to focus on learning. Therefore, poor academic performers who smoke cigarettes are more likely to not attend college than non-smoking peers as well as those who receive high academic scores. Nonetheless, research regarding college enrollment and smoking is highly dominated by current college-enrolled students and to our knowledge, no studies to date have examined whether adolescent smoking predicts subsequent post-secondary education enrollment.

To expand our limited understanding of the role that smoking may have in directly shaping later educational outcomes, the current study assessed the association between cigarette smoking during high school and post-secondary education enrollment in a prospective cohort study of adolescents. We hypothesized that longer high school smoking history is inversely associated with post-secondary education enrollment. Specifically, we posited that adolescents who reported longer cigarette smoking duration in high school, compared to non-smokers, were less likely to advance into vocational/technical schools, two-year colleges, and four-year colleges after high school.

2. Methods

2.1. Data source and sampling

The Next Generation Health Study is a longitudinal study that followed a nationally representative cohort of U.S. high school 10th grade students first assessed in 2009–2010. The study used a three-stage stratified sampling design. Primary sampling units comprised of school districts stratified by nine census divisions. Of the 137 high schools (public, private, and parochial) randomly chosen for the study, 80 high schools joined the study. Tenth grade classes in core subjects were randomly selected at each school for participation. Eligible students participated upon parental consent and student assent. Students provided consent for participation at the assessment following their 18th birthday. The study oversampled African American participants to provide adequate population estimates for ethnic and racial differences. Trained research staff administered a school-based, self-reported, voluntary, and confidential paper questionnaire during the 10th grade (baseline or T1, N = 2524) (Conway et al., 2013). Participants were surveyed annually via web-based assessments in 11th grade (T2, 2010–2011, N = 2439), 12th grade (T3, 2011–2012, N = 2407), and one year post-secondary education (T4, 2012–2013, N = 2177). Most of the sample graduated from high school or obtained a GED at T4. For these analyses, 1681 students completed all four surveys from baseline to T4 and self-reported post-secondary enrollment status at T4. Students with missing information between baseline and T4 (N = 451, 20.0%) as well as students who self-reported current high school attendance at T4 (N = 42, 2.0%) were excluded from this current study. Of those excluded from analysis, students were more likely male ($p < 0.0001$), of

non-Hispanic Black descent ($p < 0.0001$), and of lower family affluence ($p < 0.0001$). In the overall analyses, there were significant interaction differences between smoking and post-secondary education enrollment for gender ($p < 0.01$) and ethnicity/race ($p < 0.01$). The institutional review board (IRB) of the Eunice Kennedy Shriver National Institute of Child Health and Human Development approved all procedures and study materials.

2.2. Measures

2.2.1. Cigarette smoking in past month

At T1, T2, and T3, smoking behavior was assessed by asking adolescents, "On how many occasions (if any) have you smoked cigarettes in the last 30-days?" Students were asked to respond from (1) never (2) one or twice (3) 3–5 times (4) 6–9 times (5) 10–19 times (6) 20–39 times (7) 40 times or more. A dichotomized variable was created with 0 for never and 1 representing smoking at least once in the past month. This question was derived from the Health Behavior in School-age Children questionnaire (Currie et al., 1997). The cigarette smoking duration in high school corresponds to summative years of smoking participation, where 0 is no years, 1 is any one of the three years, 2 is two of the three years, and 3 is all three years during high school.

2.2.2. Post-secondary education enrollment

Participants were asked at T4, "Are you currently attending school?" Responses included (1) No, I am not attending school; Yes, (2) high school (3) technical/vocational school (4) community college (5) college/university (6) graduate school or professional school. These analytic responses were categorized into: no enrollment (i.e., not attending school), technical/vocational school, community college, and 4-year college/university.

2.2.3. Covariates

To account for differences between gender, ethnicity/race, parental education attainment, family affluence, negative affect (e.g. depressive symptoms), urbanicity, and school poverty index per school addresses, these baseline variables were included in the analyses as covariates. Parental education attainment was the highest education level reported for the participant's mother or father, and collapsed into five categories: (1) less than high school, (2) high school diploma or GED, (3) some college, technical school, vocational school, or associate's degree, (4) bachelor's degree, and (5) graduate degree. Family affluence scale (FAS) was used to measure adolescents' perception of family wealth or socioeconomic status through a sum composite of a four-item measure: (1) number of computers the family owns; (2) does the family own a car, van, or truck; (3) has own bedroom and (4) number of family vacations in the past year (Boyce et al., 2006). Answers included no = 0; yes, one = 1; and yes, two or more = 2. The composite score was then categorized into three levels: low (score = 0–2), medium (score = 3–5), and high (score = 6–9). Urbanicity is based on the National Center for Education Statistics' locale code typology of metro-centric areas assigned to school districts (Provasnik et al., 2007). Urbanicity was categorized as 'urban' (large central city, midsize city), 'suburb' (urban fringe of a large city, urban fringe of a mid-size city, large town, small town), and 'rural' (rural outside/inside mid-size city). School poverty index was determined by high school districts with a disproportionate number of families living in poverty. Ethnicity/race were classified into four categories: Hispanic, non-Hispanic Black, non-Hispanic White, and non-Hispanic Other (comprised of non-Hispanic Asian, American Indian, Alaskan Native, and Native Hawaiian Pacific Islander). Depressive symptoms were ascertained through the Modified Depression Scale (Dahlberg et al., 2005) to assess levels of adolescent psychological distress. The 6-item scale asked how often students were sad, were grouchy/irritable or in a bad mood, felt hopeless about the future, felt like not eating or eating more than usual, slept a lot more or a lot less than usual, and had difficulty concentrating on school work in

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