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# Drug and Alcohol Dependence

# Drinking, smoking, and educational achievement: Cross-lagged associations from adolescence to adulthood

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## ARTICLE INFO

## ABSTRACT

*Background:* Adolescent substance use is associated with lower educational achievement but the directionality of the association remains uncertain. We analyzed data on drinking, smoking and educational achievement to study the associations between substance use and education from early adolescence to young adulthood.

*Methods:* Longitudinal data from four time points (ages 12, 14, 17, and 19–27 years) from a population-based cohort study of Finnish twin individuals were used to estimate bivariate cross-lagged path models for substance use and educational achievement, adjusting for sex, parental covariates, and adolescent externalizing behavior. A total of 4761 individuals (49.4% females) were included in the analyses. Educational achievement was assessed with teacher-reported grade point average at ages 12 and 14, and with self-reported student status and completed education at age 17 and in young adulthood. From self-reported questionnaire items, frequency of any drinking, frequency of drinking to intoxication, any smoking and daily smoking were analyzed.

*Results:* Alcohol use and smoking behaviors at ages 12 and 14 predicted lower educational achievement at later time points even after previous achievement and confounding factors were taken into account. Lower school achievement in adolescence predicted a higher likelihood of engaging in smoking behaviors but did not predict later alcohol use. Higher educational attainment at age 17 predicted more frequent drinking in young adulthood.

*Conclusions:* Adolescent drinking behaviors are associated with lower future educational achievement independently of prior achievement, whereas smoking both predicts and is predicted by lower achievement. Early substance use indexes elevated risk for poor educational outcomes.

## 1. Introduction

Disorders and problems related to substance use are more prevalent among people with low education (Jacobi et al., 2004; Kessler et al., 2005; Latvala et al., 2009; Leach and Butterworth, 2012). However, the association between educational level and substance use is not straightforward. For example, in many countries abstaining from alcohol is less common and non-problematic alcohol use more frequent among people with high education (Casswell et al., 2003; Helakorpi et al., 2012; Helasoja et al., 2007; Patrick et al., 2012). Smoking behaviors currently exhibit a strong socioeconomic gradient in many countries such that those with higher education are much less likely to smoke (Helakorpi et al., 2008; Hiscock et al., 2012).

Substance use and educational outcomes become associated during adolescence (Townsend et al., 2007) but reasons for the association remain poorly understood. Theoretically, the association could be due to several mechanisms (see, e.g., Haller et al., 2010), which can be either causal or non-causal. First, there could be a causal influence of the educational domain on substance use. Thus, difficulties and poor performance in school might, via mediating psychological and social factors, causally lead to increased substance use. Alternatively, the causal relationship could run in the opposite direction so that substance use would influence educational outcomes. Such an adverse effect could be related to, e.g.,

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cognitive or motivational factors influencing school performance, or substance use could foster contact with peer groups unfavorable for school achievement. Third, the causal relationship could be reciprocal, whereby poor school outcomes and substance use behaviors would mutually influence each other and lead to a self-reinforcing process. Finally, the association could be non-causal and merely reflect confounding factors influencing both educational and substance use outcomes. For example, familial background may be related both to education and substance use and could create a spurious association between the two (Patrick et al., 2012; Melotti et al., 2011). Similarly, externalizing behavior problems in adolescence could confound the association (Breslau et al., 2009).

Several longitudinal studies have been conducted with results suggesting both that early substance use predicts poor school achievement and that academic failure is predictive of substance use (Ellickson et al., 2001; Hayatbakhsh et al., 2011; King et al., 2006; Pitkänen et al., 2008). More informative than studies that simply test the association in one direction are longitudinal analyses which test the predictive associations simultaneously in both directions while adjusting for the developmental stability of academic and substance use behaviors (Beal and Crockett, 2010; Maggs and Schulenberg, 2005). Cross-lagged path analysis of longitudinal data allows this by modeling autoregressive and cross-lagged associations simultaneously, but such analyses are rare in the literature, and even rarer are studies involving more than two time points.

Existing cross-lagged analyses of educational achievement and drinking or smoking behaviors have been methodologically variable and have produced differing results. Thus, among nearly 12,000 middle and high school students from the National Longitudinal Study of Adolescent Health, academic failure predicted alcohol use (but not binge drinking) one year later, but only a suggestive effect of alcohol use on academic failure was noted (Crosnoe, 2006). In contrast, a much smaller study of 405 participants in a high-risk sample found no cross-lagged associations between academic achievement and binge drinking across three study waves spanning an 18-year period (Haller et al., 2010). Bidirectional cross-lagged associations between school achievement and smoking across adolescence were indicated in two large studies (Pennanen et al., 2011; Tucker et al., 2008). In contrast, in data from the Monitoring the Future project academic achievement negatively predicted smoking from 8th to 12th grade but the reverse was not found (Bryant et al., 2000).

Clearly, more longitudinal analyses across multiple assessments through adolescence are required to capture the developmental interconnections between educational achievement and substance use. In addition, investigating different measures of substance use behaviors in the same sample would be informative as educational achievement could be differentially related to the use of different substances (e.g., alcohol vs. tobacco), and the nature of substance use (e.g., any drinking vs. drinking to intoxication).

We conducted cross-lagged path analyses on four waves of data from age 12 to young adulthood in a population-based sample of Finnish twins. Our aim was to investigate the directionality and magnitude of associations between educational achievement and drinking and smoking behaviors across adolescence and young adulthood. In order to remove potential confounding by externalizing behaviors, analyses adjusting for behavior problems in adolescence were also conducted. Based on previous findings, we hypothesized that the associations of educational achievement with drinking and smoking behaviors would be bidirectional. Further, we hypothesized that stronger associations would be found for more severe (i.e., drinking to intoxication, daily smoking) than for less severe (i.e., any drinking, any smoking) substance use behaviors. Theory and previous findings did not permit clear hypotheses concerning the relative strength of the associations with drinking and smoking behaviors.

## 2. Methods

### 2.1. Participants

*FinnTwin12* (FT12) is a longitudinal study of five consecutive birth cohorts (1983–1987) of Finnish twins and their families (Kaprio et al., 2002). Families with twins were identified via Finland's Population Register Center and contacted when the twins were 11–12 years. After baseline data collection ($N = 2724$ families, response rate 87%), the sample has been followed up with questionnaire surveys at ages 14 years, 17.5 years, and as young adults at an average age of 24 years (SD = 1.7, range 19–27), with consistently high response rates (85–90% at each wave of data collection; Kaprio et al., 2002; Kaprio, 2006). The study protocol was approved by the Ethical Committee of the University of Helsinki and the IRB of Indiana University. Parents provided written informed consent for their and their children's participation. At baseline, parents also reported on their own socioeconomic and health characteristics, including education, alcohol use and smoking.

All available data from the four study waves of FT12 were used. In total, some data were available for 5293 twin individuals (2625 or 49.6% females). The number of observations varied for each study wave and variable, ranging between 1869 and 4709 (Table 1). The smaller number for age 12 alcohol and smoking variables was because that information was available only from an intensively studied sub-sample. Namely, nested within the full population-representative FT12 study is a more intensively studied sub-sample of 2070 twin individuals who were asked to complete an in-school questionnaire at age 12, including items on alcohol use and smoking (Kaprio et al., 2002).

School performance at ages 12 and 14 was reported by the twins' teachers (see below) as part of a behavioral assessment. The teachers' reports were associated with some missing data at age 14, because many twins were unable or unwilling to nominate a teacher who knew them well. In contrast, at age 12, the twins had a single main teacher who was contacted with parental permission. Parental covariates (see below) were not available for 532 twin individuals from 274 families. Accordingly, path models adjusting for parental factors were based on a total of 4761 individuals (2354 or 49.4% females).

### 2.2. Measures

*2.2.1. Educational achievement.* In the Finnish educational system, compulsory education continues through grade nine (age 16). Secondary education is divided into vocational and academic secondary education (high-school), lasting typically two and three years, respectively. Tertiary education is provided by universities and polytechnics. In order to enter tertiary education, high-school is generally required.

Assessment of educational achievement was based on teacher-reported school performance at the first two study waves and on self-reported information on ongoing and completed education at the last two waves. Specifically, when the twins were 12 and 14 years their teachers responded to questionnaire items on school performance, including grade point average (GPA) in the latest report. Finnish schools use a uniform grading system of 7 numbered grades (4–10, from failure to highest). Five ordered categories for GPA were used in the teachers' questionnaire: (1) 9.0 or over, (2) 8.0–8.9, (3) 7.0–7.9, (4) 6.0–6.9, and (5) below 6. For analyses, this scale was reversed so that higher values denoted better performance.

At age 17, the twins reported on their current student status. Responses were classified into an ordinal variable with three categories: (0) not studying currently, (1) in vocational training, (2) in high-school. In young adulthood, educational attainment was based on a questionnaire item on the highest level of completed education, ranging from compulsory schooling to tertiary education. In addition, for those twins who had not yet completed their education, ongoing studies were treated as the final, expected education. Educational attainment in young adulthood was coded into four ordered categories: (0) compulsory education only, (1) vocational secondary education, (2) academic secondary education, and (3) tertiary education.

*2.2.2. Drinking.* Alcohol use behaviors employed in our analyses were the frequency of drinking any alcohol and the frequency of drinking to intoxication. This information was based on questionnaire items at each study wave. The item on intoxication was not included in the age 12 questionnaire. At age 12, the dichotomous drinking variable asked "Have you ever drunk alcohol without adults around". "No" responses were coded as 0 and "Yes" responses as 1. At ages 14 and 17, the frequency variables for any drinking and drinking to intoxication had the following four ordered categories: (0) I do not use alcohol, (1) less than once a month, (2) approximately once or twice a month, and (3) once a week or more often. In young adulthood, the variable for drinking to intoxication had these same four categories, while the categorization of the frequency of any drinking was: (0) less than once a month or never, (1) approximately once or twice a month, (2) once a week, and (3) a couple of times a week or more often. These variables have been used in earlier analyses of drinking behaviors in the Finnish twin cohort data (Dick et al., 2011; Latvala et al., 2014; Pagan et al., 2006; Rose et al., 1999; Viken et al., 1999).

*2.2.3. Smoking.* At age 12, a dichotomous variable on having ever tried smoking was used; with "Yes" responses coded as 1 and "No" responses as 0. Based on several questions on smoking initiation and current smoking habits, any current smoking and current daily smoking at ages 14, 17 and in young adulthood were studied.