



# The effects of alcohol and tobacco use on academic performance among Chinese children and adolescents: Assessing the mediating effect of skipping class<sup>☆</sup>

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## ABSTRACT

Using a nationally representative survey of urban areas from China, the present study examines three research questions: (1) how are alcohol and tobacco use associated with academic performance among Chinese children and adolescents? (2) how does skipping class mediate those associations? And (3) do any observed patterns differ for boys and girls? Our results show that alcohol and tobacco use are associated with poor academic performance. However, alcohol use fully accounts for the detrimental effect of tobacco use on academic performance. Moreover, skipping class partially and fully mediates the effects of alcohol and tobacco use on poor academic performance. The adverse effect of tobacco use on academic performance is stronger for girls than boys. To improve children's and adolescents' academic performance, it is important to document the potential contributing factors.

## 1. Introduction

Improving academic performance has been a central goal for school administrators and teachers (Arthur et al., 2015). Although school characteristics and teaching practices are associated with children's and adolescents' academic performance, most of the variation of the academic outcome is attributable to students' characteristics (Marzano, 2000; McCall, Hauser, Cronin, Kingsbury, & Houser, 2006). One branch of research involves substance use because of its popularity in the public health domain (Chan & La Greca, 2016). Alcohol and tobacco are the two most prevalent substances in China (Grenard et al., 2006; Xing, Ji, & Zhang, 2006). Prior studies among Chinese adolescents show that the rates of lifetime versus current tobacco use are about 33% vs. 9% (Grenard et al., 2006) and that the prevalence of lifetime versus current alcohol use is about 51% vs. 25% (Xing et al., 2006). Using 2003, 2008, and 2013 National Health Service Survey from China, Wang et al. (2019) showed that the prevalence of smoking among adolescents (aged 15–24 years) increased from 8.3% in 2003 to 12.5% in 2013. Among adolescent boys, the percentage of smoking increased from 16% in 2003 to 23.5% in 2013, and the percentage also increased from 0.4% to 1.1% for

adolescent girls during the same period. Similar patterns have also been observed for drinking (Feng & Newman, 2016). Some common reasons that adolescents initiate using tobacco involve being curious about the taste of tobacco, promoting relaxation, reducing stress and boredom, and keeping weight down (Dijk, de Nooijer, Heinrich, & de Vries, 2007; Wang, Cowdery, Trucks, & Fitzhugh, 1994). Tobacco use at an early age increases the likelihood of addiction and lengthens the duration of use (Newman & Shell, 2005). Once adolescents establish regular use, cessation will be difficult (Al Agili & Park, 2012). Similar observations are also supported by research focusing on alcohol use (Kuntsche, van der Vorst, & Engels, 2009; Newton-Howes & Boden, 2016). Together, substance use initiation during childhood and adolescence has important health implications because early substance use is strongly linked to future health problems (Newman & Shell, 2005; Newton-Howes & Boden, 2016).

Given the prevalence of alcohol and tobacco use among children and adolescents, an increasing body of research has established the adverse health consequences by substance use (Braverman, Stawski, Samdal, & Aarø, 2016; Verdurmen, Monshouwer, Van Dorsselaer, Ter Bogt, & Vollebergh, 2005). Prior research has found that tobacco use is

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associated with elevated levels of mental health problems, such as anxiety (Johnson et al., 2000), physical health problems, including numerous subjective somatic conditions of respiratory problems, headaches, stomach-aches, musculoskeletal pains, sleep problems (Botello-Harbaum, Haynie, Murray, & Iannotti, 2011; Waldie, McGee, Reeder, & Poulton, 2008), and a general self-rated health problem (Dube, Thompson, Homa, & Zack, 2013; Johnson & Richter, 2002; Wang, Ho, Lo, Lai, & Lam, 2012). Likewise, there is evidence that alcohol use is associated with higher levels of depression (Edwards et al., 2014; Skogen et al., 2014), inattention (Skogen et al., 2014; Strandheim, Holmen, Coombes, & Bentzen, 2009), hyperactivity (Skogen et al., 2014) and mortality rates (Windle & Windle, 1996).

### 1.1. Substance use and academic performance

In addition to well-established health and well-being disparities, a growing body of research has sought to explore the academic consequences of substance use. Prior studies have attributed the adverse association between substance use and academic performance to the following: substance use undermines academic outcomes by lowering concentration, memory, and motivation, or by causing brain damage (Bachman et al., 2008 for a review). To date, almost all existing studies that focus on the effects of alcohol and marijuana use on academic performance have predominately documented students in universities within western countries. Research suggests that alcohol use is negatively associated with academic consequences such as reporting falling behind in class and having lower grades (Piazza-Gardner, Barry, & Merianos, 2016; Singleton & Wolfson, 2009; Thombs et al., 2009), though there is evidence that the two are unrelated (El Ansari, Stock, & Mills, 2013; Paschall & Freisthler, 2003). Research on the effect of marijuana use on academic consequences, on the other hand, appears to generate more consistent results. For instance, scholars have found that marijuana use is negatively associated with performing poorly on tests (Shillington & Clapp, 2001), getting lower grades (Arria, Caldeira, Bugbee, Vincent, & O'Grady, 2015; Suerken et al., 2016), as well as dropping out of college (Suerken et al., 2016). It is worth acknowledging that only a handful of studies have documented a joint effect of alcohol and marijuana use on academic performance. For instance, using a convenience sample of 1142 first-university students, Meda et al. (2017) categorized students into three groups: "(1) non-users or light users of alcohol and marijuana, (2) moderate/large users of alcohol while being non-users or light users of marijuana, and (3) heavy users of both alcohol and marijuana" (p.2). Results indicated that the third group reported the lowest GPA, followed by the second and first groups. Using a convenience sample of 946 undergraduate students from a mid-sized public university in the southeast of the United States, Bolin, Pate, and McClintock (2017) found that alcohol and marijuana use were associated with lower GPAs, respectively. However, after combining alcohol and marijuana into one model, marijuana appeared to mediate the association between alcohol use and GPA.

Given that marijuana has not been legalized in China and that children and adolescents are less likely to have access to marijuana, the present study focuses on the examination of tobacco use. To our best knowledge, no empirical studies have examined a joint effect of alcohol and tobacco use on children's and adolescents' academic performance in China. We have only found one empirical study from western countries. Using the Washington Assessment of Student Learning dataset, Arthur et al. (2015) revealed that alcohol and tobacco use were associated with lower reading, writing, and mathematics scores among 10th-graders.

### 1.2. Substance use, skipping class, and academic performance

If alcohol and tobacco use relate to children's and adolescents' adverse academic consequences, it is crucial to identify what factors might account for their negative associations. One of the potential mediating mechanisms involves skipping class (Bolin et al., 2017). Some

scholars have proposed that substance use might contribute to difficulties in maintaining academic pursuits and devoting to schoolwork, ultimately undermining children's and adolescents' academic performance (Arria et al., 2015; Conway & DiPlacido, 2015). Given that skipping class is likely to manifest a lack of commitment to school life (Arria et al., 2015), it might account for the adverse effect of substance use on academic performance. Using a convenience sample of 80 first-semester college students, Conway and DiPlacido (2015) found that alcohol use was indirectly associated with academic performance through skipping class. In a longitudinal study, Arria et al. (2013) revealed that students diagnosed with either alcohol or cannabis use disorder were more likely to skip class, contributing to a lower GPA. In another study, Bolin et al. (2017) found that skipping class partially explained the association between alcohol use and academic performance, and a similar pattern had also been observed for the association between marijuana use and academic performance.

### 1.3. Gender differences

Gender might moderate the association between substance use and academic performance. People's behaviors are embedded in the constructionist perspective of gender, suggesting that individuals' behaviors are guided and reinforced by traditional gender norms (Wilkinson, Fleming, Halpern, Herring, & Harris, 2018). Given that men's behaviors are traditionally characterized by masculinity, while women's behaviors are traditionally characterized by femininity (Connell, 2005), substance use is more socially acceptable for men than women, which aligns with explaining men's traditional gender roles (Landrine, Bardwell, & Dean, 1988; Lemle & Mishkind, 1989). Children and adolescents tend to share this double-standard, suggesting that boys view substance use as a strategy to enhance their sociability, whereas girls consider substance use undesirable (Chassin, Tetzloff, & Hershey, 1985). When girls engage in substance use, they violate the traditional gender role norms (i.e., femininity). Consequently, they might experience greater problems with their parents, teachers, and peers, which negatively influences their academic performance. Thus, it is reasonable to speculate that the adverse effect of substance use on academic performance might be stronger for girls than boys. Very few studies have explored how gender might moderate the association between substance use and academic performance among children and adolescents. However, previous studies focusing on substance use and health might hint at our aforementioned proposition. For instance, there is evidence that the adverse effect of smoking on psychosocial problems appears to be stronger for girls than boys (de Meer, Crone, & Reijneveld, 2010).

### 1.4. The current study

We use a nationally representative survey of urban areas from China to examine three research questions: (1) how are alcohol and tobacco use associated with academic performance among Chinese children and adolescents? (2) how does skipping class mediate those associations? And (3) do any observed patterns differ for boys and girls? Based on the aforementioned theoretical ideas and empirical evidence, we hypothesize that:

**Hypothesis 1:** both alcohol and tobacco use are associated with poor academic performance.

**Hypothesis 2:** skipping class (at least) partially accounts for the adverse effects of alcohol and tobacco use on poor academic performance.

**Hypothesis 3:** the adverse effects of alcohol and tobacco use on academic performance are stronger for girls than boys.

## 2. Methods

### 2.1. Participants

The present study uses a nationally representative survey of urban areas from China collected in 2016, including seven cities in different provinces: Beijing, Changsha, Guiyang, Guangzhou, Lanzhou, Nanjing, and Shenyang. We purposively selected them for the purpose of geographical variety. Stratified sampling was employed. We selected one primary school, one middle school, one high school, and one vocational school in each of the seven cities. We then randomly sampled one class for each grade from each of these schools. The students from the sampled classes were invited to complete the questionnaire. We did not sample students from Grades one to three because they could not read and understand the survey questions. The sampling strategy was chosen to best balance the “representativeness,” the scientific rationale, and the available reality (Lohr, 2009). In total, 3,777 questionnaires were distributed to 28 schools (i.e., 4 schools \* 7 provinces). The response rate was 100%. However, 102 (2.7%) students were excluded from the analyses because of the missing values. The final sample is 3,675 (1,772 boys and 1,903 girls).

### 2.2. Measures

**Academic performance.** We measure academic performance based on the question: “How did you evaluate your academic performance last year?” Responses are recoded as: “very low (1),” “low (2),” “average (3),” “high (4),” and “very high (5).” We further recode it into a dummy variable (1= “very low/low,” 0= “average/high/very high”).

**Alcohol use.** We measure alcohol use based on the question: “In the past year, how often did you drink?” Responses include “never (1),” “barely (2),” “occasionally (3),” and “often (4).”

**Tobacco use.** We measure tobacco use based on the question: “In the past year, how often did you smoke?” Responses include “never (1),” “barely (2),” “occasionally (3),” and “often (4).”

**Skipping class (being late).** We measure skipping class (being late) based on the question: “In the past year, how often did you skip class (being late)?” Responses include “never (1),” “barely (2),” “occasionally (3),” and “often (4).”

We control for the following socio-demographic variables. *Gender* is coded as “boys” and “girls.” *Ethnicity* is recoded as “Han” and “minorities.” *Living arrangement* is recoded as “living with parents,” “living with one parent,” “living with grandparents,” and “others.” *Father’s education* and *mother’s education* are coded as “less than middle school,” “middle school,” “high school,” “college,” “bachelor,” and “above bachelor.” *Family’s socioeconomic status* is recoded as “very low,” “low,” “average,” “high,” and “very high.” *School type* is coded as “primary school,” “middle school,” “high school,” and “vocational school.” *Boarding school* is coded as “yes (boarding school)” and “no (non-boarding school.)” *Geographic location* is assessed as the name of the cities: “Beijing,” “Lanzhou,” “Guangdong,” “Guiyang,” “Changsha,” “Nanjing,” and “Shenyang.” Table 1 reports the descriptive statistics of selected variables used in the analyses.

### 2.3. Analytical strategy

We use a series of logistic regression to fit models for our dichotomous measure of academic performance. For these models, in addition to odds ratio, we also report average marginal effects (AME), which provides a discrete change in the outcome (i.e., the predicted probability) with other covariate values averaged across the population (Chai & Maroto, 2020).

**Table 1**

Descriptive statistics of selected variables in the analyses.

	means/%s	S.D.
Academic performance		
Very low/low	20.27%	
Average/high/very high	79.73%	
Alcohol use	1.17	0.54
Tobacco use	1.08	0.43
Skipping class	1.42	0.69
Gender		
Girls (=1)	51.78%	
Boys	48.22%	
Ethnicity		
Han	91.76%	
Minorities (=1)	8.24%	
Living arrangement		
Living with parents (REF)	73.28%	
Living with one parent	9.90%	
Living with grandparents	9.28%	
Others	7.54%	
Father’s education		
Less than middle school	10.07%	
Middle school (REF)	31.35%	
High school	24.24%	
College	11.43%	
Bachelor	14.01%	
Above Bachelor	8.90%	
Mother’s education		
Less than middle school	14.34%	
Middle school (REF)	30.01%	
High school	22.29%	
College	11.46%	
Bachelor	13.55%	
Above Bachelor	8.35%	
Family’s socioeconomic status		
Very low	3.84%	
Low	10.99%	
Average (REF)	54.20%	
High	26.39%	
Very high	4.57%	
School type		
Primary school (REF)	37.77%	
Middle school	27.76%	
High school	26.91%	
Vocational school	7.56%	
Boarding school		
Yes (=1)	18.18%	
No	81.82%	
Geographic location		
Beijing (REF)	16.08%	
Lanzhou	12.46%	
Guangdong	12.82%	
Guiyang	13.66%	
Changsha	21.44%	
Nanjing	10.56%	
Shenyang	12.98%	
N	3,675	

## 3. Results

### 3.1. Substance use, skipping class, and academic performance

Table 2 presents logistic regression models predicting the probability of reporting poor academic performance. Model 1 shows that a 1% increase in alcohol use is associated with 4.7 ( $p < .001$ ) percentage points increase in reporting poor academic performance. Similarly, Model 2 indicates that a 1% increase in tobacco use is associated with 4.1 ( $p < .01$ ) percentage points increase in reporting poor academic performance. However, after combining alcohol and tobacco use into one model (as shown in Model 3), the adverse effect of smoking observed in Model 2 becomes statistically insignificant ( $AME = 0.005$ ,  $p > .05$ ). The adverse effect of drinking remains ( $AME = 0.045$ ,  $p < .001$ ), suggesting that alcohol and tobacco use do not affect academic performance independently. In other words, alcohol use appears to fully explain the

**Table 2**  
Logistic regression models predicting alcohol and tobacco use.

	Model 1			Model 2			Model 3			Model 4			Model 5			Model 6		
	O.R.	S.E.	AME	O.R.	S.E.	AME	O.R.	S.E.	AME	O.R.	S.E.	AME	O.R.	S.E.	AME	O.R.	S.E.	AME
Alcohol use	1.378***	0.097	0.047				1.354***	0.123	0.045	1.193*	0.091	0.026	1.055	0.104	0.008	1.257*	0.117	0.033
Tobacco use				1.319**	0.119	0.041	1.036	0.121	0.005	1.451***	0.089	0.054	1.499***	0.093	0.059	0.890	0.108	-0.017
Skipping class										0.069			0.077			1.469***	0.092	0.056
Intercept	0.093			0.098			0.091			0.092			0.090			0.073		
PseudoR <sup>2</sup>	0.082			0.079			0.082											
N	3,675																	

Note: All models include full control variables.  
\*\*\*p < .001; \*\*p < .01; \*p < .05.

detrimental association between tobacco use and poor academic performance. Together, our findings from Models 1–3 partially support our **Hypothesis 1**.

Model 4 in Table 2 shows that children and adolescents who skip class are more likely to report poor academic performance, suggesting that a 1% increase in skipping class is associated with 5.4 (p < .001) percentage points increase in reporting poor academic performance. More importantly, the adverse effect of drinking on poor academic performance decreased from 4.7 percentage points (p < .001), as shown in Model 1, to 2.6 percentage points (p < .05), which suggests that skipping class might partially mediate the effect of drinking on poor academic performance. A mediating test has confirmed the proposition (Hayes, 2017). In a similar vein, Model 5 reveals that the adverse effect of smoking on poor academic performance decreased from 4.1 percentage points (p < .01), as shown in Model 1, to 0.8 percentage points (p > .05), which suggests that skipping class might fully explain the effect of drinking on poor academic performance. A mediating test has confirmed the proposition (Hayes, 2017). Together, our findings from Models 4–5 support our **Hypothesis 2**. Finally, Model 6 (the full model) concludes that only drinking is still associated with poor academic performance.

### 3.2. Gender differences

Table 3 presents logistic regression models predicting the moderating effects of gender in the association between both alcohol and tobacco use and poor academic performance. Given that the current *American Sociological Review (ASR)* editors stress that: “don’t use the coefficient on the interaction term to draw conclusions about the significance of statistical interaction in categorical models such as logit, probit, Poisson, and so on (p. 351),” we, therefore, test the interaction effects using the predicted probability metric (Mize, 2019).

By following Mize (2019) methodological approach, Models 1 and 2 in Table 4 indicate the predicted probability of reporting poor academic performance by alcohol and tobacco use and gender, respectively. Model 1 shows that a 1% increase in alcohol use is associated with 4.9 (p < .001) percentage points increase in reporting poor academic performance among boys. Likewise, a 1% increase in alcohol use is associated with 6.0 (p < .01) percentage points increase in reporting poor academic performance among girls. However, the gender difference is not statistically significant regarding the association between alcohol use and poor performance.

Model 2 shows that tobacco use is not associated with poor academic performance among boys (p > .05). However, among girls, a 1% increase in tobacco use is associated with 11.7 (p < .001) percentage points increase in reporting poor academic performance. The gender difference appears to be statistically significant (p < .05), suggesting that the adverse effect of tobacco use on academic performance is stronger for girls than boys. Our results from Table 4 align with the findings presented in Table 3. Together, our findings partially support

**Table 3**  
Logistic regression models testing the moderating effects of gender.

	Model 1		Model 2	
	O.R.	S.E.	O.R.	S.E.
Alcohol use	1.334***	0.112		
Tobacco use			1.184+	0.120
Girls (=1)	0.679+	0.138	0.420***	0.104
Alcohol use X girls	1.114	0.169		
Tobacco use X girls			1.734*	0.372
Intercept	0.097		0.111	
PseudoR <sup>2</sup>	0.082		0.081	
N	3,675			

Note: All models include full control variables.  
\*\*\*p < .001; \*\*p < .01; \*p < .05; +p < .10.



**Table 4**

The predicted probability of academic performance by alcohol and tobacco use and by gender.

	Model 1: Alcohol use	Model 2: Tobacco use
	AME	AME
Boys	0.049***	0.028
Girls	0.060**	0.117***
Interaction	0.010	0.088*

Note: All models include a full set of control variables.

\*\*\*p < .001; \*\*p < .01; \*p < .05.

### our Hypothesis 3.

## 4. Discussion

Using a nationally representative survey of urban areas from China collected in 2016, the present study examines three research questions: (1) how are alcohol and tobacco use associated with academic performance among Chinese children and adolescents? (2) how does skipping class mediate those associations? And (3) do any observed patterns differ for boys and girls? Overall, the present study contributes to previous research in three ways:

First, our study adds to the existing literature by providing new empirical evidence on the association between substance use and academic performance among children and adolescents in China. Previous studies have primarily focused on university students in western societies, showing that both alcohol and marijuana use are negatively linked to academic outcomes (Suerken et al., 2016). Our results reveal that among Chinese children and adolescents, alcohol and tobacco use are associated with poor academic performance, which is consistent with the findings observed among university students in western societies. These findings call attention on prevention efforts aimed at adolescents to reduce the detrimental consequences on academic performance developed in a later stage.

In addition, previous research has not made enough effort to demonstrate how alcohol and tobacco use might jointly influence academic outcomes. Bolin et al. (2017) found that alcohol and marijuana use were associated with lower GPAs. However, after combining alcohol and marijuana into one model, marijuana appeared to fully mediate the association between alcohol use and GPA. Our study shows that alcohol and tobacco use are linked to poor academic performance. However, the result shows that alcohol use fully mediates the adverse effect of tobacco use on poor academic performance. This inconsistent finding might be attributable to the following reasons: our study employs tobacco use rather than marijuana use and focuses on children and adolescents rather than university students, and measures academic performance based on perceived overall academic outcome rather than GPA, or/and conducts in China rather than western societies. Together, these findings warrant further investigation on a joint effect of drinking and smoking on academic outcomes.

Second, our study also sheds light on what factors might contribute to the negative association between substance use and academic performance. Existing research has primarily focused on the direct association between substance use and academic outcomes (Suerken et al., 2016). However, school administrators and policymakers would not effectively improve students' academic performance without finding out the potential mediating mechanisms. Our results indicate that skipping class partially accounts for the adverse effect of alcohol use on poor academic performance and fully account for the adverse effect of tobacco use on poor academic performance. These findings align with prior research (Bolin et al., 2017), suggesting that skipping class is one important mechanism that links substance use to academic performance. Together, it is reasonable to suggest that prevention efforts must aim to help adolescents stop skipping class, thereby improving academic outcomes.

Third, to our best knowledge, no prior study has theorized the potential gender differences regarding the association between substance use and academic performance among children and adolescents. Using the constructionist perspective of gender (Wilkinson et al., 2018) as a guiding framework, we hypothesize and confirm that the detrimental effect of tobacco use on academic performance is stronger for girls than boys. However, there is little evidence suggesting the same pattern for the association between alcohol use and academic performance. Given that girls might face greater negative academic consequences, teachers and school administrators, and policymakers might want to provide additional help towards girls.

Despite its contributions, our study has limitations. First, due to the nature of our cross-sectional data, we are unable to test the potential reverse causality between substance use and poor academic performance (Latvala et al., 2014). Second, self-reported academic performance might bias the results even though it is common to use self-reported academic performance in the literature (Florin, Shults, & Stettler, 2011). One study has shown a moderate to good correlation ( $r = 0.63$ ) between self-reported academic performance and actual GPA (Huang, Goran, & Spruijt-Metz, 2006).

## 5. Conclusion

Despite the growing popularity of documenting adolescents' academic outcomes by substance use, prior studies have primarily focused on the direct associations. Future research should pay closer attention to the potential mediating and moderating mechanisms embedded in the association between substance use and academic outcomes, thereby providing more effective school policies towards improving academic outcomes. Importantly, given that marijuana use has not been legalized in China and that children and adolescents might have limited access to marijuana, it is unknown whether tobacco would have an equally detrimental effect on academic performance as marijuana, that has been found in western studies. Although our results have provided some primary evidence, more research documenting the association between tobacco use and academic performance among Chinese children and adolescents is warranted.

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