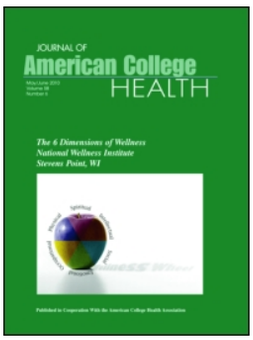

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Freshman year alcohol and marijuana use prospectively predict time to college graduation and subsequent adult roles and independence

Emily R. Wilhite, MA, James R. Ashenhurst, PhD, Elise N. Marino, BA, and Kim Fromme, PhD

Department of Psychology, University of Texas at Austin, Austin, Texas, USA

ABSTRACT

Objective: This study examined how freshman year substance use prospectively predicted time to college graduation, and whether delayed graduation predicted postponed adoption of adult roles and future substance use. **Participants**: Participants were part of a longitudinal study that began in 2004. The first analyses focused on freshman year ($N = 2{,}050$). The second analyses corresponded to a subset of participants at age 27 ($N = 575$). **Methods**: Measures included self-reported substance use, adult role adoption, and university reported graduation dates. **Results**: Results indicated that frequent binge drinking and marijuana use during freshman year predicted delayed college graduation. Those who took longer to graduate were more likely to have lower incomes and were less likely to obtain a graduate degree. Taking 5–6 years to graduate was associated with greater likelihood of alcohol-related problems. **Conclusions**: Findings support the importance of interventions during freshman year of college to decrease substance use and promote timely graduation.

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Introduction

Freshman year of college marks a pivotal moment in emerging adulthood, which is characterized by newfound independence from parental monitoring, and often coincides with an increase in experimentation with alcohol, marijuana, and other illicit drugs.[1–3] Substance use can have both proximal and distal negative implications on academic performance during college. For example, greater alcohol use relates to lower grade point averages (GPAs),[4,5] as well as discontinuous college enrollment[6] or delayed college graduation.[7] Using a longitudinal sample, this study examined whether freshman substance use was associated with delayed college graduation, and in turn, whether time to college graduation had longer-term consequences such as delayed adoption of adult roles and future problematic substance use during early adulthood.

Substance use and college graduation

Alcohol, marijuana, and other drugs have consequences that may contribute to difficulty completing academic work and graduating. For instance, heavy alcohol use is associated with missing class, lower academic engagement, and falling behind on schoolwork.[8,9] In addition, marijuana use is associated with oversleeping and missing class,[7,10] and it may also affect attention and working memory.[11] Finally, use of these substances can lead to dependence, and increased likelihood of discontinuing college.[12,13] Given the clear impact of substance use on academic outcomes overall, use during freshman year, a pivotal time of transition marked by increased autonomy and independence from parental influence,[1] may be a prognostic indicator of later academic problems. Completing college within 4 years may be challenging for those whose involvement in binge drinking, smoking marijuana, or using other drugs competes with academic progress during the first year of college. As a result, delayed college graduation may then impact more practical outcomes after college, including financial independence and other adult roles like marriage.

College graduation, adult roles, and substance use in early adulthood

In the United States in 2007, approximately 58% of college students graduated with a bachelor's degree within 6 years of matriculating, while only 34% of college students graduated with their degree in 4 years.[14] Recently, institutions of higher education have started initiatives to encourage students to graduate within 4 years.[15]

CONTACT Emily R. Wilhite, M. A. ewilhite@utexas.edu Department of Psychology, University of Texas at Austin, 108 E. Dean Keeton A8000; Room 2.302B, Austin, TX 78712, USA.
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University administrators highlight the lost income, extra year(s) of tuition, and potential for mounting college debt as incentives to finish college faster.[16]

There are several advantages of completing a college education versus only having a high school diploma, such as earning higher wages and attaining greater wealth.[17] In fact, education is often called the "great equalizer," as having a college degree allows individuals, no matter their socioeconomic background, to establish better financial and career stability.[18] Less is known about whether the *duration of time* to complete college is associated with subsequent financial success and initiation into adult roles such as owning property. It may be that those who take longer to graduate, as suggested by many college administrators, sacrifice time in the workforce, which decreases time to accrue wealth by means of promotions and raises. Similarly, those who graduate within 4 years are able to pursue post-graduate education more quickly and are consequently able to re-join the workforce at younger ages. As a result, those who graduate earlier may have higher incomes, and may also be more likely to achieve such adult milestones as living on their own or owning a home. In addition, as advanced educational pursuits become more commonplace, especially among women, marriage and childbirth are delayed, and may also be influenced by time to college graduation.[19,20]

At the same time that emerging adults are beginning their careers, a "maturing out" of substance use also often occurs across the transition into more adult roles.[21,22] This maturation often coincides with movement out of the college environment, which might be delayed for those who take longer to complete their degree. This could result in continued heavy substance use typically characteristic of a college population. Thus, this study examined whether delayed college graduation was associated with a greater likelihood of substance use in early adulthood.

Present study

The first aim of the present study was to determine whether binge drinking, marijuana use, and other illicit drug use during the first semester of freshman year of college were related to the time it took students to graduate, above and beyond demographic and socioeconomic variables. The second aim was to determine whether the time taken to graduate from college was associated with financial outcomes, marriage, childbearing, and substance use during early adulthood. Given the recent push by academic institutions to have students graduate college more quickly, it is important to understand how substance use relates to time to graduation and whether delayed graduation negatively influences individual success during early adulthood.

Methods

Participants

Participants were recruited from freshman orientation events to be a part of a large longitudinal study the summer before they matriculated into a large, public Southwestern university. A portion of students recruited for the study indicated interest ($N = 6{,}391$) and a smaller subset met the inclusion criteria of being 17–19 years old, unmarried, and having valid contact information ($N = 4{,}832$). A portion of the eligible participants were invited to complete the longitudinal arm of the study ($N = 3{,}046$), while a subset of these participants completed the first wave of data collection ($N = 2{,}245$). Starting in 2004, the longitudinal sample completed 10 surveys across 6 years. Participants completed a survey in summer 2004 during the summer after high school (wave 1), twice annually for the subsequent 3 years (waves 2–7), and once annually for the final 3 years (waves 8–10). Wave 10 was collected in Fall 2009. The sample used in the first set of these analyses included those for whom we had graduation data ($N = 2{,}050$). The sample was 60% female, 60% white, 21% Asian, 6% black/other, 18% Hispanic, and 7% multiethnic/other. For more detailed information about the sample, see Author citation.[23,24]

The follow-up analyses were designed to target a subset of this original sample (target $N = 1{,}060$) for a new study examining the interplay between genetics and subjective intoxication. Participants must have agreed to be re-contacted and have completed at least two waves of the original longitudinal study to be considered for participation in the follow-up survey. Participants were contacted for the online follow-up survey using a database of contact information from the University's alumni network between 2012 and 2015. For more information about the recruitment of the follow-up survey see Author citation.[25] At the time of analysis, the follow-up survey included 624 participants. We did not have graduation data for a portion of this follow-up sample ($N = 49$), and thus these participants were not included in the analyses. The final sample used for the second set of analyses was comprised of those who completed the follow-up survey and for whom we had graduation data ($N = 575$). This sample had an average age of 26.8 ($SD = 0.9$) and was 65% female, 66% white, 16% Asian, 11% black/other, and 14% Hispanic. The demographics of both samples are similar to the host institution in 2004, and thus are representative of a large, Southwestern University student body.[26]

Procedure

Participants completed Web-based surveys as part of a parent study, which included 10 waves of online surveys.

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The Wave 1 survey, which was when participants provided their family income, was collected the summer before students started college and participants were compensated $25. The Wave 2 survey was collected the fall of the participants' freshman year and participants were compensated $20. Waves 8, 9, and 10 were used to determine the graduation dates for some survey participants who received $40 in compensation. The follow-up survey was completed 4–6 years after Wave 10 and participants were compensated $20. The University Institutional Review Board approved all procedures and survey measures.

Measures: Common to Study Aims 1 and 2

Demographics

Respondents self-reported their ethnicity and biological sex at Wave 2. All ethnicity variables were coded into white, Asian, Hispanic, and given the relatively low rates of all other categories, "Other" (including black, mixed, American Indian, and "other").

Grade point averages (GPA)

Participants provided their self-reported freshman GPAs at Wave 2.

Family income and educational attainment

During Wave 1, respondents provided information on their family's estimated annual income (1 = *under $20,000* to 8 = *over $100,000*), and their mother and father's highest level of education (1 = *some education, but did not complete high school or obtain GED* to 6 = *post-graduate degree*).

Binge drinking

Participants provided open-ended responses to the prompt "During the past three months, how many times did you have [five (men)/four (women)] drinks at a sitting?" For purposes of these analyses, all substance use items were taken from Wave 2 and the follow-up survey.

Marijuana use

One item assessed past 3 month marijuana use: "How many times did you smoke marijuana?" A six-point ordinal scale was used (0 = *0 times* to 6 = ≥ *20 times*).

Illicit drug use

One item assessed the use of illicit drugs other than marijuana during the past 3 months by asking participants how often they, "Used drugs other than marijuana or designer drugs?" on an ordinal scale (0 = *0 times* to 6 = ≥ *20 times*).

Measures: Study Aim 1 Only

Employment status

One item assessed whether participants were employed. This item was separated into full-time (0 = *No*, 1 = *Yes*) and part-time work (0 = *No*, 1 = *Yes*), and was collapsed across Waves 4–6, as this measure was not assessed at early waves.

Time to graduation

Graduation dates were collected from the local university's alumni association for participants who graduated from the original institution. For participants for whom we did not have graduation dates (i.e., they did not graduate from the university to which they matriculated their freshman year), we used the item that asked whether they had "obtained a bachelor's degree" from Waves 8, 9, and 10. Based on these combined sources, participants were binned into three categories based on their graduation dates: (a) graduated in 4 years or less, (b) graduated in 5–6 years, and (c) graduated in 7+ years or did not graduate.

Measures: Study Aim 2 Only (all from the follow-up survey)

Personal income

Respondents provided their estimated annual income, which included a total of their income and any partner's income, but not their parents', using an ordinal scale (1 = *under $20,000* to 8 = *over $100,000*).

Home ownership

Participants indicated whether they had bought or sold a home (0 = *No*, 1 = *Yes*) since the last survey they completed in 2009.

Pregnancy

Respondents reported whether they or their partner became pregnant (0 = *No*, 1 = *Yes*) since the last survey in 2009.

Marriage

One item asked about whether the participant had gotten married (0 = *No*, 1 = *Yes*) since the last assessment in 2009.

Living independently

Participants reported on whether they had moved in with their parents or other relatives (0 = *No*, 1 = *Yes*) since the last survey in 2009.

Post-graduate education

Respondents indicated whether (0 = *No*, 1 = *Yes*) they completed a post-bachelor's degree (i.e., M.A., M.B.A., J.D., Ph.D., M.D.).

Full-time employment and student status

Respondents reported on their current status as a full-time student (0 = *No*, 1 = *Yes*) or employed person (0 = *No*, 1 = *Yes*).

Alcohol-related problems

Negative consequences of alcohol use was measured using the 23-item Rutgers Alcohol Problem Index (RAPI).[27] Items were assessed for the past 3 months and included items such as, "Kept drinking when you promised yourself not to" on an ordinal scale (0 = *0* to 4 = *More than 10*). Internal reliability was excellent ($\alpha = .99$).

Data analytic plan

For the first aim, we ran path models in M*plus* version 7.31 (Los Angeles, CA) to examine the associations between freshman binge drinking, marijuana use, and other illicit drug use on time to college graduation. In order to account for missing data, these analyses used full information maximum likelihood to account for missing data.[28] These analyses controlled for gender, ethnicity (dummy coded with reference to whites), parental income, highest parental education achievement, GPA, full-time, and part-time employment status by regressing each substance use variable and the categorical graduation outcome variable on covariates. Given that the variance of the binge drinking variable was larger than the mean, indicative of overdispersion, we assumed a negative binomial distribution. Further, for the marijuana and illicit drug use variables, we used a negative binomial censored distribution, given that the majority of respondents reported no use and the highest available response item included only 20 or more times in the past 3 months.

For the second aim, we ran a series of logistic regression models to determine how time to college graduation was associated with financial success and adoption of other adult roles. These multivariate logistic regression analyses included whether a participant got married, had a child, completed a graduate degree, bought or sold a home, or lived independently from family. Further, in order to assess how time to graduation influenced income, we ran a hierarchical ordinary least squares regression. Finally, to determine whether time to graduation was associated with early adulthood binge drinking, marijuana use, illicit drug use, and alcohol-related problem, we ran a series of separate generalized linear models (GzLM), using a negative binomial distribution to account for the skewed distribution. All GzLM results were reported using incidence rate ratios (IRR) and controlled for freshman year family income, freshman GPA, mother and father's highest level of education, ethnicity, gender, and freshman year substance use (i.e., the freshman substance that corresponded to the outcome variable). The SPSS analyses used listwise deletion, but there was a low rate of missing data (range = 0.2–1.9%) among study variables in this smaller data set.

Results

Participant characteristics

We compared the participants who completed the Wave 2 survey and for whom we had graduation data ($N = 2{,}050$) and those not included in analyses ($N = 195$) on demographic variables. For the analysis that used Wave 2 data, there was a greater proportion of Hispanic participants (30.8%) among those excluded relative to those included in the analysis (18.1%), $\chi2(1) = 18.43$, $p < .001$. There was also a smaller proportion of white participants among those excluded (51.8%) relative to those included in these analyses (60.1%), $\chi2(1) = 5.15$, $p < .05$. There were no gender differences between groups. All Wave 2 demographics are presented in Table 1.

We also compared those who were included in Aim 1 analyses ($N = 2{,}050$) to those included in Aim 2 analyses ($N = 575$) on freshman year substance use and demographic variables. There were more women in the Aim 2 sample (65.0% vs. 58.4%), $\chi2(1) = 7.64$, $p < .01$, more white (61.0% vs. 53.3%), $\chi2(1) = 9.75$, $p < .01$, and fewer Asian (15.7% vs. 19.6%), $\chi2(1) = 4.20$, $p < .05$, participants relative to the Aim 1 sample. There were no differences in substance use during freshman year between the samples. Finally, for Aim 2, we compared those with ($N = 575$) and without graduation data ($N = 49$). There were no differences in study variables. For those with graduation data relative to those without, there were fewer participants in the other ethnicity category (10.7% vs. 8.6%), $\chi2(1) = 191.03$, $p < .001$ and more Asian (15.7% vs. 2.0%), $\chi2(1) = 7.12$, $p < .01$, Latino (13.5% vs. 0.0%), $\chi2(1) = 7.83$, $p < .01$, and white (60.1% vs. 11.8%), $\chi2(1) = 44.51$, $p < .001$ participants.

Path analyses

Many common fit statistics and standardized path coefficients are not available for models using negative binomial distributions; thus, Figure 1 shows the unstandardized coefficients for the final path analysis for all participants for whom we had graduation data (N = 2,050). Akaike

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Table 1. Freshman year demographics.

	Graduated ≤ 4 years n = 1271		Graduated 5–6 years n = 600		Graduated 7+ years n = 179	
Freshman year	M	(95% CI)	M	(95% CI)	M	(95% CI)
Frequency of binge drinking	2.58	[2.27, 2.88]	3.35	[2.78, 3.91]	3.19	[2.19, 4.19]
Grade point average	3.12	[3.04, 3.20]	2.78	[2.64, 2.91]	2.65	[2.41, 2.90]
	Proportion	(95% CI)	Proportion	(95% CI)	Proportion	(95% CI)
Marijuana use	14.3	[12.4, 16.4]	19.1	[16.1, 22.6]	22.2	[16.5, 29.2]
Illicit drug use	2.3	[1.6, 3.4]	2.7	[1.7, 4.5]	4.9	[2.5, 9.4]
Hispanic	11.9	[10.2, 13.8]	19.3	[16.2, 22.8]	27.2	[20.9, 34.5]
African-American/other	11.1	[9.5, 13.0]	15.7	[12.9, 18.9]	22.8	[17.1, 29.9]
Asian	19.5	[17.3, 21.8]	22.2	[18.9, 25.9]	14.2	[9.7, 20.4]
White	63.2	[60.4, 65.9]	52.1	[47.9, 56.2]	46.3	[38.8, 54.0]
Female	65.2	[62.4, 67.8]	63.0	[58.9, 67.0]	64.8	[57.2, 71.8]
Family income > $50,0000	73.6	[71.0, 76.0]	70.5	[66.5, 74.2]	50.0	[42.4, 57.6]
Worked full-time during waves 4–8	0.5	[0.2, 1.1]	1.1	[0.5, 2.4]	8.6	[5.2, 14.0]
Worked part-time during waves 4–8	0.8	[0.4, 1.4]	2.2	[1.3, 3.8]	13.0	[8.6, 19.0]

Note. Substance use variables and GPA were for past 3 months. Working status was reported about past 3 months and collapsed across 5 waves. Proportions are within-column. For example, 63.2% of those who graduated in 4 years or fewer were female.

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Information Criterion (AIC) was 14,887.52 and the Bayesian Information Criterion (BIC) was 15,178.02. For simplicity of representation, Figure 1 only includes the main study variables, but the model also controlled for ethnicity, gender, family income, GPA, mother and father's highest education, full-time, and part-time job status on all substance use variables and time to graduation.

According to the path analysis, marijuana use and binge drinking were related to a longer time to graduation, while use of other drugs was not. Binge drinking and marijuana use in freshman year were positively related, as were marijuana use and use of other drugs, while binge drinking was not associated with other drug use. In regard to demographics, greater family income (B = −0.10, SE = 0.04, $p <$ .001), higher GPA (B = −0.13, SE = 0.03, $p <$ .001), and higher levels of paternal education (B = −0.13, SE = 0.04, $p <$ .001) were associated with graduating more quickly,

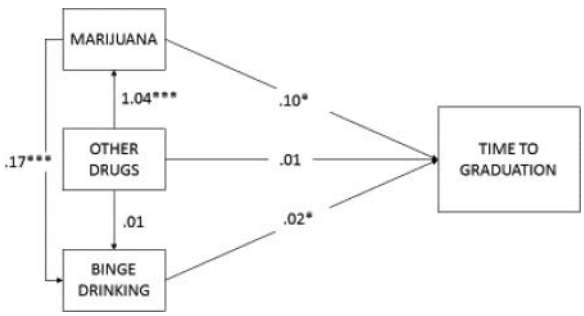

Figure 1. Path model of substance use and college graduation. Path model of freshman year substance use on time to college graduation. Model also controlled for gender, ethnicity, maternal and paternal education, high school family income, GPA, and job status. Time to graduation was binned into three categories: (a) graduated in 4 years or less, (b) graduated in 5–6 years, and (c) graduated in 7+ years, with positive path values indicating longer time to graduation. $^{*}p < .05$, $^{***}p < .001$.

whereas being employed full-time (B = 1.71, SE = 0.54, $p <$ .01) or part-time (B = 2.10, SE = 0.36, $p <$ .01), higher levels of maternal education (B = 0.09, SE = 0.04, $p <$ .05), being Hispanic (B = 0.56, SE = 0.15, $p <$ .001) or black (B = 0.56, SE = 0.14, $p <$ .001), and being male (B = 0.22, SE = 0.10, $p <$ .05) were all associated with delayed time to graduation.

We also ran a sensitivity analysis that included only those participants who completed Wave 2 surveys and for whom we had graduation data (N = 1,916). The AIC was 56,455.28 and the BIC was 56,866.57. According to this more stringent test, binge drinking was related to a longer time to graduation (B = 0.02, SE = 0.01, $p <$ .05), while marijuana use was marginally associated with longer time to college graduation (B = 0.08, SE = 0.04, $p =$ .06), and use of other drugs was not (B = 0.03, SE = 0.14, $p >$ .05). All other paths between substance use variables had the same effects as the larger sample. Additionally, all demographic variables had the same effect on time to college graduation as the larger sample except working part-time during college, which was not significantly related to college graduation (B = −0.17, SE = 0.10, $p >$ .05).

Time to graduation as a predictor of adult roles

Sample demographics were explored for the smaller follow-up sample (Table 2). Overall, we found that longer times to college graduation were associated with lower odds of achieving milestones in young adulthood (Table 3). Specifically, results indicated that those who graduated in 5–6 years had 48% lower odds, and those who took 7+ years to graduate from college had 40% lower odds of living independently compared to those who graduated in 4 years or less. In addition, those who took 7+ years to graduate had 22% lower odds of buying

Table 2. Follow-up demographics.

	Graduated ≤ 4 years n = 361		Graduated 5–6 years n = 161		Graduated 7+ years n = 53	
Follow-up	M	(95% CI)	M	(95% CI)	M	(95% CI)
Binge drinking	5.20	[4.37, 6.04]	5.69	[3.99, 7.40]	5.53	[3.09, 7.97]
RAPI	3.19	[2.44, 3.93]	4.13	[2.86, 5.39]	4.26	[2.67, 5.86]
	Proportion	(95% CI)	Proportion	(95% CI)	Proportion	(95% CI)
Marijuana use	19.6	[15.8, 24.0]	18.1	[12.9, 24.8]	30.0	[19.1, 43.8]
Illicit drug use	6.9	[4.7, 10.0]	5.0	[2.5, 9.5]	17.0	[9.2, 29.2]
Hispanic	10.0	[7.3, 13.5]	16.9	[11.9, 23.4]	28.3	[18.0, 41.6]
African-American/other	10.3	[7.6, 13.9]	10.0	[6.3, 15.6]	15.1	[7.9, 27.1]
Asian	14.7	[11.4, 18.8]	20.6	[15.1, 27.6]	7.6	[3.0, 17.9]
White	70.6	[65.7, 75.0]	60.0	[52.3, 67.3]	54.7	[41.5, 67.4]
Female	66.1	[61.1, 70.8]	65.2	[57.5, 72.2]	58.5	[45.1, 70.7]
Personal income > $50,000	57.6	[52.4, 62.7]	50.6	[42.9, 58.4]	44.2	[31.6, 57.7]
Own their home	25.4	[21.2, 30.0]	18.6	[13.3, 25.3]	9.4	[4.1, 20.2]
Full-time employed/student	90.0	[86.5, 92.7]	88.8	[82.9, 92.8]	83.0	[70.8, 90.8]
Received graduate degree	36.9	[32.1, 42.0]	22.5	[16.7, 29.6]	13.2	[6.6, 24.8]
Did not graduate college					20.8	[12.0, 33.5]

Note. RAPI, Rutgers Alcohol Problems Index. All substance use variables were about past 3 months. All other variables were asked in reference to the time since the previous survey in 2009. Percentages are within-column. For example, 19.6% of those who graduated in 4 years or fewer used marijuana.

or selling a home relative to those who graduated in 4 years or less. Those who graduated in 5–6 years had 53% lower odds and those who graduated in 7+ years had 31% lower odds of obtaining a graduate degree compared to those who graduated in 4 years or less. There were no group differences for marriage, full-time student or employed status, or pregnancy.

Finally, based on an ordinary least squares linear regression, time to graduation significantly predicted income level, such that those who took longer to graduate had lower incomes by follow-up ($\beta = -0.35$, $p < .05$), controlling for gender, ethnicity, past 3-month substance use, and family income during high school (Table 4).

Time to graduation as a predictor of substance use and alcohol problems

In GzLM controlling for gender, ethnicity, family income during high school, mother and father's education, GPA, and freshman year substance use (i.e., freshman substance use that matched the outcome variable), the only differences among groups for substance use at follow-up were for alcohol-related problems (Table 5). Results indicated that by follow-up, those who graduated in 5–6 years were more likely to have higher levels of alcohol-related problems relative to those who graduated in 4 years or less (IRR = 1.31, CI = 1.03–1.66, $p < .05$).

Table 3. Logistic regression of time to graduation on adult roles at follow-up.

	Graduated in 5–6 years		Graduated 7+ years	
Measure	*OR*	*95% CI*	*OR*	*95% CI*
Lived alone	0.49*	0.29–0.81	0.42*	0.19–0.92
Bought/sold a home	0.62	0.37–1.05	0.21*	0.06–0.72
Full-time job	0.85	0.51–1.43	1.53	0.62–3.78
Full-time student	0.98	0.55–1.75	0.42	0.14–1.26
Obtained grad degree	0.53**	0.34–0.85	0.32*	0.13–0.81
Pregnant	1.07	0.49–2.35	1.96	0.70–5.49
Married	0.81	0.50–1.32	0.68	0.29–1.57

Note. Reference group is graduated in 4 years or less. All analyses controlled for gender, ethnicity, high school family income, mother and father's highest education, and GPA.
*$p < .05$, **$p < .01$.

Comment

Hypotheses for this study were partially supported, as freshman marijuana use and binge drinking, but not other illicit drug use, were both associated with delayed time to graduation. Further, results indicated that delayed college graduation was associated with a decrement in late emerging adult financial successes. Further,

Table 4. Linear regression of time to graduation on follow-up personal income.

Measure	*B*	*SE*	*t*	ΔR^2
Step 1				0.02**
High school family income	0.41	0.05	3.02**	
Step 2				0.01
Hispanic	−0.45	0.34	−1.32	
Asian	−0.05	0.31	−0.15	
African-American/other	−0.74	0.35	−2.10*	
Gender	−0.05	0.22	−0.21	
Step 3				0.03**
Binge drinking	−0.02	0.01	−0.00	
Marijuana use	−0.99	0.28	−3.94**	
Other drug use	0.13	0.42	0.32	
Step 4				0.01*
Graduation status	−0.35	0.16	−2.11*	

Note. *$p < .05$, **$p < .01$. All ethnicities are reported relative to white participants. The substance use variables listed in step 3 measured past 3 month use assessed in the follow-up survey.

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Table 5. Generalized linear model of time to graduation on substance use at follow-up.

Measure	Illicit drugs			Marijuana			Binge drinking			RAPI		
Variable	*b*	*SE b*	*IRR*	*b*	*SE b*	*IRR*	*b*	*SE b*	*IRR*	*b*	*SE b*	*IRR*
Gender	−0.69	0.34	0.50*	−0.31	0.22	0.73	−0.38	0.10	0.68***	−0.28	0.11	0.75*
White	—	—	—	—	—	—	—	—	—	—	—	—
Asian	0.17	0.49	1.15	−0.53	0.39	0.59	−0.26	0.15	0.77	−0.28	0.11	0.94
Hispanic	0.17	0.55	1.09	0.52	0.34	1.68	0.28	0.16	1.32	−0.03	0.18	0.97
Other	−0.11	0.55	0.90	0.11	0.34	1.12	0.05	0.17	1.05	0.15	0.18	1.17
High school family income	−0.02	0.10	0.09	0.00	0.06	1.00	0.03	0.03	1.03	−0.01	0.03	0.99
Grade point average	−0.14	0.10	0.87	−0.04	0.07	0.96	−0.04	0.03	0.96	0.11	0.04	1.12**
Mother's education	0.08	0.15	1.05	−0.02	0.10	0.98	0.02	0.04	1.02	0.13	0.05	1.13**
Father's education	−0.00	0.15	0.99	0.16	0.10	1.17	−0.03	0.04	0.97	−0.10	0.04	0.90*
Freshman substance use	0.58	0.25	1.80*	0.25	0.07	1.28***	0.06	0.01	1.06***	0.04	0.01	1.04**
Follow-up binge drinking	—	—	—	—	—	—	—	—	—	0.08	0.01	1.08***
Graduation (4 years or less)	—	—	—	—	—	—	—	—	—	—	—	—
Graduation (5–6 years)	−0.38	0.42	0.68	−0.16	0.26	0.85	−0.02	0.11	0.98	0.27	0.12	1.31*
Graduation (7+ years)	0.66	0.47	1.88	0.12	0.37	1.13	−0.04	0.19	0.96	0.28	0.20	1.33

Note. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$. All ethnicities are reported relative to Whites and graduation variables are relative to graduating in 4 years or less. RAPI = Rutgers Alcohol Problems Index. Freshman Substance Use is the substance used during freshman year that matches that set of analyses (e.g., Freshman marijuana use for the follow-up marijuana analyses and Freshman RAPI scores for follow-up RAPI analyses).

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taking 5–6 years to graduate from college was associated with a higher likelihood of alcohol-related problems 10 years after initiating college, beyond freshman substance use. These results highlight that early college marijuana use and binge drinking are related to time to graduation, and play an important role in later financial independence and alcohol-related problems. Overall, these findings suggest that colleges could highlight the negative impact of frequent marijuana use and binge drinking during the first semester of college on graduation rates and longer-term financial outcomes in interventions designed to curb substance use during college.

Binge drinking and time to graduation

Findings suggest that greater frequency of binge drinking episodes predicted delayed college graduation compared with those who binge drank less often. This is consistent with previous findings that individuals who were heavy drinkers during their senior year of high school were significantly less likely to complete college.[29,30] This may be the result of lower academic engagement (e.g., missing class) for those who drink heavily.[8,9] It may also be the case that immediate physiological effects of heavy alcohol use can interfere with academic progress, such as experiencing frequent hangovers, blackouts, and alcohol poisoning.[31]

More severely, heavy underage drinkers are also at increased risk of neurodegeneration in brain regions implicated in learning and memory, functional brain activity impairments, and overall neurocognitive deficits.[31] As such, binge drinking could impair academic progress by affecting intellectual development. Over time, this can detrimentally affect time to graduation, and it may affect individuals through adulthood. Thus, our findings suggest that interventions aimed at decreasing binge drinking before freshman year of college as part of pre-matriculation orientation activities could lead to fewer neurobiological consequences. Providing this intervention prior to the start of freshman year could promote safer drinking patterns during that first year in college. In turn, preventing binge drinking during freshman year could promote greater academic engagement and performance, which can reduce time to graduation.

Marijuana and time to graduation

Results of our path model indicated that marijuana use during freshman year was a predictor of longer time to graduation. This result is consistent with those of other reports, which show that marijuana use is associated with lower GPAs[7,32] and longer time to graduation.[7] One study examining latent classes of trajectories of marijuana use from age 15 to 25 established three groups of individuals (abstainers, occasional users, and frequent users).[33] Frequent users had lower high school grades, more conduct problems, and were less likely to complete high school and enroll in post-secondary education relative to abstainers and occasional users.[33] Further, occasional users were more likely to drop out of secondary education relative to abstainers. Thus, adolescent and young adult marijuana use has important implications for delayed enrollment and completion of college.

Although our survey data preclude direct causal inferences, our results may be explained by the known impact of marijuana use (both the short-term and prolonged) on cognition and executive functioning. These include acute effects on working memory, decision-making, attention, impulsivity,[11] prolonged effects on decision-making, IQ (particularly among early-onset users),[34] and

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some mixed evidence for effects on impulsivity. The negative impact on decision-making and impulsivity may in turn lead to a higher rate of skipping class, a significant mediator in the associations between marijuana use, GPA, and delayed graduation.[7] If true, these findings suggest that interventions to decrease marijuana use freshman year of college may increase class attendance, GPAs, and shorten delays to graduation.

The association between marijuana use and delayed college graduation should be interpreted in light of our sensitivity analyses, which showed marginal significance between these variables when restricted to a sample with complete data only. One explanation is that there was a decrement in power with the smaller and more conservative sample. Another explanation for the lack of a robust effect in our data may be the dramatic shift toward acceptance and legalization of marijuana throughout the United States since 2004. Presently, there are 28 states that have legalized the use of marijuana for medical or recreational purposes. If our survey study was replicated today, there may be greater use and less disapproval of marijuana among college students, as the climate has shifted toward highlighting the benefits of using marijuana (e.g., pain management).[35] As a result, there may be a stronger association between marijuana and time to college graduation now as more college students may be using marijuana than in previous cohorts. Thus, these results should be replicated in a more recent sample in order to determine the extent to which marijuana use continues to be associated with delayed time to college graduation.

Time to graduation and financial/adult role outcomes

One key result of this study was the association between time to college graduation and indices of financial achievement in early adulthood. This result is likely mediated by having less time to advance one's career in the work force, as those who took longer than 4 years to graduate had lower incomes, and those who took 5–6 years to graduate were less likely to live independently from family. Thus, delayed time to graduation may be associated with less time to receive raises and other financial incentives that come with gaining experience and skills at a new job position necessary for a higher income. Additionally, taking longer to graduate could lead to less time to accrue savings, which would make it more difficult to afford independent housing. Finally, those who delayed graduation had less time to pursue and complete advanced education, an achievement also associated with higher incomes.[36] These findings should be interpreted in light of the severe economic recession that occurred between 2007 and 2009, which corresponds to when the majority of our sample was joining the workforce. This period precipitated a spike in unemployment rates, which may have influenced our findings.[37] Despite these environmental factors, results indicate that during the years directly after college, individuals who take longer to finish a bachelor's degree are at a financial disadvantage.

Accounting for past substance use, early adults who took 5–6 years to graduate from college were more likely to report alcohol-related problems than their peers who graduated in 4 years or fewer. One explanation could be that those who took longer to graduate likely hold more junior positions at their workplace, given they have had fewer years in the work force since graduating from college. As a result, they may experience more stress and lower wages, which, coupled with less time to accrue wealth and the potential for more student debt, could contribute to problematic drinking used to cope with stress. Further, in our sample, although not significantly different, a smaller proportion of those who took longer to graduate were employed full-time, which could mean higher rates of unemployment, a factor closely related to lower psychological well-being, lower life satisfaction, and worse mental health.[38] Those who are unemployed may be more likely to experience alcohol-related problems because of drinking to cope with the stress,[39] which is a common reason for drinking post-college.[40] On the other hand, these results could reflect the persistence of alcohol-related problems after graduation experienced by this heavier drinking group. Future studies could examine whether drinking to cope motives or stress mediate the association between delayed college graduation and alcohol-related problems.

Demographic effects

Similar to prior national findings[41] and results reported by the University,[42] our results indicated that Hispanic, black, and male students took longer to graduate from college. Further, working part-time or full-time conferred greater risk for delayed time to college graduation. These students may be paying their own tuition and housing, while balancing the stress of working 20–40 hours/week and attempting to complete a college course load. This could result in falling behind academically, and thus needing longer to complete their bachelor's degree. These results speak to the importance of providing additional academic support to students who work during college and students who come from households with lower incomes.

Limitations

This study should be interpreted in light of its limitations and strengths. First, all substance use variables were self-report measures of past 3 month use, which may not accurately reflect typical substance use.

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Second, this sample reported higher 4-year graduation rates (62%) than those reported by the university from which they were drawn (52%)[42] and from other public universities (31%)[41] where students matriculated in 2004, suggesting a somewhat biased final sample. Third, this sample was obtained from a university with a strong emphasis on graduating students in 4 years, and many students involved in higher education in the United States complete 2-year programs rather than bachelor's programs. Fourth, we do not have data on students who may not have graduated college after Wave 10, which means we cannot address factors that may contribute to noncompletion. Lastly, demographic representation at this university may differ from those at others; thus, results may not fully generalize to other campuses or to post-secondary education in general. Nevertheless, the longitudinal and prospective nature of our analyses represents a major strength, as we were able to follow the same individuals over many years. Although there may be possible unknown or unmeasured confounding variables in our prospective associations, we are confident in the predictive power of our stringent models across time.

Conclusions

These results indicated that greater frequency of freshman year binge drinking and marijuana use is significantly related to delayed college graduation, which supports the importance of pre-college interventions targeted at decreasing heavy drinking and marijuana use. Thus, highlighting the harmful academic outcomes associated with binge drinking and marijuana use, including longer time spent in college might augment these pre-college interventions. Further, we found a significant association between delayed college graduation and decreased financial prosperity during early adulthood, which could also be integrated into incentives for college students to graduate college in 4 years. It is essential to note that there are myriad reasons why students take longer to graduate college likely not captured in these analyses. Nevertheless, it appears that delayed college graduation is prospectively associated with certain harmful longer-term outcomes in early adulthood.

Conflict of interest disclosure

The authors have no conflicts of interest to report. The authors confirm that the research presented in this article met the ethical guidelines, including adherence to the legal requirements, of the United States and received approval from the Institutional Review Board of The University of Texas at Austin.

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