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Post-high school changes in tobacco and cannabis use in the United States

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Abstract

Background: The transition from high school into young adulthood is a critical developmental period with many young people going to college, moving residence, and entering the work force for the first time. The NEXT Generation Health Study (NEXT) is a nationally representative longitudinal study of adolescent health behaviors. Previous NEXT research has found that the post-high school environment is associated with changes in alcohol use.

Objectives: The current study investigated the impact of school status, residential status, and work status on cannabis and cigarette use among post-high school participants.

Results: Living in a dorm/fraternity/sorority was associated with an increased prevalence in cannabis use while attending a 4-year college was associated with a decreased prevalence in cigarette use.

Conclusions: Some aspects of the post-high school environment are related to cannabis and cigarette use. Differences in the social circumstances of cigarette and cannabis use and recent campaigns in colleges to reduce smoking may explain some of these trends.

The transition from high school into young adulthood is marked by changes in interpersonal relationships and role responsibilities, and increased rates of substance use behaviors (Jackson, Sher, & Schulenberg, 2008; Newcomb & Bentler, 1987; White, Labouvie, & Papadaratsakis, 2005). While many young adults move toward the assumption of adult roles and responsibilities during this stage of life, considerable individual variation exists in decisions and pursuits regarding education, work, financial autonomy, and romantic and peer involvement (Cohen, Kasen, Chen, Hartmark, & Gordon, 2003; Schulenberg, Bryant, &

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O'Malley, 2004). Greater freedom, less social control, and increased exploratory behaviors within new contexts contribute to increases in substance use (Arnett, 2005; Schulenberg & Maggs, 2002). In this critical transition period, many adolescents go to college, take jobs, and live away from their parents for the first time.

Cigarette and cannabis use during this later stage of adolescence are important for multiple reasons. Research on the impact of early age at initiation of smoking has typically focused on those initiating before age 16 years (e.g. Khuder, Dayal, & Mutgi, 1999; Thompson, Tebes, & McKee, 2015). However, studies that incorporate a broader age range of initiation have found that individuals who begin smoking during this transition-age (17–19 years), compared with older initiators, have decreased interest in quitting later (Lando et al., 1999) and decreased probability of successfully doing so (Chen & Millar, 1998), smoke more cigarettes per day (Fernandez et al., 1999), and have more physical dependence symptoms (Lando et al., 1999). Among university students smoking has been associated with higher levels of depression and greater utilization of mental health services (Halperin, Smith, Heiligenstein, Brown, & Fleming, 2010). Cannabis use among undergraduates has been associated with major depressive, anxiety, and substance use disorders (Keith, Hart, McNeil, Silver, & Goodwin, 2015). Additionally, cannabis use has been found to reduce post-secondary school performance (Arria, Caldeira, Bugbee, Vincent, & O'Grady, 2015).

Cigarette Smoking and Cannabis Use by College, Residence, and Work Status

Community-based (e.g. White et al., 2005) and national cross-sectional studies of young adults (e.g. Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2015) suggest that, in contrast to drinking, which is more prevalent among those college-bound, cigarette smoking and cannabis use are more common among those non-college-bound. Johnston et al. found, using data from Monitoring the Future, that non-college-bound young adults had higher 30-day prevalence rates of cigarette smoking (24.6%) and cannabis use (26%) than their college-bound peers (12.9% and 20.8% respectively). Multiple regional studies indicate that young adults attending 2-year colleges are more likely than those attending 4-year colleges to report smoking; though those who not attending college have the highest prevalence of smoking (Lenk et al., 2012; Sanem, Berg, An, Kirch, & Lust, 2009; VanKim, Laska, Ehlinger, Lust, & Story, 2010). Operationalization of college status differs across studies; some consider full- and part-time students as separate groups and some consider 2- and 4-year colleges as separate types of education (see Carter, Brandon, & Goldman, 2010). Accordingly, comparisons of cigarette smoking and cannabis use rates across these three groups (i.e., not in college, 2-year college, and 4-year college) are difficult.

About 28% of 18–24 year olds in the U.S. attend 4-year colleges and about 13% attend 2-year colleges (NCES, 2014). There is considerably more research on 4-year college students than other emerging adults. Notably, college students' affiliation with on-campus organizations, e.g., fraternities or sororities has been linked to a cluster of risk behaviors including alcohol, tobacco, and cannabis use, as well as more sexual partners and sex under the influence of substances (Primack et al., 2012; Scott-Sheldon, Carey, & Carey, 2008;

Sidani, Shensa, & Primack, 2013). A recent review showed that fraternity/sorority members are more likely to smoke cigarettes and use cannabis than nonmembers, and that members who lived in a fraternity/sorority house had greater rates of smoking than members who lived elsewhere (Cheney, Harris, Gowin, & Huber, 2014). Fraternity/sorority membership confers risk for college student substance use through both selection and socialization, although membership was associated with increases in drinking and cannabis use but not cigarette smoking over time (McCabe et al., 2005). In a community-based longitudinal study that directly examined living away from home, White et al. (2006) found that it was not associated with changes in cannabis use.

High school graduates not attending college are almost twice as likely to be working as those attending college (73% vs. 38%, respectively; Bureau of Labor Statistics, 2015). There is limited research on the relationship between employment and substance use in this age group. Among adults, working longer hours has been associated with increased cigarette use among regular smokers, greater likelihood of relapse among former smokers, and reduced likelihood of quitting smoking (Angrave, Charlwood, & Wooden, 2014). Angrave et al. speculate that this may be due to the increased stress experienced by those working longer hours. Among adolescents, number of hours worked per week has been associated with increased likelihood of cigarette and cannabis use among 8th- and 10th-graders (Bachman, Safron, Sy, & Schulenberg, 2003). Bachman et al. suggest that this may be due to some students adopting premature adult roles, though they do not offer evidence to support this. In a college sample, Sanem et al. (2009) found those who worked 20–39 hours had higher odds of current and daily cigarette use.

Peer and Parental Influences

Peer substance use strongly predicts increased substance use during the transition after high school (Kirst, Mecredy, Borland, & Chaiton, 2014). In a prospective study among a small non-national sample, Andrews, Tildesley, Hops, and Li (2002) found that socialization with substance-using peers predicted increased binge drinking and cigarette smoking but not cannabis use. A longitudinal investigation in New Jersey found that friends' tobacco use was positively associated with the probability of smoking among adolescent females but not males (White, Pandina, & Chen, 2002). Positive parenting behaviors such as support and monitoring are protective against adolescent substance use and, to a lesser extent, substance use during young adulthood (Kirst et al., 2014; Stone, Becker, Huber, & Catalano, 2012). Parental influence on substance use may be indirect by influencing levels of deviant peer affiliation (Simons-Morton & Farhat, 2010; Van Ryzin, Fosco, & Dishion, 2012).

Current study and objectives

The NEXT Generation Health Study (NEXT) is a 7-year, nationally representative, longitudinal study beginning with 10th grade students in 2010. Previous research has generally examined community and local samples (e.g. White et al., 2005), with cross sectional studies (e.g. Johnston et al., 2015), or with relatively old data, such as the Monitoring the Future Project (Schulenberg et al., 2004) which began in 1975. The current study extends Simons-Morton et al.'s (2016) study of the relationship between school, residential, and work statuses and alcohol use in this age group. The purpose of this research

is to examine how the exposure to different school, residential, and work environments shapes cigarette/cannabis use behaviors in the first year after high school.

Materials and methods

Sample

NEXT is a longitudinal study of a cohort of U.S. students ascertained through multistage sampling. Primary sampling units consisted of school districts or groups of school districts stratified across the nine U.S. census divisions. Eighty-one out of 137 (58.4%) randomly selected schools agreed to participate starting in the 2009–2010 school year (Conway et al., 2013). Within each school, 10th-grade classes were randomly selected; student assent and parental consent were obtained; participants provided consent at age 18. Students were surveyed annually, with a school-based assessment in the spring semester of 10th grade (Wave 1 [W1], 2010; $n = 2,524$), and web-based assessments in 11th grade (W2, 2011; $n = 2,439$), 12th grade (W3, 2013; $n = 2,407$), and the first year after high school (W4, 2013; $n = 2,177$). No information was collected on the characteristics of those schools that declined to participate, or on the students within those schools. The protocol was approved by Institutional Review Board of the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development.

Measures (all waves unless otherwise indicated)

Cigarette and Cannabis use.—30-day cigarette use and 12-month cannabis use prevalence were assessed as the number of occasions used in the time-frame. For both questions, response ranged from never to 40 times or more. Sparsity in some categories necessitated collapsing each variable to three levels: never, 1–5 times, 6 or more times. The word “cannabis” is used in the present manuscript. However, all questions in the questionnaire that asked about this substance used the word “marijuana.”

Demographic covariates.—Baseline demographic variables included: sex; race/ethnicity (White, African American, Hispanic, other); family structure (two biological parents, biological parent and stepparent, single parent, other), parent reported parental education (high school or less, some college or technical school, bachelor's degree or higher), and family affluence (low, moderate, high). The latter of these variables was calculated based on responses to 4 questions relating to the number of computers owned by family, number of cars/vans/trucks owned by family, number of vacations taken each year by family, and whether the participant had their own bedroom.

Parenting practices (Waves 1, 2, 3).—Perceived parental expectations for cigarette and cannabis use were measured. Participants were asked how important it is to their parents/guardians that they do not use cigarettes and, separately, not use cannabis (Hartos, Eitel, Haynie, & Simons-Morton, 2000; Hetherington et al., 1992). Response options ranged from 1 (*not at all*) to 7 (*extremely*). Parental monitoring-knowledge was assessed using questions adapted from a validated five-item scale (Brown, Mounts, Lamborn, & Steinberg, 1993). Adolescents reported their perceptions of their mother's and, separately, father's knowledge about who their friends were, how they spent their money, where they were after school,

where they went at night, and what they did with their free time. Response options (1–4) ranged from don't have/see father/mother, to he/she knows a lot. Higher scores reflect higher levels of monitoring-knowledge. Scores were averaged across items and across parents ($\alpha = .87, .88, \text{ and } .89$ for W1, W2, and W3, respectively).

Peer cigarette and cannabis use.—Participants indicated their perceptions of the frequency with which their five closest friends “smoke cigarettes” and, separately, “smoke/use marijuana”. Response options ranged from never, to almost always, collapsed to three levels (1=*never*, 2–3=*almost never/sometimes*, 4–5=*often/almost always*) because of sparsity in some categories.

Depressive symptoms (Waves 2, 3, and 4).—Respondents completed the Pediatric Depressive Symptoms Scale (Irwin et al., 2010), reporting how often they felt unhappy, sad, lonely, alone, that life was bad, that everything went wrong, that they could not do anything right, and that they could not stop feeling bad. Response options (1–5) ranged from never, to almost always. Responses were averaged, a higher score indicated more depressive symptoms (Dahlberg, Toal, Swahn, & Behrens, 2005) ($\alpha = .94, .95, \text{ and } .96$ for W2, W3, and W4, respectively).

Residential status (Wave 4).—Participants reported their current and previous residence in the past 12 months. Categories were combined to reflect living with parents, on their own (own place, rented room), on campus (residence hall/dorm or fraternity or sorority house), or other (dropped from analysis due to sparsity).

School status (Wave 4).—Participants indicated that they did not attend school, attended high school, technical/vocational school, community college, college/university, or graduate/professional school, and provided the school's name and location. Three categories were used in the analysis: not attending school, attending technical school/community college, and attending a college/university.

Work status (Wave 4).—Total hours per week in paid and unpaid employment was assessed using an item from Monitoring the Future (Bachman et al., 1983). Response options ranged from 0 to more than 30 hours. Working status was defined as *not working, less than 20, 21–30, or more than 30 hours*.

Analysis—One hundred twenty-six participants (those in high school and those who reported as their residence barracks, hospital, living with family members other than parents, and who were homeless) were excluded from this analysis. Multiple imputation by chained equations (MICE) based on the assumption of missing at random (Little & Rubin, 2002; van Buuren & Groothuis-Oudshoorn, 2011) was used to impute missing values due to subject or item nonresponse in both outcome and independent variables. Fifty multiply imputed data sets were generated using R package “mice.”

After descriptive statistics were calculated by wave, transition models (Diggle, Heagerty, Liang, & Zeger, 2002) were fitted to analyze the data ($N = 2,659$). The outcome variables at W2–W4, 30-day cigarette use and 12-month cannabis use, were analyzed separately. Ordinal

logistic transition models were used to deal with the trichotomized outcomes. For model simplicity and ease of interpretation, we made a “Markov assumption” (i.e., use in the current wave depended on use in the immediate past wave, but not on prior waves). Therefore, we included cigarette /cannabis use in the previous wave as a covariate. Other previous wave covariates included peer cigarette /cannabis use, depressive symptoms, and parenting practice. Coefficients reflect the average effects of that correlate at each wave on cigarette and cannabis use in the subsequent wave (i.e., W1 on W2, W2 on W3, and W3 on W4).

Environmental variables (school, residential and working status) were assessed only at W4 and hence enter the model as a predictor of W4, but not W1–W3 outcomes. Three environmental variables (employment, residential status, and school status) were tested in separate transition models for both outcome measures for a total of 6 models. The environmental variables were not analyzed in a single model to avoid over-adjusting. For example, one of the categories of residence (dorm) is related to the school status variable and so including these two in the same may model could lead to an attenuated estimation of the residential effect. Coefficients are interpreted as the effect of the environment on W4 cigarette /cannabis use. Models adjusted for baseline demographic variables. Transition models were estimated using generalized estimating equations, implemented in SAS PROC GENMOD (SAS Institute Inc., Cary, NC). Features of complex survey design, including clustering and sampling weights, were taken into account. Analyses were repeated for 50 imputed data sets; results combined using Rubin’s combination rule (Little & Rubin, 2002) implemented in SAS PROC MIANALYZE.

Results

Of the 2,659 participants, 45% (weighted) were male, and 56% were White, 20 % African American, and 18% Hispanic. The mean age at W1 was 16.3 years (SE = 0.03). There were 23.6% of participant in the low family affluence category, 50.0% in the moderate affluence category, and 27.3% in the high affluence category. Prevalence of cigarette use and cannabis use and values of other time-varying covariates are shown in Table 1. Cigarette use changed very little between W1 and W2; 9%–10% of participants reported having smoked cigarettes six or more times in the last 30 days. There was an increase at W3 to roughly 14% and with little change at W4. Cannabis use fluctuated with the lowest prevalence at W2 (12.8% for 6 or more times) and the highest at W4 (20.2%), a similar fluctuation found for reports of using 1–5 times.

Tables 2 and 3 show results of the transition models. Each transition model examined one environmental variable. Because the odds ratios for other variables (e.g., sex) were very similar across models for both cigarette and cannabis use, the non-environmental variables discussed below are taken from the model with school status (the first column in Tables 2 and 3).

For cigarette use (Table 2), females had a lower prevalence than males (odds ratio [OR] = 0.71, 95% CI [0.57,0.89]). White participants had a higher prevalence than African American (OR = 0.34 [0.22,0.53]) and Hispanic participants (OR = 0.57 [0.39,0.85]). Living

with a biological parent and stepparent was with an increased prevalence of cigarette use (OR = 1.32 [1.03–1.7]). Higher levels of depression were associated with high prevalence of cigarette use (OR = 1.25 [1.06,1.48]), while higher parental expectations not to use were associated with lower levels (OR = 0.9 [0.85,0.94]). Having used cigarettes frequently was strongly associated with using cigarettes in the current wave (OR = 18.08 [12.03,28.15], OR = 3.55 [2.57,4.9], for more than 6 times and 1 to 5 times, respectively). Having friends who smoke was associated with increased cigarette use, (OR = 2.72 [1.72,4.31] and OR = 1.85 [1.37,2.5] often/always smoke and seldom/sometimes smoke, respectively). In the school status model, participants not attending school had an increased prevalence of cigarette use compared with participants in a four year college (OR = 2.06 [1.33,3.19]). There was no difference between non-attenders and those attending technical school/community college (OR = 1.13 [0.64,1.99]). Cigarette use was not associated with either residential status or work status.

Females had a lower prevalence of cannabis use than males (Table 3; OR = 0.66 [0.56,0.78]), Hispanic participants had a lower prevalence than White participants (OR = 0.8 [0.63,1.0]), increased parental knowledge was associated with less cannabis use (OR = 0.75 [0.6,0.94]), and increases in parental expectation to not use were associated with less use (OR = 0.94 [0.89,0.99]). Compared with those who had low family affluence, high family affluence was associated with cannabis use (1.45 [1.04–2.01]). Previous use was highly associated (OR = 17.15 [12.03–24.46] for more than 6 times) and friends' use was associated (OR = 2.99 [1.99–4.51] for friends often/always use) with cannabis use. Regarding residential status, participants staying in a dorm/sorority/fraternity had marginally significant ($p = 0.054$) increased prevalence of cannabis use versus those living with their parents (OR = 1.34 [1.0,1.81]). There was no difference between participants living in their own place or a rented room and those living with their parents (OR = 0.78 [0.45,1.33]). No relationship was found between cannabis use and either school status or work status

Discussion

Similar to previous findings, we found females less likely to smoke cigarettes than males (Johnston et al., 2015) and African-American and Hispanic participants less likely to smoke cigarettes than white participants (Wallace et al., 2002). Higher levels of depressive symptoms were associated with increased cigarette use. Previous research suggests that cigarette smoking during adolescence may increase the likelihood of depression later in life (Brook, Schuster, & Zhang, 2010). We found that depressive symptoms, in turn, lead to continuation of cigarette use in the future. As expected, previous use and peer smoking strongly predicted smoking, (Kirst et al. (2014). Perceived parental expectations for not smoking was associated with less smoking, though the effect was small. Regarding the environmental variables, participants attending a 4-year college/university smoked less than their non-attending peers. This confirms in a longitudinal, nationally representative study findings from previous community (White et al., 2005) and cross sectional research (Johnston et al., 2015). Cigarette use was associated with neither residential nor work status. This latter finding contrasts with previous research suggesting that young people who work are more likely to smoke (Bachman et al., 2003; Sanem et al., 2009). However, past research has looked at younger adolescents or has focused solely on college students.

Females were less likely than males and Hispanic participants were less likely than white participants to use cannabis. While these sex differences are compatible with previous findings (Johnston et al., 2015), past research has found that African-Americans are less likely to use cannabis than white Americans (Wallace et al., 2002), which was not found in the current study. The current, nationally representative data are some of the most recently available, so this lack of differences could reflect a secular trend. Parental expectations not to use and higher monitoring/knowledge were associated with less cannabis use; both results consistent with a recent meta-analysis (Lac & Crano, 2009). As with cigarette use, cannabis use in a previous wave and peer cannabis use were the strongest predictors of current cannabis use. Regarding environmental variables, those living in a college dorm or a fraternity/sorority house were more likely to use cannabis than those living with their parents, though this difference was only marginally significant ($p = .054$). This result somewhat contrasts with that of White et al. (2006) who found that living away from home was not associated with an increase in cannabis use. Given the almost 20 year gap between the current sample and that of White et al., this difference could reflect general societal changes.

Findings in the current study make an interesting comparison with those of Simons-Morton et al. (2016), using the same sample and analytic methods, that those living on campus had higher levels of alcohol use and heavy episodic drinking. In the current study, cannabis use matched this pattern; cigarette use did not. The dissimilarity may reflect the typically social nature of alcohol and cannabis use, though this is speculative. Living on campus may be conducive to socializing in ways that living at home or in other accommodations may not be. Simons-Morton et al. found almost the reverse of the current cigarette findings, that those in a 4-year university used alcohol more than nonstudents and those attending technical/community college. Current findings on cigarette use, but not cannabis use, support the efficacy of recent efforts by universities to reduce on-campus smoking (ANRF, 2016). Additionally, social circumstances in which cigarettes and cannabis are used may differ substantially. Collectively, these findings suggest that alcohol and cannabis use are associated with similar post-high school environmental risk factors which do not play the same role for cigarette use. Future research could examine factors that lead non-college-bound young adults to be at a greater risk for increased cigarette use and factors that lead those living in dorms/fraternities/sororities to be at a greater risk for increased cannabis use after high school.

Strengths and limitations

Strengths of this research include data from a relatively large, nationally representative sample of adolescents surveyed over 4 years that include information on a breadth of related factors. Additionally, the study includes emerging adults who do not attend college immediately after high school, or who opt to attend community college or technical schools, groups that have received limited attention. Study limitations include the fact that all measures were self-reported. The different time frames used to measure use complicate direct comparisons of predictors of cigarette use with predictors of cannabis use. Lastly, there were too few respondents living in sorority/fraternity houses to consider them as separate analytic group. This is limiting because past research suggests increased cigarette use among this group (Cheney et al., 2014).

Conclusions

Cigarette and cannabis use among young adults are associated primarily with past use, but also with both parental support and peer use. Those who do not attend college/university are more likely to use cigarettes. This may reflect successes of recent college/university policies in reducing cigarette use, e.g., campus-wide bans. Residents of dorms or fraternity/sorority houses are most likely to use cannabis than their peers who live at home, perhaps reflecting social environments typifying cannabis use.

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Table 1.

Summary statistics for longitudinal outcomes and covariates. Mean (*SE*) is reported for continuous variables and percentage (*SE*) is reported for categorical variables

Variable	Range/labels	W1, %	W2, %	W3, %	W4, %
Cigarette Use	Never	81.6 (2.4)	82.3 (2)	77.4 (2.5)	75 (1.97)
	1–5 Times	8.7 (1.4)	8.5 (1)	8.5 (1.2)	10.6 (0.96)
	6+ Times	9.7 (1.6)	9.2 (1.7)	14.1 (2)	14.4 (1.99)
Cannabis Use	Never	74 (2.1)	75 (2)	72.7 (1.8)	65.8 (2.35)
	1–5 Times	11.4 (1)	12.2 (1.2)	11.5 (0.9)	13.9 (1.59)
	6+ Times	14.6 (1.7)	12.8 (1.5)	15.8 (1.7)	20.2 (1.99)
5 Friends Cigarette Use	Never	74.6 (2.3)	76.9 (2)	73.8 (1.9)	71.9 (2.22)
	Almost never/sometimes	15.9 (1.4)	13.6 (1.4)	15.4 (1)	17.7 (1.42)
	Often/always	9.5 (1.4)	9.5 (1.6)	10.9 (1.5)	10.4 (1.54)
5 Friends Cannabis Use	Never	72.5 (2.3)	74.7 (1.9)	72.3 (2.1)	68.8 (2.67)
	Almost never/sometimes	17.8 (1.8)	17.2 (1.4)	16.3 (1.3)	19 (2.02)
	Often/always	9.7 (1.1)	8.1 (1.1)	11.4 (1.3)	12.2 (1.5)
Parental Knowledge	1–4	2.35 (0.02)	2.32 (0.02)	2.3 (0.03)	–
Parental Expectations Cigarette Use	1–7	6.19 (0.05)	5.96 (0.06)	5.91 (0.07)	–
Parental Expectations Cannabis Use	1–7	6.16 (0.06)	5.99 (0.06)	5.9 (0.08)	–
Depressive symptoms	1–5	2.34 (0.03)	2.08 (0.03)	2.04 (0.05)	2.01 (0.04)
Working status	Not working	–	–	–	48.9 (2.7)
	20 hours or less	–	–	–	20.4 (1.8)
	21–30 hours	–	–	–	14.2 (1.2)
	>30 hours	–	–	–	16.5 (1.7)
Residential status	Parent's home	–	–	–	56.5 (2.6)
	On campus	–	–	–	16.1 (1.5)
	Own place	–	–	–	27.4 (2.3)
School status	Not attending	–	–	–	28.3 (2)
	Technical school/ community college	–	–	–	28.9 (1.8)
	College/university	–	–	–	42.8 (2.5)

Notes: W = wave

Table 2.

Transition model for cigarette use in the last 30 days.

Variable	Cigarette use as the outcome		
	Model 1 ^a	Model 2	Model 3
Sex			
Male (ref)			
Female	0.71 (0.57–0.89) **	0.7 (0.56–0.87) **	0.7 (0.56–0.86) ***
Race/Ethnicity			
White (ref)			
African-American	0.34 (0.22–0.53) ***	0.34 (0.22–0.53) ***	0.34 (0.22–0.53) ***
Hispanic	0.57 (0.39–0.85) **	0.57 (0.39–0.83) **	0.57 (0.39–0.83) **
Other	0.67 (0.33–1.38)	0.66 (0.32–1.37)	0.66 (0.32–1.38)
Parent Education			
High school or less (ref)			
Bachelor's degree or higher	0.81 (0.59–1.13)	0.79 (0.57–1.1)	0.77 (0.56–1.06)
Some college	1.12 (0.81–1.54)	1.07 (0.78–1.48)	1.07 (0.78–1.48)
Family structure			
Both biological parents (ref)			
Biological and stepparent	1.32 (1.03–1.7) *	1.35 (1.05–1.73) *	1.35 (1.06–1.73) *
Other	1.38 (0.96–2)	1.41 (0.99–2.03)	1.43 (0.99–2.05)
Single parent	1.2 (0.9–1.61)	1.21 (0.9–1.62)	1.21 (0.9–1.64)
Family Affluence			
Low (ref)			
Moderate	0.92 (0.73–1.17)	0.92 (0.72–1.18)	0.91 (0.72–1.16)
High	1.17 (0.87–1.57)	1.16 (0.86–1.58)	1.14 (0.85–1.54)
Depression	1.25 (1.06–1.48) **	1.25 (1.06–1.48) **	1.25 (1.06–1.48) **
Parental Knowledge	0.85 (0.65–1.11)	0.86 (0.66–1.13)	0.86 (0.66–1.12)
Parental Expectations about cigarette use	0.9 (0.85–0.94) ***	0.89 (0.85–0.94) ***	0.89 (0.85–0.94) ***
Cigarette use Previous Wave			
Never (ref)			
1 to 5 times	3.55 (2.57–4.9) ***	3.65 (2.65–5.02) ***	3.71 (2.73–5.05) ***
More than 6 times	18.08 (12.03–27.17) ***	18.67 (12.38–28.15) ***	19.17 (12.78–28.77) ***
Five Closest Friends Smoke Cigarettes			
Never (ref)			
Seldom/Sometimes	1.85 (1.37–2.5) ***	1.83 (1.36–2.47) ***	1.81 (1.35–2.41) ***
Often/Always	2.72 (1.72–4.31) ***	2.72 (1.73–4.27) ***	2.68 (1.69–4.26) ***
Wave			
2 (ref)			
3	1.81 (1.33–2.47) ***	1.82 (1.33–2.49) ***	1.82 (1.33–2.5) ***

Variable	Cigarette use as the outcome		
	Model 1 ^a	Model 2	Model 3
4	1.23 (0.81–1.85)	1.71 (1.29–2.27) ***	1.76 (1.21–2.54) **
W4 *School Status			
College/university (ref)			
Not attending	2.06 (1.33–3.19) **		
Technical school/community college	1.13 (0.64–1.99)		
W4 *Residential Status			
Parents' Home (ref)			
Dorm/Sorority/Fraternity		0.72 (0.43–1.22)	
Own Place/Rented Room		1.14 (0.72–1.82)	
W4 *Work Status			
0 hours per week (ref)			
Less than 20 hours per week			0.71 (0.33–1.51)
21–30 hours per week			1.08 (0.6–1.96)
30+ hours per week			0.86 (0.48–1.55)

* $p < .05$

** $p < .01$

*** $p < .001$.

Notes. ref = referent.

^a Each model includes just one environmental variable without adjustment for the other two environmental variables.

Table 3.

Transition model for Cannabis use in the last year

Variable	Cannabis use as the outcome		
	Model 1 ^a	Model 2	Model 3
Sex			
Male (ref)			
Female	0.66 (0.56–0.78) ***	0.66 (0.55–0.78) ***	0.66 (0.56–0.78) ***
Race/Ethnicity			
White (ref)			
African-American	0.99 (0.72–1.36)	0.97 (0.72–1.32)	0.97 (0.71–1.32)
Hispanic	0.8 (0.63–1) *	0.79 (0.64–0.99) *	0.77 (0.62–0.97) *
Other	0.93 (0.44–1.96)	0.93 (0.44–1.94)	0.91 (0.43–1.92)
Parent Education			
High school or less (ref)			
Bachelor's degree or higher	1.01 (0.75–1.37)	1 (0.74–1.34)	1.01 (0.75–1.37)
Some college	0.94 (0.76–1.16)	0.93 (0.76–1.16)	0.93 (0.76–1.16)
Family structure			
Both biological parents (ref)			
Biological and stepparent	1.03 (0.8–1.33)	1.03 (0.8–1.33)	1.03 (0.8–1.33)
Other	1.2 (0.87–1.65)	1.2 (0.87–1.67)	1.19 (0.86–1.65)
Single parent	1.27 (0.98–1.64)	1.27 (0.99–1.64)	1.27 (0.99–1.64)
Family Affluence			
Low (ref)			
Moderate	1.2 (0.96–1.51)	1.19 (0.95–1.5)	1.21 (0.96–1.52)
High	1.45 (1.04–2.01) *	1.42 (1.03–1.97) *	1.45 (1.04–2.01) *
Depression	1.11 (0.99–1.25)	1.11 (0.99–1.25)	1.11 (0.99–1.24)
Parental Knowledge	0.75 (0.6–0.94) *	0.75 (0.6–0.93) **	0.75 (0.6–0.93) **
Parental expectations about cannabis use	0.94 (0.89–0.99) *	0.94 (0.89–0.98) **	0.94 (0.89–0.99) *
Cannabis Use Previous Wave			
Never (ref)			
1 to 5 times	5.62 (4.11–7.69) ***	5.66 (4.14–7.74) ***	5.58 (4.09–7.62) ***
More than 6 times	17.15 (12.03–24.46) ***	17.31 (12.11–24.75) ***	17.09 (12.03–24.28) ***
Five Closest Friends Use Cannabis			
Never (ref)			
Seldom/Sometimes	1.93 (1.42–2.62) ***	1.91 (1.41–2.59) ***	1.94 (1.44–2.61) ***
Often/Always	2.99 (1.99–4.51) ***	2.95 (1.97–4.41) ***	3 (2.01–4.49) ***
Wave			
2 (ref)			
3	1.37 (0.97–1.95)	1.37 (0.97–1.94)	1.37 (0.96–1.95)
4	2.13 (1.58–2.88) ***	1.87 (1.39–2.51) ***	2.13 (1.62–2.79) ***

Variable	Cannabis use as the outcome		
	Model 1 ^a	Model 2	Model 3
W4 *School Status			
College/university (ref)			
Not attending	0.89 (0.58–1.38)		
Technical school/community college	0.83 (0.53–1.31)		
W4 *Residential Status			
Parents' Home (ref)			
Dorm/Sorority/Fraternity		1.34 (1–1.81)	
Own Place/Rented Room		0.78 (0.45–1.33)	
W4 *Work Status			
0 hours per week (ref)			
Less than 20 hours per week			0.94 (0.56–1.57)
21–30 hours per week			0.72 (0.43–1.2)
30+ hours per week			0.86 (0.51–1.44)

*
 $p < .05$

**
 $p < .01$

 $p < .001$.

Notes. ref = referent.

^a Each model includes just one environmental variable without adjustment for the other two environmental variables.