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Substance use behaviors and the timing of family formation during young adulthood

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Abstract

The impact of substance use on the life course of young adults can be substantial, yet few studies have examined to what extent early adult substance use behaviors are related to the timing of family formation, independent of confounding factors from adolescence. Using panel data from the Monitoring the Future study (N~20,000), the current study examined the associations between three substance use behaviors (i.e., cigarette use, binge drinking, and marijuana use) and the timing of family formation events in young adulthood. Survival analysis and propensity score weighting addressed pre-existing differences between substance users and non-users in the estimation of the timing of union formation (i.e., marriage, cohabitation) and parenthood. Results for young adult substance users showed general patterns of reduced rates of marriage and parenthood, and increased cohabitation during young adulthood. Variations were evident by substance and sex.

Keywords

cohabitation; marriage; parenthood; social roles; substance use; young adulthood

The transition to adulthood is a distinct period with key life events such as marriage and parenthood (Furstenberg, Rumbaut, & Settersten 2005; Schulenberg, Bryant, & O'Malley 2004). Recent decades have seen increased diversity in the type and the timing of family formation in young adulthood (Furstenberg et al., 2005; Oesterle, Hawkins, Hill, & Bailey, 2010). This heterogeneity in family formation choices (Schoen, Landale, & Daniels 2007) occurs in a complex setting of individual characteristics and behaviors (Schoen & Cheng, 2006; Schwartz & Mare, 2005), and cultural and economic factors (Arnett, 2005; Shanahan, 2000). Among these, the present study examines how three substance use behaviors at age 19/20 (cigarette smoking, binge drinking, and marijuana use) are related to the timing of family formation events at ages 21-30 (cohabitation, marriage, and parenthood), while controlling for factors already present at age 18. Understanding these associations is critical since young adulthood is a juncture in which early substance use behaviors may develop into lifelong substance misuse (Schulenberg & Maggs, 2002).

Substance use behaviors typically peak during adolescence and young adulthood (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2016) when individuals may begin to establish families. Previous literature has demonstrated two distinct associations between substance use and union formation and parenthood. First, substance use behaviors are associated with premature transitions to adult social roles, including teenage pregnancy and early marriage (Cavazos-Rehg et al., 2011; Krohn, Lizotte, & Perez, 1997; Martino, Collins, & Ellickson, 2004). Only a small percentage of youth engage in these early transitions; in the US, less than 1% marry (Copen, Daniels, Vespa, & Mosher, 2012) and 2.4% give birth before age 20 (Hamilton, Martin, Osterman, Curtin, & Mathews., 2015). Second, substance use behaviors are associated with lower rates of or delays in marriage (Fu & Goldman, 1996; Johnston et al., 2016; Green & Ensminger, 2006; Waldron et al., 2011) and parenthood (Staff, Greene, Maggs, & Schoon, 2014; Yamaguchi & Kandel, 1985). These associations have been observed for smoking (McDermott, Dobson, & Owen, 2006), alcohol (Fu & Goldman, 1996; Waldron et al., 2011), and illicit drugs (Green & Ensminger, 2006; Yamaguchi & Kandel, 1985).

Theoretically, substance use may directly affect family formation when it is viewed as incompatible with the responsibilities and social norms associated with marriage and parenthood (Yamaguchi & Kandel 1985). Individuals may then delay transitioning in order to maintain substance use or reduce substance use when transitioning to adult roles. This theory posits that the extent of incompatibility is related to a role's level of responsibility. The demands of marriage and parenthood may be associated with reduced substance use. Staff and colleagues (2014) found that married individuals and those residing with children showed lower problematic drinking than singles, after controlling for time-invariant individual characteristics like sex and race. Furthermore, married individuals show lower levels of alcohol consumption than those cohabiting (Plant et al., 2008), as cohabitation is potentially viewed to entail less commitment (Cherlin 2004; Forrest 2014, Nock 1995).

Arnett (2005) presents an alternative theory for associations between substance use and delayed family formation during emerging adulthood, a period spanning well into the 20s. The trends of delayed family formation may be primarily driven by cultural changes in education, employment, sexual behavior norms, and the role of marriage. The high rates of substance use in emerging adulthood may be due to greater freedom from parental and social control, or in response to the challenging process of defining one's identity. Thus, Arnett suggests that substance use and delayed family formation may both arise from the cultural phenomena that ascribe greater independence and less obligation to social norms for individuals during emerging adulthood (Arnett 2005; 2014).

Varying level of independence and obligation may be associated with particular substances and the frequency of use. Higher rates of delayed and deferred marriage have been found among binge drinkers and marijuana users (Duncan, Wilkerson, & England, 2006; Fu & Goldman, 1996; Yamaguchi & Kandel, 1985). Similarly, individuals who become parents show significant declines in alcohol and drug use disorders (Fergusson, Boden, & Horwood, 2012). In contrast, smoking cigarettes, as it is a legal and relatively stable substance use behavior (Hughes, Keely, & Naud, 2004) unlikely to result in significant negative consequences early in life, may be less strongly associated with delays in family formation.

No significant reductions in cigarette smoking were found in the transition to marriage and cohabitation among US adults (Duncan et al., 2006). Such variations across substances have not yet been examined in prior studies on family formation as these have typically focused on any substance use (King & South, 2011; Lonardo et al., 2010) or use of a single substance (e.g., cigarettes, Chassin, Presson, Sherman, & Edwards, 1992; marijuana, Yamaguchi & Kandel, 1985).

Previous studies provide some evidence that the associations between substance use behaviors and family formation differ for males and females (Peralta, 2008; Fu & Goldman, 1996; Oesterle, Hawkins, & Hill, 2011). Females tend to marry, cohabit, and have children earlier than males (Copen et al., 2012; Fussell & Furstenberg, 2005; Oesterle et al., 2010; Woodward, Fergusson, & Horwood, 2006). Female substance users, conversely, are less likely than their male counterparts to transition to any type of union (Fu & Goldman, 1996). Similarly, females experience declines in alcohol consumption during transition to adult roles, especially marriage and parenthood; no significant change is found for males (Christie-Mizell & Peralta, 2009), nor a significant effect of substance use on the timing of fatherhood (Pears et al., 2005). Females may still take on greater responsibilities in family roles than males (Bird, 1997; Sayer, 2005) and have concern regarding in utero exposure to substances, factoring into greater associations between substance and family formation for females than males.

These associations are likely also affected by pre-existing differences between substance users and non-users. Several earlier studies take baseline differences into account when investigating the impact of substance use on adult role transitions more broadly (e.g., educational attainment, Fergusson & Boden 2008; Maggs et al. 2015). Studies on family formation, however, have generally not carefully controlled for potential confounders. Using panel data from nationally representative samples of high school seniors, the present study examines associations between substance use behaviors at ages 19/20 and the timing of family formation during young adulthood (ages 21-30), while adjusting for potential confounders. We address several gaps in the literature by using recent cohorts, various substances (rather than “any substance use”), survival analysis to investigate timing (rather than overall rates), and propensity score weighting (PSW) to address potential confounding. PSW adjusts for pre-existing differences between substance users and non-users in the survival analysis models of marriage and cohabitation, and parenthood from ages 21 to 30. In our research hypotheses we expect that (1) substance use behaviors will be related to delays in marriage and parenthood and to earlier transition into cohabitation; (2) these associations will be stronger for binge drinking and marijuana use than for cigarette use; and (3) the associations will differ among females than males.

Data

The current analysis used data from the Monitoring the Future (MTF) study. MTF is an ongoing, annual series of surveys of nationally representative samples of U.S. students (8th, 10th, and 12th grades); a portion of the 12th graders are followed into adulthood (Johnston et al. 2016; see also <http://www.monitoringthefuture.org/>). Each year since 1976, about 2,400 high school seniors (modal age 18) have been selected for longitudinal follow-up; a random

half of the selected follow-up sample is surveyed every two years beginning one year after high school, and the other half every two years beginning two years after high school. Longitudinal surveys from 31,973 respondents who were high school seniors in 1990-2002 were completed between 1991 and 2014 at modal ages 19/20, 21/22, 23/24, 25/26, 27/28, and 29/30. Respondents were excluded from the analyses if they were lost to follow-up at the first follow-up at ages 19/20 (42.8% and 27.7% for males and females, respectively) or had missing values on the substance use exposures at ages 19/20 (1.2 - 2.6%). This procedure yielded total samples of 20,368 respondents for cigarette use, 19,910 for binge drinking, and 20,365 for marijuana use.

Measures

Substance use exposures

Cigarette use.—Participants were asked how frequently they smoked cigarettes during the past 30 days (responses from *not at all* to *two packs or more per day*). A dichotomous variable (1 = *ever smoked*, 0 = *never smoked*) was created to indicate whether respondents smoked any cigarettes in the last 30 days during their senior year in high school (modal age 18) and another dichotomous variable at first follow-up survey (modal ages 19/20).

Binge drinking.—Respondents were asked how many times they have had five or more drinks in a row during the past two weeks (responses from *none* to *10 or more times*). Binge drinking was coded by a dichotomous indicator of 1 = *ever binged*, 0 = *never binged during the last 2 weeks* at modal ages 18 and 19/20.

Marijuana use.—Marijuana use status was measured by the frequency of marijuana use during the last 30 days (responses from *0 occasions* to *40 or more*). A dichotomous variable was created to indicate 1 = *ever used marijuana*, 0 = *never used marijuana during the last 30 days* at modal ages 18 and 19/20.

Family formation outcomes

Marriage and cohabitation.—At each follow-up, respondents were asked about their marital status (1 = *married*, 2 = *engaged*, 3 = *separated/divorced*, 4 = *widowed*, and 5 = *single*) and household members including their opposite or same sex partner. Using this information, a variable of union status was created to indicate 0 = *neither married nor cohabiting*, 1 = *married*, and 2 = *cohabiting (living with a nonmarital partner)* for each follow-up survey.

Parenthood.—Participants reported their number of children (biological, adopted, and stepchildren) during every follow-up survey (*none* to *three or more*). Parenthood was coded as 1 = *have any child (i.e., a parent)* and 0 = *no children* for each follow-up survey.

Potential confounders

Demographic variables included race/ethnicity, religiosity, cohort, parental educational attainment, and family structure. Race/ethnicity was coded as *Black*, *Hispanic*, and *Others*, with *White* as a reference category. Religiosity was coded as an ordinal scale from 1 = *not*

important, to 4 = *very important* to the respondent. Cohort was coded as a set of dummy variables: 1990 to 1994, 1995 to 1999 and 2000 to 2002. Parental educational attainment was coded as 1 = *at least one parent had a college degree* and 0 = *no parent with a college degree*. Family structure at age 18 was coded as 1 = *both father and mother in the household*, and 0 = *others*.

High school characteristics included GPA (from 1 = *D [69 or below]* to 9 = *A [93-100]*), truancy (from 1 = *none* to 7 = *11 or more during the last four weeks*), evenings out (from 1 = *less than one* to 6 = *six or seven during a typical week*), and plans to attend college (1 = *definitely attend 2 or 4 year college*, 0 = *others*). High school program was included as a dichotomous variable of 1 = *academic or college preparation* and 0 = *other programs (general, vocational, technical or commercial, and others or don't know)*. The use of illicit drugs other than marijuana during the last 12 months (i.e., LSD, other hallucinogens, cocaine, heroin, other narcotics, amphetamines, barbiturates, and tranquilizers) was also included (1 = *any use*, 0 = *no use*).

Methods

Survival analysis

For each of the three substance use behaviors, we conducted survival analysis to assess how substance use behaviors at ages 19/20 were related to the timing of family formation events in young adulthood. Two models of interest were used to examine the timing of (1) two types of union formation, marriage and cohabitation, and (2) parenthood; both models were stratified by sex. The outcomes were assessed from ages 21/22 to 29/30 in order to separate the influence of substance use at ages 19/20 on later family formation after balancing for pre-existing differences at age 18. A discrete time multinomial regression model for union formation and a discrete time logistic regression model for parenthood were used.

Specification of a distribution for the event times is important in parametric survival models (Allison, 1984; Box-Steffensmeier & Jones, 2004; Singer & Willett, 1993). For each exposure / outcome survival model of interest, we considered several time specifications: only linear main effect terms for time, inclusion of quadratic and cubic time terms, and a general specification with a series of dummy variables for each time period. Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC) were used to select the best model with regard to time specification (Allison, 2010). We then examined the proportional hazards assumption for each survival model by assessing whether inclusion of (time \times substance use) interaction terms improved model fit based on a Wald test (Box-Steffensmeier & Jones, 2004).

Propensity score weighting

The exposures of interest in this study were three substance use behaviors at modal ages 19/20: cigarette use, binge drinking, and marijuana use. Given observed differences between substance users (exposure) and non-users (control) groups at ages 19/20, a propensity score weighting method was used to adjust for potential confounders (McCaffrey, Ridgeway, & Morral, 2004; Stuart & Rubin, 2007). The propensity score, denoted $\hat{\pi}$, is defined as an

individual's conditional probability of being in the substance user group at ages 19/20, given his/her observed covariates at age 18. Specifically, an inverse probability of treatment weighting (IPTW) approach was used, in which individuals in the exposure group receive a weight of $\frac{1}{\pi}$ while those in the control group receive a weight of $\frac{1}{1-\pi}$ (Lunceford & Davidian, 2004; Robins, Hernán, & Brumback, 2000). IPTW weighting estimates the population average treatment effect (ATE; Austin 2011; Stuart 2010). The Toolkit for Weighting and Analysis of Nonequivalent Groups (*twang*) package was used to estimate the PSW, using Stata 14 and R version 3.2.2 (Cefalu, Liu, & Martin 2015; Ridgeway et al., 2015). *Twang* uses generalized boosted modeling (GBM), a flexible and nonparametric estimation method that has been shown to outperform other algorithms for propensity score estimation with respect to bias (McCaffrey et al. 2004). GBM performance is particularly effective when a large set of covariates is involved in the propensity score modeling (Bühlmann & Yu 2003; McCaffrey et al. 2004).

The covariates included in the propensity score regression were high school substance use behaviors as well as demographic characteristics that were relevant to both substance use and family formation during young adulthood. All propensity score covariates were measured in 12th grade (age 18), prior to the substance use exposures measured at the first follow-up (ages 19/20). Specifically, these included cigarette use, binge drinking, marijuana use, and other illicit drug use in the high school senior year; race/ethnicity; high school GPA; frequencies of truancy and of evenings out for fun and recreation; plan to attend college; high school program; religiosity; parental educational attainment; two parents in the home; and 12th grade cohort. We estimated a separate propensity score model for each substance use behavior at modal ages 19/20 by sex; each propensity score model included all of the covariates. Covariate missingness rates were low (ranging from 0.01 - 6.80%). The *twang* package generated missingness indicators for every covariate with missing values; these indicators were included in the propensity score regression, such that exposure groups were balanced both on observed covariate values and degree of missingness (Cefalu et al. 2015). We assessed whether the PSW provided sufficient balance by considering absolute standardized mean difference (ASMD) value (Austin 2011; Stuart 2010). The smaller the ASMD value, the more the exposure and control groups are similar with regard to a specific covariate (Austin 2011; Stuart 2010). In general, ASMD values less than 0.20 indicate a good balance between exposure and control groups (Cohen 1992; Rubin 2001).

Final Model Specification

Additionally, we used an attrition weight to address attrition at the first follow-up wave at age 19/20 when our exposure (i.e., substance use behaviors) was measured and the majority of loss to follow-up (> 90%) occurred. Specifically, the rates of dropout at this follow-up wave were 43% and 28% of males and females, respectively; attrition was high at this stage as it was the first study wave not administered in a school setting. The attrition weight was estimated using a set of age 18 characteristics (i.e., sex, race/ethnicity, college plans, high school grades, two parents in the home, religiosity, parental education, alcohol use, cigarette use, marijuana use, use of illicit drugs other than marijuana, region, cohort) and the MTF drug-user oversampling weight. This attrition weight reweights the individuals at the age 19/20 follow-up wave to match the original baseline sample at age 18.

All survival analysis models were weighted using a composite weight composed of the product of IPTW and the attrition weight. Additionally, we included each substance use behavior at age 18 in all models. This is a form of “double-robust” estimation (Bang & Robins, 2005; Lunceford & Davidian 2004; Robins 2000); estimates for ATE will be unbiased if either the propensity score regression or outcome regression is correctly specified.

Results

Descriptive Statistics

By ages 29/30, 36.3% of our sample had married, 27.3% had cohabited, and 30.4% had become parents. The family formation events occurred at mean ages 23 and 24 for those who had experienced these transitions by age 29/30. Note that individuals who experienced outcome events before ages 21/22 were excluded, but these frequencies were low in our sample (4.5% marriage, 5.3% cohabitation, and 4.4% parenthood).

Tables 1 and 2 report baseline characteristics of users (exposure group) and non-users (control group) of three substances (cigarettes, binge drinking, and marijuana) before and after PSW. Prior to weighting, notable differences were found between substance users and non-users for both males and females (i.e., ASMD values for most indicators were greater than 0.20). Specifically, a greater proportion of substance users at ages 19/20 used substances at age 18, had a lower high school GPA, and reported more frequent truancy and evenings out. Additionally, a smaller proportion of substance users were Black or Hispanic, religious, in a college preparation program, planning to go to college, and from a two parent household. After PSW, the differences between groups were significantly reduced for both males and females, and good covariate balance was achieved for all variables as ASMD values were less than 0.1.

Survival Analyses

Model Selection.—For each exposure / outcome pairing among both males and females, a general rather than parametric time specification yielded the best model fit (results upon request). Additionally, for males, inclusion of interaction terms yielded significantly improved fit only for binge drinking / union formation. For females, inclusion of interaction terms improved model fit for cigarette use / union formation, binge drinking / union formation, and marijuana use / union formation. In all other models, the general time specification without interaction terms was used (results upon request).

Timing of Marriage.—In general, a greater proportion of non-users married than substance users during ages 21-30 (Figure 1). The left columns of table 3 report relative risks ratios (RRR) of marriage. Among males, binge drinking and marijuana use at ages 19/20 were significantly associated with reduced odds of marriage (RRR = 0.78 for each). We also observed a significant age-varying association for binge drinking (RRR = 1.11), indicating that the magnitude of this association is stronger at younger ages and decreases towards a null association with increasing age. For females, smoking cigarettes was associated with reduced odds of marriage (RRR = 0.81) and showed a significant age-

varying association (RRR = 1.08), indicating that the magnitude of this association is stronger at younger ages and decreases with age. Although the associations between binge drinking and marijuana use at ages 19/20 and marriage among females were not statistically significant, their marriage rates did appear to be lower than those for non-users (RRR = 0.93 [p= 0.34]) and 0.80 [p= 0.06] for binge drinking and marijuana use, respectively). Interestingly, significant age-varying associations were observed for both drinking and marijuana use among females, indicating that the marriage rates for users and non-users became more similar with increasing age (binge drinking RRR = 1.06; marijuana RRR = 1.09).

Timing of Cohabitation.—A greater proportion of substance users cohabited than non-users during ages 21-30 (Figure 1). The middle columns of table 3 present RRR for cohabitation. For males, binge drinking and marijuana use at ages 19/20 were associated with increased odds of cohabitation (RRR = 1.29 for each). For females, cigarette use, binge drinking, and marijuana use at ages 19/20 were all significantly associated with increased odds of cohabitation (RRR = 1.30, 1.49, and 1.44, respectively).

Timing of Parenthood.—A greater proportion of non-users than substance users became a parent during ages 21-30 (Figure 2). Odds ratios of parenthood for males and females are reported in the right columns of table 3. For males, binge drinking and marijuana use at ages 19/20 were significantly associated with reduced odds of parenthood (OR= 0.86 and 0.81, respectively). Among females, only binge drinking at ages 19/20 was significantly associated with reduced odds of parenthood (OR = 0.78).

Discussion

How and when young adults in the US start their families has become increasingly diverse over last few decades (Schoen et al. 2007). More young adults now delay their entry into marriage and parenthood and tend to cohabit as an alternative to marriage and being single (Bumpass & Lu 2000; Schoen et al. 2007; Martin, Hamilton, & Osterman 2014). Previous studies have shown that substance use behaviors during young adulthood are significantly related to variations in the timing of transition to adult roles (Krohn et al. 1997; Yamaguchi & Kandel 1985) and patterns of transition (e.g., completion of education; Patrick, Schulenberg, & O'Malley 2013). This study addresses several gaps in the literature by assessing associations between family formation and three types of substance use (rather than “any substance use”) among recent cohorts. Survival analysis was used to investigate timing (rather than overall rates) and propensity score weighting was used to address potential confounding.

Our results show overall reduced odds of marriage for males who reported binge drinking or marijuana use at ages 19/20 and females who reported cigarette smoking at ages 19/20. While marriage rates have been declining overall (Copen et al., 2012), these early adult substance users have even further reduced odds of marriage relative to non-users. The findings expand previous research documenting significantly delayed marriage among primarily white substance users (Fu & Goldman, 1996) by replicating the results for specific substances in a diverse and more recent national sample. As substance use in early

adulthood is a strong predictor of substance use in later adulthood (Merline et al., 2004), individuals reporting substance use at age 19/20 may be perceived as less desirable spouses during their 20s, resulting in lower rates of marriage by age 30. Interestingly, no significant effects of binge drinking and marijuana use at ages 19/20 on marriage were found among females. This may be due to the fact that binge drinking and marijuana use tend to be less persistent behaviors among females than males (Schuler, Vasilenko & Lanza, 2015) and thus less likely to impact perceived suitability for marriage. Alternatively, males and females may differentially perceive a partner's substance use to be "incompatible" with marriage (Peralta, 2008); females may be less tolerant of a potential spouse's substance use, resulting in a greater negative association with marriage among males.

We also observed significant age-varying associations between substance use behaviors and the timing of marriage. The difference in marriage rates between users and non-users was greater at younger ages and decreased with age, suggesting that substance users may delay rather than abstain from marriage. These age-varying associations occurred for binge drinking among males and cigarette smoking, binge drinking or marijuana use among females. As college attendance is associated with substance use at age 19/20, delayed marriage may be a result of extended education for some individuals (Arnett 2005; Goldstein & Kenney 2001; White, Labouvie, & Papadaratsakis 2005).

Substance use behaviors at ages 19/20 were linked to greater odds of cohabitation in young adulthood. The associations were quite robust: among females, all three substance use behaviors were associated with increased cohabitation, while both binge drinking and marijuana use were associated with increased cohabitation among males. These findings may reflect the perception that cohabitation is less incompatible with substance use than other family formation behaviors (Thornton, Axinn, & Teachman 1995). Cohabitation may be viewed as a means of exploring intimacy among young adults (Michael, Gagnon, Laumann, & Kolata, 1995; Huang, Smock, Manning, & Bergstrom-Lynch, 2011) that does not require meeting the commitment level or social expectations of marriage (Nock 1995). Additionally, the associations between cohabitation and early adult substance use may be explained by a common "nonconforming" personality factor, as social norms often discourage both substance use and cohabitation.

The prevalence of parenthood between ages 21 and 30 was significantly lower for males who reported binge drinking or marijuana use at ages 19/20 and for females who reported binge drinking at ages 19/20. The overall associations between substance use and reduced prevalence of parenthood are similar to those observed for marriage, suggesting that the decreases in parenthood for users may, in part, be explained by decreased rates of marriage. Additionally, reduced parenthood among binge drinkers and male marijuana users may result from concerns about potential negative effects of substance use behaviors on children; this may hold in particular for those whose substance use continues into the 20s and who may be concerned about role modelling of substance use (Hurd, Zimmerman, & Xue, 2009; Bailey, Hill, Hawkins, Catalano, & Abbott, 2008). On the other hand, for individuals with more transient binge drinking in their early 20s (e.g., during college), decreased rates of parenthood may be associated with graduate education or increased career demands (Fromme, Corbin, & Kruse, 2008; Johnston et al., 2016).

While our analyses did not explicitly test for gender differences, our stratified analyses revealed different patterns of associations between substance use behaviors and the timing of family formation by sex. For females, we found significant effects of binge drinking on delayed parenthood and cigarette use on delayed marriage while among males delayed parenthood and marriage were found for binge drinking and marijuana use. For both males and females, earlier transition to cohabitation was found among all substance users except male cigarette smokers. These findings differ from previous research that showed significant associations between substance use and marriage (Fu & Goldman, 1996) and parenthood (Christie-Mizell & Peralta, 2009) among females but not males (Pears et al., 2005). Our findings may reflect changing gender roles such that males and females in recent cohorts (i.e., high school seniors in 1990-2002) have more similar levels of responsibility toward family roles. Additionally, our use of propensity score weighting that adjusts for baseline adolescent characteristics to achieve less biased estimates may explain differences with earlier studies. Specifically, we did not observe an association between marriage and either binge drinking or marijuana use among females; previously observed associations may have been largely due to confounding. We also found significant associations between cigarette smoking among women in their early 20s and the timing of marriage and cohabitation, despite no significant effect of cigarette use on family formation in previous research (Duncan et al., 2006). Further research is needed to describe and understand the changing landscape of sex differences in terms of the impact of substance use behaviors on family formation for males and females.

A few limitations need to be acknowledged. First, we investigated family formation patterns of young adults from ages 21 to 30, which excluded earlier and later transitions to adult social roles; differential associations with substance use may be observed for earlier or later age ranges. Second, marital and cohabitation status were assessed every 2 years in the MTF survey, which may have resulted in misclassification of individuals who experienced short-term family formation and dissolution that were not captured between survey waves. Third, while propensity score weighting was used to balance substance users and non-users on a set of observed covariates, propensity score weighting cannot address potential differences with regard to unmeasured or omitted variables. Thus, residual confounding may arise from unmeasured or omitted variables that may have significantly affected both family formation and substance use behaviors (e.g., personality, social support, concurrent mental health conditions). Fourth, MTF data are collected from only those remaining in school through the 12th grade; thus our results may not be generalized to those who drop out of high school. Fifth, sex was measured based on respondent self-report of being either male or female, such that it is not possible to make a biological or sociological distinction (West & Zimmerman, 2009). Finally, although we control for cohort in our analyses, there may be residual confounding regarding family formation due to cohort effects.

The current study adds to the existing literature on the transition to adulthood by focusing on the effects of young adult substance use behaviors on normative family formation across young adulthood for males and females. Through the use of propensity score weighting, we were able to rigorously adjust for observed pre-existing differences between substance users and non users which may have confounded the associations between substance use behaviors and the timing of family formation events. In general, studies of substance use

behaviors and life course outcomes should be mindful of selection effects and other possible confounding factors stemming from baseline differences between individuals. Overall, our results provide evidence that substance use behaviors are related to delays in marriage and parenthood but higher rates of cohabitation during young adulthood, and indicate that there is variation in the associations between substance use behaviors and family formation across substances and across sex. While our study was designed to carefully investigate the associations between substance use in early adulthood and subsequent family formation events, we are not able to examine causality of the underlying mechanisms for the observed associations. From our results, it is not possible to determine whether substance use behaviors causally delay family formation, as suggested by Yamaguchi and Kandel (1985), or whether they are associated due to common causes, such as shifting social norms regarding independence and responsibility, as suggested by Arnett (2005, 2014). Furthermore, the current study does not examine the potentially dynamic relationship between substance use and family formation or the longitudinal effects of substance use at various ages across the 20s; we recommend that these time-varying effects of substance use behaviors on family formation are explored in additional studies. Future research should also extend the current research into middle adulthood in order to understand midlife outcomes for young adults involved in substance use, as well as the extent to which family formation may mediate the association between substance use and later health and well-being.

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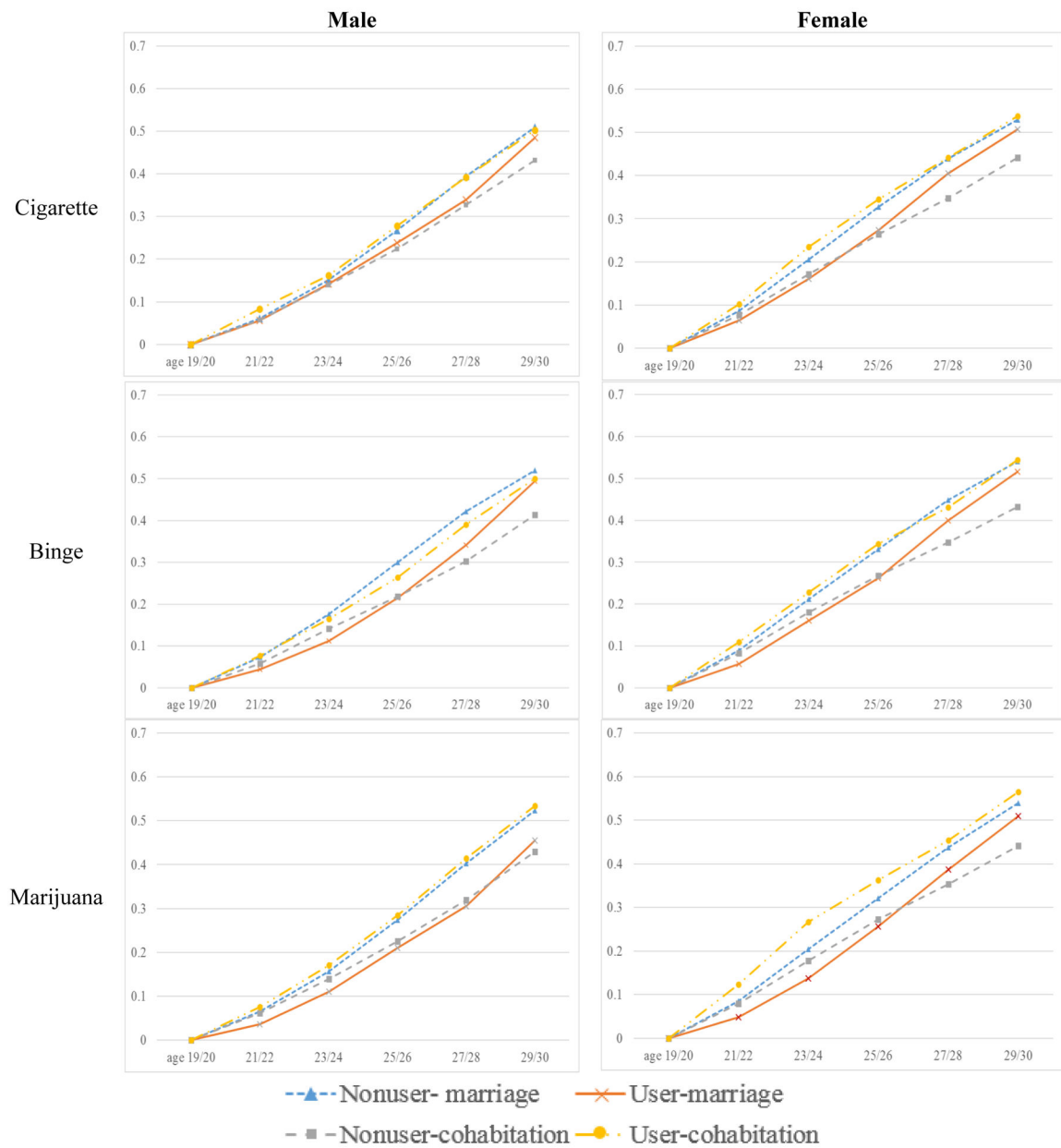


Figure 1.
 Cumulative Incidence Curves for Union Formation (Marriage/Cohabitation) Among
 Substance Users and Non-users

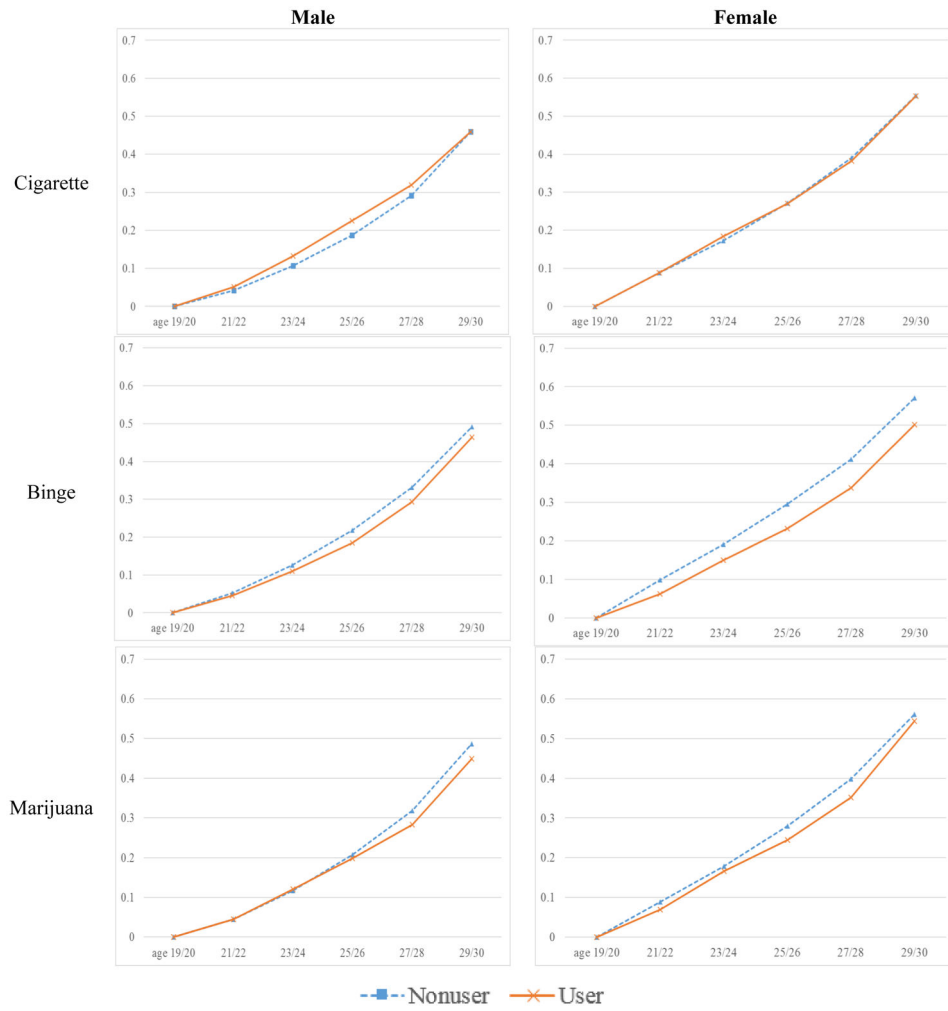


Figure 2. Cumulative Incidence Curves for Parenthood Among Substance Users and Non-users

Table 1. Sample Characteristics of Male Substance Users (exposure group) and Non-users (control group) before and after PSW in the Propensity Score Regression Models of Cigarette, Binge Drinking, and Marijuana Uses at Ages 19/20

| | Cigarette use at ages 19/20 | | | | Binge drinking at ages 19/20 | | | | Marijuana use at ages 19/20 | | | |
|---------------------------|-----------------------------|--------------------|-----------|--------------------|------------------------------|--------------------|-----------|--------------------|-----------------------------|--------------------|-----------|--------------------|
| | Before PSW Users | After PSW Users | Non-users | n | Before PSW Users | After PSW Users | Non-users | n | Before PSW Users | After PSW Users | Non-users | n |
| Age 18 | | | | | | | | | | | | |
| n | 3,115 | 5,675 | - | - | 3,936 | 4,640 | - | - | 2,251 | 6,555 | - | - |
| Cig. | 74.2% | 13.0% | 36.0% | 33.1% ^a | 50.3% | 20.9% | 35.2% | 34.2% ^a | 61.0% | 25.2% | 36.5% | 33.8% ^a |
| Binge | 57.3% | 27.7% | 40.1% | 38.2% ^a | 60.7% | 18.8% | 38.8% | 37.9% ^a | 62.8% | 29.5% | 42.3% | 37.9% ^a |
| MJ | 47.6% | 14.3% | 26.8% | 25.2% ^a | 40.1% | 14.1% | 26.8% | 25.9% ^a | 65.7% | 12.2% | 28.3% | 25.1% ^a |
| OTM | 47.8% | 18.4% | 29.5% | 28.1% ^a | 41.0% | 18.3% | 29.7% | 28.6% ^a | 58.0% | 18.5% | 30.2% | 28.0% ^a |
| Race/ethnicity | | | | | | | | | | | | |
| Black | 3.9% | 8.5% | 5.6% | 6.7% ^a | 2.9% | 9.7% | 6.0% | 6.7% ^a | 5.6% | 7.4% ^a | 7.5% | 6.8% ^a |
| Hispanic | 5.6% | 8.2% | 6.6% | 7.3% ^a | 6.3% | 7.9% ^a | 6.9% | 7.2% ^a | 6.5% | 7.5% ^a | 7.3% | 7.3% ^a |
| Others | 7.8% | 10.1% ^a | 8.7% | 9.2% ^a | 6.9% | 11.1% | 9.0% | 9.3% ^a | 7.5% | 9.7% ^a | 7.5% | 9.2% ^a |
| GPA (range: 1-9) | 5.59 | 6.26 | 6.02 | 6.06 ^a | 5.90 | 6.14 | 6.01 | 6.02 ^a | 5.61 | 6.15 | 5.96 | 6.03 ^a |
| Cut classes (range: 1-7) | 2.02 | 1.63 | 1.78 | 1.75 ^a | 1.97 | 1.59 | 1.77 | 1.77 ^a | 2.20 | 1.62 | 1.79 | 1.75 ^a |
| Evenings out (range: 1-6) | 4.10 | 3.52 | 3.75 | 3.72 ^a | 4.06 | 3.43 | 3.74 | 3.71 ^a | 4.24 | 3.55 | 3.79 | 3.71 ^a |
| College preparation | 49.3% | 59.2% | 55.9% | 56.4% ^a | 57.5% | 55.1% ^a | 55.8% | 55.8% ^a | 54.5% | 56.1% ^a | 56.8% | 56.1% ^a |
| College intention | 51.5% | 59.6% | 57.8% | 57.6% ^a | 58.5% | 55.6% ^a | 56.6% | 56.6% ^a | 55.8% | 57.0% ^a | 59.2% | 57.1% ^a |
| Religiosity (range: 1-4) | 2.36 | 2.69 | 2.56 | 2.58 ^a | 2.41 | 2.71 | 2.56 | 2.56 ^a | 2.26 | 2.68 | 2.55 | 2.58 ^a |
| Parent college | 71.3% | 70.7% ^a | 71.9% | 71.4% ^a | 74.8% | 68.1% | 71.8% | 71.3% ^a | 74.7% | 69.4% | 71.2% | 70.8% ^a |
| Two parent cohort | 74.5% | 76.1% ^a | 76.9% | 75.9% ^a | 77.1% | 74.5% ^a | 75.6% | 75.4% ^a | 73.8% | 76.2% ^a | 75.9% | 75.8% ^a |
| 90_94 | 42.2% | 44.9% ^a | 44.0% | 43.9% ^a | 43.1% | 45.1% ^a | 44.2% | 44.7% ^a | 37.8% | 46.5% | 44.5% | 44.5% ^a |

| n | Cigarette use at ages 19/20 | | Binge drinking at ages 19/20 | | Marijuana use at ages 19/20 | |
|-------|-----------------------------|--------------------|------------------------------|--------------------|-----------------------------|--------------------|
| | Before PSW | After PSW | Before PSW | After PSW | Before PSW | After PSW |
| 95_99 | 39.6% | 37.8% | 38.1% | 36.1% | 40.5% | 37.6% |
| 00_02 | 18.3% | 18.2% | 18.8% | 18.8% | 21.8% | 17.9% |
| | 3,115 | 5,675 | 3,936 | 4,640 | 2,251 | 6,555 |
| | 35.8% ^a | 37.1% ^a | 36.8% ^a | 36.9% ^a | 35.8% ^a | 37.0% ^a |
| | 19.2% ^a | 19.0% ^a | 18.5% ^a | 18.5% ^a | 17.8% ^a | 18.5% ^a |

Note:

^a indicates ASMD (Absolute Standardized Mean Difference) less than 0.1.

PSW: propensity score weighting, Cig: cigarette use, Binge: Binge drinking, MJ: Marijuana use, OTM: Other than marijuana use (other illicit drug use)

Table 2.

Sample Characteristics of Female Substance Users (exposure group) and Non-users (control group) before and after PSW in the Propensity Score Regression Models of Cigarette, Binge Drinking, and Marijuana Uses at Ages 19/20

| | Cigarette use at ages 19/20 | | | | Binge drinking at ages 19/20 | | | | Marijuana use at ages 19/20 | | | |
|---------------------------|-----------------------------|--------------------|-----------|--------------------|------------------------------|--------------------|-----------|--------------------|-----------------------------|--------------------|-----------|--------------------|
| | Before PSW | | After PSW | | Before PSW | | After PSW | | Before PSW | | After PSW | |
| | Users | Non-users | Users | Non-users | Users | Non-users | Users | Non-users | Users | Non-users | Users | Non-users |
| n | 3,806 | 7,772 | - | - | 3,494 | 7,840 | - | - | 2,220 | 9,339 | - | - |
| Age 18 | | | | | | | | | | | | |
| Cig. | 74.2% | 12.2% | 34.1% | 31.7% ^a | 51.2% | 24.2% | 33.7% | 32.2% ^a | 64.2% | 24.8% | 35.0% | 32.0% ^a |
| Binge | 43.6% | 15.3% | 26.5% | 24.4% ^a | 47.5% | 14.4% | 25.4% | 24.0% ^a | 50.1% | 18.4% | 27.2% | 24.3% ^a |
| MJ | 41.6% | 9.5% | 21.1% | 19.5% ^a | 35.9% | 13.1% | 20.6% | 19.7% ^a | 59.1% | 10.6% | 21.6% | 19.6% ^a |
| OTM | 44.8% | 16.5% | 27.2% | 25.3% ^a | 40.1% | 19.3% | 26.6% | 25.5% ^a | 53.8% | 18.9% | 27.7% | 25.3% ^a |
| Race/ethnicity | | | | | | | | | | | | |
| Black | 2.7% | 12.9% | 7.8% | 9.6% ^a | 3.1% | 12.1% | 7.8% | 9.4% | 5.0% | 10.6% | 9.6% | 9.5% ^a |
| Hispanic | 5.9% | 9.6% | 7.7% | 8.4% ^a | 6.7% | 8.9% ^a | 7.8% | 8.2% ^a | 6.8% | 8.8% ^a | 8.0% | 8.4% ^a |
| Others | 6.7% | 8.9% ^a | 7.5% | 8.2% ^a | 6.2% | 9.0% | 7.9% | 8.2% ^a | 7.8% | 8.2% ^a | 8.1% | 8.1% ^a |
| GPA (range: 1-9) | 6.09 | 6.77 | 6.52 | 6.57 ^a | 6.47 | 6.59 ^a | 6.57 | 6.56 ^a | 6.23 | 6.62 | 6.49 | 6.55 ^a |
| Cut classes (range: 1-7) | 1.97 | 1.49 | 1.67 | 1.63 ^a | 1.93 | 1.53 | 1.67 | 1.64 ^a | 2.14 | 1.53 | 1.73 | 1.64 ^a |
| Evenings out (range: 1-6) | 3.83 | 3.22 | 3.45 | 3.40 ^a | 3.83 | 3.23 | 3.45 | 3.41 ^a | 4.01 | 3.27 | 3.50 | 3.41 ^a |
| Collegepreparation | 53.0% | 63.2% | 60.5% | 60.7% ^a | 61.7% | 59.3% ^a | 60.7% | 60.0% ^a | 57.5% | 60.4% ^a | 61.5% | 60.1% ^a |
| College intention | 62.1% | 71.4% | 69.6% | 69.0% ^a | 69.9% | 67.5% ^a | 69.3% | 68.3% ^a | 65.9% | 68.8% ^a | 70.0% | 68.4% ^a |
| Religiosity (range: 1-4) | 2.54 | 2.94 | 2.78 | 2.82 ^a | 2.56 | 2.91 | 2.77 | 2.80 ^a | 2.41 | 2.90 | 2.74 | 2.81 ^a |
| Parentcollege | 69.1% | 67.3% ^a | 69.0% | 68.3% ^a | 73.8% | 65.4% | 69.1% | 67.9% ^a | 74.1% | 66.2% | 69.4% | 67.7% ^a |
| Two parent Cohort | 71.1% | 74.5% ^a | 73.8% | 73.8% ^a | 74.7% | 73.0% ^a | 74.3% | 73.4% ^a | 68.3% | 74.6% | 73.0% | 73.7% ^a |
| 90_94 | 39.2% | 41.3% ^a | 40.6% | 40.8% ^a | 38.0% | 41.9% ^a | 40.9% | 40.9% ^a | 33.2% | 42.6% | 38.5% | 41.0% ^a |

| | Cigarette use at ages 19/20 | | Binge drinking at ages 19/20 | | Marijuana use at ages 19/20 | |
|----------|-----------------------------|--------------------|------------------------------|--------------------|-----------------------------|--------------------|
| | Before PSW | After PSW | Before PSW | After PSW | Before PSW | After PSW |
| n | Users | Non-users | Users | Non-users | Users | Non-users |
| 95_99 | 3,806 | 7,772 | - | - | 2,220 | 9,339 |
| | 40.0% | 37.1% ^a | 39.7% | 38.1% ^a | 41.6% | 37.1% ^a |
| 00_02 | 20.8% | 21.6% ^a | 19.7% | 21.1% ^a | 25.2% | 20.3% ^a |
| | | | 23.3% | 20.4% ^a | 20.9% | 21.0% ^a |
| | | | | | 22.3% | 21.1% ^a |

Note:

^a indicates ASMD (Absolute Standardized Mean Difference) less than 0.1.

PSW: propensity score weighting, Cig: cigarette use, Binge: Binge drinking, MJ: Marijuana use, OTM: Other than marijuana use (other illicit drug use)

Table 3.

Estimates for Predictors of the Time to Family Formation in Three Survival Models of Each Substance Use Behavior at Ages 19/20 after PSW

| | Age 19/20 substance use behavior | Union Formation | | | | Parenthood | | | |
|----------------|----------------------------------|-----------------|--------------|---------|--------------|------------|--------------|----|--------|
| | | RRR | 95% CI | RRR | 95% CI | OR | 95% CI | OR | 95% CI |
| Males | | | | | | | | | |
| Model1 | Cigarette | 0.87 | [0.72, 1.05] | 1.13 | [0.93, 1.36] | 0.92 | [0.78, 1.08] | | |
| Model2 | Binge | 0.78** | [0.66, 0.91] | 1.29** | [1.11, 1.51] | 0.86* | [0.74, 0.99] | | |
| | (Binge × Time) | 1.11*** | [1.06, 1.16] | 1.04 | [0.99, 1.09] | - | - | | |
| Model3 | Marijuana | 0.78* | [0.62, 0.99] | 1.29* | [1.05, 1.59] | 0.81* | [0.65, 1.00] | | |
| Females | | | | | | | | | |
| Model1 | Cigarette | 0.81* | [0.68, 0.96] | 1.30** | [1.09, 1.54] | 0.92 | [0.80, 1.07] | | |
| | (Cigarette × Time) | 1.08** | [1.03, 1.13] | 1.01 | [0.95, 1.06] | - | - | | |
| Model2 | Binge | 0.93 | [0.80, 1.08] | 1.49*** | [1.30, 1.72] | 0.78*** | [0.69, 0.88] | | |
| | (Binge × Time) | 1.06** | [1.02, 1.11] | 1.02 | [0.97, 1.06] | - | - | | |
| Model3 | Marijuana | 0.80 | [0.63, 1.00] | 1.44*** | [1.17, 1.75] | 0.90 | [0.75, 1.08] | | |
| | (Marijuana × Time) | 1.09** | [1.02, 1.17] | 1.00 | [0.94, 1.06] | - | - | | |

* $p < .05$

** $p < .01$

*** $p < .001$

*** $p < .001$

Notes: Reference group for union formation is neither married nor cohabited. Age 18 substance use variables (cigarette, binge, marijuana, and other illicit drugs) were included in each model as a doubly-robust estimation. PSW: propensity score weighting, OR: Odds Ratio, RRR: Relative Risks Ratio.