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# Sexual behavior and heavy episodic drinking across the transition to adulthood: Differences by college attendance

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## Abstract

Despite a growing literature on college students' sexual behaviors, little is known about how sexual behaviors, and their associations with alcohol, differ for college and non-college attenders, and whether these patterns represent changes during college or an extension of pre-college behaviors. This paper applied time-varying effect models to data from the National Longitudinal Study of Adolescent to Adult Health to examine 1) prevalence of four sexual behaviors from ages 14–24 and 2) how their association with frequent heavy episodic drinking varied across these ages for college and non-college attenders. Non-attenders have higher prevalence of all sexual behaviors than college attenders across most ages; however, the association between heavy episodic drinking and sexual behaviors is stronger for college attenders during ages 18–20.

### Keywords

sexual behavior; alcohol use; college attendance; time-varying effect modeling

Research has increasingly focused on sexual risk behavior, such as casual sex, one-time sexual relationships known as "hookups," and sex under the influence of alcohol among college students (Bogle, 2008; Cooper, 2002; Stinson, 2010). However, the prevalences of alcohol, sexual behavior, and their co-occurrence during this age period may differ depending on the context an individual is embedded in, such as whether they are attending college, and little research in this area has examined sexual behavior and its co-occurrence with alcohol for both college and non-college attenders. In addition, little research on sexual behavior has followed college and non-college-attending individuals from adolescence into adulthood, and therefore it is unclear whether sexual behaviors during college are anomalous or part of a longer-lasting developmental trajectory. Thus, in this study we apply an innovative analytic method, time-varying effect modeling (TVEM), to examine potential

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differences in the rates of four sexual behaviors and their associations with frequent heavy episodic drinking heavy episodic drinking across the transition to adulthood for individuals who did and did not attend a traditional four-year college.

## Sexual Behavior and Associations with Alcohol across Age

Sexual behaviors are age-varying, as the prevalence and correlates of these behaviors differ across different developmental periods (Vasilenko, 2016; Vasilenko & Lanza, 2014). Behaviors like engaging in sexual intercourse and having sex with multiple partners are relatively uncommon in early adolescence, increase in prevalence throughout adolescence, and peak early in adulthood (Fergus, Zimmerman, Caldwell, 2007; Kan, Cheng, Landale, & McHale, 2010; Vasilenko, 2016; Vasilenko & Lanza, 2014). This is consistent with the idea that the age period from 18–25, termed emerging adulthood, is a time of exploration in relationships and sexual behavior (Arnett, 2000; Lefkowitz, 2005).

In addition, sexual behavior may be differentially associated with correlates, such as alcohol use, across adolescence and the transition to adulthood. According to problem behavior theory, behaviors such as excessive drinking, unsafe sexual behavior, cigarette use, and illicit drug use can often cluster together in adolescence (Donovan & Jessor, 1985). Because these behaviors are non-normative or off-time early in adolescence, individuals who engage in these behaviors may be generally more deviance-prone; however, at later ages, these behaviors may be more normative, and less linked to deviance (Jessor & Jessor, 1975). In addition, because exploration of both alcohol use and sexual behavior is more common and viewed as acceptable as individuals transition to adulthood (Arnett, 2000; Lefkowitz, 2005), associations between these behaviors may be weaker. Thus, although both adolescents (Baskin-Sommers & Sommers, 2006; Cavazos-Rehg, Krauss, Spitznagel, Schootman, Cottler, & Bierut, 2011; Oshri, Tubman, Morgan-Lopez, Saavedra, & Csizmadia, 2013; Tapert, Aarons, Sedlar, & Brown, 2001) and college students (Bersamin et al., 2012; Caldeira, Arria, O'Grady, Zarate, Vincent, & Wish, 2009; Patrick, O'Malley, Johnston, Terry-McElrath, & Schulenberg, 2012; Scott-Sheldon, Carey, & Carey, 2010) who engage in heavy drinking are more likely to engage in behaviors like having multiple partners, condom non-use, and sex with a stranger, there is some evidence that the strength of the association between multiple partners and heavy drinking weakens from adolescence into adulthood (Dogan, Stockdale, Widaman, & Conger, 2010; Vasilenko & Lanza, 2014) and from the early to late 20s (Patrick et al., 2012).

## Differences by College Attendance

Although there is some research suggesting that sexual behaviors both increase in prevalence and become less strongly associated with alcohol use as individuals move from adolescence into adulthood, such a pattern may not hold for all individuals. A large portion of research on sexual risk behavior and its association with alcohol use during the transition to adulthood has focused on college students at traditional four-year colleges, despite the fact that the majority (60%) of 18 to 24 year-olds are not currently enrolled at such an institution (NCES, 2014). As a result, much research investigating behavioral patterns during this period is not inclusive of the majority of the population. Critics of emerging adulthood as a

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developmental stage suggest that a period marked by exploration without adult responsibilities may be representative of middle-class college students at traditional four-year residential colleges and universities, but not those who do not attend college at normative ages or attend non-residential or community colleges (Côté, 2014). Instead of being a period as one of possibilities and exploration, many individuals have work or caretaking responsibilities that preclude such exploration (Hendry & Kloep, 2010).

Thus, explorations in sexual behavior and substance use may be more common for individuals who attend four-year residential colleges. The setting of these colleges may provide a context in which exploration is possible, and these behaviors are seen as normative and acceptable (Lefkowitz, 2005; Maggs & Schulenberg, 2004/2005). The college context may also be one in which alcohol and sexual behaviors more often occur together. For example, “hookups,” or other non-relationship sexual behavior often occur under the influence of alcohol (LaBrie et al., 2014; Paul, McManus, & Hayes, 2000), and individuals commonly meet casual partners at places where alcohol is served, like bars and parties (Bersamin et al, 2012; Kuperberg & Padgett, 2014), suggesting a context where alcohol and sexual behavior are linked.

Although considerable research has suggested that individuals who later attend college drink less during adolescence but more during the college years compared to those who do not attend college (Carter et al., 2010; Johnston, O’Malley, Bachman, Schulenberg, & Miech, 2016; Patrick & Terry-McElrath, 2017; Patrick, Terry-McElrath, Kloska, & Schulenberg, 2016; Quinn & Fromme, 2011; Timberlake et al., 2007), research comparing sexual behaviors, as well as their associations with alcohol, between college attenders and non-attenders is scarce. A number of studies have used data from nationally representative samples to show how rates of sexual behavior increase across adolescence and peak in young adulthood (Kan et al., 2010; Vasilenko, 2016; Vasilenko & Lanza, 2014), but have not examined the role of college status. Other research has focused only on college students, and suggests that non-relationship sexual behavior and condom non-use are common among college students (American College Health Association, 2016; Eisenberg, 2001; Garcia, Reiber, Massey, & Merriwether, 2012; Grello et al., 2006; Lewis, Miguez-Burban, & Malow, 2009; Olmstead, Pasley, & Fincham, 2013; Paul et al., 2000; Trepka, Kim, Pekovic, Zamor, Velez, & Gabaroni, 2008). The limited research comparing sexual behavior by college status indicates that same-age non-attenders may be at even greater risk for a variety of sexual risk behaviors and consequences such as sexually transmitted infections (STIs), multiple sexual partners, inconsistent condom use, and casual sex than compared to college attenders (Bailey, Fleming, Henson, Catalano, & Haggerty, 2008; Patrick et al., 2012; Yarnall et al., 2003)

In addition to limited research on how sexual behaviors may differ for college attenders and non-attenders, relatively little is known about how associations between alcohol and sexual behavior may differ for these two groups. Research has found associations between frequency or amount of alcohol consumed and sexual behaviors at the person- (Bersamin et al., 2012; Caldeira et al., 2009; Patrick et al., 2012; Scott-Sheldon et al., 2010) and event-levels (Barta, Portnoy, Kiene, Tennen, Abu-Hasaballah, & Ferrer, 2008; Kiene, Barta, Tennen, & Armeli, 2009; Patrick & Maggs, 2009; Patrick, Maggs, & Lefkowitz, 2015) in

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college students, as well as person-level associations in a general population studies of adolescents and young adults (Dogan et al., 2010; Vasilenko & Lanza, 2014). However, to our knowledge no study has examined how this association may differ for college and non-college attenders. This sort of information is important in understanding whether the college environment has a unique influence on these behaviors, or whether changes that occur in college represent the continuation of a developmental trend.

## A New Method to Examine Associations Over Age

A new methodological approach, the time-varying effect model (TVEM), is well-suited to examine these sorts of changes in behavior over age. TVEM is a flexible, non-parametric method that estimates rates of behaviors and the associations between predictors and an outcome as a function of continuous time, and has been used successfully to examine developmental changes in longitudinal panel data (Evans-Polce et al., 2015; Patrick, Evans-Polce, Kloska, Maggs, & Lanza, 2017; Patrick, Kloska, Vasilenko, & Lanza, 2016; Vasilenko, 2016; Vasilenko & Lanza, 2014). A major difference between TVEM and other methods is that the shape of these associations does not need to take on a specified parametric form. In other methods typically applied to longitudinal data, such as growth curve models, the type of research questions tested typically focus on linear or quadratic age trends in the rate of a behavior, and whether time-invariant and time-varying covariates are associated with that behavior. TVEM, on the other hand flexibly estimates the shape of age trends in the rate of a behavior; it does not provide significance tests of particular parametric forms, but instead uses model selection to choose an optimal (non-parametric) age trend representing a behavior across continuous age. Further, TVEM uses the same approach to model age trends in the associations between covariates and a behavior at every point across continuous age. Thus, TVEM can provide not only nuanced estimates of the rate of drinking and of risky sexual behavior across age, but also estimates that highlight critical age periods at which associations between drinking and risky sexual behavior are strongest. Further, TVEM can provide age periods at which significant moderation occurs. Such information could indicate ages when prevention efforts for risky behavior are most needed and which factors are the most relevant targets for different subgroups (Coyle & DiClemente, 2014). A new version of TVEM that allows for the inclusion of survey weights has recently been introduced (Dziak, Li, & Wagner, 2017), allowing researchers to provide precise estimates that are representative of the population.

## Current Study

In this study we examined changes in prevalence of sexual behavior and the strength of associations between frequent heavy episodic drinking and sexual behavior across adolescence into young adulthood (ages 14 to 24) by applying to data from a large, nationally representative longitudinal study. We had two specific aims:

1. To document the past-year prevalence of four sexual behaviors (any sexual intercourse, sex with multiple partners, non-relationship sex, and condom non-use) throughout adolescence and the transition to adulthood for individuals who did and did not attend a four-year college. Based on prior research, we predict

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higher rates of sexual risk behavior across all ages for non-college attenders compared to college attenders.

2. To examine how the strength of the associations between frequent heavy episodic drinking and each sexual risk behavior changed throughout adolescence and the transition to adulthood, and whether these patterns varied by college attendance. Based on prior research, we predict stronger associations between alcohol and sexual behavior during the traditional college years for college attenders compared to non-attenders.

## Method

### Participants and Procedures

Data are from the contractual sample of Add Health (Harris, 2013). Eighty high schools and associated middle schools were sampled, employing a clustered sampling design to ensure that the sample was representative of schools in the United States. Participants completed in-school and in-home interviews in 1994–1995 (Wave I), when they were in 7$^{th}$ through 12$^{th}$ grade (approximate ages 12–18, with follow-up interviews during 1995–1996 (Wave II; 12$^{th}$ graders not interviewed; approximate ages 13–18), 2001–2002 (Wave III; ages 18–26) and 2007–2008 (Wave IV; approximate ages 24–32). The Add Health data can be viewed as a cohort sequential or accelerated cohort design (Duncan, Duncan, & Hops, 1996; Nesselroade & Baltes, 1979) in which multiple cohorts are followed over time in order to more efficiently sample across a larger age range. Some of our primary variables of interest were not asked in a comparable way at Wave IV, so we used data from Waves I–III. We included participants with data from Wave III, including valid data on college status assessed at Wave III, and valid Wave III longitudinal weights. The sample contained 11,848 individuals (50.5% female, 20.5% African American, 17.4% Hispanic, 6.4% Asian, 3.0% other race, *M* age at Wave I=16.6 years, *SD*=1.4). About 80% of participants from the Wave I sample participated in each of the later waves. We used data from Waves I–III, and restricted the sample to person-waves where a participant was between 14 and 24 years old due to sparsity of data outside this range. Thus, we included 35,829 person-waves of data. Age in months was used as the time variable.

### Measures

Our primary outcomes (sexual behaviors) and predictor (frequent heavy episodic drinking) variables were measured longitudinally in Waves I–III, with measures of moderators and control variables assessed at a single wave. Descriptive statistics are presented in Table 1.

**Outcomes—***Past-year intercourse* was a measure of whether a participant engaged in sexual intercourse in the past year (0 = no, 1 = yes). In Waves I and II, participants who reported ever having sexual intercourse were asked about their date of most recent sex; if this date was in the past year, participants were coded 1. In Wave III, participants were asked if they ever had intercourse, and if so, asked how many partners they had in the past year. Responses were coded 1 if they reported at least one partner in the past year, and 0 if they had never had sex or had zero partners in the past year.

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*Multiple partners* was a measure of whether an individual engaged in sexual behavior with more than one partner in the past year (0 = *0–1 partner*, 1 = *2+ partners*). At Waves I and II, this measure was computed using two sets of measures, one of which assessed whether they engaged in sexual intercourse with up to three relationship partners they named previously, and one assessing intercourse with any additional partners. At Wave III, participants reported how many partners they had vaginal intercourse with in the past 12 months.

*Non-relationship sex* was a measure of whether participants reported sex in the past year with a partner with whom they were not in a romantic relationship (*1=yes, 0=no*). In Waves I and II, participants were asked how many people other than romantic partners they had sex with in the past year. In Wave III, participants listed all of their sexual partners in the past year, and then indicated whether they were in a romantic relationship with each partner.

*Condom non-use* was a measure of whether a participant had engaged in any sexual intercourse without a condom in the past year. In Waves I–II, participants were asked if they had ever used a condom during intercourse (Wave I) or ever in the past year (Wave II), and, if so, what proportion of the time, with 5 response options from “none of the time,” to “all of the time.” During Wave III, participants were asked how many times they had intercourse in the past twelve months, followed by how many occasions they used a condom, rated on a 5-point scale “None” to “All.” Participants were coded as engaging in condom non-use in the past year (1) if they used a condom most of the time or less, and were coded 0 if they didn’t have sex or used a condom every time.

**Predictor—**Our primary predictor was a measure of *frequent heavy episodic drinking* (heavy episodic drinking) in the past year, defined as whether an individual reported more than monthly heavy episodic drinking. This was derived from a question asking how often the participant drank 5+ drinks in a row. These were rated on a 7-point scale from “none/never” to “every day/almost every day.” The variable was highly skewed, with the majority of participants engaging in no heavy episodic drinking in the past year. Thus, we recoded it into a binary measure of frequent heavy episodic drinking, as used in prior longitudinal research with Add Health (Evans-Polce, et al., 2015). Participants were coded as engaging in frequent heavy episodic drinking if they reported heavy drinking 2 or 3 days a month or more, and not engaging in frequent heavy episodic drinking if they reported the category “once a month or less,” or less often, or reported no drinking in the past year.

**Moderator—**Traditional four-year *college attendance* was a measure of whether a participant attended a four-year residential college. This particular definition of college attendance was chosen to reflect the unique environment of four-year college campuses that may promote exploration in alcohol use and sexual behaviors (Lefkowitz, 2005; Maggs & Schulenberg, 2004/2005). This variable was created from a series of Wave III questions asking about the highest grade completed, whether the participants was currently in school, what type of school they were enrolled in, and if they were attending full- or part-time. Participants were coded as attending a four-year college if they had earned a bachelor’s degree or were currently enrolled at a four-year college full-time.

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**Time variable—**The primary associations in this model were estimated across continuous age, from ages 14–24. This age variable was an indicator of an individual's age at each assessment, coded to the nearest month, and was calculated by subtracting each participant's month of birth from the date of each interview. This age range was chosen because there was adequate coverage of data points at all ages using data from Waves I–III.

**Covariates—**We included several Wave 1 covariates in the models assessing associations between alcohol use and sexual behavior. *Race/ethnicity* was measured with 4 dummy-coded variables (Hispanic/Latino [HL]; non-HL Black; non-HL Asian; non-HL other, with non-HL White as the reference group). Mother's education indicated whether the respondent's mother had completed any college education or more and was used as a proxy for SES (household income was only asked in parents' self-reports, resulting in substantial missing data on income measures). *Biological sex* was a self-report item asking whether the participant was male or female.

## Statistical Analyses

We used TVEM (Li, Dziak, Tan, Huang, Wagner, & Yang, 2015; Tan, Shiyko, Li, Li, & Dierker, 2012) to examine the age-varying prevalences of sexual behaviors and frequent heavy episodic drinking, as well as their age-varying associations. All analyses used the weighted TVEM SAS macro (Dziak, et al., 2017). Longitudinal Wave III grand sample weights that account for both sample design and attrition were used in all analyses. In all models, we used the B-spline method for model estimation, and used the Bayesian Information Criterion (BIC) to select the optimal number of knots (splitting points) for each coefficient function (Li et al., 2015). Knots in TVEM determine the number of segments in a given coefficient function that, pieced together, allow complex functions to be approximated. A greater number of knots enables a more complex function to be expressed, whereas a smaller number of knots is sufficient to represent less complex functions.

Our primary interest was to compare college and non-college participants in their rates of frequent heavy episodic drinking and sexual behaviors and their associations across age. We used two different approaches for examining dynamic (i.e., age-varying) moderation in TVEM. First, the weighted TVEM macro can provide stratified analyses for groups that retain full sample survey weighting. This is particularly useful for estimating precise rates of an outcome over time by subgroups, and thus is used in our first aim examining differences in rates of behavior by college status. Second, interaction terms can be entered as time-varying effects, using procedures similar to those used in traditional regression analyses (e.g., calculating an interaction term and adding it to the model as a time-varying effect). This can provide coefficients for estimating associations and interaction effects across all ages, such as an age-varying estimate of how the association between frequent heavy episodic drinking and sexual risk behaviors differs by college status, and thus can be particularly useful for examining moderation of time-varying effects. We used this approach in Aim 2. Details of model estimation are described below.

For our first aim, we estimated the nonparametric age trends in the prevalences of the four sexual behaviors outcomes and our primary predictor, frequent heavy episodic drinking

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across ages 14–24 using five separate intercept=only weighted logistic TVEMs. An example equation for an outcome (labeled here as “SEX”), is as follows:

$$ln\left(\frac{p(SEXit)}{1-p(SEXit)}\right) = \beta_0(t)$$

In this model, the coefficient followed by “($t$)” indicates a coefficient that was modeled as a time-varying function (in other words, the intercept was allowed to vary as a nonparametric function of age). Thus the ($\beta_0$), the intercept coefficient, was modeled as a function of age, and represents the odds of engaging in a particular behavior across continuous age. This model was used for college and non-college attenders, using the domain procedure described below.

Sample SAS syntax for intercept-only weighted logistic TVEM is presented in Appendix A, Part 1. The weighted TVEM analyses are built on the foundation of SAS PROC survey logistic, which includes options for examining models by group while retaining full sample survey weighting (specified by the “domain” and “which” statements). Thus, for each variable we modeled prevalence of the behavior across age for college and non-college attending participants by specifying the variable for college attendance as the domain, and specifying models for non-college (which = 0) and college (which = 1). The intercept function is modeled by creating a variable (indicated by X0 in our sample code), which consists of a column of 1s for each row in the dataset, and then entering this variable and specifying it to have a time-varying effect. Model selection was conducted using an iterative process. Specifically, models with between 1 and 5 knots were estimated for the intercept coefficient function, ($\beta_0(t)$), and we chose the model with the lowest BIC.

For Aim 2, we examined frequent heavy episodic drinking as a predictor of each sexual behavior across age, again using weighted logistic TVEM. In this model, we used age-varying interactions terms (calculated by multiplying our variables for frequent heavy episodic drinking and college status) to estimate differences in the effect of heavy episodic drinking by college attendance. Four separate models were estimated corresponding to each sexual behavior. The basic equation for this model is as follows:

$$ln\left(\frac{p(SEXit)}{1-p\,(SEXit)}\right) = \beta_0(t) + \beta_1(t)HED_{it} + \beta_2(t)College_i + \beta_3(t)HED_{it} \times College_i +$$
$$\beta_4 Female_i + \beta_5 Hispanic_i + \beta_6 Black_i + \beta_7 Asian + \beta_8 Other\ Race_i + \beta_9 Mother\ College_i$$

where $_i$ indexes the individual and $_t$ denotes age. In this equation, the odds of engaging in a given sexual behavior (*SEX*) is expressed as a function of an age-varying intercept ($\beta_0(t)$; estimated by entering a variable of 1s as described above), the age-varying effect of engaging in heavy episodic drinking (HED; $\beta_1(t)$), the age-varying effect of college ($\beta_2(t)$), and the age-varying effect of the college × heavy episodic drinking interaction ($\beta_3(t)$). Thus, each of these age-varying effects represents an age-varying odds ratio conveying the estimated association between a given predictor and sexual behavior outcome at every point across continuous age. Demographic covariates (gender, race/ethnicity, and mother’s

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education) were included as control variables and specified to have time-invariant effects ($\beta_4$ through $\beta_9$).

Sample SAS syntax for Aim 2 analyses is presented in Appendix A, Part 2. To select the best-fitting model, we had to choose the appropriate number of knots for each parameter coefficient that was specified as time-varying. This is done in order to select a shape of the age-varying intercept and the age-varying associations with the appropriate degree of complexity. To choose the appropriate model, we estimated models with between 1 and 5 knots for each age-varying parameter. For example, we estimated a model with 5 knots specified for our intercept function ($\beta_0(t)$) and each of our three predictors (heavy episodic drinking, college, and heavy episodic drinking X College; ($\beta_1(t)$ through $\beta_3(t)$). We then held the number of knots constant at 5 for heavy episodic drinking, college, and heavy episodic drinking X college, and ran models with 1–4 knots for the intercept term (designated in the knots= line of code as 5 5 5 5, then 4 5 5 5, then 3 5 5 5, etc). We selected the model with the lowest BIC to set the number of knots for intercept, and held this number constant while estimating the appropriate number of knots for each additional parameter, one by one in a similar manner (for example, if 2 knots was selected for the intercept, models for the effect of heavy episodic drinking would next be estimated by comparing models with knots= 2 5 5 5, then 2 4 5 5, then 2 3 5 5, etc).

For all models, results are presented as figures because coefficient functions are estimated across continuous age. Ages at which 95% confidence intervals for odds ratios do not include 1.0 indicate statistical significance at the $p < .05$ level; ages at which confidence intervals do not overlap across groups provides a conservative estimate of significant differences between groups.

## Results

First, we examined the estimated proportion of college attenders and non-attenders engaging in each of four sexual behaviors by age, using intercept-only logistic TVEMs (Aim 1; Figure 1). Sexual intercourse in the past year increased steadily from age 14 and plateaued in the early twenties, when most participants were sexually active. At all ages, the proportion of participants engaged in past-year intercourse was about 10% higher for non-attenders compared to college attenders. Multiple partners and non-relationship sex followed similar patterns of increasing prevalence through the teens followed by a plateau, with about 30% of individuals engaging in sex with multiple partners and non-relationship sex in the past year at age 21. Non-attenders reported higher rates of these behaviors until about age 21, after which there was no significant difference. Non-use of a condom was relatively low until age 18 (10% college, 20% non-college), and then increased rapidly until plateauing in the early twenties at about 75% for college and 85% for non-college. Non-attenders had higher rates prior to age 19 and after age 21, and college attenders had higher rates from ages 20–21. In addition, we estimated an intercept-only model showing prevalence of heavy episodic drinking by age for college attenders and non-attenders (Figure 2), which showed a cross-over around age 18; specifically, frequent heavy episodic drinking was higher for non-attenders before age 18, whereas it was more common for college attenders after age 20.

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Next, we examined the associations between frequent heavy episodic drinking and the four sexual behaviors by age (Aim 2). Figure 3 presents the association between heavy episodic drinking and the four sexual behaviors by age, with age-varying odds ratios for this association calculated for college attenders and non-attenders. Boxes indicate age periods during which the College × heavy episodic drinking interaction term was significant, and the odds ratios of heavy episodic drinking predicting sexual behavior differ for college attenders and non-attenders. Note that the associations between alcohol and sexual behavior, as well as the differences by college status, were allowed to vary flexibly with age, and therefore odds ratios presented are an age-varying function of time. Overall, the same general patterns of associations were found across all four behaviors. Heavy episodic drinking predicted greater odds of all sexual behaviors at most ages, with the exception of condom non-use, where the association became nonsignificant after age 23. For both groups, the heavy episodic drinking/sexual behavior associations tended to be stronger at younger ages and decline into the later teens. However, the association continued to decline into the early twenties for non-attenders, whereas it began to rise again during the early college years for college attenders.

There were two primary periods where the associations differed for college attenders and non-attenders. During about ages 14–15, associations were much stronger for college-bound compared to non-college-bound adolescents, and this difference was significant for intercourse, non-relationship sex, and condom non-use. As an example, at age 14.5, heavy episodic drinking was associated with about 12 times greater odds of past-year intercourse, 13 times greater odds of non-relationship sex, and 17 times greater odds of condom non-use for adolescents who went on to attend college, but 3–4 times greater odds of each of these behaviors for adolescents who did not later attend college. Second, for all four sexual behaviors, there was a period from about age 18–20 during which the association was once again significantly stronger for college attenders compared to non-attenders. As an example, at age 18.5, heavy episodic drinking was associated with about 3 times greater odds of having multiple partners in the past year for non-attenders and 6 times greater odds for college attenders, with similar differences observed for associations between heavy episodic drinking and past-year intercourse, non-relationship sex, and condom non-use. These associations all became non-significant by age 20, after which there were no differences based on college attendance.

## Discussion

This study examines how sexual behaviors, frequent heavy episodic drinking, and their associations differed from adolescence through the transition to adulthood for college-attending and non-attending individuals. Consistent with prior research, we found evidence of a cross-over effect of frequent heavy episodic drinking, whereby prevalence of this behavior was more common for non-attenders during adolescence, but became higher for college attenders during the college years (Timberlake et al., 2007). However, this sort of cross-over was not observed for sexual behaviors. For three out of the four behaviors studied (any intercourse, multiple partners, non-relationship sex), rates were higher at most ages, including during the college years, for non-attenders compared to college attenders. Although this is consistent with the limited prior research that compares sexual behavior in

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college versus non-college attenders (Bailey et al., 2008; Patrick et al., 2012; Yarnall et al., 2003), it does somewhat call into question the almost exclusive emphasis on college students in research on hookups and casual sex (Bogle, 2008; Stinson, 2010), given that both non-relationship sex and sex with multiple partners are higher for non-attenders during the college years. In addition, these results do not provide evidence of a major shift in sexual behaviors during the transition to college like that observed for alcohol (Timberlake, 2007), suggesting college does not substantially alter the prevalence of sexual risk behaviors, and may not be a unique context in terms exploration of sexual behavior.

It is important to note that although this pattern of higher rates of sexual behaviors for non-attenders was consistent for three of the four behaviors; the prevalence of condom non-use over time looked considerably different. The prevalence of sex without a condom was higher for non-attenders prior to the college years, was higher for college attenders during the early years of college, and was then higher again for non-attenders after age 22. There are a number of explanations for this association. It is possible that college students are less likely to use contraception during the traditional college years, possibly as a result of alcohol use, which has been associated with condom non-use at the daily level in college students (Barta et al., 2008; Kiene et al., 2009; Patrick et al., 2009). However, lower rates of condom use may also reflect use of other types of birth control, such as the birth control pill and other hormonal methods, which tend to be used by older adolescents and young adults and those who are in more serious or longer relationships (Frost & Darroch, 2008; Katz, Fortenberry, Zimet, Blythe, & Orr, 2012; Kusonoki & Upchurch, 2011). College-attending individuals may have greater access to health care in general and birth control in particular, due to greater likelihood of being insured and access to student health centers (Blanco et al., 2008). Despite these sorts of methods being effective at preventing unintended pregnancy, individuals using hormonal birth control may still be at increased STI risk, as individuals often transition from condoms to hormonal birth control without testing or discussions with their partner about STIs (Longmore, Johnson, Manning, & Giordano, 2012; Witte, El-Bassel, Gilbert, Wu, & Chang, 2010). Unfortunately, comparable questions about hormonal birth control were not asked in the same way across waves. Thus, future research should attempt to better understand patterns and predictors of both condom and hormonal contraceptive use among college and non-college attenders, in order to better prevent STIs and promote sexual health for each group.

Although we found little evidence of sexual behavior changing as a result of attending college, we did find differences in the associations between frequent heavy episodic drinking and sexual behaviors between college attenders and non-attenders. The association between frequent heavy episodic drinking and all four sexual behaviors was the highest during the earlier adolescent years (ages 14–16) for both groups, but this association was particularly strong at these ages for those who went on to attend college. These very high odds ratios are likely due to the fact that all of these behaviors were rare for younger adolescents who went on to attend college, and those individuals who did engage in heavy episodic drinking were also likely to engage in these sexual behaviors. These results are consistent with problem behavior theory (Jessor & Jessor, 1977), as during adolescence all of these behaviors may be considered deviant, and this only engaged in by a smaller segment of the population who is more prone to deviant behavior. For individuals who go on to attend college, alcohol use and

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sexual behavior may both be seen as more deviant during high school because other college-bound students are less likely to be engaging in the behaviors. Consequently, college-bound individuals who engage in these behaviors at an early age may be particularly deviance-prone or in social groups with higher norms of engaging in these behaviors. However, there is no significant difference between college and non-college students between ages 15 and 18. This suggests that as the behaviors become more normative, they move from being strongly correlated (for example as part of a problem behavior syndrome) to being more distinct behaviors with less difference between college-bound and non-college-bound individuals. Relatively little research has examined these topics by college attendance, so our explanations are speculative, and future research could help us better understand these processes.

College attendance may also lead to a shift in the associations between frequent heavy episodic drinking and sexual risk behaviors. Around age 18, associations between heavy episodic drinking and sexual behaviors begin to rise again for college students, and remained higher than associations for non-attenders until about age 20. It is possible that this is due to increased alcohol use leading to risky sexual behaviors, as research has documented event-level correlations between alcohol and sexual behaviors at the daily level for college students (Barta et al., 2008; Kiene et al., 2009; Patrick et al., 2015). It is also possible that parties and other events where alcohol is served are a primary source of socializing for many college students, and a place where they meet sexual or romantic partners. Regardless of the explanation, these results do suggest that although rates of sexual behaviors themselves may not change significantly, the early years of college may provide a unique socialization environment for college students in regard to the co-occurrence of alcohol use and sexual behavior. However, our findings suggest this is only true from about ages 18–20, roughly corresponding to the first two years of college for most traditionally aged-students. The subsequent decoupling of alcohol and sexual behavior may reflect a number of factors, such as individuals beginning to mature out of heavy alcohol use due to increased responsibilities (White, Labouvie, & Papadaratsakis, 2005) and the development of more serious romantic relationships in which sexual behaviors may be less often linked to the influence of alcohol (Patrick et al., 2015).

There are a number of implications for prevention and intervention research. First, associations between frequent heavy episodic drinking and sexual behaviors are significant for both college attenders and non-attenders across ages from 14 to 24, suggesting that targeting these behaviors jointly is one important prevention strategy. Second, there are two developmental periods during which these associations are stronger, which suggest important periods for joint interventions. Because associations between these behaviors are strongest during the earlier years of adolescence, programs aimed at reducing both alcohol use and sexual risk behaviors may be needed for middle or early high school youth (Coyle & DiClemente, 2014; Vasilenko & Lanza, 2014). In addition, associations between heavy episodic drinking and sexual behaviors are stronger at ages 18–20 for those who transition to college. Thus, it may be particularly beneficial for programs for college students to focus on both alcohol and sexual behavior as students transition to a new context which provides opportunities for freedom and exploration (Dermen & Thomas, 2011; Lewis et al., 2014). Third, young adults who do not attend college are more likely to engage in sexual behaviors

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than college attenders, and providing access to sexual health resources may be particularly important for this population.

## Limitations

There are a number of limitations to this study. First, college student status was defined as attending or graduating from a four-year, residential university based on a measure at one particular point during ages 18–24, and thus we do not have information about individuals who attended different types of colleges. Future research should examine whether students attending different types of colleges (e.g., two-year community college), have similar rates and co-occurrence of alcohol and sexual behavior to college or non-college attenders, or whether they have unique patterns of use which may require different types of interventions. Relatedly, although we controlled for mother's education as a proxy for SES, associations between college attendance, SES, and risk behaviors are likely complex and require further exploration. For example, students who are from a lower SES background but attend a traditional four-year college may spend more time working at a job, and thus may have less time available for attending parties where alcohol us served and engaging in heavy episodic drinking. Thus, future research could examine these associations in college students of different SES backgrounds.

Second, we did not examine rates of hormonal contraception or prevalence of sexual behaviors other than vaginal intercourse, and future research should examine these aspects to more fully understand sexual behaviors in college attenders and non-attenders. Third, because relatively few adolescents engaged in these risk behaviors at the youngest ages included in our study, findings at these ages are driven by a relatively small number of individuals, which lead to less stable estimated and larger confidence intervals. Fourth, this analysis focuses on one particular cohort of individuals, and thus findings may not generalize to more recent cohorts.

Finally, it is important to note that this study examined average rates and associations between alcohol use and sexual behavior, and these patterns likely do not hold for all college attenders and non-attenders. Thus, it is important to examine the variability within these subgroups, to better identify which individuals may be at greatest risk. Person-centered methods have been used to identify different patterns of alcohol use (Kuvaas et al., 2014; Lau-Barraco et al., 2014; Linden-Carmichael, Lanza, Dziak, & Bray, 2017) and sexual behaviors (Beadnell, et al., 2005; Haydon, Herring, Prinstein, & Halperon, 2012; Vasilenko, Kugler, Butera, & Lanza, 2015), and differing trajectories of these behaviors over time (Chassin, Pitts, & Prost, 2002; Maggs & Schulenberg, 2004/2005; Moilanen, Crockett, Raffaelli, & Jones, 2010; Murphy, Brecht, Herbeck, & Huang, 2009). These methods can be helpful in understanding the heterogeneity and co-occurrence of adolescent and young adults risk behaviors. In addition, a new method, mixture TVEM (Dziak, Li, Tan, & Shiffman, 2015), can identify different subgroups marked by varying trajectories of associations between variables (e.g., different patterns of associations between alcohol use and sexual behavior over time). This method could identify groups of individuals who are at risk of co-occurrence of alcohol use and sexual behavior at different ages, and examine factors predicting these particular patterns.

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### Conclusions

This study provides important information about sexual behavior, heavy episodic drinking and their associations across adolescence and the transition to adulthood among college attending and non-attending individuals from a nationally representative sample. Results suggest that college attendance does not lead to a major increase or shift in sexual behavior, although college attenders do have higher rates of frequent heavy episodic drinking and a stronger association between heavy episodic drinking and sexual behavior during the early traditional college years compared to non-attenders. These findings demonstrate the importance of programs aimed at reducing problematic alcohol use and the co-occurrence of alcohol use and sex for college attenders, as well as the importance of sexual behavior-focused interventions for those who do not attend college.

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# Appendix A

## Part 1: Intercept Only Models of Sexual Behaviors

Moderation estimated using the “domain” and “which” statements:

```
%WeightedTVEM(
   dist=binary,
   data = AHTVEM_long,
   cluster = id,
   time = calcage,
```

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```
   dv = pysex,
   tvary_effect = x0,
          invar_effect = female w1black w1hisp w1asian w1other mcoll,
          plot = simple,
   knots = 2,
          weight=weight3,
          domain=college,
          which=0
);
%WeightedTVEM(
   dist=binary,
   data = AHTVEM_long,
   cluster = id,
   time = calcage,
   dv = pysex,
   tvary_effect = x0,
          invar_effect = female w1black w1hisp w1asian w1other mcoll,
          plot = simple,
   knots = 2,
          weight=weight3,
          domain=college,
          which=1
);
```

## Part 2: Time-Varying Associations between Heavy Episodic Drinking and Sexual Behaviors

Moderation modeled using interaction terms:

```
%WeightedTVEM(
   dist=binary,
   data = AHTVEM_long,
   cluster = id,
   time = calcage,
   dv = pysex,
   tvary_effect = x0 hed college hedcol,
          invar_effect = female w1black w1hisp w1asian w1other mcoll,
          plot = simple,
   knots = 2 1 1 1,
          weight=weight3
);
```

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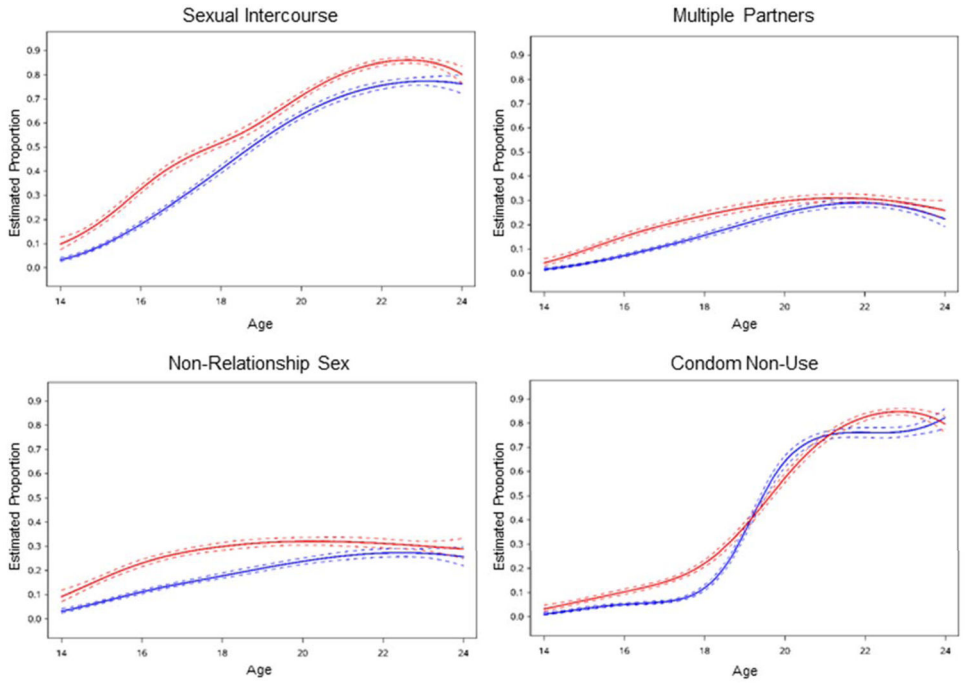


**Figure 1.**

Estimated proportion of participants engaging in sexual behaviors in the past year over ages 14–24 by attendance at a 4-year college at normative ages (red = non-college, blue = college). Dashed lines indicate 95% confidence intervals.

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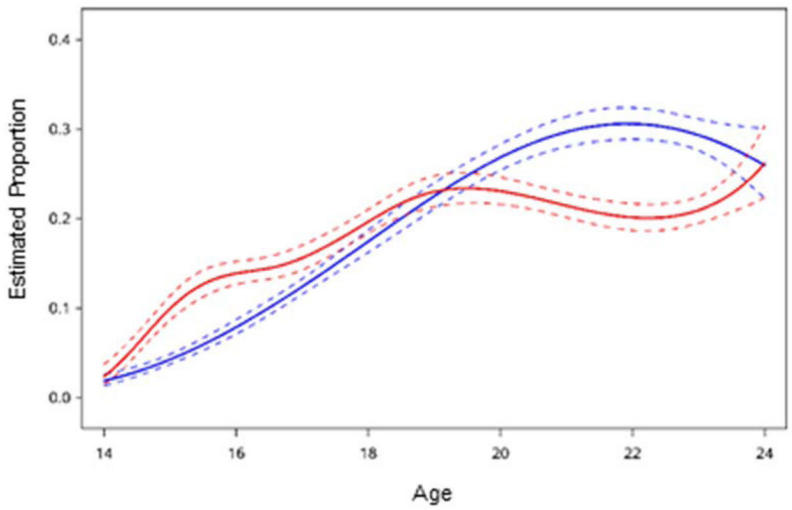


**Figure 2.**

Estimated proportion of participants engaging in frequent (more than monthly) heavy episodic drinking in the past year over ages 14–24 by attendance at a 4-year college at normative ages (red = non-college, blue = college). Dashed lines indicate 95% confidence intervals.

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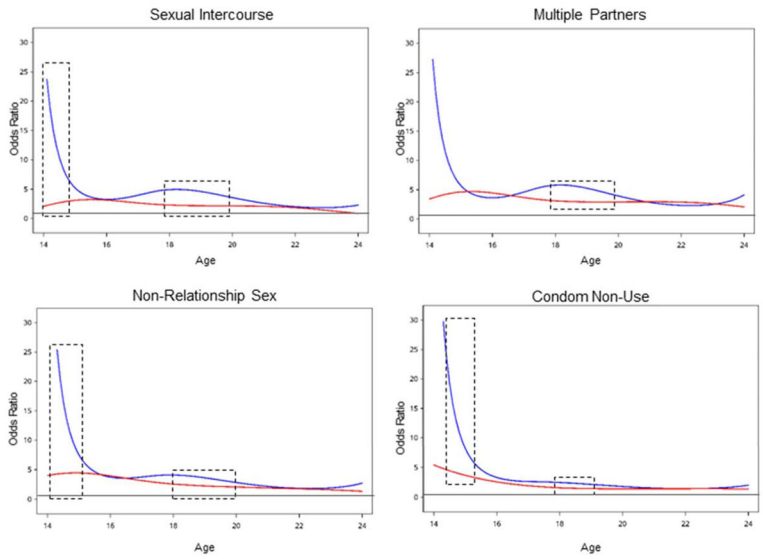


**Figure 3.**

Associations between frequent heavy episodic drinking and sexual behaviors from ages 14–24 by 4-year college attendance (red = non-college, blue = college). Boxes indicate ages at which the association between frequent heavy episodic drinking and a given sexual behavior is significantly different for college attenders and non-attenders, based on a time-varying interaction term ($p < .05$).

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**Table 1**

Unweighted descriptive statistics, by college attendance

| | **College (39%)** | | | **Non-College (61%)** | | |
|---|---|---|---|---|---|---|
| Demographics | W1 (14–18) | | | W1 (14–18) | | |
| Female | 58.4% | | | 49.2% | | |
| Race/Ethnicity | | | | | | |
| White | 55.8% | | | 51.8% | | |
| Black | 18.4% | | | 22.6% | | |
| Latino | 12.92% | | | 18.4% | | |
| Asian | 9.7% | | | 4.7% | | |
| Other | 3.2% | | | 3.4& | | |
| Mother College | 65.1% | | | 37.3% | | |
| Study Variables | W1 (14–18) | W2 (14–18) | W3 (18–24) | W1 (14–18) | W2 (14–18) | W3 (18–24) |
| Frequent heavy episodic drinking | 22.0% | 9.2% | 27.1% | 19.9% | 14.8% | 20.4% |
| Past-Year Intercourse | 26.3% | 23.6% | 71.6% | 45.0% | 32.5% | 82.2% |
| Multiple Partners | 12.17% | 7.6% | 26.6% | 23.7% | 11.7% | 30.38% |
| Non-Relationship Sex | 13.1% | 11.8% | 25.1% | 25.6% | 22.7% | 29.9% |
| Condom Non-Use | 5.7% | 7.4% | 73.1% | 12.3% | 14.8% | 78.7% |