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Jeff DeSimone

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Jeff DeSimone*

Abstract

This study examines the relationship between binge drinking and sexual behavior in nationally representative data on age 18–24 four-year college students. For having sex, overall or without condoms, large and significant positive associations are eliminated upon holding constant proxies for time-invariant sexual activity and drinking preferences. However, strong relationships persist for sex with multiple recent partners, overall and without condoms, even controlling for substance use, risk aversion, mental health, sports participation, and sexual activity frequency. Promiscuity is unrelated with non-binge drinking but even more strongly related with binge drinking on multiple occasions. Results from a rudimentary instrumental variables strategy and accounting for whether sex is immediately preceded by alcohol use suggest that binge drinking directly leads to risky sex. Some binge drinking-induced promiscuity seems to occur among students, especially males, involved in long-term relationships. Effects are concentrated among non-Hispanic whites and are not apparent for students in two-year schools.

* University of Texas at Arlington & NBER; Department of Economics, UTA, 701 S. West St., Arlington, TX 76019, jdesimone@uta.edu, (817) 272–3286. For very helpful comments, I am indebted to participants in seminars at American University, Appalachian State University, IUPUI and University of Louisville, as well as a session at the 2009 Southern Economic Association meetings, especially Greg DeAngelo, David Dickinson, Jose Fernandez, Per Fredriksson, Steve Gohmann, Bob Harris, Tim Perri, Josh Pinkston, Dan Rees, Anne Royalty, Joe Sabia, Bob Sandy, Rich Steinberg, John Whitehead, Mark Wilhelm and Ye Zhang.

1. Introduction

This paper examines the relationship between sexual activity and binge drinking, defined as having five or more drinks of alcohol consecutively or within a few hours. Anecdotal evidence of complementarity between alcohol and sex, particularly between individuals who are not long-term partners, is overwhelming. For instance, in the extract of the 1995 National College Health Risk Behavior Survey (NCHRBS) analyzed here, 23% of four-year college students who ever had sex admitted using alcohol or drugs before their last episode of sexual intercourse. Given that past month use is reported by 71% of respondents for alcohol compared with only 17% for marijuana, by far the most popular illegal drug, and some students separately report using drugs in combination with drinking, it is likely that most of the reported pre-sex substance use involves alcohol.

Explanations abound for why alcohol consumption is associated with sexual encounters that are unplanned and not accompanied by protection against pregnancy or sexually transmitted disease (STD). Some who hope to find a sex partner might attend parties that serve alcohol, and then partake, in order to mingle with those having similar preferences. Others might become inebriated specifically to lose inhibitions and make themselves accessible for social interactions potentially leading to sex. Or, certain types of people might simply be more likely to engage in all sorts of risky behaviors, including both drunkenness and sex that is either outside of an existing relationship or without normally-used protection against disease or pregnancy.

This study investigates whether, alternatively, there is a direct pathway from alcohol consumption to sex, which could plausibly occur via pharmacological effects of intoxication. Because of compromised judgment or lowered inhibition, individuals under the influence of alcohol might engage in sex that would not otherwise occur, or fail to use condoms or other birth

control. Information on whether drinking facilitates such "risky" sexual interactions is relevant for alcohol policy. If drunkenness causes unplanned sexual encounters, an exogenous reduction in binge drinking could diminish rates of STD infection and unwanted pregnancy.

Specifically, the goal of this analysis is to ascertain whether the observed positive correlation between binge drinking and various sexual behaviors is reasonably interpreted as a causal effect of heavy alcohol use. As the next section describes, previous studies of individual-level data on alcohol consumption and sexual activity have used one of three approaches to address the possibility that at least some of this correlation might be spurious. However, all three methods – instrumental variables (IV), individual fixed effects and functional form restrictions – suffer from potentially severe limitations in this context. Furthermore, my data are cross-sectional and lack geographic identifiers, eliminating the possibility of identifying effects using IV as a primary strategy, or person-specific fixed effects at all.

I therefore pursue the simpler approach of holding constant proxies for the precise unobservables that might induce a non-causal association between drinking and sexual behavior, namely preferences for alcohol consumption and sex. This tactic would seem subject to the criticism that proxying for every unobservable that could potentially impact the relationship between alcohol use and sexual activity is impossible. However, two opposing sets of results from the study are highly suggestive. At one extreme, the relationships between binge drinking and some less risky types of sex are eliminated by conditioning on fairly crude proxies for time-invariant proclivities to engage in sex and alcohol consumption. At the other extreme, controlling for more stringent sexual activity preference proxies, as well as many other behaviors correlated with drinking and sexual activity, fails to eliminate relationships between binge drinking and more risky types of sex. Along with results from an IV model that satisfies basic

validity criteria and specifications showing intensive margin effects of drinking, these results are consistent with the possibility that binge drinking directly increases risky sexual behavior.

Another contribution of this study is that it is the first in economics to focus on college students, even though the potential for binge drinking to impact sexual activity is particularly important among this demographic. In my sample of never-married four-year college students, for instance, 46% of respondents binge drank in the past month. Even among those who did not binge drink, 54% had sex in the past three months, and 12% of the sexually active had sex with at least two different partners during that time. However, the corresponding percentages among binge drinkers, 68% for any sex and 25% for multiple partners, are considerably higher.

2. Previous Literature

Many studies in the social science literature, e.g. Hingson et al. (1990), Leigh & Stall (1993), Cooper et al. (1994), Lowry et al. (1994), Donovan & McEwan (1995), Shrier et al. (1997) and Staton et al. (1999), have observed that adolescent drinkers are more likely to be sexually active and have more recent sexual partners, while those who drank before having sex are more likely to not use a condom. Subsequent economics research has attempted to move beyond simply describing these associations by specifically exploring whether alcohol use directly increases sexual risk taking.

One strategy for establishing causality has been to identify, in U.S. state panels, a reduced form relationship between an outcome of unprotected sex, rates of either STDs or births, and a policy that is known to influence alcohol consumption and was implemented at varying times across states. In 1981–1995 data, Chesson et al. (2000) estimated that rates of gonorrhea and syphilis were reduced by increases in alcohol taxes and the minimum legal drinking age

(MLDA). Dee (2001) showed in 1977–1992 data that MLDA increases lowered teen childbearing, particularly among blacks. Using data from 1985, 1988, 1992 and 1996 on women age 15–19, Sen (2003) estimated that beer taxes were related negatively to abortion rates, but unrelated to birth rates. Carpenter (2005) found that zero tolerance drunk driving laws reduced gonorrhea rates of 15–19 year old white males in 1981–2000 data. These studies control for unobserved time- and state-specific spurious correlates by including fixed effects for years and states (or in Sen (2003), regions), as well as state/region-level time trends. To establish the connection between alcohol policies and outcomes of unprotected sex, however, one must rely on evidence from separate research finding that more restrictive drinking policies directly reduce alcohol consumption.

Other economists have attempted to identify a direct causal effect of drinking on risky sexual behavior using IV regression with data on individual teens and young adults. While all of the following studies estimated large and significant positive relationships between alcohol use and risky sex in single equation models, most found the relationship to be insignificant in IV models. In data from the 1995 wave of the National Longitudinal Study of Adolescent Health (Add Health), Rees et al. (2001) obtained an insignificant IV relationship between intoxication and having sex, both overall and without contraception. Among participants in the National Longitudinal Survey of Youth, 1997 (NLSY97), Sen (2002) estimated positive IV coefficients that are significant for any alcohol use but paradoxically smaller and often insignificant for binge drinking.[1] Using Add Health, Averett et al. (2004) revealed relationships, by race/ethnicity for each gender, which are mostly insignificant though at times quantitatively large (and negative). Their only significant effect, for any past year drinking among white males, is extremely big

[1] The explanation offered in the paper is that alcohol-induced reductions in judgment and inhibition leading to sex take effect with 1–4 drinks, but once the 5-drink binge threshold is reached, individuals are too inebriated for sex.

(over 0.5 for any past year sex) and twice as large as the (insignificant) effect of past year drunkenness. For respondents to both NLSY97 and Add Health, Grossman et al. (2004) estimated relationships that are significantly negative, and sometime large, for both males and females. Grossman et al. (2005) found that for both male and female high school students in the 1991–1999 Youth Risk Behavior Surveys, binge drinking did not impact having any sex or the number of recent partners, but significantly reduced the use of condoms and any birth control by much larger amounts than implied by OLS.

Using the same data from Add Health and NLSY97, Rashad & Kaestner (2004) criticized the identification strategies used by Rees et al. (2001) and Sen (2002), because in many specifications one or both of the necessary conditions for instrument validity are violated. Some instrument sets are not significant predictors of drinking, while significance of other sets was inflated because standard errors were not clustered to account for varying only at the county or state level. Making use of the fact that a bivariate probit is identified by nonlinearity, they further pointed out that some instruments are significant when also included in the sexual behavior regressions. Moreover, they showed that an analogous IV strategy fails a falsification test by predicting large positive impacts of cigarette use on sexual intercourse, even though there is no reason to believe that smoking causally influences sexual behavior.

Even ignoring the oft-problematic issue of instrument exogeneity, which as Rashad & Kaestner (2004) imply might be a concern in studies like Rees et al. (2001), Sen (2002) and Averett et al. (2004) that rely on cross-sectional variation in relevant state policies, lack of instrument strength is a clear threat to the identification strategies in this literature. Weak instruments inflate standard errors, limiting the power to identify reasonably-sized effects. Furthermore, the asymptotic bias of IV relative to OLS, where F is the F-statistic for joint

significance of the excluded instruments, is approximately [1 / (F – 1)] (Stock & Yogo, 2005). This has lead to a rule of thumb that first stage F-statistics should be at least 10, implying a relative IV bias of roughly 10% or less. In contrast, instrument F-statistics range from 3 to 5 in Rees et al. (2001) and Averett et al. (2004), and 1 to 4 in Sen (2002) and Grossman et al. (2005).

The analysis in Grossman et al. (2004), which estimated bivariate probits identified solely by functional form, is immune from such criticism. They test the sensitivity of their results to various pre-specified choices for the value of the correlation between the error terms in the sex and drinking equations, but not their assumption that the bivariate probit model is correct.

Given these issues, perhaps the strongest estimates in the literature are those of Grossman et al. (2004) from person-specific fixed effects models. These are smaller than estimates from the corresponding OLS models and usually larger for binge drinking than any alcohol use, relationships that are expected but are often contradicted by the IV estimates in the literature. Binge drinking increased the probability of both any sexual intercourse and risky sex, defined as occurring without birth control at least 10% of the time, by between 7 and 9 percentage points in the NLSY97, although analogous estimates for any sex were insignificant in Add Health data. As the authors caution, however, fixed effects models do not control for time-varying omitted factors that might induce spurious correlation between drinking and sexual behavior.

3. Data

I analyze data from the National College Health Risk Behavior Survey (NCHRBS), developed by the Centers for Disease Control (CDC) and administered during the first half of 1995. As described in CDC (1997), the NCHRBS was designed to monitor college student health-risk behaviors. Two-stage cluster sampling produced a nationally representative group of

college students aged 18 and over. From 16 strata with varying percentages of black and Hispanic students, the first stage selected 148 institutions, half two-year and half four-year, with probability proportional to undergraduate enrollment. The second stage randomly sampled undergraduates in the 136 institutions that chose to participate, targeting 72 students from each two-year school and 56 from each four-year school. The questionnaire was mailed to 7,442 students for self-administration and completed by 4,814.

I drop 1,911 students age 25 and above, for whom only 10-year age ranges are known, or with missing age; 169 students who are either graduate students or have class standing of "other" (not freshman, sophomore, junior or senior) or missing; 184 students currently or previously married, since unprotected sex within marriage is not considered socially "risky"; 216 students missing information on current sexual behavior or alcohol use; and 331 students with missing values of explanatory variables. Among the remaining 2,003 respondents, I focus the analysis on the 1,272 students at the 67 four-year colleges in the survey. Students at two-year schools, for whom I also show results later, differ along many dimensions potentially relevant for the relationship in question. Most importantly, while 46% of four-year college students binge drink, only 36% of two-year college students do so.[2] The number of sample respondents from each four-year college ranges from 4 to 45, but is less than 10 for only 4 of the 67 schools.

Binge drinking is defined as having "five or more drinks of alcohol in a row, that is, within a couple of hours," and encompasses the past month. This does not take into account the relatively recent NIAAA definition change, which lowered the number of drinks threshold for women to four because of biological differences in rates of metabolizing alcohol. Using a strict number of drinks to define a proxy for intoxication ignores variation in tolerance levels across

[2] Other possibly pertinent differences include full-time attendance (94% v. 76%), class standing (45% freshmen or sophomores v. 82%), and living arrangements (43% university housing and 23% with parents v. 4% and 72%, respectively), although these factors are among the many that are included as controls in the analysis.

students, although controls such as age, gender, bodyweight and age when first consumed alcohol will partially account for this.

The NCHRBS asks how many partners of each gender the respondent has had sexual intercourse with in the past three months (oddly, since no other survey question uses this timing), and whether the respondent or partner used a condom never, rarely, sometimes, most of the time or always in the past month, or did not have sex during that time. From these, I construct four binary indicators of sexual activity that serve as the primary dependent variables for the analysis: whether the respondent had sex and had multiple partners, both overall and without always using condoms. Since binge drinking in the past month cannot literally impact sexual behavior in the preceding two months, the implied assumption is that binge drinking over the period one to three months before the interview is similar to that in the past month.

The mismatch in timing between condom use and sexual behavior means that the "sex without condoms" variables might either understate or overstate the inherent riskiness of corresponding sexual activity. A respondent who is recorded as always using a condom might have had sex without a condom prior to the past month but within the past three months. In contrast, a respondent categorized as having sex with multiple partners while not always using a condom might have had one partner in the past month and at times not used a condom, but used a condom in all previous encounters with a different partner. More generally, simply having sex, even without always (or ever) using condoms, might convey very little risk of STD transmission or unplanned pregnancy, particularly when occurring within a long-term monogamous relationship and accompanied by use of the pill or another form of birth control. Robustness checks, therefore, use alternate dependent variables that incorporate responses to an additional question about specific birth control methods used during the last sexual encounter.

Sexual behavior frequencies are reported in the headings to columns 2–5 of table 1. In the preceding three months, three-fifths of students had sex, and one-ninth did so with at least two partners. In each case, 65% of the sexually active failed to use a condom at least once in the previous month. The first row of column 1 shows that, as mentioned previously, nearly 46% of students binge drank at least once in the past month.

4. Results

The empirical analysis consists primarily of linear probability, i.e. ordinary least squares (OLS), models in which one of the sexual behavior indicators described above is regressed against the binge drinking indicator and, except initially, a set of additional covariates. Unreported statistical inferences and average marginal effects from logit and probit models are similar. Standard errors are robust to heteroskedasticity.

Baseline estimates

Table 2 displays the main results of the analysis. Each cell contains the coefficient and, in parentheses, absolute *t*-statistic for the binge drinking indicator in the regression of the sexual behavior dependent variable in the row heading. Column 1 begins with a simple difference-in-means estimator. Binge drinking significantly predicts all four types of sexual behaviors at the 1% level. Relative to sample means, binge drinkers are more likely to have sex by 25%, sex without a condom by 20%, and multiple recent sex partners, both unconditionally and without always using a condom, by 94%. As will be the case moving forward, these differences are considerably larger for multiple partners than any sex. Although these estimates almost certainly reflect at least some spurious correlation, they are useful to consider as a starting point.

Each subsequent column of table 2 adds to the model a set of control variables, as indicated in the lower panel. Table 1 lists the specific covariates included in each control set, with means shown in column 1 and regression coefficients, from more fully saturated models in column 8 of table 2 (for any sex) or column 2 of table 3 (for multiple partners), presented in columns 2–5. The column 2 specification of table 2 includes school fixed effects. All binge drinking coefficients grow in size and significance, suggesting that binge drinking is more common in universities where sexual activity is less frequent. School indicators are highly significant at this stage, but in the equations for any sex and multiple partners without a condom, ultimately remain significant only at the 10% level upon inserting remaining covariates.

Column 3 adds a vector of "exogenous" variables. These include not only a standard set of predetermined demographic characteristics, but also some behavioral variables that seem unlikely to directly affect the relationship between drinking and sex. As table 1 details, these include indicators for age, gender, class standing, full-time enrollment, race and ethnicity, residence type, work hours, health insurance coverage and parental schooling, along with gender-specific quadratics in height and weight. Controlling for these variables has little impact on the binge drinking coefficients. If anything, as with the school indicators, characteristics that predict binge drinking are associated with less sexual activity.

Table 1 shows that significant relationships between these factors and sexual behavior are sparse and not uniform across dependent variables. Sex is less likely among males, freshmen and students living with parents, and more likely among students working 10–39 hours/week, but only the relationship for working 20–39 hours/week persists for sex without a condom. Sex with multiple partners is more common among Asians, those with unknown maternal schooling (suggesting less maternal involvement) and, for females, as bodyweight rises.

Proxying for sexual behavior & alcohol use preferences

The covariates added in remaining table 2 specifications are intended to proxy for specific forms of unobserved heterogeneity likely to contaminate the relationship between binge drinking and sexual activity. I attempt to avoid controlling for behaviors occurring currently or very recently, i.e. within the past month, that are possibly on the direct causal pathway from alcohol use to sex. However, many variables reflecting choices occurring over the past year or lifetime are included in order to hold constant relevant time-invariant preferences. If concurrent behavioral choices drive variation in these measures, this strategy could, in principle, impart a negative bias on the estimated binge drinking parameters. As it turns out, though, the few regressors responsible for the substantive ensuing changes in the binge drinking coefficients are defined to capture decisions made prior to the survey period. In contrast, regressors that potentially pick up contemporaneous behaviors have relatively small effects on the estimates.

Column 4 of table 2 expands the model by a single additional control, a set of indicators for age at first sexual intercourse, which is recoded to current age for virgins. Table 1 reports that 37% of respondents had sex by age 16, presumably before entering college. From unreported cross-tabulations, at least another 33% had sex before turning their current age. Only 23% of the sample has never had sex.[3] Columns 2–5 of table 1 show that, not surprisingly, age at first intercourse is strongly associated with sexual behavior, but much more so for any sex than multiple partners.

Accordingly, controlling for age of first sexual episode has a much larger impact on the binge drinking coefficient in the two equations for any sex than the two for multiple recent partners. Binge drinking is still significant in the equation for any sex regardless of condom use,

[3] Many of the remaining 7% might have engaged in sex prior to the past three months. Among those who first had sex after age 16, it is known only whether sexual initiation occurred in age range 17–18, 19–20 or 21–24 years old.

but its effect is reduced by two-thirds, to 10% of the sample mean. More dramatically, the entire effect of binge drinking on any sex without always using a condom is eliminated. In contrast, the decrease in the multiple recent partners binge drinking coefficients is only 20–30%. Compared to the initial difference-in-means model, the impact of binge drinking is the same for multiple partners and only 15% less for multiple partners while not always using a condom.[4]

The next specification further controls for two additional measures of inherent proclivity for risky sex, whether respondents have ever impregnated a partner or been pregnant themselves and have ever been tested for HIV. Table 1 reveals that over 10% of respondents have been or gotten someone pregnant at least once, while 30% have taken HIV tests and another 10% might have but are unsure (or unwilling to report conclusively). These are crude proxies for risky sex, as not all unplanned or unprotected sex leads to pregnancy, while reciprocally HIV infection can result from other behaviors such as drug injection. Nonetheless, previous pregnancy is significantly associated not only with having sex, but also with having more than one recent partner. Although the former might imply "safe" sex within a monogamous relationship, the latter obviously does not. Moreover, controlling for previous pregnancy and HIV testing, in column 5 of table 2, reduces the binge drinking coefficient in the any sex equation by another 13% and renders it insignificant at 5%. Binge drinking effects in the multiple partners models, however, are diminished by only about half as much proportionately, remaining large and highly significant.

[4] The relationship between age at first intercourse and current sexual activity does not become deterministic via setting age at first intercourse equal to current age for virgins. Of the 392 respondents for whom initiation and current age are the same, i.e. those for whom current age falls within the sex initiation age category, 100 (26%) have previously had sex and 77 (20%) have had sex in the past three months. Conversely, 22% of students who initiated sex prior to their current ages also report not having sex in the past three months. Moreover, in the fully specified models from column 8 of table 1, alternatively including a single indicator variable reflecting whether or not the respondent has had sex before his or her current age, and doing the same for age at first drink, produces a negative (though insignificant) effect on any sex and a larger negative (but still insignificant) effect on any sex without a condom, but a very similar effect on multiple recent partners and a larger positive effect on multiple recent partners without a condom.

Next, to capture previously determined tastes for alcohol, age at first drink, again recoded to current age for lifetime abstainers, is added as a control. Table 1 indicates that students generally initiate drinking before sex: 57% tried alcohol by age 16, and another 25% drank by age 18, with 81% of this latter group currently age 19 or older. Unreported cross-tabulations show that 82% of respondents consumed alcohol before their current age, while only 11% had never tried alcohol. Relative to the modal age 15–16 category, however, age at first drink age has little significant impact on sexual activity, other than a negative effect of not initiating alcohol until at least age 21 on sex without a condom.

Still, in column 6 of table 2, the effect of binge drinking on having sex has shrunk by another 27%, to about 6% of the sample mean, and become insignificant at 10%. The combined result of adding the sexual behavior and drinking preference proxies, i.e. moving from column 3 to 6, suggests that the correlation between binge drinking and participation in sex, both overall and without a condom, among college students stems largely from previous initiation of alcohol use and sexual activity. A more complex temporal relationship between drinking and sex cannot be ruled out, but current binge drinking could not initiate this causal pathway. In contrast, the binge drinking coefficient has also declined in the multiple partners equations, but by only another 10% or so compared with column 5, and significance at 1% is maintained.

Adding further unobserved heterogeneity controls

Table 2 reports estimates from two additional specifications. The first controls for having ever tried, regularly smoked, and attempted to quit smoking cigarettes, along with ever having used marijuana, cocaine and any other illegal drug. These variables reflect earlier-formed substance use preferences that might be correlated with current drinking preferences, as well as

complementary consumption of illegal drugs that might be the true cause of some drinking-related sex. Alternatively, cigarette smoking in particular might reflect higher rates of future discounting (Farrell & Fuchs, 1982), which could be correlated with binge drinking. Including lifetime rather than current measures of substance use avoids holding constant mechanisms that might lie along the causal pathway between contemporaneous drinking and sexual behavior.

Table 1 shows that the only significant relationships between use of other substances and sexual behavior is for previous smoking in the any sex equation, and previous cocaine use in the any sex without a condom equation. Nonetheless, in table 2, holding constant previous substance use further weakens (or makes more negative) the effect of binge drinking in all four sexual behavior equations. The coefficient in the any sex model now has a *t*-statistic below 1, and an impact of only 3% relative to the sample mean. Although the coefficients in the multiple recent partners models are reduced by more than 10%, they remain large and highly significant.

The final table 2 model attempts to control for several additional correlates of binge drinking and sexual risk-taking. Seat belt use frequency serves as a proxy for risk preference; Anderson & Mellor (2008) found that risk aversion significantly predicts both more seat belt use and less heavy drinking. Because substance use, including heavy drinking, often co-occurs with psychological disorders, I control for two indicators of depression, having considered and planned a suicide attempt, along with self-described bodyweight relative to ideal. Having already held constant height and weight (and age and gender), considering oneself under- or overweight might reflect self-esteem deficiencies. Also, sports participation might lead to situations in which both alcohol and interactions with members of the opposite sex are available, possibly spuriously correlating the two.

In table 1, less risk-averse students are more likely to participate in sex, but significant

relationships with individual indicators are neither consistent across specifications nor systematic in the direction from never to often using seat belts. Planning suicide increases multiple partner sex, but decreases sex without a condom. A large negative relationship between considering oneself very overweight and the likelihood of sexual activity is not significant for sex without a condom, and also is evident for being only slightly overweight in the any sex equation. Considering suicide and playing sports do not enter significantly. Accordingly, in table 2, positive binge drinking effects are further diminished, but by relatively small magnitudes.

At this point, I conclude that binge drinking does not directly increase the propensity to have sex. Although the sample size limits identification power, the column 8 coefficient in the any sex equation is very small in an absolute sense, representing 1.7% of an increase in the mean likelihood of having sex. The insignificant effect of binge drinking on any sex without a condom, and smaller effect on multiple partners without a condom than unconditionally, also suggests that binge drinking does not reduce protective behavior. Because the negative effect on any sex without always using a condom seems odd, particularly as it would be statistically significant in a moderately larger sample, I further investigate use of condoms and other forms of birth control in table 5.

The large and significant positive coefficients in the two equations for sex with multiple recent partners are consistent with binge drinking directly increasing sexual promiscuity. However, inserting additional controls in table 2 diminished these coefficients, and by column 8, the impact on multiple partners without always using a condom is no longer significant at 1%. Thus, I continue to probe these relationships below.

Robustness checks

Table 3 begins, in column 1, by showing standard errors adjusted for correlation of error terms among students from the same school. In principle, this reduces the available degrees of freedom to the number of schools, so should not be used when school indicators are already held constant. Still, it is reassuring that clustering actually slightly reduces the standard errors.

The remainder of table 3 further tests for causation in three different ways. First, column 2 adds a strong control for preferences towards sexual activity, the number of times respondents had sex in the past month. Not surprisingly, table 1 shows a significant association between having sex in the past month and having at least two partners in the past three months, even holding constant the previously introduced covariates, although some students who abstained in the past month (1.2%) still had multiple partners in the two preceding months (and 15% had sex during that time). The pattern of coefficients, though, shows a perhaps unexpected relationship. Students having past month sex infrequently, especially just once, are most likely to have multiple partners, presumably via "one-night stands," whereas those having sex at least 20 times in the past month are not statistically more likely to have multiple partners than those who did not have past month sex. Below I further investigate a prospective implication of this result for estimated relationships between binge drinking and birth control use.

Despite the large impact of past month sex frequency, the effects of binge drinking on having multiple recent sex partners remain virtually unchanged in column 2 of table 3. As a result, I keep the number of sex episodes indicators in the regressions for most remaining specifications. In this model, relative to sample means, binge drinking raises the likelihood of multiple partners, unconditionally and without always using a condom, by 62% and 51%, respectively, with significance at 1% in the former case and 5% in the latter.

Columns 3 and 4 of table 3 exploit information on drinking without binging and number of binge drinking episodes, both also during the previous month: 28% of students drank but did not binge, while 35% of students, i.e. 78% of binge drinkers, had at least two episodes of binge drinking. If intoxication is the mechanism by which drinking causes risky sex, non-binge drinking should have an effect that is negligible (although not necessarily zero, as for some people inebriation may occur before five drinks). In column 3, I add an indicator of drinking without binging, based on separate information about whether respondents drank at all in the past month. Students who reported drinking, but not binging, are coded as non-binge alcohol users, while binge drinkers and non-drinkers are both coded as not having used alcohol without binging. As expected, non-binge alcohol use has effectively no relationship with having multiple sex partners. The effect of binge drinking is slightly altered, as the control group is now non-drinkers rather than all students who did not binge drink, but virtually the same, although standard errors have risen.

Column 4 goes one additional step, recoding the original binge drinking indicator to zero for everyone except those who binge drank exactly once in the past month, and adding a separate indicator reflecting binge drinking at least twice during that time. The logic is that causation should imply an effect on the intensive margin, i.e. more binge drinking episodes should create more chances for risky sex to occur. Indeed, the impacts of multiple-occasion binge drinking are even larger, relative to not drinking at all, than were those of any binge drinking.

Instrumental variables

Column 5 of table 3 reports the third check on causation, a rudimentary instrumental variables model. The strategy is motivated by the results of adding the six substance use

variables to the regressions in table 1. Specifically, in columns 4 and 5, none are individually significant, even at the 20% level, in either of the multiple partners equations. The *F*-statistics in table 3 show that they are also jointly insignificant. Thus, I specify these variables as instruments in a two-stage GMM model. The first stage regresses binge drinking on all the controls, while the second stage re-runs the regression from column 2 of table 3 with the substance use measures excluded and binge drinking predicted from the first stage in place of observed binge drinking (using an efficient weighting matrix, which distinguishes GMM from two-stage least squares). This strategy is not necessarily ideal because as described earlier, substance use is potentially correlated with risky sex through preferences related to time and risk. Controlling for the age of alcohol initiation, though, might mediate any such correlation.[5]

The first stage *F*-statistic for the instruments is 12.52, larger than the Stock & Yogo (2005) critical values corresponding to 10% maximal bias of IV relative to OLS and 20% maximal bias relative to the IV estimate magnitude, which are 11.12 and 11.72, respectively. Not shown is that all six substance use instruments have the expected sign in the binge drinking regression. Significance levels are 1% for previous cigarette and marijuana use, 5% for previous use of other drugs and 10% for having regularly smoked cigarettes.

For unconditional multiple sex partners, the IV coefficient of .167 is significant at 5% and more than twice the size of the OLS coefficient from column 2. However, the *p*-value of the formal test for endogeneity is .269. This insignificant difference between IV and OLS implies the more efficient OLS estimate should be used, and the fact that the IV estimate is larger

[5] In contrast, columns 2 and 3 of table 1 show that several substance use coefficients have or are approaching significance in the any sex equations. Moreover, the substance use variables are jointly significant in these equations, meaning they are unlikely to be exogenous as instruments for binge drinking. Not surprisingly, the IV coefficients in the any sex equations are much larger than in column 8 of table 1, which is counterintuitive and almost certainly due to the substance use instruments having a separate positive correlation with having sex, with or without a condom, outside of the pathway from binge drinking to sex.

supports the interpretation of the OLS estimate as a causal effect of binge drinking. In the sex with multiple partners without a condom equation, the IV coefficient is slightly smaller than the corresponding OLS coefficient, although the difference clearly is highly insignificant, again implying that OLS is consistent. Though insignificant, the IV estimate is quantitatively large, i.e. 43% of the sample mean.

The IV estimates also illustrate why it is difficult to draw inferences from instrumental variables models in this literature, at least without much bigger samples. Unlike IV models from previous studies, first stage instrument strength is sufficient to avoid appreciable bias from weak instruments. Yet, the IV coefficient standard errors are much too large, i.e. 70–90% of the corresponding sexual activity sample means, to identify reasonable-sized effects.

Does binge drinking directly precede risky sex?

For binge drinking to truly cause risky sex, it must be directly initiating sexual contact by occurring just before intercourse. Table 4 investigates the evidence for this timing by examining the connection between binge drinking, sex with multiple recent partners, and a separate variable, reported in the introduction, on whether respondents drank or used drugs before the last time they had sex. Samples are restricted to the 766 respondents who had past three month sex.

Columns 1 and 4 begin by re-estimating the preferred specification, from column 2 of table 3.[6] Not surprisingly, given the lack of effect on overall sexual activity, coefficient significance and size relative to sample means, 65% overall and 49% for without a condom, remain about the same even conditional on being sexually active. The implication is that the effect of binge drinking on sexual behavior is primarily to increase promiscuity among students

[6] Degrees of freedom are insufficient for estimating the effect of binge drinking on condom use among the 141 students who had multiple recent partners or, later in the table, the 159 sexually active respondents who drank or used drugs before their last episode of intercourse.

who would be sexually active regardless. Because some of this activity would have occurred without a condom anyway, the net effect is to also increase unprotected sex among those who have multiple partners, even though there is no apparent direct impact on protective behavior.

Columns 2 and 5 insert into the regression an indicator for drinking or using drugs before the last episode of sex, which occurred among 18% of students overall (table 1) and 21% of students who had sex in the past three months. The large positive coefficients are expected, but do reaffirm the connection between drinking & promiscuity, and provide evidence that relevant alcohol use occurs directly before sex. Moreover, the binge drinking coefficient falls by 23% and 36% in the overall and without condom equations, respectively, losing significance in the latter case. This suggests that at least some of the binge drinking that the regressions link to promiscuity is leading directly to the risky sex itself. When the sample is further restricted to the 607 respondents who report no alcohol or drug use before their last sexual encounter, binge drinking effects are reduced even more, by 37% in column 3 and 47% in column 6. Because the "substance use before sex" variable encompasses only the last sexual episode, though, it makes sense that the binge drinking coefficient would remain sizable.

Column 7 re-runs the regression in columns 1 and 4, with the indicator of using alcohol or drugs before sex as the dependent variable. Again, although not surprising, it is reassuring that the binge drinking coefficient is large, 82% of the sample mean, and highly significant.

Past month & other birth control behavior

Table 5 returns to the issue of protection. The first four columns investigate sex and condom use over the last month, which matches the time frame encompassed by binge drinking. Columns 1 and 2 re-estimate the regressions in the top two rows of table 2, column 8, for having

sex in the past month. Results are quite similar, providing some validation for drawing inferences about past three month sexual activity even though the condom use and drinking variables reflect only past month behavior.

In column 3, I look at a different margin of condom use, that of never rather than simply not always doing so. As the headings of columns 1–3 imply, 72% of students sexually active in the past month did not use a condom at least once, but only 43% never used one. The effect of binge drinking is again counterintuitively negative, although still insignificant and smaller than in column 2. Among just the 684 students who had sex in the past month, column 4 investigates how often condoms were used during sex, where "never," "rarely," "sometimes," "most of the time" and "always" are recoded to fractions in increments of 0.25 from zero to one, respectively. Results are similar to column 2; binge drinking actually increases the fraction of episodes involving a condom by 13% at the sample mean, albeit insignificantly.

The condom use results in tables 2, 3 and 5 consistently suggest that binge drinking does not decrease efforts to protect against STDs & unwanted pregnancies. However, among partners in a monogamous relationship, sex without a condom is not necessarily risky. If partners know they are not infected with an STD and are having sex only with each other, so that the primary reason for birth control is to prevent pregnancy, the pill might be the method of choice. In that sense, using no birth control at all, which involves at least as much disease risk as not using a condom for sex with a partner with unknown STD status and more pregnancy risk even for monogamous partners, might be a more appropriate indicator of sexual risk-taking.[7]

Columns 5–8 thus examine the use of no birth control and the pill the most recent time the respondent had sex, reverting to the sample of 766 students who were sexually active in the

[7] Long-term partners might be trying to conceive a child, although not with a current spouse since all sample respondents are unmarried.

past three months. In columns 5–6, the coefficient for binge drinking in the sex without birth control regressions do not provide much information. Effects are large relative to the low proportions of students who do not use birth control, especially in conjunction with multiple recent partners, and positive in the latter case, but highly insignificant. Binge drinking also has virtually no impact on using the pill, especially relative to the nearly half of the sample that does so. However, binge drinking is associated with a significantly higher likelihood, 57%, of using the pill while also having multiple recent partners.

This last result might explain the unexpected positive relationship between binge drinking and condom use. It could be that those who do not use condoms are particularly likely to be in a monogamous relationship in which no protection against STD transmission is needed, and the pill is used to prevent pregnancy. If sex is more likely among those in relationships than not, the fact that binge drinkers are less likely, though not quite significantly, to have sex without a condom might simply mark a weak association between binge drinking and not being in a stable relationship. Interestingly, binge drinkers being more likely to have multiple recent partners, which evidently involves less condom and more pill use, would then imply that some binge drinking-induced promiscuity represents students who are cheating on their long-term partners. The effect of binge drinking on having multiple partners and also using the pill, i.e. the specification in column 8 of table 5, is particularly strong for males (.127, $t = 2.15$), while also positive (.024) but insignificant for females.

Stratified samples

Table 6 begins, in panel A, by showing that there are no comparable promiscuity effects of binge drinking among NCHRBS two-year college students. Unreported results reveal that this

lack of effect is not explained by two-year students having higher propensities to be part-time: coefficients remain slightly negative among full-time students, who still compose 76% of the two-year sample. Similarly, among the 72% of two-year students who live with parents, binge drinking coefficients are actually positive, although still less than half the size of those for four-year students and insignificant. In panel B, binge drinking effects are actually slightly smaller, though still significant, among the vast majority of the four-year sample that attends full-time.

The remainder of table 6 shows results for samples split along the dimensions indicated in the row headings. Perhaps surprisingly, binge drinking coefficients are larger for students of legal drinking age but exhibit minimal difference by gender. Effects are large among non-Hispanic whites, especially for multiple partners without a condom, but insignificant among others. This contradicts Dee (2001), which finds more MLDA responsiveness for teen childbearing among blacks than whites. Whether alcohol or sex was initiated at an age that clearly precedes college entrance has no impact on the coefficients in the unconditional equation. However, binge drinking has a larger association (but not necessarily more significant, because of sample size) with promiscuity accompanied by not always using a condom among early initiators of each activity. As anticipated, living with parents dampens the impact of binge drinking on sex with multiple partners, especially without respect to condom use, while effects are more substantial among those who have had a previous HIV test, do not always use a seatbelt and play sports. Less expected is that among students who have ever tried cigarettes, coefficients are largest among those who have previously tried to quit. This could simply mean that many ever-smokers who do not currently smoke have never used cigarettes regularly enough to necessitate “quitting.”

5. Conclusion

The results of the analysis suggest that the observed relationship between binge drinking and participation in sex is the product of spurious correlation with other characteristics that are difficult to measure. Specifically, whether students have previously had sex, and to a lesser extent consumed alcohol, is seemingly a much more important determinant of being sexually active than is current binge drinking. However, the positive binge drinking coefficient persists for sex with multiple recent partners, both overall and not always using condoms, when the covariate set is extended to include a multitude of potentially correlated behaviors. This conclusion holds even when controlling for number of recent sex episodes and in an empirically defensible IV model. Consistent with a prospective causal effect of binge drinking, non-binge alcohol use has no effect on promiscuity, while binge drinking on multiple occasions has a particularly strong effect. Furthermore, the estimated relationship is connected with reports of using alcohol or drugs prior to the most recent sexual encounter.

The main limitation, of course, is that it is impossible to know for sure that the control set accounts for all unobservable factors inducing spurious correlation between sexual behavior and binge drinking. Thus, we cannot be certain that binge drinking causally increases promiscuity. Nonetheless, binge drinkers are clearly more likely to have sex with multiple partners within a relatively short time period, separately from various factors related to previously established attitudes regarding sex and drinking. Low power to identify even large effects is another limitation, as the standard errors in the preferred multiple partners equations specifications are roughly 20% of the corresponding sexual behavior sample frequencies. Yet, this feature of the data in a sense strengthens the argument for a direct effect of binge drinking, given that its estimated impact on sex with multiple partners still manages to attain statistical significance.

Because many regressors are defined for the past year or lifetime, and these longer periods still encompass current behavior, the possibility remains that the identification strategy biases the binge drinking coefficients negatively by controlling for behaviors that are on the causal pathway from drinking to sexual activity. Consequently, my empirical approach might be better viewed as a relatively strong test for potential causality, rather than a way to obtain the least-biased point estimates of the relationship between binge drinking and sexual activity.

An important implication is that policies reducing binge drinking among college students have the potential to convey the positive external benefit of decreasing disease transmission and unwanted pregnancies that can result from risky sex. This, of course, does not imply that such policies exist, or that any loss in utility accompanying the resulting behavioral changes would not outweigh the social benefits. Moreover, even if restrictive campus alcohol policies decrease adverse consequences of risky sex, the harm from moving alcohol consumption to off-campus locations might offset any corresponding benefit.

An obvious extension of this study is to pursue the same strategy in a larger data set. In particular, the Harvard College Alcohol Study collected nationally representative data on over 40,000 four-year college undergraduates on four occasions during 1993–2001. It contains the same type of information examined here, and in fact has many additional measures of drinking propensity that might be used to control even more strictly for unobserved heterogeneity, but is considerably larger. These data would seemingly allow for an even stronger test of causation between binge drinking and risky sexual behavior with considerably more power to detect small effects. Furthermore, the additional sample size would presumably make it possible to examine condom use in a sample of students with multiple partners, thus enabling further disaggregation of effects on promiscuity from those on protection against pregnancy and STDs.

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Table 1: Variable means & effects on past three month sexual behavior

Variable	Mean	Regression results			
		Any sex [μ = .602]	Any sex, sometimes no condom [μ = .389]	2+ partners [μ = .111]	2+ partners, sometimes no condom [μ = .072]
	(1)	(2)	(3)	(4)	(5)
Past month binge drinking	.456	.010 (0.33)	–.047 (1.50)	.069 (3.44)	.037 (2.28)
Exogenous					
Age 18	.124	–.080 (1.33)	–.127 (1.92)	.044 (1.08)	.003 (0.08)
Age 19	.202	–.025 (0.60)	–.049 (1.09)	.043 (1.47)	.005 (0.22)
Age 20	.219				
Age 21	.208	.058 (1.26)	.095 (1.95)	–.003 (0.09)	.026 (0.96)
Age 22	.134	.050 (0.89)	.076 (1.26)	–.032 (0.90)	.010 (0.34)
Age 23	.077	.066 (1.10)	.153 (2.42)	.002 (0.05)	.049 (1.21)
Age 24	.036	.037 (0.46)	.024 (0.26)	–.090 (1.67)	.008 (0.15)
Female	.594	.077 (2.16)	.046 (1.27)	–.006 (0.27)	–.004 (0.20)
Freshman	.210	–.111 (1.73)	–.098 (1.48)	–.040 (1.04)	–.001 (0.02)
Sophomore	.241	–.074 (1.50)	.000 (0.00)	–.002 (0.05)	.038 (1.28)
Junior	.243	–.037 (0.94)	–.001 (0.02)	–.027 (1.10)	.002 (0.10)
Senior	.307				
Full-time	.939	–.040 (0.64)	–.039 (0.62)	–.049 (1.12)	–.012 (0.34)
White, non-Hispanic	.673				
Black, non-Hispanic	.124	.057 (1.10)	.009 (0.15)	.032 (0.82)	.000 (0.00)
Hispanic	.090	.012 (0.24)	.037 (0.66)	.034 (1.04)	.004 (0.15)
Asian	.077	–.039 (0.74)	.058 (1.08)	.091 (2.76)	.070 (2.47)
Other race	.035	.077 (1.12)	.027 (0.34)	–.002 (0.04)	–.020 (0.55)
Lives in university housing	.425				
Lives in off-campus housing	.344	–.017 (0.51)	.021 (0.59)	.004 (0.16)	–.004 (0.19)
Lives with parents	.232	–.080 (1.95)	–.013 (0.30)	–.019 (0.67)	–.016 (0.66)

Table 1: Variable means & effects on sexual behavior (continued)

Variable	Mean	Regression results			
		Any sex	Any sex, sometimes no condom	2+ partners	2+ partners, sometimes no condom
	(1)	(2)	(3)	(4)	(5)
Exogenous (continued)					
Does not work	.344				
Works 1–9 hours/week	.127	.051 (1.19)	.037 (0.85)	–.027 (1.07)	–.027 (1.37)
Works 10–19 hours/week	.226	.077 (2.35)	.048 (1.40)	.022 (0.98)	.004 (0.19)
Works 20–29 hours/week	.190	.129 (3.57)	.090 (2.18)	.029 (1.08)	.002 (0.10)
Works 30–39 hours/week	.054	.118 (2.05)	.145 (2.19)	.027 (0.55)	.025 (0.55)
Works 40 hours/week	.037	.101 (1.32)	–.029 (0.38)	.019 (0.37)	.013 (0.28)
Works 40+ hours/week	.021	.086 (1.01)	.003 (0.04)	.122 (1.61)	.078 (1.26)
Has health insurance	.761				
Does not have health insurance	.153	.015 (0.40)	.007 (0.17)	–.011 (0.41)	.003 (0.14)
Health insurance coverage unknown	.086	.039 (0.88)	.018 (0.40)	–.056 (1.91)	–.019 (0.76)
Mother did not finish high school	.061	–.016 (0.25)	.026 (0.41)	.065 (1.49)	.077 (1.96)
Mother graduated from high school	.237	.011 (0.32)	.024 (0.59)	.002 (0.08)	–.006 (0.25)
Mother attended college	.290	–.010 (0.32)	.020 (0.59)	.010 (0.45)	–.001 (0.07)
Mother graduated from college	.398				
Mother’s schooling unknown	.013	–.068 (0.76)	.132 (1.24)	.163 (1.85)	.191 (2.18)
Father did not finish high school	.072	.015 (0.28)	–.016 (0.25)	–.002 (0.04)	–.026 (0.74)
Father graduated from high school	.177	.019 (0.50)	–.010 (0.23)	.010 (0.38)	.011 (0.46)
Father attended college	.239	–.007 (0.19)	–.039 (1.13)	–.013 (0.55)	–.024 (1.31)
Father graduated from college	.476				
Father’s schooling unknown	.035	.038 (0.55)	–.016 (0.18)	–.077 (1.76)	–.066 (1.52)
Height if male (inches)	71.0 (3.08)	.002 (0.21)	.003 (0.35)	–.001 (0.22)	–.002 (0.47)
Height if female (inches)	65.2 (2.79)	.002 (0.36)	.006 (0.91)	.005 (0.94)	.003 (0.77)
Weight if male (pounds)	173 (32.4)	.001 (1.05)	.000 (0.22)	.001 (1.11)	.001 (1.27)
Weight if female (pounds)	137 (29.9)	–.001 (1.09)	–.002 (1.39)	.002 (2.02)	.002 (2.62)

Table 1: Variable means & effects on sexual behavior (continued)

Variable	Mean	Regression results			
		Any sex	Any sex, sometimes no condom	2+ partners	2+ partners, sometimes no condom
	(1)	(2)	(3)	(4)	(5)
Sexual behavior & drinking preferences					
First had sex by age 12	.013	.158 (1.78)	.068 (0.61)	.175 (1.70)	.055 (0.57)
First had sex age 13–14	.070	.157 (3.46)	.115 (1.98)	.050 (1.10)	.067 (1.62)
First had sex age 15–16	.283	.079 (2.30)	.081 (2.13)	.035 (1.42)	.039 (1.83)
First had sex age 17–18	.342				
First had sex age 19–20	.198	–.282 (7.09)	–.197 (4.92)	–.003 (0.13)	.002 (0.13)
First had sex age 21+	.094	–.522 (9.86)	–.378 (7.27)	.042 (1.48)	.023 (0.95)
Never been/gotten someone pregnant	.892				
Been/gotten someone pregnant once	.088	.188 (4.85)	.153 (2.96)	.096 (2.10)	.064 (1.62)
Been/gotten someone pregnant 2+ times	.016	.132 (2.19)	.371 (3.81)	–.021 (0.31)	.012 (0.21)
Been/gotten someone pregnant unknown	.005	.086 (0.55)	.224 (1.13)	.067 (0.43)	.184 (1.17)
Have been tested for HIV	.295	.039 (1.35)	.015 (0.47)	–.009 (0.42)	.004 (0.24)
Never tested for HIV	.607				
Unknown whether tested for HIV	.098	–.004 (0.10)	–.047 (1.07)	–.008 (0.29)	–.006 (0.25)
First drink by age 12	.122	–.074 (1.70)	–.079 (1.64)	–.042 (1.32)	–.010 (0.36)
First drink age 13–14	.179	–.042 (1.21)	.054 (1.32)	.034 (1.15)	.044 (1.70)
First drink age 15–16	.274				
First drink age 17–18	.252	–.049 (1.33)	–.034 (0.86)	–.013 (0.50)	–.019 (0.96)
First drink age 19–20	.119	–.025 (0.50)	–.038 (0.70)	.003 (0.12)	.017 (0.63)
First drink age 21+	.056	–.067 (1.03)	–.130 (2.08)	.001 (0.04)	.001 (0.02)
Substance use					
Ever smoked cigarette	.671	.064 (1.93)	.019 (0.54)	–.003 (0.15)	–.017 (1.00)
Ever smoked cigarettes daily for month	.204	–.068 (1.49)	–.077 (1.50)	.023 (0.56)	.003 (0.07)
Tried quitting cigarettes past year	.240	.034 (0.80)	.050 (1.09)	–.035 (1.02)	–.008 (0.27)
Ever used marijuana	.420	.039 (1.21)	.024 (0.67)	.023 (0.98)	.005 (0.23)
Ever used cocaine	.053	.085 (1.47)	.136 (2.13)	.072 (1.22)	.060 (1.14)

Ever used another illegal drug	.145	.032 (0.80)	.037 (0.78)	.037 (1.02)	.026 (0.86)

Table 1: Variable means & effects on sexual behavior (continued)

Variable	Mean	Regression results			
		Any sex	Any sex, sometimes no condom	2+ partners	2+ partners, sometimes no condom
	(1)	(2)	(3)	(4)	(5)
Risk aversion, mental health & sports					
Never wear seat belt as passenger	.022	.050 (0.66)	–.040 (0.42)	.179 (2.45)	.113 (1.62)
Rarely wear seat belt as passenger	.057	.096 (1.87)	.062 (1.00)	.050 (1.04)	.044 (1.03)
Sometimes wear seat belt as passenger	.105	.053 (1.23)	.071 (1.57)	.022 (0.72)	.025 (0.91)
Most of time wear seat belt as passenger	.291	.033 (1.18)	.033 (1.09)	.059 (2.93)	.031 (1.79)
Always wear seat belt as passenger	.525				
Seriously considered suicide past year	.106	.028 (0.56)	.024 (0.44)	–.021 (0.56)	.014 (0.42)
Planned suicide past year	.068	–.039 (0.70)	–.111 (1.76)	.140 (2.86)	.041 (0.97)
Describe self as very underweight	.010	–.135 (1.00)	–.129 (1.20)	.095 (0.95)	–.025 (0.65)
Describe self as slightly underweight	.133	–.028 (0.67)	–.019 (0.43)	–.022 (0.95)	–.017 (0.92)
Describe self as about right weight	.524				
Describe self as slightly overweight	.300	–.110 (3.07)	–.027 (0.73)	–.033 (1.20)	–.006 (0.24)
Describe self as very overweight	.034	–.242 (2.97)	–.098 (1.13)	–.125 (1.88)	–.135 (2.69)
Did not play college/intramural sports this year	.698				
Played on 1 sports team this year	.175	.007 (0.19)	–.022 (0.58)	.002 (0.09)	–.002 (0.08)
Played on 2 sports teams this year	.066	.058 (1.06)	–.033 (0.63)	–.044 (1.24)	–.040 (1.32)
Played on 3+ sports teams this year	.061	–.001 (0.01)	.028 (0.51)	–.014 (0.36)	–.001 (0.02)
Additional covariates					
Did not have sex past month	.462				
Had sex 1 time past month	.065			.264 (5.30)	.176 (4.28)
Had sex 2–3 times past month	.106			.154 (4.46)	.073 (2.81)
Had sex 4–9 times past month	.173			.141 (5.16)	.105 (4.94)
Had sex 10–19 times past month	.126			.098 (3.21)	.097 (3.60)
Had sex 20+ times past month	.068			.047 (1.19)	.039 (1.07)
Alcohol or drugs preceded last sex episode	.180				

The sample size is 1,272. Regression estimates correspond to table 2, column 8 in columns 2–3, and table 3, column 2 in columns 4–5. Parentheses contain standard deviations for non-binary controls (height and weight) in column 1, and absolute heteroskedasticity-robust *t*-statistics in columns 2–5. Demeaned height

and weight (and their squares) enter the regressions. Brackets in row headings contain sexual behavior dependent variable frequencies.

Table 2: Effects of past month binge drinking on sexual behavior

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Any sex past 3 months	.148	.184	.184	.060	.052	.038	.018	.010
	(5.47)	(6.49)	(6.19)	(2.15)	(1.86)	(1.30)	(0.61)	(0.33)
Any sex past 3 months & did not always use condom past month	.077	.092	.096	–.002	–.008	–.029	–.042	–.047
	(2.80)	(3.21)	(3.22)	(0.08)	(0.26)	(0.96)	(1.34)	(1.50)
Multiple sex partners past 3 months	.104	.117	.129	.104	.098	.089	.075	.071
	(5.74)	(6.54)	(6.78)	(5.43)	(5.14)	(4.63)	(3.74)	(3.45)
Multiple sex partners past 3 months & did not always use condom past month	.068	.077	.080	.058	.054	.048	.042	.037
	(4.56)	(5.17)	(5.11)	(3.68)	(3.43)	(3.05)	(2.61)	(2.31)
Model includes as controls:								
School fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exogenous variables	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Age first had sex	No	No	No	Yes	Yes	Yes	Yes	Yes
Other sex preferences	No	No	No	No	Yes	Yes	Yes	Yes
Age first drank alcohol	No	No	No	No	No	Yes	Yes	Yes
Substance use	No	No	No	No	No	No	Yes	Yes
Risk aversion, mental health & sports	No	No	No	No	No	No	No	Yes

Each cell represents the coefficient of the past month binge drinking indicator in the OLS regression of the sexual behavior dependent variable in the row heading, with the control variable set expanding from column 1 to 8 as described in the last 7 rows. Parentheses contain heteroskedasticity-robust absolute *t*-statistics. Table 1 lists the specific variables included in each control variable set. The sample size is 1,272.

Table 3: Effects of past month drinking on sex with multiple partners in alternative models

Dependent variable	Coefficient/statistic	(1)	(2)	(3)	(4)	(5)
Multiple sex partners past 3 months	Binge drinking	.071	.069	.074	.039	.167
		(3.56)	(3.44)	(3.13)	(1.27)	(2.07)
	Non-binge alcohol use {μ = .737}			.007	.009	
				(0.32)	(0.42)	
	Binge drinking 2+ days {μ = .354}				.092	
					(3.46)	
	F-statistic (IV in sex equation)					1.03
						[.404]
	F-statistic (IV in binge equation)					12.52
						[.000]
Multiple sex partners past 3 months & did not always use condom past month	Binge drinking	.037	.037	.034	–.010	.031
		(2.37)	(2.28)	(1.76)	(0.45)	(0.48)
	Non-binge alcohol use {μ = .737}			–.003	–.001	
				(0.18)	(0.04)	
	Binge drinking 2+ days {μ = .354}				.057	
					(2.56)	
	F-statistic (IV in sex equation)					0.70
						[.647]
	F-statistic (IV in binge equation)					12.52
						[.000]
Model feature:						
Standard errors clustered by school		Yes	No	No	No	No
Controls for # times had sex past month		No	Yes	Yes	Yes	Yes
Controls for non-binge alcohol use		No	No	Yes	Yes	No
Controls for binge drinking 2+ days		No	No	No	Yes	No
GMM (IV are substance use indicators)		No	No	No	No	Yes

Each column represents a separate OLS regression of the sexual activity from the "Dependent Variable" column on the drinking indicators listed in the "Coefficient/statistic" column and the full set of controls from column 8 of table 2. Parentheses contain absolute *t*-statistics and square brackets contain *F*-statistic *p*-values, both robust to heteroskedasticity. Curved brackets contain frequencies of non-binge alcohol use and multiple-occasion binge drinking. In column 4, the binge drinking indicator is recoded to zero for respondents who binge drink on 2+ days. The sample size is 1,272.

Table 4: Binge drinking, multiple partners & alcohol/drugs before last sexual episode among sexually active

Dependent variable:	2+ partners			2+ partners & no condom			Pre-sex alcohol or drugs
Sample:	All	All	No pre-sex alcohol or drugs	All	All	No pre-sex alcohol or drugs	All
Regressor	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Binge drinking	.120	.092	.076	.058	.037	.031	.170
	(3.67)	(2.80)	(2.20)	(2.27)	(1.44)	(1.19)	(5.33)
Used alcohol or drugs before last sex episode		.160			.119		
		(.042)			(3.16)		

Each cell represents the coefficient of the variable in the row heading in the OLS regression of the sexual behavior dependent variable in the column heading. The control variable set corresponds to column 2 of table 3. Parentheses contain heteroskedasticity-robust absolute *t*-statistics. Samples include only the 766 respondents who had sex in the past three months. The columns 3 and 6 samples are further restricted to the 607 such respondents who did not use alcohol or drugs before the last time they had sex.

Table 5: Effects of past month binge drinking on sex & birth control in past month & at last episode

Sample:	All			Had sex past month	Had sex past 3 months			
Dependent variable:	Had sex	Had sex without condom	Had sex & never used condom	Fraction of times used condom	No birth control last episode	> 1 partner & no birth control	Used pill last episode	> 1 partner & used pill
Regressor	[μ = .538]	[μ = .390]	[μ = .232]	[μ = .431]	[μ = .080]	[μ = .007]	[μ = .486]	[μ = .077]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Binge drinking	.006	–.046	–.018	.056	–.008	.002	–.004	.044
	(0.18)	(1.44)	(0.61)	(1.31)	(0.30)	(0.28)	(0.09)	(2.03)

Each cell represents the coefficient of past month binge drinking in the OLS regression of the sexual behavior dependent variable in the column heading. The control variable set corresponds to table 2, column 8 for columns 1–3 and table 3, column 2 for columns 4–8. Parentheses contain heteroskedasticity-robust absolute *t*-statistics, and brackets contain dependent variable frequencies. The sample size is 1,272 in columns 1–3, 684 in column 4 and 766 in columns 5–8.

Table 6: Effects of binge drinking on sex with multiple partners in stratified samples

	Sample	N	2+ partners (1)	2+ partners & not always use condom (2)
A.	Two-year schools	731	–.007 (0.20)	–.021 (0.78)
B.	Full-time students	1,195	.065 (3.20)	.035 (2.15)
C.	Ages 18–20	693	.061 (2.14)	.033 (1.58)
	Ages 21–24	579	.105 (3.11)	.048 (1.76)
D.	Females	755	.084 (3.09)	.041 (2.16)
	Males	517	.087 (2.40)	.050 (1.54)
E.	Non-Hispanic whites	856	.076 (3.46)	.055 (3.20)
	Non-whites & Hispanics	416	.032 (0.64)	–.007 (0.17)
F.	Drank alcohol by age 16	730	.071 (2.52)	.056 (2.30)
	First drink age 17 or later	542	.065 (2.21)	.011 (0.55)
G.	Had sex by age 16	465	.071 (1.47)	.059 (1.37)
	No sex until age 17 or later	807	.075 (3.44)	.034 (2.36)
H.	Do not live with parents	977	.092 (3.96)	.046 (2.36)
	Live with parents	295	.009 (0.19)	.038 (1.09)
I.	Never had HIV test	772	.069 (2.58)	.026 (1.44)
	Have had HIV test (or unknown)	500	.080 (2.26)	.071 (2.23)
J.	Always wear seatbelt as rider	668	.059 (2.21)	.037 (1.92)
	Do not always wear seatbelt	604	.090 (2.50)	.051 (1.63)
K.	Play college or intramural sports	384	.120 (2.42)	.059 (1.24)
	Do not play sports	888	.069 (2.75)	.031 (1.68)
L.	Never smoked cigarettes	418	.066 (1.99)	.030 (1.26)
	Ever tried to quit smoking	305	.075 (1.27)	.076 (1.43)
	Never tried to quit smoking	549	.060 (1.74)	.022 (0.76)

Cells in columns 1 and 2 represent the coefficient of past month binge drinking in the OLS regression of the sexual behavior dependent variable in the column heading, with the sample restricted as indicated in the row heading. The control variable set corresponds to column 2 of table 3. Parentheses contain heteroskedasticity-robust absolute *t*-statistics.