

Association Between Adolescent Drinking and Adult Violence: Evidence From a Longitudinal Study of Urban African Americans*

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ABSTRACT. Objective: This study examined the relationship between adolescent alcohol use and adult violence from a developmental perspective, specifically whether frequent adolescent drinking predicts adult violence once shared risk factors are taken into account through propensity score matching. The research considered multiple types of violence, including assault, robbery, and suicidal behavior, as well as other types of offending. It tested whether educational attainment and adult alcohol use and problems contribute to the adolescent drinking–adult violence relationship. **Method:** Data came from a longitudinal epidemiological study of a community cohort of urban African Americans followed from age 6 to 42 ($N = 702$; 51% female). Frequent adolescent drinking was operationalized as 20 times or more by age 16. Data on violent arrests and offenses were collected throughout adulthood from self-reports and official criminal records. Matching variables came from childhood and

adolescence and included such shared risk factors as childhood externalizing behaviors, school achievement, and family functioning. **Results:** Adjusted logistic regression analyses on the sample matched on childhood and adolescent risk factors showed that frequent adolescent drinking was associated with an increased risk of violence in young adulthood (in particular assault) but not with other types of crime, self-directed violence, or violence in midlife. Findings varied by gender. Heavy episodic drinking in adulthood seemed to account for some of the association between frequent adolescent drinking and adult assault. **Conclusions:** The results of this study suggest that preventing frequent adolescent drinking could potentially decrease adult assault. This study adds to the growing body of literature suggesting long-term negative consequences of adolescent alcohol use. (*J. Stud. Alcohol Drugs*, 72, 701–710, 2011)

ALCOHOL USE HAS BEEN FOUND TO PLAY a significant role in increasing the risk of violence. Studies have linked alcohol to multiple types of violence, such as physical and sexual assault (Caetano et al., 2001; World Health Organization, 2002) and intentional and unintentional injuries to self and others (Rehm and Monteiro, 2005; World Health Organization, 2002). Studies have shown the relationship to be particularly strong for assault-related violence compared with other forms of violence and other criminal acts (Collins, 1988). Although the relationship between acute intoxication and violence is well established, this article focuses on the developmental association between frequent alcohol use and violence over the life course, with a specific focus on the relationship between alcohol and violence over the long term.

Adolescent drinking and later violence

There is a limited research base demonstrating that adolescent drinking has been associated longitudinally with violent behavior and arrests (Dembo et al., 1991; Komro et al., 2000; Wells et al., 2007). Studies show that adolescent drinkers are more likely to participate in violent behavior and other types of crime in adulthood (e.g., theft, damage to property) compared with nondrinking adolescents (Anderson et al., 1999; Duncan et al., 1997; Swahn et al., 2004). Xue et al. (2009), for example, found significant associations between trajectories of adolescent alcohol use and trajectories of violence over 8 years in an African American sample, even after controlling for shared risk factors. In addition, Ellickson et al. (2003) found that in early adulthood (age 23), early adolescent drinkers had twice the likelihood of being arrested and engaging in predatory violence, stealing, and committing a felony, compared with nondrinkers.

Despite the evidence of adolescent drinking predicting adult violence and other crime, it is unclear whether the longitudinal relationship is a causal one. As described by Jessor and Jessor's problem-behavior theory (1977), shared predisposing risk factors serve to facilitate and perpetuate various forms of deviance, including both alcohol use and violent behaviors. Such shared risk factors include socioeco-

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conomic status, family characteristics and functioning, personal characteristics, measures of behavior problems and delinquency, academic achievement, and other drug use (Hicks et al., 2010; Swahn and Donovan, 2006; Wells et al., 2004; White et al., 1999; Xue et al., 2009). Although much of the relationship between various forms of deviance seems to be attributable to shared causes, evidence suggests that shared risk factors only partially explain the relationship between alcohol and violence (Osgood, 1998).

Using a life course developmental perspective, this study investigates whether adolescent drinking relates to adult violence over time and identifies potential factors that may explain the continued association. The life course perspective suggests continuity in deviance over time that follows a variety of pathways (Robins, 1966; Sampson and Laub, 1992). For instance, early drinkers are more likely to continue drinking into adulthood and to develop alcohol-related problems at higher rates (Grant and Dawson, 1997; Hawkins et al., 1997). Thus, early problematic drinking can set an individual on a trajectory of problematic drinking, and this problematic adult drinking creates a lifestyle that makes violence more likely (Osgood, 1998; Wells et al., 2007). Studies have shown that intoxication has a particularly strong, direct association with aggression (Hoaken and Stewart, 2003; Miczek et al., 1994), but nonintoxicated heavy drinkers also have an increased risk because of the social contexts in which drinking occurs, cultural acceptance of violence among drinkers, and general mood disturbance among heavy drinkers (Pernanen, 1991; White et al., 1993).

In addition to adolescent drinking putting an individual on a pathway of problematic alcohol use, early drinking can also lead to continuity of deviance through a long-term reduction in opportunities (Hicks et al., 2010; Sampson and Laub, 1997). In particular, problematic drinking during adolescence can lead to school dropout and other types of educational failure (Hawkins et al., 1997; Newcomb and Bentler, 1988; Schulenberg and Maggs, 2002; Staff et al., 2008), which in turn, have been linked to an increased risk of crime (Thornberry, et al., 1985). Thus, drinking during adolescence may serve as a contributing factor for adult violence in that it can set an individual on a long-term trajectory of socioeconomic failures that perpetuate all types of crimes, including violence.

Whereas others have controlled for shared risk factors in a regression framework to estimate the potential presence of a causal association between frequent adolescent drinking and adult violence, this study uses a more advanced statistical technique, propensity score matching, designed to adjust for confounding in nonexperimental studies (Rosenbaum, 2009; Rosenbaum and Rubin, 1983). By matching frequent adolescent drinkers with light/nondrinkers on multiple childhood and adolescent risk factors, this technique approximates the random assignment of an experimental design. The propensity scores help capture confounding effects of

differential variation among observed covariates and aid in reducing selection into frequent drinking. This technique helps isolate the impact of frequent adolescent drinking on adult violence from their shared risk.

Gender differences in the alcohol–violence relationship

Previous work has demonstrated a differential relationship between alcohol use and violence for men and women, with some studies showing a stronger effect for men and others showing a strong effect for women, although this research is primarily cross-sectional (e.g., Duncan et al., 1997; Giancola and Zeichner, 1995; Martin and Bryant, 2001). For example, White et al. (1993) found that adolescent males were more likely to engage in alcohol-related aggression than adolescent females. Alternatively, Wells et al. (2007) found that heavy episodic drinking was more strongly associated with alcohol-related fighting for adolescent girls than boys. Conflicting findings demonstrate the importance of considering gender when examining the relationship between alcohol and violence.

Alcohol and violence among African Americans

Research suggests that the rates of perpetrating violence and the burdens and consequences of violence may be unequally distributed throughout society and experienced disproportionately by minorities. Inner-city, disadvantaged urban communities often are characterized by high levels of chronic violence (Feigelman et al., 2000; Swahn and Bossarte, 2009). Examining trends over 5 years, a U.S. Department of Justice, Bureau of Justice Statistics report (2007) showed that African Americans were victims of violent crimes at rates higher than Whites, Asians, and Hispanics, with younger African American men particularly vulnerable to victimization. Experiencing victimization has been shown to be associated with violence perpetration (Feigelman et al., 2000), especially in disadvantaged areas (Vaughn et al., 2010). In addition to high rates of victimization, incarceration rates for African Americans are 5.6 times higher than those experienced by Whites (Mauer and King, 2007). This context makes the African American community all the more relevant for investigating early life factors that contribute to violence.

Current study

This study investigates the prospective association between adolescent alcohol use and adult violent crime in a cohort of urban African Americans using a developmental framework to examine life course consequences of frequent adolescent drinking. The longitudinal design allows us to establish appropriate temporal ordering to evaluate any potential causal relationships over time. The propensity

score matching approach helps in attempting to isolate the impact of frequent adolescent drinking on adult violence by matching on childhood and adolescent risk factors that may confound the association. The study addresses the following research questions:

1. Is there a longitudinal relationship between frequent adolescent alcohol use and adult violence once shared risk factors are taken into account?
2. Does frequent adolescent alcohol use relate to overall crime in adulthood or is the relationship unique to violence?
3. Does the relationship between frequent adolescent alcohol use and adult violence differ for men and women?
4. What role does problematic adult drinking and educational failure play in these associations?

Method

Woodlawn Study

This study used data from the Woodlawn Study, a community epidemiological study of urban African Americans followed from age 6 to 42 (Crum et al., 2006; Ensminger et al., 2002; Kellam et al., 1975). This study was approved by the institutional review boards at The Johns Hopkins Bloomberg School of Public Health and the University of Maryland.

The study began in 1966 by recruiting all families of first graders in the Woodlawn public and parochial schools ($N = 1,242$; only 13 families declined to participate). In first grade (1966–1967), extensive data were collected from mothers and teachers on each child's mental health, social adaptational status, and the family and classroom contexts. In 1975–1977, extensive data were collected from those mothers and adolescents who remained in the Chicago area. Mothers provided in-depth in-person interviews ($n = 939$), and adolescents (age 16; $n = 705$) completed a group-administered questionnaire with questions administered via audio tape to control for reading differences (Petersen and Kellam, 1977). In 1992–1993, 952 individuals completed the young adult interview (age 32). In 2002–2003, 833 completed the mid-adult interview (age 42). Overall, 1,053 participants completed at least one of the adult interviews, representing 85% of the original cohort. In 1985 and 1992, the Chicago Police Department provided criminal arrest records for all Woodlawn participants; in 1993, Federal Bureau of Investigations (FBI) arrest records were obtained.

Attrition

Included in these analyses were those Woodlawn Study participants who took part in the adolescent assessment and responded to the two questions about alcohol use ($N = 702$). Because of funding constraints, those targeted for in-person follow-up in adolescence were those who remained in the

Chicago area and whose mothers were interviewed during adolescence and thus were able to provide consent for their children to be contacted. Attrition analyses showed that mothers not interviewed were younger, began childbearing younger, and had greater residential mobility by the child's first-grade year. Comparing adolescents who were assessed and those who were not, no differences were found on such key variables as gender, psychological well-being, early social adaptational status, childhood poverty status, welfare receipt, or family structure in the home (Fleming et al., 1982; Kellam et al., 1983). There was one main difference with respect to adult crime between those assessed during adolescence and those not assessed. Those with a violent arrest during young adulthood were more likely to have been assessed during adolescence than those without a violent arrest, although adolescent participation did not vary by mean number of violent arrests or self-reports of violence. There were no differences in adult alcohol or drug use disorders or a diagnosis of major depression disorder, although those not assessed during adolescence were more likely to drop out of high school. These attrition analyses suggested that those interviewed during adolescence are relatively representative of the original Woodlawn population.

Measures

Frequent adolescent drinking. Frequent adolescent drinking was the primary independent variable. It was based on two questions in which adolescents self-reported their lifetime frequency of use of beer or wine and the use of distilled spirits. Response categories included the following: no use, 1–2 times, 3–9 times, 10–19 times, 20–39 times, and 40 or more times. A person who reported using either beer/wine or distilled spirits 20 or more times in his or her lifetime (by age 16) was coded as a frequent drinker (26.5%). Those who reported no use or use of both less than 20 times were coded as light/nondrinkers (73.5%); this group comprised nondrinkers (19.5%) and infrequent drinkers (54.0%). To confirm the relevance of this threshold, we conducted sensitivity analyses (not shown). Specifically, we tested the cutoff point of 40 or more times to define “frequent” drinkers with similar results and a cutoff point of 10 or more with substantially attenuated results, suggesting 20 or more times as a threshold of seriousness.

Adult violence. The dependent variables were arrests for specific violent acts, gathered from official arrest records from the Chicago Police Department and FBI rap sheets, and self-reports of violent acts at the young- and mid-adult interviews. All outcomes were binary and represent whether the individual was arrested for (or self-reported) the particular act of violence. In measuring arrests, we included FBI and Chicago arrest records to help ensure that crimes within and outside of the Chicago area would be included in our analysis.

Official records were last collected in 1992/1993 and represented crime from age 17—the age of majority in Illinois at the time—up to age 32. These records included information on type of crime, disposition of the offense, and date/age at arrest. Violent offenses included such acts as murder, assault, robbery, and rape. Twenty-three percent had an official record of a violent offense.

We examined the two most common types of violent arrests, assault and robbery, separately. Assault was defined as an unlawful physical attack by one person on another; 18.6% were coded as having an assault arrest. Robbery was defined as taking property from a person by the use of force or by threatening the imminent use of force; 6.7% were coded as having a robbery arrest.

We also examined self-reports of assault and robbery. At the young adult (age 32) and mid-adult (age 42) interviews, respondents self-reported whether they had committed a series of violent acts. The young adult assessment included lifetime perpetration of these acts as adults, whereas the mid-adult assessment covered the time since the young adult assessment (between ages 33 and 42). Thus, the mid-adult interview assessed the period subsequent to that included in the official records. In the self-reports of crimes, three items assessed assault and included beating up someone in the family, beating up someone outside of the family, or purposely injuring someone physically; 33.7% self-reported assault at the young adult interview and 13.3% reported it at midlife. Two items assessed robbery: obtaining money or other valuables by beating up someone or using threats; 10.6% self-reported robbery at the young adult interview and 5.0% reported it at the midlife interview.

We considered self-directed violence in the form of attempted or completed suicides based on self-reports from either the young or midlife interview and from death records collected from the National Death Index. All sources were combined because this outcome was relatively rare (6.2%).

Nonviolent crime. We also considered drug and property arrests, as contrasts to violent offenses. Drug-related arrests were the unlawful production, distribution, and/or use of controlled substances, and the equipment or devices used in their preparation and/or use; 16.7% of the study sample was arrested for a drug-related crime. Property arrests included burglary, larceny/theft, arson, forgery, fraud, criminal damage, and criminal trespassing; 23.3% of the study sample was arrested for a property crime.

Mediators. To further understand the alcohol–violence relationship, we tested three potential pathways to violence in adulthood—heavy episodic drinking, having an alcohol disorder, and educational attainment. Young adult heavy episodic drinking was a binary item of whether the respondent ever drank five or more drinks on drinking days (33.5%). We also tested meeting criteria for an alcohol use disorder. This mediator was restricted to those whose onset of alcohol use disorder was before the age at first arrest to ensure proper

time. Diagnosis of an alcohol use disorder was assessed using the Composite International Diagnostic Interview (Kessler et al., 1994). Criteria were based on the *Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised* (American Psychiatric Association, 1987) in young adulthood and the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (American Psychiatric Association, 2000) in mid-life. Fifteen percent met lifetime criteria for alcohol abuse or dependence with an age at onset before the age at first violent arrest. We also examined educational attainment, which was measured by whether the study participant dropped out of high school or graduated; 19.1% dropped out of high school.

Matching variables. To attempt to isolate the effect of frequent adolescent drinking on adult violence perpetration, we matched on covariates expected to confound the association. These variables included indicators of gender, socioeconomic status, family background, school achievement, school adaptation, delinquency, and smoking (see Green et al., 2010).

Poverty status was a binary indicator of whether the family was living below the federal poverty line at the time of the first-grade assessment. We also included mother's education (range: 0–22 years), family mobility (number of residential moves between the child's birth and first grade, range: 0–9), whether the child lived in a female-headed household, and the number of children in the household (range: 1–15), all reported by mothers at the first-grade interview.

We matched on two indicators of family functioning reported by mothers at the first-grade assessment: family discipline and activities. Family discipline was the sum of two items about the frequency of spanking, ranging from *never* (0) to *almost every day* (5), and the frequency of punishment for misbehavior, ranging from *hardly ever* (1) to *always* (4) (see also Juon et al., 2006). Family activities was the sum of two questions on how frequently the mother plays with or reads to the child (1 = *less often* to 3 = *every day*) and how often the child gets taken out (0 = *never* to 4 = *weekly*).

We included two indicators of family history of substance use as reported by mothers during the adolescent assessment. The first was the mother's report of regular alcohol use or any illicit drug use by anyone in the family. The other was the mother's self-report of regular alcohol use or use of any illicit drugs.

We matched on first-grade teacher's assessment of conduct problems and math achievement, both of which were reported on a four-point scale ranging from excellent to unsatisfactory. We matched on first-grade teacher's ratings of social adaptational status in five areas: achievement, aggression, immaturity, inattention, and shyness (Kellam et al., 1975). Ratings were on a four-point scale ranging from adapting to severely maladapting.

We matched on an overall frequency, on a five-point scale, of perpetrating 18 possible adolescent delinquent activities

(range: 0–69). Items included running away from home, taking a nonfamily car without permission, shoplifting, trespassing, skipping school, damaging school property on purpose, carrying a weapon, participating in a gang fight, getting into a serious fight with a student at school, getting something by threatening, and hitting parents or teachers. Finally, we matched on reports of smoking at least occasionally before age 15.

Statistical analyses

Propensity score matching. We used the MatchIt Program (Ho et al., 2006), a component of the R Statistical package, to conduct the propensity score matching (Hansen, 2004; Rosenbaum, 1991), following the steps suggested by Ho et al. (2007). The full matching approach allowed us to retain all adolescents in our data analysis sample and has been shown to be particularly effective at reducing bias because of observed confounders (Stuart and Green, 2008). This approach created a series of matched sets optimally grouping together individuals with similar propensities to be a frequent drinker. Full matching assumed that after conditioning on the observed covariates, there were no other differences between the frequent drinkers and light/nondrinkers. Thus, to the extent that the observed matching variables capture confounding, bias was removed and potential causal impacts could be estimated.

After assigning propensity scores, we assessed the adequacy of the matching through diagnostic checks (Stuart and Green, 2008). We examined the balance between frequent drinkers and light/nondrinkers of each covariate, its square, and every two-way interaction as determined by standardized bias. To improve matching, we tested the inclusion of various squared terms and interactions in the matching equation. The final model included an interaction between residential mobility and first-grade teacher's rating of inattention. As soon as adequate sets were formed, individuals were assigned a weight based on the ratio of frequent drinkers to light/nondrinkers within a set.

This analysis created 143 matched sets based on the propensity score, which ranged from .01 (very low) to .86 (high). Each set contained, on average, 4.9 individuals. Each matched set included at least one of the 186 frequent drinkers (mean = 1.31, median = 1.00) and at least one of the 516 light/nondrinkers (mean = 3.64, median = 1.00).

Weighted logistic regression. Next, we used Stata/SE 11 (StataCorp LP, College Station, TX) to apply weighted logistic regression. Regression models included the matching variables and the interaction of inattention and residential mobility as controls to further adjust for any remaining difference in the matched samples (Ho et al., 2007). After main effects were examined, we tested gender interactions using the matched data.

Last, we conducted mediation analyses as described by

MacKinnon and Dwyer (1993) because of the binary nature of the mediators and outcome variables (Kenny, 2008). Mediation testing was conducted for any outcome in which frequent adolescent drinking was a statistically significant predictor after propensity score adjustment (i.e., for those relationships in which there was an effect to mediate). We reported Sobel test statistics and associated *p* values, which indicated the statistical significance of the indirect effect (Preacher and Hayes, 2004).

Missing data

To reduce bias because of missing data (Graham, 2009; Little and Rubin, 1987), we used multiple imputation by chained equation to handle missingness, maintaining a final sample size of 702 for all analyses. Forty data sets were imputed. Multiple imputation was implemented by ICE in Stata 11/SE. We assumed no missingness on arrest records because the search was conducted for all original Woodlawn Study participants.

Results

Table 1 shows descriptive statistics for frequent drinkers and light/nondrinkers on the matching variables. This table includes standardized bias before and after propensity score matching. Before matching, frequent drinkers were statistically significantly more likely to be male and to be early-onset smokers compared with light/nondrinkers. Frequent drinkers also had higher ratings of conduct problems and aggressive behavior by first-grade teachers, poorer math achievement in first grade, and greater self-reported adolescent delinquency. After matching, none of these differences was statistically significant; all standardized biases after matching were less than .20, demonstrating good fit (Ho et al., 2007).

As shown in Table 2, frequent adolescent drinking was highly related to all types of adult arrests. Frequent adolescent drinkers were 2.39 times as likely to have a violent arrest, 2.32 times as likely to have a property crime arrest, and 2.26 times as likely to have a drug arrest as were light/nondrinkers (*ps* < .01). However, after propensity matching adjustment, the only statistically significant association that remained was between frequent adolescent drinking and having an arrest for a violent offense. Frequent adolescent drinkers were 1.73 times as likely to have a violent arrest as are light/nondrinkers (*p* = .013).

Table 3 shows the relationship between frequent adolescent drinking and multiple types of violence, including official and self-reported assault and robbery, and suicidal behavior. Before propensity score matching, frequent adolescent drinkers were more likely to have an official arrest record for assault and for robbery and to self-report assault and robbery at the young adult interview. There was no sta-

TABLE 1. Comparison of frequent and light/nondrinking before propensity score matching on covariates: means or percentages, standardized biases, and statistical significance ($N = 702$)

Covariates	Frequent drinkers ($n = 186$)	Light/ nondrinkers ($n = 516$)	Standardized bias before matching ^a	Standardized bias after matching ^a
Male	65.59%	42.44%**	.486	.023
Poverty status	54.21%	51.76%	.057	.183
Mother's years of education	10.65	10.50	.065	.095
Number of residential moves	2.21	2.15	.030	.072
Female-headed household	40.86%	34.88%	.121	.129
No. of children in household	4.16	4.41	-.109	-.024
Family discipline	5.36	5.45	-.047	-.070
Family activities	4.86	4.72	.103	-.085
Mother's regular use of alcohol or illicit drug use	13.44%	12.00%	.040	.052
Other family members' regular use of alcohol or illicit drug use	41.13%	41.89%	-.015	.059
Teacher's rating of conduct problems	2.45	2.25**	.252	.032
Teacher's assessment of math achievement	2.38	2.54*	-.205	.050
TOCA achievement	0.56	0.68	-.128	.037
TOCA aggression	0.68	0.45**	.237	-.123
TOCA immaturity	0.57	0.61	-.042	-.045
TOCA inattention	0.60	0.55	.053	-.099
TOCA shyness	0.45	0.46	-.018	-.094
Adolescent self-reported delinquency	18.74	10.43**	.730	.020
Smoking before age 15	64.52%	32.63%**	.665	-.007

Notes: TOCA = Teacher Observation of Classroom Adaptation (Kellam et al., 1975). ^aCompares frequent drinkers with light/nondrinkers.

* $p < .05$; ** $p < .01$. Variables significantly different based on t tests for continuous variables and chi-square tests for categorical variables.

tistically significant association between frequent adolescent drinking and violent or suicidal behavior at midlife, although the risk of these outcomes was elevated for frequent drinkers compared with light/nondrinkers.

After propensity score matching, the relationship between frequent adolescent drinking and having an official arrest for assault remained. Frequent adolescent drinkers were 2.06 times as likely to be arrested for assault as light/nondrinkers, after taking into account their propensity for violence. None of the other violent outcomes were statistically significantly predicted by frequent adolescent drinking after propensity score matching.

In testing interactions between frequent adolescent drinking and gender with the propensity score-matched data, we found that there was a statistically significant relationship between frequent adolescent drinking and self-reported assault (by age 32) among women. Girls who drank 20 times or more by age 16 were 2.46 times (95% CI [1.27, 5.73],

$p = .020$) as likely to self-report assault behavior in young adulthood as girls who drank less than 20 times or not at all. The association between frequent adolescent drinking and self-reported assault in young adulthood was not statistically significant for boys. No other gender interactions were significant.

Next, we tested the three mediators of the association between frequent adolescent drinking and adult assault arrest. In regression analyses on the matched sample, we found that frequent adolescent drinkers were 2.05 times as likely to engage in heavy episodic drinking in adulthood ($p = .002$) and 2.32 times as likely to drop out of high school ($p = .002$). Frequent adolescent drinkers were not significantly more likely to develop an alcohol use disorder once the time order between the onset of the alcohol disorder and the age at first violent arrest was taken into consideration (odds ratio = 1.22, $p = .426$). Thus, we only tested adult heavy episodic drinking and dropping out of high school as mediators.

TABLE 2. Comparing the adolescent frequent drinking–adult violence relationship with other crime types based on official records before and after propensity score matching adjustment

Variable	Before propensity score adjustment		After propensity score adjustment	
	Unadjusted odds ratio	[95% confidence interval]	Adjusted odds ratio	[95% confidence interval]
Violent offense official arrest	2.39**	[1.64, 3.50]	1.73*	[1.12, 2.68]
Property offense official arrest	2.32**	[1.60, 3.38]	1.17	[0.75, 1.81]
Drug offense official arrest	2.26**	[1.48, 3.44]	1.00	[0.62, 1.61]

* $p < .05$; ** $p < .01$.

TABLE 3. Association between frequent adolescent alcohol use and assault and robbery before and after propensity score matching adjustment ($N = 702$)

Outcome	Unadjusted OR [95% CI] on unmatched sample	Adjusted OR [95% CI] on matched sample
Official assault arrest	2.27** [1.51, 3.39]	2.06** [1.30, 3.26]
Self-report of assault behavior, young adulthood	1.81* [1.25, 2.62]	1.23 [0.79, 1.90]
Self-report of assault behavior, mid-life	1.66 [0.93, 2.97]	1.10 [0.54, 2.24]
Official robbery arrest	2.30** [1.25, 4.23]	1.41 [0.71, 2.80]
Self-report of robbery, young adulthood	2.53** [1.50, 4.27]	1.53 [0.87, 2.69]
Self-report of robbery, mid-life	1.99 [0.76, 5.24]	1.45 [0.39, 5.40]
Suicidal behavior, multiple sources	1.42 [0.70, 2.87]	1.33 [0.59, 3.00]

Notes: OR = odds ratio; CI = confidence interval.

* $p < .05$; ** $p < .01$.

Mediation testing results showed a significant indirect effect of heavy episodic drinking in adulthood on adult assault (Sobel test = 2.44, $p = .015$) and a nonsignificant indirect effect of high school dropout on adult assault (Sobel test = 0.95, $p = .344$) in separate models. Thus, heavy episodic drinking in adulthood accounted for a significant portion of the relationship between frequent adolescent drinking and adult assault arrests, mediating 26.5% of the total effect.

Discussion

Although a number of studies have found a long-term association between alcohol use and violence, this study adds to the existing literature by carefully taking into account confounding variables through propensity score matching and examining various types of violence using longitudinal data from multiple sources, including self-reports of interpersonal and self-directed violence and arrests for violence, based on Chicago police and FBI criminal records. Overall, we find evidence that frequent adolescent drinking (use ≥ 20 times by age 16) predicts an increased risk of having a violent arrest once predisposing factors are taken into account. Thus, the findings are consistent with the perspective that adolescent drinking may contribute to increasing violent arrests in the long term, independent of other risk factors.

On further examination, we find that the overall relationship between frequent adolescent drinking and violence is attributed to assault, a more dispute-related type of violence, rather than robbery, which tends to be a more predatory type of violence involving strangers. This finding provides support for the importance of contextual factors in the alcohol–violence relationship, and combining it with our finding of heavy episodic drinking as a mediator is consistent with literature on concurrent effects. As described by Felson and Staff (2010), alcohol use may lead the individual into situations or states in which personal confrontation is more likely or normative. Their study of offenders found that alcohol effects were stronger for assault than for other types of offenses (robbery, burglary, and drug offenses).

In the Woodlawn sample, clearly, the association between

alcohol and nonviolent crime appears to be spurious, supporting the shared risk factor perspective for nonviolent crime. Having used propensity score matching to help isolate the effect of frequent adolescent drinking from risk factors for drinking and crime, the association between adolescent drinking and property crimes and drug crimes disappears. Thus, the longitudinal association observed in the literature between adolescent alcohol use and adult crime in general (Ellickson et al., 2003) does not seem to be a causal one for nonviolent offenses.

We also do not find frequent adolescent drinking to be related to self-directed violence (i.e., suicide attempts or completions), which differs somewhat from others who have found a link (Flensburg-Madsen et al., 2009). However, few used as careful a consideration of confounding effects or had the long period between adolescent drinking and the follow-up age. Thus, the divergent findings may be the result of confounding, or they may reflect differences in populations, measures, or short- versus long-term effects.

In attempting to understand the association between frequent adolescent drinking and assault, we tested three mediators: (a) heavy episodic drinking in adulthood, (b) the development of an alcohol use disorder, and (c) high school dropout. We find a statistically significant indirect effect through heavy episodic drinking only. Thus, evidence suggests that the longitudinal association between frequent adolescent drinking and adult assault may be explained in part by problematic drinking that continues into adulthood.

We find that the development of an alcohol use disorder in adulthood is not a mediator of the association. Our analysis on the matched sample shows that frequent adolescent drinkers are not at increased risk of developing an alcohol use disorder once we consider that the age at onset of the alcohol disorder needs to predate the age at first violent arrest. The majority of those with a violent arrest who meet criteria for an alcohol use disorder developed the alcohol use disorder after their first violent arrest. This suggests the need for future studies to consider the development of an alcohol use disorder as a consequence of arrest. In developing violence prevention interventions, those engaging in

problematic drinking but not meeting disorder criteria may be an especially relevant population to target.

We also do not find high school dropout to be a mediator, suggesting that the link between adolescent drinking and adult assault is not through the lack of educational attainment. Future research is necessary to better understand other potential causal pathways.

For women, we find a significant association between frequent adolescent drinking and both assault arrests and self-reported assault. For men, we find an association with assault arrests only. It is unclear why this distinction exists. It may be that in such a highly violent population, adolescent drinking is not related to assault perpetration for men overall but is related to assault arrests in that alcohol-related violence among a population of highly violent men may be more likely to result in an arrest than non-alcohol-related violence because of contextual factors. Although some studies have found stronger effects of alcohol on violence for women (Wells et al., 2007), there is limited research and theoretical work guiding our understanding of violence among women. Future work is clearly needed.

There are a number of limitations that should be considered when interpreting findings. First, although we attempt to examine causal associations, propensity score matching only takes into account observed covariates. We match on a wide array of risk factors including family functioning, aggression, conduct problems, delinquency, and other substance use to attempt to rule out spurious relationships. However, the limitation remains that there may be other unmeasured confounders that influence the relationship between adolescent drinking and violence. Thus, although our findings do not prove causality, they provide evidence consistent with a causal conclusion. Second, our testing of mediation is limited because we do not have information on intoxication at the time of the assault offense, which has been shown to be highly predictive of violence. One reason we may have found an indirect effect through heavy episodic drinking in adulthood is that this variable may be a crude measure of intoxication at the time of the offense. Further, the results of our mediation testing provide limited intervention implications beyond reinforcing the importance of preventing frequent drinking among adolescents and adults. More work is needed to identify more proximal mediators to adolescent drinking that can improve interventions for reducing violence.

Also, our study focuses only on the frequency of drinking in adolescence and does not provide evidence on the effects of other problematic alcohol involvement, such as number of drinks on drinking occasions or alcohol disorders. Because we compare frequent adolescent drinkers (defined as ≥ 20 times by age 16) with less frequent and nondrinkers, we are unable to provide evidence of whether less frequent drinking during adolescence increases the risk of adult violence.

Further, the official reports of arrests are only up to age 32, and therefore we cannot examine the relationship

between adolescent drinking and midlife violence as measured by official arrests. However, we do have self-reports from midlife, and they are not associated with adolescent drinking. Reports of assault are much lower during midlife, consistent with literature on aging and crime (Hirschi and Gottfredson, 1983). This may explain the lack of association, although more work is needed.

Another consideration is the generalizability of the findings. The Woodlawn Study participants represent an African American urban cohort growing up in the 1970s and 1980s. They have high rates of poverty and crime but not elevated rates of adolescent drinking compared with national samples. Thus, the relationship we observe between adolescent drinking and adult assault may differ for other populations or ethnicities with higher rates of drinking or lower rates of violence. The results may or may not replicate in other populations, but the Woodlawn population, because of its relatively high rates of violence, is an important one in which to examine these impacts. By examining the alcohol–violence relationship in a high-risk community cohort, we overcome the limitations of selection bias of treatment samples and contribute knowledge about a population not often captured in household surveys because of high rates of incarceration and homelessness.

In sum, despite the link we find between adolescent alcohol use and violent behavior years later, national data indicate that prevalence of heavy alcohol use and alcohol use disorders remains high, and the perceived risk concerning alcohol use is low among adolescents (Eaton et al., 2010; Johnston et al., 2010; Substance Abuse and Mental Health Services Administration, 2006). This study adds to the growing body of literature on negative adult social and behavioral consequences of adolescent drinking (Oesterle et al., 2004; Staff et al., 2008, Zufferey et al., 2007). In addition to reinforcing the importance of preventing frequent drinking among youth, findings suggest that violence prevention efforts should focus on the role of early frequent drinking and later problematic drinking.

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