Heavy Episodic Drinking in Early Adulthood and Outcomes in Midlife*

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ABSTRACT. Objective: This study assessed to what extent drinking patterns of young adults persist into midlife and whether frequent heavy episodic drinking as a young adult is associated with educational attainment, labor market, and health outcomes at midlife. **Method:** Using the National Longitudinal Survey of Youth 1979, we grouped individuals into three baseline drinking categories using data on the number of occasions they consumed six or more drinks on one occasion from the 1982–1984 surveys. Categories were frequent heavy episodic drinker, occasional heavy episodic drinker, and other drinker/abstainer. We used propensity score matching to compare baseline drinking groups on midlife alcohol consumption, educational attainment, and labor market and health outcomes. **Results:** Frequent heavy episodic drinkers substantially reduced alcohol consumption between baseline and follow-up 25 years later. However, they were much more likely to abuse alcohol and

be alcohol dependent in 1994 and be heavy episodic drinkers at the 25-year follow-up compared with the other drinking groups. After matching, there was little indication that being in a higher consumption baseline alcohol group was adversely associated with years of schooling completed by middle age, the probability of being employed, earnings conditional on being employed in midlife, and health problems in midlife. Results on the probability of surviving to follow-up were mixed. **Conclusions:** Frequent heavy episodic drinking at ages 17–25 years was associated with higher rates of alcohol dependence and abuse at a 10-year follow-up and alcohol consumption 25 years following baseline but not with other study outcomes at midlife. Lack of differences in outcomes at midlife may be because of decreased heavy episodic drinking among the heaviest baseline drinkers. (*J. Stud. Alcohol Drugs*, 72, 459–470, 2011)

HEAVY EPISODIC DRINKING and high levels of drinking by young persons, including college students, remains a widespread concern (Kypri et al., 2010). Although alcohol consumption has declined overall, it remains at high levels among young adults. Enrollment in college and not living with parents is associated with higher rates of heavy alcohol use (Gfroerer et al., 1997). Heavy episodic drinking (large amounts of alcohol consumed in a short period, such as an evening) among college students is widespread (Wechsler et al., 2000, 2002). Although short-term adverse effects of such drinking tend to be the most immediate concern, such excess drinking may also have adverse effects in later life.

Several studies have linked such heavy consumption to continued alcohol consumption later in life (Bennett et al., 1999; Chassin et al., 1992, 2002; Donovan et al., 1983; Fillmore, 1974; Pitkänen et al., 2005). Trajectories in alcohol consumption have been documented, but few studies have included follow-up periods of two or more decades (Costanzo et al., 2007; Fillmore, 1974; Pitkänen et al., 2005; Platt et al., 2010); follow-up periods have been short (i.e., from adolescence to young adulthood or from early college

years to the mid-20s; Chassin et al., 1992, 2002; Gotham et al., 2003; Jackson et al., 2000, 2001; Kenkel et al., 1994; Merline et al., 2004; Oesterle et al., 2004; Patton et al., 2007; Schulenberg et al., 1996a, 1996b).

Compared with analysis of contemporaneous or short-term relationships between heavy drinking and various outcomes, such as sexual activity, educational attainment, and earnings (Jones and Richmond, 2006; Markowitz et al., 2005; Wood et al., 2000), analysis of longer-term outcomes associated with heavy alcohol consumption in early adult life (among persons <25 years of age) has been rare (Casswell et al., 2002).

Other research focused on adults ages 25 and older has assessed relationships between alcohol consumption, longevity (Gaziano et al., 2000; Grønbaek et al., 2004), and health. This research, consisting of case studies, randomized controlled trials, and quantitative studies using observational data, has reached no clear consensus on the benefits or costs of consuming alcohol, even at moderate levels. Alcohol use in moderation, although potentially addictive, reduces cardiovascular risk; however, alcohol consumption has also been linked to brain atrophy (Klatsky, 2010; Mukamal, 2010). Other studies have analyzed the association between alcohol consumption patterns in early adulthood and human capital accumulation, including educational attainment and earnings (Bachman et al., 2008).

This study used the National Longitudinal Survey of Youth 1979 (NLSY79) to investigate two issues. First, to what extent do the drinking patterns of persons in young adulthood at baseline—1982–1984, especially among per-

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sons reporting frequent heavy episodic drinking at ages 17–25—persist into midlife? Our study tracked individuals up to 2008, when the same individuals interviewed in 1982–1984 were 43–51 years of age. Is heavy drinking temporary, reflecting risk taking in early adulthood that eventually ceases, or do drinking patterns of early adult life persist into middle age? Our approach differed from previous analyses in having a longer follow-up period on a national sample of adults.

Second, compared with each of two control groups, do frequent heavy episodic drinkers at 17–25 years experience reduced years of schooling finally completed, poorer labor market outcomes, poorer physical and mental health, or shorter longevity? Some research with shorter follow-up periods than our study has shown that heavy drinking in early adulthood is associated with delays in schooling completion and reduced earnings. A longer follow-up period allowed for a catch-up in human capital accumulation and earnings that may occur in midlife.

Method

Data

The NLSY79 was a national sample of 12,686 individuals. Black, Hispanic, and White youths with low incomes were oversampled. In 1979, all individuals were ages 14–22 years. Re-interviews were conducted annually until 1994 and biennially thereafter. An attempt was made to interview persons living in institutions, including jails.

The most recently available public use file contains data through 2008. Many questions have remained the same, although not every question was asked in every wave. The NLSY79 has asked participants about alcohol use, labor market participation, illicit drug use, family characteristics, and educational attainment and tracks mortality as part of the process of documenting reasons for noninterviews. In 2008, the response rate was 81.9%. Of the persons interviewed in 1979, 7,757 persons were interviewed in 2008 (61.1%); among the 4,929 persons interviewed in 1979 but not in 2008, 524 deaths were documented. Alcohol consumption questions were first asked in 1982. Hence, we treated 1982 as the first base year in our analysis.

The analysis used 1979–1984 interviews for baseline information and 2008 as the terminal date. To be included in the analysis, an individual had to be interviewed in 1979 through 1984 and in 2008.

Statistical approach

A challenge for analysis is to demonstrate that any associations between heavy drinking in early adulthood and outcomes in later life do not reflect a third, unidentified factor. The most likely reason drinking patterns in youth may not be causal in analysis of midlife outcomes is that

the presence of individual characteristics—for example, ability, self-esteem, and ambition—is often unobservable to researchers but affects both alcohol consumption and other behaviors in youth and outcomes in midlife. The NLSY79 contains some information on motivation and expectations, allowing us to include variables in our empirical analysis that are often omitted. Measurement error may also be present, because longitudinal alcohol consumption tends to be volatile (Clemens et al., 2007; Harford, 1993; Kerr et al., 2002). Thus, consumption measured for a single 30-day period may be unrepresentative of typical drinking patterns in early adulthood.

Several studies of alcohol consumption and its association with various outcomes have used instrumental variables to address the problem of endogeneity, which frequently arises with observational data. The goal of the method is to find an exogenous variable systematically related to the endogenous explanatory variable but unrelated to the dependent variable except through its effect on the endogenous explanatory variable. This approach poses at least two practical problems: (a) weak instruments and (b) the assumption of no direct effect of the instrumental variable on study outcomes when, in fact, a direct effect exists. Variables correlated with heavy alcohol consumption in early adulthood, such as parents' alcohol consumption or childhood stressors, are plausibly related to life outcomes as well and cannot be excluded from outcome equations. Alcohol prices may be a valid instrumental variable in cross-sectional analysis, but because alcohol prices in one year are likely to be positively correlated with alcohol prices in subsequent years, alcohol prices at baseline may be systematically related to alcohol consumption and specific future life outcomes.

Rather than rely on instrumental variables, we used propensity score matching (Rosenbaum and Rubin, 1983). The underlying assumption is that differences in variables observed in the survey data are correlated with variables not observed in the data but associated with both alcohol use and outcomes.

The groups on which we performed propensity score matching are categories based on the amount of heavy episodic drinking or drinking the individual reported to the NLSY79 during the baseline period, 1982–1984. The NLSY79 asked participants about alcohol consumption in 10 waves: 1982–1985, 1988–1989, 1994, 2002, 2006, and 2008. Individuals were asked how often they consumed six or more drinks on one occasion, defined here as “heavy episodic drinking,” during the 30 days before the interview. We classified males reporting four or more heavy drinking episodes and females reporting three or more heavy drinking episodes during the past month as frequent heavy episodic drinkers (FHEDs). This was our treatment group.

We defined two control groups. The first was for other heavy episodic drinkers at baseline. Males consuming six or more drinks on one occasion at least once but fewer than

four times in the past month were defined as occasional heavy episodic drinkers (OHEDs). For females, the upper threshold was fewer than three times.

The second control group consisted of all other young adults at baseline. This group (hereafter known as other drinkers and abstainers [ODAs]) included the following: (a) for males and females, individuals reporting having consumed an alcoholic drink during the past 30 days but not any heavy drinking episodes during the same period and (b) persons reporting having consumed no alcoholic beverages during the same period. Because there was year-to-year variation in alcohol consumption and in heavy episodic drinking, we classified persons into baseline drinking categories using data on mean values of self-reported heavy episodic drinking and other alcohol consumption reported in the 1982–1984 interviews.

In the first step in the matching process, we performed logit analysis to predict the probability of an individual being in each of the three baseline drinking categories. We included variables for matching, described below.

Matching on propensity scores should reduce selection bias in assigning persons to drinking categories (D'Agostino, 1998; Rosenbaum and Rubin, 1983). We matched an individual engaging in frequent heavy episodic drinking to his or her nearest match who engaged in occasional heavy episodic drinking using the predicted probability of an individual engaging in high heavy episodic drinking. Separately, we matched persons in the FHED category to ODAs. The null hypothesis was that after matching persons in the FHED category at baseline to the two control groups on several baseline characteristics, there were no differences in alcohol consumption patterns or in important life outcomes up to about 25 years later.

We matched treatment to each of the control groups with nearest neighbor matching without replacement, with a caliper of 0.02, using PSMATCH2 from Stata 11 (StataCorp LP, College Station, TX). Observation pairs were dropped if differences in values exceeded this amount. Standardized differences were calculated for the matched sample and revealed no differences greater than 10%, resulting in a well-matched sample (Austin, 2007; Normand et al., 2001). We present average treatment effects on treated subjects (ATT) for matched samples below. The ATT measures effects of a treatment among those receiving treatment versus no treatment, the control group.

In our study, persons classified in the FHED category are the treated subjects; there are two alternative control groups. We performed propensity score matching to create two separate matched samples: FHEDs matched to OHEDs and FHEDs matched to ODAs. ATT estimates are differences in mean values of the dependent variables, all evaluated at follow-up between treatment and control groups. PSMATCH2 provides an estimate of the treatment effect as the difference in mean values of the dependent variables between treatment

and control groups and standard errors of the effect from which *t* values and statistical significance can be calculated.

The PSMATCH2 routine does not provide an option for using weights. We performed propensity score matching without weights. Weighted means of variables defined at baseline for persons in the FHED category were very similar to their unweighted counterparts (not shown).

Dependent variable

Our first outcome-dependent variables were drinker category (FHED, OHED, ODA) and milliliters of alcohol consumed daily in 2008, and alcohol abuse and dependence as of 1994, the most recent year for which NLSY79 obtained the latter measure. (See Grant et al., 2001, for a discussion of alcohol abuse and dependence.) Second, we assessed educational attainment (years of schooling completed; the probability of being employed; and, conditional on being employed, the natural logarithm of earnings in 2008).

Third, we gauged relationships between baseline drinking and health at midlife using questions asked in the 40+ health module, administered once per respondent between 1998 and 2006 at the first interview after the respondent turned 40. Summary measures of health status at midlife were scores on the Short Form-12 (SF-12), separately for physical and mental health; the probability of being in excellent, very good, or good health, as compared with being in fair or poor health; the Center for Epidemiologic Studies Depression Scale (CES-D); and whether persons reported having heart problems, emotional problems, being unconscious as a result of a head injury, breaking or fracturing a bone in the last 10 years, or missing work because of back pain.

The SF-12, an abbreviated version of a longer instrument, the Medical Outcomes Study Short Form-36 (SF-36), asks respondents 12 questions about general health, health limitations, and recent physical and emotional problems. Individuals rated their health on the following: whether his or her health limited moderate activities (e.g., climbing stairs, with response options of no, a little, and a lot); whether the respondent accomplished less than he or she would have liked in the past 4 weeks; if health limited work or other activities in the past 4 weeks; whether emotional problems had caused the person to accomplish less than he or she would have liked in the past 4 weeks; and whether emotional problems had made the respondent less careful in the past 4 weeks. Sample persons were asked on a scale of 1–5 how much pain interfered with normal work in the past 4 weeks, and on a scale of 1–6 how often he or she felt calm and peaceful, had a lot of energy, felt downhearted or blue, and had physical or emotional problems interfere with social activities in the past 4 weeks. Higher scores indicate better physical and mental functioning (Ware et al., 1995, 1996). The SF-12 question about general health, “in general, would you say your health is . . .,” was used to create the good/

excellent health variable. Individuals responding “good,” “very good,” or “excellent” to this question were considered to be in good/excellent health. Others reporting fair or poor health were assigned a 0 for this variable.

The CES-D scale measures symptoms of depression, discriminates between clinically depressed individuals and others, and is highly correlated with other depression rating scales (Radloff, 1977; Mirowsky and Ross, 1989). The CES-D was first administered to NLSY79 respondents in 1992, the responses from which we used for matching. Sixteen items ask about negative symptoms (e.g., feeling sad, depressed, poor appetite). Four items ask about positive symptoms (e.g., feeling happy). Symptom severity is measured by asking the frequency of occurrence of each item in the preceding week. Responses range from 0 (*rarely or none of the time/1 day*) to 3 (*most or all of the time/5–7 days*). The four positive symptom items are reverse-scored and the sum responses to all items computed. Higher scores indicate greater depressive symptoms. Subsequently, the number of CES-D items was reduced to five, which is the scale we used.

We also assessed whether individuals had a health condition limiting their ability to work or limiting the type of work they could do in 2008, and whether respondents had died by 2008.

Variables used in propensity score matching

We used propensity score matching to identify two control groups for persons classified in the FHED category at baseline. The variables used for matching fell into five groups.

First, consumption of other substances, such as tobacco products and illicit drugs, is positively associated with alcohol consumption (Dee, 1999; McKee et al., 2007; Picone et al., 2004; Wechsler et al., 1995). The NLSY79 did not ask about consumption of these other substances until 1984. We used data for 1 year for consumption of other substances because data were unavailable on these substances for the entire 3-year baseline period. We defined cigarette smokers as individuals reporting smoking at least one cigarette in the 30 days before the 1984 interview. Marijuana use was defined as whether an individual reported using marijuana or hashish in the same 30 days. Individuals were asked in 1984 whether they had used amphetamines or stimulants, barbiturates or sedatives, tranquilizers, psychedelics, cocaine, heroin, other narcotics, inhalants, or other drugs “on [their] own, without a doctor telling [them] to” during the past 30 days. If an individual responded affirmatively to any of these questions, the variable for “other drug use” was set to 1. In 1980, individuals were asked if they had “ever been convicted of any charge other than a minor traffic offense,” which we used to measure the “delinquent” status of respondents.

Second, we accounted for baseline health. Although the NLSY79 is rich in health measures starting after the 40th

birthday of respondents, only a few health questions were asked earlier. Our variable for baseline health reflected whether an individual had any condition that prevented him or her from performing any work task (asked in 1982). Individuals with no limitations were assigned a 1; all others were assigned a 0. Individuals were also asked to report both their height and their weight. We included separate variables for height, a determinant of labor market success (Persico et al., 2004), and the person’s body mass index as matching variables.

Third, we matched on educational attainment, ability, and labor force status at baseline. Ability was measured by the Armed Forces Qualification Test (AFQT), administered in 1981, and baseline labor force status was measured in 1982. The AFQT was created from the Armed Services Vocational Aptitude Battery using scores from the arithmetic reasoning, word knowledge, paragraph comprehension, and mathematics knowledge areas. The AFQT is used to determine whether an individual is qualified to enlist in the U.S. military (Rodgers and Spriggs, 1996). We matched on binary variables for baseline unemployment and being out of the labor force.

Fourth, we accounted for individual motivation and long-term expectations. Individuals not motivated to accumulate human capital and who are less ambitious may also be more likely to engage in heavy drinking. Motivation and long-term expectations and heavy alcohol consumption in early adulthood are also likely to affect labor market performance in midlife.

The Rosenberg Self-Esteem Scale, administered in 1980, is based on 10 questions designed to measure a person’s self-esteem. Responses are scored 1–4, with the overall self-esteem scale ranging from 10 to 40. The scale is a self-evaluation of self-esteem and has proved highly reliable, especially in high school and college-age individuals (Crandall, 1973). To properly construct the scale, certain responses must be recoded; thus, a higher score represents greater self-approval (Rosenberg, 1965). The Rotter Internal–External Locus of Control Scale, administered in 1979, is designed to gauge the extent to which an individual feels he or she controls his or her life. Rotter scores range from 4 to 16, with lower scores signifying more control over one’s environment.

In 1982, to measure educational aspirations, individuals were asked, “What is the highest grade or year of regular school . . . that [you] would like to complete?” Survey participants were also asked the highest grade they thought they would actually complete. Based on responses to these questions, we defined three variables for matching: educational aspirations, educational expectations, and a binary for whether aspirations exceeded expectations to capture the interaction between aspirations and expectations.

Respondents were also asked about occupational aspirations. We created a binary variable for whether an individual

planned to be a manager or a professional at age 35. The NLSY79 in 1982 also asked about their chances of getting into the work they aspired to by age 35 on a four-point scale ranging from “excellent” to “poor.” To define an explanatory variable for being in work the person aspired to by age 35, we set responses of excellent or good to 1 and fair or poor to 0.

Fifth, we matched FHEDs at baseline to the two control groups on these other variables. Respondents were asked their household income, how many times a week they attend

religious services, and whether they lived in a rural or urban setting in 1982. Respondents were asked to report both their mother’s and their father’s highest year of schooling completed in 1979. They were also asked with whom they lived at age 14. Individuals reporting living with both biological parents were assigned a 1, whereas others were assigned a 0 for “lived with parents.” We also matched on female gender, Black race, Hispanic ethnicity, with White race, the reference group, age, and marital status at baseline 1 if currently married and 0 if not currently married).

TABLE 1. Descriptive statistics: Baseline

Variable	All	FHED	OHED	ODA
Alcohol use				
Alcohol per day, ml	10.43	33.03	10.59***	1.65***
FHED	17%	—	—	—
OHED	40%	—	—	—
ODA	43%	—	—	—
Substance use and delinquency				
Smoked marijuana	19%	39%	23%***	7.9%***
Took other drugs	6.9%	20%	7.2%***	1.7%***
Smoked cigarettes	40%	62%	47%***	26%***
Delinquent	4.8%	8.8%	5.9%**	2.2%***
Health				
No health limitation	94%	96%	95%	93%**
Height, in inches	66.9	67.7	67.8	65.8***
Body mass index, weight in kg / (height in m) ²	23.1	23.3	23.1	22.9**
Education and labor market				
Educational attainment, in years	11.9	11.7	11.9**	11.9**
Armed Forces Qualification Test, percentile	38	40	39	36***
Unemployed	15%	15%	15%	14%
Out of the labor force	27%	21%	23%	32%***
Motivation and long-term expectations				
Rosenberg Self-Esteem score, range: 10–40	32.2	31.9	32.3**	32.2*
Rotter Scale score, range: 4–16	9.16	9.23	9.10	9.19
Highest educational attainment aspiration, years	14.4	14.1	14.4***	14.5***
Highest educational attainment expected, years	13.9	13.6	13.9***	14.0***
Expect to achieve lower educational attainment than hope for	23%	24%	23%	22%
Plan to be manager/professional by age 35	59%	57%	60%	60%
Expect to achieve employment goals by age 35	74%	71%	74%*	74%*
Family characteristics				
Religiosity, range: 0–7	4.4	2.7	3.4***	5.9***
Household income, U.S. \$	\$21,000	\$22,000	\$22,000	\$19,000***
Urban	80%	82%	80%	79%*
Parents together at child age 14?	68%	68%	71%	65%
Mother’s educational attainment, years	10.8	11.1	11.0	10.6***
Father’s educational attainment, years	10.9	11.4	11.2	10.5***
Demographic characteristics				
Female	52%	41%	39%	68%***
Black	31%	18%	28%***	39%***
Hispanic	19%	18%	19%	19%
Age, in years	20.6	20.5	20.6	20.6
Married	21%	11%	19%***	26%***
Divorced/other	4.3%	5.7%	4.1%*	3.8%***
Observations, <i>n</i>	7,386	1,221	2,964	3,201
% of total sample	100%	16.5%	40.1%	43.3%

Notes: *T* tests compare adjacent baseline alcohol categories. FHED = frequent heavy episodic drinker; OHED = occasional heavy episodic drinker; ODA = other drinkers/abstainers.

p* < .05; *p* < .01; ****p* < .001.

We tested for statistically significant differences using both *t* tests and McNemar tests, but we report results using only the former. The tests differed in only one case (see below).

Results

Descriptive statistics at baseline

At baseline, the sample consisted of 17% FHEDs, 40% OHEDs, and 43% ODAs (Table 1). Thus, the majority of young adults, 57%, engaged in heavy episodic drinking at least once during 1982 to 1984. Mean baseline age was 20.6 years.

FHEDs consumed 33 ml of alcohol per person per day at baseline, roughly equivalent to two alcoholic beverages daily, compared with 10.6 ml for OHEDs ($p < .001$) and 1.65 ml for ODAs. Individuals who used marijuana or other illicit drugs, smoked cigarettes, and/or were delinquent were significantly more likely to belong to baseline FHED than to the control groups.

At baseline, not surprisingly, FHEDs tended to be more similar on variables used in matching to OHEDs than to ODAs. This was particularly true of consumption patterns of addictive substances other than alcohol. The use of drugs and

cigarette smoking at baseline were much higher for FHEDs than for ODAs. Religiosity, which also differed substantially among the three drinking groups, exhibited the opposite pattern. ODAs and OHEDs had higher educational aspirations and expectations and higher employment aspirations on average than did FHEDs at baseline, although in absolute terms, differences were small. Blacks and married individuals were less likely to be baseline FHEDs than either OHEDs or ODAs.

Descriptive statistics at follow-up before matching

FHEDs at baseline substantially reduced mean daily alcohol consumption at follow-up (Table 2). Mean alcohol consumption among baseline FHEDs, measured in milliliters, fell by more than half by 2008 but remained high relative to consumption by baseline OHEDs and ODAs. Eighteen percent of baseline FHEDs remained in the FHED category in 2008. The vast majority (67%) were ODAs at the 2008 follow-up. Slightly more than one quarter (26%) of baseline FHEDs were classified as alcohol abusers in 1994—much higher shares than for baseline OHEDs and ODAs. Eleven percent of baseline FHEDs were alcohol dependent in this

TABLE 2. Descriptive statistics: Outcomes in midlife

Variable	All	FHED	OHED	ODA
Alcohol use in 2008				
Alcohol per day, ml	7.21	15.5	8.02***	3.30***
FHED	7.5%	18%	8.3%***	2.7%***
OHED	6.6%	15%	7.8%***	2.3%***
ODA	86%	67%	84%***	95%***
Alcohol abuse/dependence in 1994				
Alcohol abuse	11%	26%	14%***	3.3%***
Alcohol dependence	4.1%	11%	4.1%***	1.4%***
Educational attainment, employment, and earnings in 2008				
Educational attainment, in years	13.4	13.1	13.4***	13.5***
Working	78%	78%	79%	77%
Log earnings, \$	\$10.4	\$10.4	\$10.5	\$10.3**
Earnings, U.S. \$	\$41,000	\$42,000	\$44,000	\$37,000**
Health measures at age 40				
SF-12 physical ^a	521	520	524	518
SF-12 mental ^b	530	530	531	529
Good/excellent health	87%	87%	88%	87%
CES-D score ^c	33.5	34.6	31.3*	35.1
Heart problems	7.7%	7.5%	7.3%	8.1%
Emotional problems	15%	15%	14%	16%
Head injury	8.5%	11%	9.7%	6.5%***
Broken bone	13%	16%	14%	11%***
Miss work with back pain	1.6%	1.9%	1.5%	1.5%
Health and longevity in 2008				
Health limitations	16%	17%	15%	17%
Died	4.5%	6.6%	4.5%**	3.7%***
Observations, <i>n</i>	7,386	1,221	2,964	3,201
% of total sample	100.0%	16.5%	40.1%	43.3%

Notes: *T* tests compare adjacent baseline alcohol categories; outcome variables in 2008 unless otherwise noted. FHED = frequent heavy episodic drinker; OHED = occasional heavy episodic drinker; ODA = other drinker/abstainer; SF-12 = Short-Form-12; CES-D = Center for Epidemiologic Studies Depression Scale.

^aSF-12 physical can range from 0 to 1,200; in this sample, the scores ranged from 112.2 to 683.7. ^bSF-12 mental can range from 0 to 1,200; in this sample, the scores ranged from 75.4 to 720.1. ^cCES-D can range from 0 to 69; in this sample, the scores ranged from 0 to 59.

* $p < .05$; ** $p < .01$; *** $p < .001$.

FIGURE 1. Mean milliliters of alcohol consumed per day, 1985–2008, by baseline drinking category in unmatched sample with 95% confidence intervals. FHED = frequent heavy episodic drinker; OHED = other heavy episodic drinker; ODA = other drinker/abstainer.

year, also appreciably higher than for the two baseline control groups.

Much of the decrease in daily alcohol consumption for the baseline FHED group occurred in the first few years after baseline (Figure 1). Although consumption among baseline OHEDs and ODAs declined at a much lower rate than for baseline FHEDs, consumption remained persistently lower for baseline OHEDs and ODAs as the latter approached their 40s and 50s.

Frequent heavy episodic drinkers' alcohol consumption patterns at follow-up compared with controls after matching

All mean values for each control group used to match with FHEDs' characteristics at baseline were within 10% of the corresponding mean values for FHEDs (not shown). Requiring that mean values of treatment versus control groups

be within 10% of each other resulted in more matches between FHEDs and OHEDs than between FHEDs and ODAs, as reflected in higher numbers of observations in the FHED–OHED comparisons.

After propensity score matching, baseline FHEDs differed on all alcohol consumption indicators at follow-up compared with OHEDs in both 1994 and 2008 (Table 3). In 2008, baseline FHEDs consumed 15.0 ml of alcohol as compared with nearly 9.0 ml for baseline OHEDs (Table 3, Panel A). The probability that baseline FHEDs were other ODAs in 2008 was 0.12 lower than for baseline OHEDs. Likewise, probabilities of alcohol abuse and dependence in 1994 were 0.044 and 0.11 higher for baseline FHEDs than for baseline OHEDs. Differences between baseline FHEDs and baseline ODAs were consistently higher than between baseline FHEDs and OHEDs (Table 3, Panel B). Follow-up values for baseline FHEDs are slightly different because the number of persons in the baseline FHED category for the

TABLE 3. Differences in alcohol consumption at follow-up (1994 and 2008) after matching with FHEDs

Panel A. Propensity score matching with FHEDs and OHEDs					
Variable	Baseline alcohol category		Difference	[95% CI]	Matched obs., <i>n</i>
	FHED	OHED			
Alcohol use in 2008					
Alcohol per day, ml	15.0	8.96	6.01	[4.16, 7.86]	2,240
FHED	17%	9.5%	7.7%	[4.9%, 11%]	2,240
OHED	15%	10%	4.7%	[2.0%, 7.5%]	2,240
ODA	68%	80%	-12%	[-16%, -8.8%]	2,240
Alcohol abuse/dependence in 1994					
Alcohol abuse	10%	5.8%	4.4%	[2.4%, 6.5%]	2,610
Alcohol dependence	26%	15%	10.5%	[7.4%, 14%]	2,610
Panel B. Propensity score matching of FHEDs with ODAs					
Variable	Baseline alcohol category		Difference	[95% CI]	Matched obs., <i>n</i>
	FHED	ODA			
Alcohol use in 2008					
Alcohol per day, ml	14.2	5.24	8.96	[6.95, 11.0]	1,498
FHED	16%	4.5%	11%	[8.3%, 14%]	1,498
OHED	14%	3.7%	11%	[7.8%, 14%]	1,498
ODA	70%	92%	-22%	[-26%, -18%]	1,498
Alcohol abuse/dependence in 1994					
Alcohol abuse	9.4%	2.4%	6.9%	[4.7%, 9.1%]	1,730
Alcohol dependence	22%	5.1%	17%	[14%, 20%]	1,730

Notes: **Bold** indicates statistical significance ($p < .05$). FHED = frequent heavy episodic drinker; OHED = occasional heavy episodic drinker; CI = confidence interval; ODA = other drinker/abstainer; obs. = observations.

FHED–OHED match exceeds the number of baseline FHED persons in the FHED–ODA match.

Other outcomes at follow-up compared with controls after matching

In contrast to our results for alcohol use at follow-up, there are no statistically significant differences between adults who were baseline FHEDs and the two baseline con-

trol groups in terms of labor market outcomes at follow-up (2008) (Table 4). The earnings variable contains observations for persons with zero earnings, whereas log earnings are limited to persons with some earnings. Baseline FHEDs reported higher mean earnings on average at follow-up than either baseline OHEDs or ODAs, although this result was not statistically significant at conventional levels. Differences in the number of years of schooling finally completed were not statistically significant by baseline drinking category.

TABLE 4. Differences in educational attainment, employment, and earnings at follow-up (2008) after matching with FHEDs

Panel A. Propensity score matching of FHEDs and OHEDs					
Variable	FHED	OHED	Difference	[95% CI]	Matched obs., <i>n</i>
Educational attainment, years	13.2	13.1	0.043	[-0.15, 0.24]	2,326
Employed	79%	79%	-0.63%	[-4.0%, 2.7%]	2,326
Log earnings, \$	10.4	10.4	0.016	[-0.088, 0.12]	1,808
Earnings, \$	42,783	41,555	1,228	[-3008, 5464]	2,186
Panel B. Propensity score matching of FHEDs with ODAs					
Variable	FHED	ODA	Difference	[95% CI]	Matched obs., <i>n</i>
Educational attainment, years	13.3	13.4	-0.088	[-0.34, 0.16]	1,498
Employed	77%	79%	-1.9%	[-6.1%, 2.3%]	1,498
Log earnings, \$	\$10.4	\$10.4	\$0.0087	[-0.11, 0.13]	1,166
Earnings, \$	\$43,012	\$39,547	\$3,465	[-1,878, 8,808]	1,466

Notes: FHED = frequent heavy episodic drinker; OHED = occasional heavy episodic drinker; ODA = other drinker/abstainer; CI = confidence interval; obs. = observations.

TABLE 5. Differences in health at follow-up after matching with FHEDs

Panel A. Propensity score matching of FHEDs with OHEDs

Variable	FHED	OHED	Difference	[95% CI]	Matched obs., <i>n</i>
Health measures at age 40					
SF-12 physical ^a	521	525	-4	[-109, 19]	2,240
SF-12 mental ^b	529	528	1	[-51, 86]	2,240
Good/excellent health	88%	87%	0.3%	[-2.5%, 3.0%]	2,240
CES-D score ^c	34.3	30.6	3.7	[0.41, 7.1]	2,246
Heart problems	7.2%	7.2%	0%	[-2.1%, 2.1%]	2,246
Emotional problems	15%	16%	-1.2%	[-4.1%, 1.8%]	2,246
Head injury	11%	11%	0%	[-2.6%, 2.6%]	2,246
Broken bone	16%	14%	1.4%	[-1.5, 4.4%]	2,246
Miss work with back pain	1.9%	0.9%	1.1%	[0.089, 2.0%]	2,246
Health measures in 2008					
Health limitations	17%	15%	1.8%	[-1%, 5%]	2,246
Died	6.0%	4.8%	1.1%	[-1%, 3%]	2,810

Panel B. Propensity score matching of FHEDs with ODAs

Variable	FHED	ODA	Difference	[95% CI]	Matched obs., <i>n</i>
Health measures at age 40					
SF-12 physical ^a	523	520	3	[-48, 110]	1,498
SF-12 mental ^b	532	529	3	[-44, 119]	1,498
Good/excellent health	89%	88%	0.13%	[-3.1%, 3.4%]	1,498
CES-D score ^c	34.9	35.9	-1.0	[-5.3, 3.4]	1,492
Heart problems	7.1%	7.2%	-0.13%	[-2.8%, 2.5%]	1,492
Emotional problems	16%	18%	-2.1%	[-5.9%, 1.6%]	1,492
Head injury	8.7%	8.0%	0.7%	[-2.1%, 3.5%]	1,492
Broken bone	14%	12%	1.3%	[-2.1%, 4.8%]	1,492
Miss work with back pain	1.9%	1.7%	0.13%	[-1.2%, 1.5%]	1,492
Health measures in 2008					
Health limitations	17%	16%	0.80%	[-3.0, 4.6%]	1,492
Died	4.7%	4.3%	0.43%	[1.4%, 2.3%]	1,876

Notes: **Bold** indicates statistical significance ($p < .05$). FHED = frequent heavy episodic drinker; OHED = occasional heavy episodic drinker; SF-12 = Short-Form-12; CES-D = Center for Epidemiologic Studies; CI = confidence interval; obs. = observations; ODA = other drinker/abstainer. ^aSF-12 physical can range from 0 to 1,200; in this sample, the scores ranged from 1,122 to 6,837. ^bSF-12 mental can range from 0 to 1,200; in this sample, the scores ranged from 754 to 7,201. ^cCES-D can range from 0 to 69; in this sample, the scores ranged from 0 to 59.

There were a few statistically significant differences between baseline FHEDs and the control groups at follow-up in terms of health outcomes at age 40 and older (most outcomes) or at the 2008 follow-up interviews (Table 5). Given the large number of comparisons, some statistically significant results could have occurred by chance. FHEDs had significantly higher CES-D scores than did OHEDs at age 40, suggesting that baseline FHEDs were slightly more depressed on average at follow-up. Baseline FHEDs were also more likely to have reported missing work because of back pain than were baseline OHEDs. However, the difference in probabilities was only .011. For the baseline FHED and ODA comparisons, the only statistically significantly different result was for the probability of death by 2008 (difference in probabilities .004). However, death probabilities appear to be quite sensitive to sample selection. In the FHED–OHED comparison, the death rate for baseline FHEDs was 0.060, whereas in the FHED–ODA comparison, the corresponding death rate for baseline FHEDs was 0.047. Also, the difference in death rates between baseline FHED

and OHED persons was the only comparison for which the results of standard *t* tests and McNemar tests differed. The difference was not statistically significant according to the latter test.

Discussion

We found that frequent heavy episodic drinking at ages 17–25 was associated with higher rates of alcohol dependence and abuse at a 10-year follow-up and alcohol consumption about 25 years after baseline. Although persons who engaged in frequent heavy episodic drinking in early adulthood had higher levels of alcohol consumption at follow-up, their consumption declined relative to the other baseline drinker groups (Figure 1). Frequent heavy episodic drinking at baseline was positively associated with the probability of frequent heavy episodic drinking at midlife, albeit on average at a lower probability of such drinking. Furthermore, FHEDs were more likely to experience problems of alcohol abuse and dependence a decade later, an important

result in its own right. Alcohol abuse and dependence has been associated with various problems, such as motor vehicle accidents, physical and mental health problems, marital discord, violent behavior, and lost market productivity (Hicks et al., 2010; McGinnis and Foege, 1999; Topitzes et al., 2009; Xue et al., 2009). A short-term (3-year) relationship between alcohol dependence and SF-12 scores has been demonstrated previously (Moss et al., 2010).

After matching, there was generally no indication that being an FHED in early adulthood was adversely associated with years of schooling completed by middle age, the probability of being employed, and earnings conditional on being employed in midlife. Furthermore, there was no statistical difference in the probability of surviving to follow-up. Because there were differences in health and longevity by baseline drinking category before matching, these differences are attributable to differences in the characteristics of persons in the various baseline drinking categories.

Our findings on increased alcohol consumption at follow-up among heavy drinkers in early adulthood are consistent with previously reported evidence. For example, earlier age at onset of drinking increased later drinking and the probability of being a later heavy episodic drinker in a Finnish sample with more than 20 years of follow-up (Pitkänen et al., 2005). Fillmore and Midanik (1984) found that drinking patterns among individuals in their 40s were much more predictive of problem drinking over the short term than among younger individuals (such as the sample we used).

Other studies have assessed heavy drinking effects on labor market outcomes, but drinking was generally measured for about the same period as labor market outcomes (Jones and Richmond, 2006; Mullahy and Sindelar, 1993). None of the previous studies used propensity score matching.

Studies of effects of alcohol use on labor market outcomes have found relationships. Keng and Huffman (2007) also used NLSY79, but they investigated the relationship between contemporaneous heavy episodic drinking and earnings rather than far-in-the-future earnings as in our study.

Limiting analysis to early waves of NLSY79, Renna (2007) examined the association between heavy episodic drinking (defined as reporting at least two heavy drinking episodes during the last month) and whether the person graduated from high school "on time." In both male and female analyses, individuals engaging in heavy episodic drinking had a lower probability of graduating on time, but the coefficients were statistically significant only at the 10% level.

Our findings raise the issue of whether the few, if any, differences in the baseline drinking group at follow-up were an artifact of the methodology we used. We considered several possibilities.

One is that we assessed outcomes at too early a stage in the life course. However, the evidence from prior literature indicates otherwise. Some prior research reported

associations between heavy drinking in early adulthood and increased probability of delayed high school completion; reduced probability of college enrollment (Dee and Evans, 2003; Renna, 2007); reduced earnings, even conditional on years of schooling completed (Keng and Huffman, 2007; Renna, 2007); and reduced probability of working (MacDonald and Shields, 2004). The rationale advanced for this finding was that heavy drinking at least postponed human capital accumulation, which in turn subsequently decreased earnings. The follow-up period in these studies was appreciably less than ours. Our evidence suggests a potential catch-up over time in educational attainment on average and in skill accumulation affecting earnings.

Second, given that we matched on several variables, including aspirations and expectations, which may themselves have been affected by baseline drinking, we may have overadjusted by matching on so many variables. There is a sound rationale for matching on each of the variables, and by matching on these variables, we have lessened the probability of bias that results from confounding. Dropping substance use variables from variables used for matching did not materially alter our findings, except for mortality. In one analysis (not shown), we dropped aspiration and expectation variables in matching, which did not alter our findings. Additional matching on alcohol problems of father, mother, and other relatives also did not alter our findings. Because the unmatched groups differed in outcomes in midlife, one would expect differences in midlife outcomes to persist if one matched on only a few variables. Overall, our findings were insensitive to dropping one or two variable types from matching.

Third, we investigated the possibility that comparisons in outcomes among nonadjacent baseline drinking categories may have revealed differences in outcomes at midlife. As seen above, even comparisons between baseline FHED and other drinkers revealed few differences in educational attainment, labor market, and health outcomes at midlife.

Fourth, a possible reason for not finding a relationship between frequent heavy episodic drinking in early adulthood and educational, labor market, and health outcomes at midlife is that drinking patterns are highly variable over the life course. Although high levels of baseline drinking are predictive of average future drinking levels, the considerable variability about the average may have obscured a relationship between baseline drinking and future long-term outcomes. Mean alcohol consumption of baseline FHEDs remained substantially higher than for any of the other baseline drinking groups. FHEDs at baseline were FHEDs at the 2008 follow-up 18% of the time. In contrast, OHEDs and ODAs were FHEDs only 8.3% and 2.7% of the time, respectively, in 2008. Thus, although there was some variability in heavy episodic drinking among interviewees, overall, FHEDs at baseline exhibited much more persistent heavy episodic drinking than the other baseline groups did. Those FHEDs

whose heavy episodic drinking did not persist beyond young adulthood presumably had a chance to recover in terms of the outcomes we measure (Hicks et al., 2010).

Major strengths of our study are that we measured outcomes from early adulthood to a period 25 years later when the same individuals were middle aged. The data we used contain information on many important personal attributes, assumed to be time invariant (a possible limitation), and on the use of substances other than alcohol at baseline. We studied educational attainment, labor market, and health outcomes on the same individuals.

We acknowledged several study limitations above. In addition, our results apply to a cohort of persons born from 1958 to 1965. Cohort differences in alcohol consumption patterns have been documented (Kerr et al., 2004). Our results may not apply to earlier or later cohorts. The baseline sample was fully nationally representative, as described above. Over time, sample attrition, which occurs in all longitudinal databases, makes the sample even less representative. Also, health and other outcomes may reflect health at baseline, which was not well measured by NLSY79. Possibly, unmeasured poor health at baseline led to bias in treatment effects of alcohol consumption at baseline.

In sum, frequent heavy drinking episodes in early adulthood were positively related to drinking patterns at midlife. Probably because about half of the heaviest drinkers ceased having heavy drinking episodes by midlife, we found virtually no relationship between frequent heavy episodic drinking in early adulthood and educational attainment, labor market outcomes, and health outcomes at midlife.

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