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Age, period, and cohort effects in heavy episodic drinking in the US from 1985 to 2009☆

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ABSTRACT

Background: Evaluating population-level patterns of heavy episodic drinking by age, period, and cohort is critical to understanding population-level influences on rates over time and to forecasting future trends for public health planning efforts. The present study examined trends in heavy episodic drinking in the US from 1985 through 2009 in a nationally representative sample that included adolescents and adults.
Methods: Data are drawn from repeated cross-sectional surveys of US households as part of the National Household Survey on Drug Use and Health conducted in 1985, 1988, and annually from 1990 though 2009, inclusive (N = 809,281). Heavy episodic drinking was defined as any instance of consuming five or more drinks in one sitting in the past month. Age–period–cohort models were identified using the Intrinsic Estimator algorithm.
Results: Heavy episodic drinking is decreasing in the US among adolescents and young adults, with the most recently born cohorts (born in the 1990s) at lower odds of heavy episodic drinking compared with cohorts born in the 1960s, 1970s, and 1980s. Results were consistent across sex and race/ethnicity, with the exception that the decrease is not apparent among Hispanics.
Conclusions: These data are promising in that young cohorts appear to be reducing heavy episodic drinking, however the lack of decrease among Hispanics suggests targeted intervention and prevention as well as increased surveillance are necessary.

1. Introduction

Heavy episodic drinking, or consumption of a large amount of alcohol in a short period of time with the primary goal of intoxication, is implicated in over half of the alcohol-attributable deaths in the U.S. (Naimi et al., 2003a). Acute effects of heavy episodic drinking include intentional as well as unintentional injury (Hingson et al., 2002), intimate partner violence (Thompson and Kingree, 2006), unintended pregnancy (Naimi et al., 2003b), and fetal alcohol syndrome (May and Gossage, 2001), and chronic heavy episodic drinking is associated with several forms of cancer (Longnecker, 1994), disruption in liver function, and premature mortality (Holman et al., 1996). While surveillance estimates indicate overall reductions in heavy episodic drinking in the US over the last 10 years (Johnston et al., 2011), the prevalence remains high and reducing consequences of heavy drinking continues to be a significant public health priority (Casswell and Thamarangsi, 2009). Evaluating patterns of heavy episodic drinking by age, period, and cohort is critical to understanding population-level influences on rates over time and to forecasting future trends.

Existing literature on trends in overall alcohol consumption and alcohol use disorders generally indicate that strong cohort effects are operative in shaping patterns over time (Keyes et al., 2011). With regard to heavy episodic drinking specifically, however, available data are inconsistent. Kerr et al. (2009) documented in sequentially conducted cross-sectional samples over 26 years that two simultaneous processes are operative in alcohol consumption trends (Kerr et al., 2009). While cohorts born in the late 1970s and early 1980s consume alcohol less frequently and have a lower overall consumption mean compared with previously born cohorts, heavy episodic drinking is more prevalent. If true, this suggests that increases in risky patterns of alcohol consumption may portend greater drinking consequences for these cohorts later in life. However, other national studies have not found similar results, and instead documented that heavy episodic drinking is either decreasing in cohorts born in the 1980s (Bachman et al., 1999; Keyes et al., 2008), or that period effects explain trends over time in heavy episodic drinking rather than cohort effects (Karlamangla

☆ Supplementary material can be found by accessing the online version of this paper. Please see Appendix A for more information.

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et al., 2006). These latter studies have not used age–period–cohort models to formally estimate cohort effects, which could be a source of divergence in results across study. Outside of the US, data has predominately shown increases in heavy episodic drinking among younger cohorts (Bjork et al., 2008; Kemm, 2003). No study to date has documented patterns among cohorts of the 1990s, who are now in the primary age of risk for heavy episodic drinking and the development of alcohol use disorders.

Of further interest is variation in heavy episodic drinking trends over time by sex and race/ethnicity. Accumulating evidence, both in the US and cross-nationally, indicates that the gender differences in heavy episodic drinking and alcohol disorders are converging in more recently born cohorts, primarily due to increases among women (Bjork et al., 2008; Grucza et al., 2008a,b; Holdcraft and Iacono, 2002; Kemm, 2003; Kerr et al., 2009; Keyes et al., 2008, 2011; Rice et al., 2003). Whether these trends will continue in the birth cohorts of the late 1980s and early 1990s, who are now passing through the primary age at risk for heavy episodic drinking and alcohol disorders, has not been investigated to date.

Information on trends by race and ethnicity is generally overlooked in national studies of alcohol consumption, and remains a critical epidemiologic gap. Large-scale surveys generally find that lifetime rates of heavy episodic drinking are lower among Blacks compared to non-Hispanic Whites, and that current rates are more comparable if slightly lower among Blacks (Hasin et al., 2007). Heavy episodic drinking patterns among Latinos are comparable if not slightly higher compared to non-Hispanic Whites (Caetano, 1984b), with Puerto Ricans evidencing the highest rate of heavy episodic drinking compared to Cuban, Mexican, and South American Latino subgroups. Further, while heavy episodic drinking and frequent heavy episodic drinking have decreased among non-Hispanic Whites, rates remained stable among Latinos and increased among Latino women across the 1980s and 1990s (Caetano and Clark, 1998). Additionally, several large-scale epidemiologic studies have documented a 'cross-over' effect (Caetano, 1984a; Robins, 1985; Watt, 2008), whereby non-Hispanic Whites have higher rates of alcohol use and problematic patterns of use compared to Latinos and Blacks only in adolescence; this difference not only converges in adulthood, it changes direction. Data on racial/ethnic differences in alcohol consumption in more recent decades is critical to understand more recent trends by race and ethnicity. If data indicate further increases in heavy episodic drinking among Latinos, target messages may be necessary. Further, age–period–cohort modeling across racial/ethnic subgroup is necessary to control for crossover patterns in the epidemiologic data when assessing period and cohort effects, which previous studies have not done.

The present study aims to provide updated information on age, period, and cohort effects in the prevalence of heavy episodic drinking in the US across the last 25 years using nationally representative surveillance data. Further, we focus on differences in these effects across sex and race/ethnicity due the paucity of available evidence on heavy episodic drinking trends in cohorts born in the late 1980s and early 1990s by these critical demographic axes.

2. Methods

2.1. Sample

Data were drawn from the National Household Survey on Drug Use and Health (NHSDUH), a series of nationally representative cross-sectional surveys of the US civilian, non-institutionalized population. Data for the present study was collected in 1985, 1988, and annually from 1990 though 2009, inclusive. A primary purpose of the NHSDUH was to provide representative estimates of drug and alcohol use in the US population, thus the sampling scheme was a multistage probability sample, with over-representation of African Americans, Hispanics, and young adults adjusted to be representative of the nearest census using sampling weights. This analysis focuses on respondents aged 15–64 at each survey wave, with a total of 809,281 respondents.

Two methodological changes in the survey administration are worth noting. First, in 1999 the survey was administered using computer-assisted software rather than paper and pencil. Evidence indicates that reporting of substance use increased to some degree when the instrument was administered via computer (Barker et al., 1998; Penne et al., 1998; Wright et al., 1998). Second, in 2002 respondents were offered monetary incentives to participate. This change improved response rates, and evidence indicates a slight increase in the prevalence of substance use when these harder to reach respondents were included (Office of Applied Studies, 2002, 2003).

Interviews were conducted in the home by trained interviewers. Response rates were typically 80% or higher. All information is self-reported. More detailed information about the survey is available at the SAMHSA website at (http://www.oas.samhsa.gov/nhsda.htm).

2.2. Measures

2.2.1. Heavy episodic drinking. Heavy episodic drinking was defined as any instance of consuming five or more drinks in one sitting in the past month. While studies generally now define a lower threshold of drinks for women, these data were collected over the past twenty years and this was the only stably queried measure across the full study time. Further detail on the alcohol measures collected in the NHSDUH and changes over time in these questions can be found at (National Household Survey on Drug Use and Health, 2012).

2.2.2. Demographics. Birth cohort was defined by subtracting current age from year of the survey. Because of the large sample size, we were able to group birth cohorts into five-year intervals, which is standard in age–period–cohort modeling of surveillance data. Age and period groupings were also across five-year categories. We conducted sensitivity analyses by categorizing age, period, and birth cohort into four-year age groups in order to examine the robustness of our effects.

Sex and race/ethnicity were self-reported; racial categories were based on US census categories. Hispanic ethnicity was assessed separately. We divided the sample into those reporting non-Hispanic White race/ethnicity (heretofore referred to as "White"), non-Hispanic Black race/ethnicity (heretofore referred to as "Black"), and Hispanic ethnicity regardless of race. Other racial groups were not analyzed separately in the present study.

2.3. Statistical analysis

Prevalence estimates were generated from basic cross-tabulations. All analyses were weighted to take into account the complex survey design. In analyses of men, women, and racial/ethnic groups data from all survey years were included in one analysis pool and data from each survey were assigned unique strata numbers to adjust standard errors for design effects (Korn and Graubard, 1999). We first examined the prevalence of heavy episodic drinking by age and period in order to guide statistical model choice. This included assessment of potential age by period interactions, non-linearity, and/or the potential presence of cohort effects (Keyes and Li, 2010).

Age–period–cohort analysis was conducted using the Intrinsic Estimator approach developed by Yang and colleagues (Fu, 2000; Yang et al., 2004, 2008). Because age, period, and cohort are linear functions of one another (Cohort = Period − Age), attempts to simultaneously model the linear effects of age, period, and cohort in a traditional least squares regression will not be identified; i.e., they will produce an infinite number of equally-plausible estimates for which it is not possible to determine which are the best fit for the model. Therefore, researchers have either focused on estimating non-linear effects, or imposing some constraint on the model purely for identification purposes. Typically, this is done by equating one or more parameters to be equal (for example, setting the effects of first and second age groups to equal, or the first age group and the first time period, etc.). Unfortunately, parameter estimates are sensitive to the constraint chosen and the validity of the constraints is difficult to empirically assess. The IE is an approach that places a constraint on the model, but not a constraint that affects the estimation of regression parameters for age, period, and cohort in any way. That is, the regression parameter estimates are unbiased by the constraint placed, and a unique set of regression estimates can be estimated.

Technical descriptions of the IE can be found elsewhere (Yang et al., 2004, 2008). Briefly, the central premise of the IE is that a unique estimable function can be found by decomposing the parameter space of the age–period–cohort regression design matrix into two additive components that are geometrically perpendicular in the orthogonal subspace. It has been demonstrated that one of these additive components corresponds to the unique zero eigenvalue of the design matrix. As elegantly demonstrated by Yang and colleagues (Yang et al., 2004, 2008), this additive component has some unique properties that can be exploited for use in an age–period–cohort analysis. Specifically, it is independent of the actual age–period–cohort effects that gave rise to the data; it is a function of the number of age groups and period groups only. As such, it takes on a fixed vector form and does influence coefficient estimation. Further, using this decomposition, an Intrinsic Estimator can be estimated that is invariant to model constraints identified through the Moore–Penrose generalized inverse (Searle, 1971).