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Gender differences in the developmental trajectories of multiple substance use and the effect of nicotine and marijuana use on heavy drinking in a high-risk sample

Anne Buu [a,*], Agata Dabrowska [b], Justin E. Heinze [c], Hsing-Fang Hsieh [c], Marc A. Zimmerman [c]

[a] School of Nursing, University of Michigan, Ann Arbor, MI 48109, USA
[b] Department of Psychiatry and Addiction Research Center, University of Michigan, Ann Arbor, MI 48109, USA
[c] Department of Health Behavior and Health Education, University of Michigan, Ann Arbor, MI 48109, USA

HIGHLIGHTS

- Females were at risk for increasing nicotine use across time.
- Early onset of nicotine and marijuana use added risk for heavy drinking.
- Higher consumption of nicotine and marijuana contributed to heavy drinking.
- The effect of nicotine use quantity on heavy drinking was greater among males.

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ABSTRACT

Background: Heavy drinking is highly comorbid with nicotine and marijuana use among young adults. Yet, our knowledge about the longitudinal effects of nicotine and marijuana use (including onset timing and quantity/frequency) on heavy drinking and whether the effects vary by gender is very limited. This study aims to characterize gender-specific developmental trajectories of multiple substance use and to examine gender differences in the effects of nicotine and marijuana use on heavy drinking.
Methods: We conducted secondary analysis on 8 waves of data from 850 high-risk youth who were recruited as ninth graders with low GPA in an economically disadvantaged school district in the Midwest and were followed up annually to young adulthood. Onset ages and quantity/frequency of multiple substance use were assessed by a self-report questionnaire at each wave. The time-varying effect model and linear mixed model were adopted for statistical analysis.
Results: Males' levels of heavy drinking, nicotine use, and marijuana use tended to grow persistently from adolescence to emerging adulthood. Females, on the other hand, only gradually increased their nicotine use across time while maintaining low levels of heavy drinking and marijuana use. Controlling for the early onset status of alcohol use, early onset statuses of nicotine use and marijuana use both added additional risk for heavy drinking; late onset marijuana users were also at higher risk for heavy drinking than nonusers of marijuana. Controlling for substance use onset statuses, higher quantity/frequency of nicotine and marijuana use both contributed to more involvement in heavy drinking. We also found that the effect of nicotine use quantity on heavy drinking was greater among males.
Conclusions: Our study demonstrates the longitudinal effects of onset timing and quantity/frequency of nicotine and marijuana use on heavy drinking. Our analysis of gender differences also identifies female youth's nicotine use and male youth's co-use of nicotine and alcohol as two important areas for future prevention and intervention work.

1. Introduction

Researchers have reported that heavy drinking is associated with many negative outcomes, including alcohol use disorders, drug use disorders, poor health, violence/crime, and social/economic disadvantage (Berg et al., 2013; Bonomo, Bowes, Coffey, Carlin, &

* Corresponding author at: School of Nursing, University of Michigan, 400 North Ingalls, Ann Arbor, MI 48109. Tel.: +1 734 7649008.
E-mail address: buu@umich.edu (A. Buu).

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Patton, 2004; Dawson, Li, & Grant, 2008; Hill, White, Chung, Hawkins, & Catalano, 2000; Jennison, 2004; Tucker, Ellickson, Orlando, Martino, & Klein, 2005). Furthermore, researchers have demonstrated some gender differences in drinking patterns and risk factors for alcohol use (Nolen-Hoeksema, 2004). By understanding gender differences in developmental trajectories and risk factors of heavy drinking, particularly among high-risk youth, we may be able to tailor prevention and early intervention efforts to the special timing and risk factors of each gender group and, thus, thwart progression to worse outcomes.

National data from the United States indicate that heavy drinking is highly comorbid with nicotine and marijuana use among young adults (Jackson, Sher, & Schulenberg, 2008). Chen and Jacobson (2012) analyzed four waves of data from a nationally representative sample of adolescents and found similar developmental trajectories for heavy drinking, nicotine use, and marijuana use by gender: females tend to be involved in higher levels of substance use in early adolescence, whereas males exhibit greater increases across time and higher levels of use in mid-adolescence and early adulthood. A significant limitation of the study is that the developmental trajectories for all the three substances were derived by fitting quadratic growth models that prespecified a simple shape for developmental changes, which may contribute to the similarity in trajectories across substances. Furthermore, the majority of existing longitudinal studies on substance abuse include predominantly White samples or college samples. To the best of our knowledge, no researchers have characterized gender-specific trajectories of heavy drinking, nicotine use, and marijuana use among minority samples who are at risk for dropout and related deleterious outcomes such as substance abuse. However, this kind of analysis may have important implications for prevention and intervention and thus is needed in the field.

Researchers report that early onset of drinking is highly predictive of subsequent heavy drinking (Eliasen et al., 2009; Jefferis, Power, & Manor, 2005; Muthén & Muthén, 2000; Pitkänen, Lyyra, & Pulkkinen, 2005; Rossow & Kuntsche, 2013). D'Amico et al. (2001) investigated the association between early onset of nicotine use or marijuana use and heavy drinking among high school students over an academic year. A major limitation of their study, however, is that the association between early onset of nicotine or marijuana use and heavy drinking was established without taking into account the effect of early onset of alcohol use. It is, therefore, unclear if the observed association is simply a manifestation of the greater likelihood of being early onset drinkers among early onset users of nicotine or marijuana. Furthermore, a potential gender difference in such an association could have important implications for gender-specific intervention but has not yet been examined. Thus, it is a research question open to investigation. Moreover, the majority of existing studies reviewed above were based on predominantly White samples so the results may not be generalizable to the high-risk minority population.

National data consistently indicate that smokers are at much greater risk for being involved in heavy drinking than nonsmokers (Harrison & McKee, 2011; Harrison, Desai, & McKee, 2008; Jackson, Sher, Cooper, & Wood, 2002). Although marijuana use has been legalized in a growing number of states and its prevalence rate has increased drastically in recent years (Miech & Koester, 2012), studies of its effect on heavy drinking are sparse. Researchers have reported that both nicotine and marijuana use are associated with heavy drinking (Fenzel, 2005; Jessor, Costa, Krueger, & Turbin, 2006), but neither research team found any significant gender differences in such association. The information derived from these studies is, however, limited because they studied predominantly White college students within a very narrow developmental period (the former was a cross-sectional study; the latter had 3 waves within 2 academic years). Jackson et al. (2008) analyzed 4 waves of data spanning ages 18–26 from a nationally representative sample of high school seniors and found that heavy drinking, nicotine use, and marijuana use are highly associated during emerging adulthood. Yet, whether the association is moderated by gender was not examined in that study. Furthermore, it is necessary to extend this line of research to the high-risk youth in order to more fully understand the concomitant effects of other substances on heavy drinking.

This study fills in the current knowledge gaps by conducting secondary analysis of eight waves of data from a longitudinal study on predominantly Black youth at high risk for multiple substance use from adolescence to emerging adulthood (ages 14–24). The first objective of this study is to characterize the gender-specific developmental trajectories of heavy drinking, nicotine use, and marijuana use during this critical developmental period. In order to take full advantage of the relatively large number of waves in the data, we used the time-varying effect model (TVEM; Tan, Shiyko, Li, Li, & Dierker, 2012) that does not impose any particular shape on the trajectories, so we might gain better insights into the differences across gender groups and multiple substances. The second objective is to investigate the longitudinal effects of early onset status and quantity/frequency of nicotine and marijuana use on heavy drinking, controlling for early onset status of alcohol use. Unlike the majority of researchers who relied on retrospective reports of substance use onset, the onset ages of use for the three substances in this study were derived from youth reports across waves with the most prospective report as the best estimate, in order to minimize recall bias. The third objective is to examine gender differences in the developmental trajectories of heavy drinking, as well as in the effects of nicotine and marijuana use (including onset and quantity/frequency) on heavy drinking.

2. Methods

2.1. Design and sample

The Flint Adolescent Study (FAS) is an ongoing longitudinal study that aims to investigate both risk and protective factors for substance use and related health risk behaviors from adolescence to adulthood (Elkington, Bauermeister, & Zimmerman, 2010; Stoddard & Zimmerman, 2011). The study recruited ninth-grade students with a GPA of 3.0 and below from the four public high schools in an economically disadvantaged school district in the Midwest. The grade cutoff was used to select the youth who were at high risk for many deleterious outcomes. Of the 979 adolescents who met criteria, 52 had left the public schools; 67 were consistently absent from school after several attempts to interview them; and 10 participants either refused to participate or were refused participation by their parents. Therefore, the final sample ($N = 850$) represents 87% of the eligible youth who completed the data collection at Wave 1.

The participants were followed for eight waves. Waves 1–4 correspond to the participants' high school years (1994–1997); Waves 5–8 correspond to the second through fifth years post high school (1999–2002). A response rate of 90% was maintained from Waves 1–4; a 68% response rate was maintained from Waves 5–8. Trained interviewers from a non-profit organization specializing in survey methodology conducted a structured 50–60 minute face-to-face interview with each participant, in school or a location that the participant identified as convenient and that provided adequate privacy with no interruptions. In addition, a questionnaire on substance use related behaviors was self-administered at the end of the interview to avoid under-report.

In this study, we analyzed 8 waves of data from 850 participants (50% males). The racial composition of this sample was 80% Black, 17% White, and 3% mixture of Black and White. The high percentage of Blacks (self-identified) makes this sample unique because the few large-scale longitudinal studies on the risk and protective factors of substance abuse include predominantly White samples. We know relatively little about these issues among Black youth. On average, the highest education level of their parents was completing vocational/training school. About 94% of the participants had completed at least 4 waves of assessment. The two statistical models described under Analytic Approach were particularly designed to handle unequal numbers of